

**Effects of Collaboration on Problem Solving Performance in Healthy Elderly Couples
and Parkinsonian-Caregiver Dyads**

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ABSTRACT

This study investigated problem solving performance in Parkinson's disease (PD) individuals, PD individuals in collaboration with their caregiving spouses, as well as in healthy older adult individuals and collaborating couples. Problem solving abilities represent executive functions mediated by frontal cortex. Given frontal lobe involvement in PD, the supporting neuropsychological evidence indicates problem solving deficits in this patient population. The extent to which these individual-level deficits could be overcome (or compensated) through collaboration was explored. Two groups of elderly married couples participated in the study. The control group consisted of 20 healthy couples with neither partner having a medical diagnosis of PD. The experimental group comprised 17 couples in which the male spouse had received a diagnosis of PD from a qualified neurologist. All participants met several selection criteria: (a) aged 55 years or older, (b) relatively well-educated for their age cohort, (c) above a criterion in mental status, and (d) below a clinical criteria of depression. They performed three problem solving tasks: verbal fluency, the Wisconsin Card Sorting Test (WCST), and the 20 Questions task. These tasks were performed twice -- once individually and once collaboratively with their spouse. This within-subjects group size variable was counterbalanced so that half of the subjects were tested first as individuals and then as dyads and vice versa. The collaborative part of each testing session was videotaped. The results indicated: (a) poorer performance by the

experimental couples and Parkinsonian men relative to the other participants on qualitative indices of the verbal fluency task, (b) a detrimental effect of collaboration on the speeded verbal fluency task, (c) group level benefit of collaboration and inferred individual-level benefit to the Parkinsonian men for some measures on the card sorting task, (d) a benefit of collaboration for the experimental group on the 20 Questions task, (e) greater verbal input to the process of solving the 20 Questions task by the experimental females apparently to compensate for their Parkinsonian husbands, and (f) differences between the control and experimental groups in the process variables that were related to efficient questioning strategies on the 20 Questions task. Theoretical and clinical implications of this research are discussed. Limitations and possible directions for future investigation are noted.

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DEDICATION

" $F = m a$, and you can't push a rope"

This dissertation is dedicated to my parents, for instilling the courage and confidence
in me to challenge myself to be the best that I can be.

CHAPTER 1

Introduction

In 1817, James Parkinson, an English physician, wrote a short essay describing six patients with a slowly progressive physical disease. He wrote that the illness was characterized by "involuntary tremulous motion, with lessened muscular power, in parts not in action even when supported, with a propensity to bend the trunk forward and to pass from a walking to a running pace" (cited in Stern & Lees, 1990, p. 1). Today, this illness is known worldwide as Parkinson's disease.

Parkinson's disease (PD) is a neurological motor disorder of the basal ganglia. It is related to the degeneration of the substantia nigra and to the loss of the neurotransmitter substance dopamine, which is produced by cells of this nucleus. There are four major symptoms of PD: a distinctive "resting tremor", plastic (cogwheel) rigidity, slowness of movement (bradykinesia), and disturbances of posture, each of which may manifest in different body parts in different combinations (Kolb & Whishaw, 1990; Skuster, Digre, & Corbett, 1992).

The incidence and prevalence of PD increase with advancing age. The prevalence rate is 0.1% of the population under the age of 60 years, 1% of the population over 60 years, and 2.5% in those over age 85 years (Rajput, 1991). It afflicts 70,000 Canadians (nearly 8000 in B.C.), and men and women equally (Wright, 1996). It strikes most commonly over the age of 55, but also occurs in younger people (Wright, 1996).

The etiology of PD remains a mystery. The genetic contribution is not significant (Rajput, 1991), and it has been estimated that only 10-15% of cases are

possibly hereditary (Wright, 1996). It is neither infectious nor contagious, and the evidence strongly favors environmental causes (Rajput, 1991). However, the search for a specific environmental cause is difficult because the typically late onset of the disease means that many prior events could play a role (Rajput, 1991). Present treatment consists of drugs to assist muscular control. However, until a cure is found, it remains a degenerative disease, although its progression, in some cases spread over many years, differs widely from patient to patient.

In addition to the physical symptoms of PD, research is increasingly focused on the cognitive changes that occur. It is now generally agreed that many patients with PD who are not clinically demented exhibit deficits of at least mild proportions on neuropsychological tests (Beatty, Monson, & Goodkin, 1989). Deficits have been documented in almost all areas of cognitive functioning (e.g., Brown & Marsden, 1990; Dubois, Boller, Pillon, & Agid, 1991). Problem solving ability is one such area in which PD patients appear to have difficulty (e.g., Beatty & Monson, 1990; Dalrymple-Alford, Kalders, Jones, & Watson, 1994). It is of special interest because it is indicative of cortical involvement of the frontal lobes. For this reason, problem solving was the focus of the present research.

This study was born out of my interest and training in two broad areas of psychology: clinical neuropsychology and cognition and aging. There is a growing recognition that the study of cognitive development over the lifespan can benefit from considering the social situations in which cognitive activity frequently occurs (e.g., Azmitia & Perlmutter, 1989; Dixon, 1992; Middleton & Edwards, 1990). Indeed,

much everyday cognitive activity is shared or collaborative in nature (Resnick, Levine, & Teasley, 1991). Especially interesting are collaborative processes when one partner is experiencing organic cognitive impairment (Dixon & Bäckman, in press).

Consistent with this emphasis, this research examined the problem solving performance of Parkinson's disease patients in collaboration with their spouses. A control group of healthy elderly couples with no history of neurological disease was included as a comparison group. The collaborative aspect of this research served to increase its ecological validity by being more representative of everyday problem solving. The theoretical rationale guiding this research was the notion of compensation and that the presence of a collaborator (spouse) may serve as an external aid to "compensate" for individual problem solving deficits in PD (Dixon & Bäckman, in press). The goal of this research was to better understand how PD patients solve problems in everyday life when they work together with a spouse, to evaluate the potential contribution of compensatory strategies, and to suggest implications for how loved ones can be of the most service in helping Parkinsonians in their everyday problem solving efforts. To provide some background on the development of the ideas governing this study, the relevant research is reviewed in the next chapter.

CHAPTER 2

Literature Review

This chapter is organized into three broad sections. The first section addresses the neuropsychological perspective on problem solving. Discussions of executive function, cognitive impairments in Parkinson's disease (PD), and the influence of depression on cognition in PD are presented. The results of neuropsychological studies of executive function in healthy elderly and Parkinsonian subjects are reviewed. The second section focuses on the social cognition and aging perspective and includes discussions of everyday problem solving and the 20 Questions task. The final section presents the theoretical rationale underlying this research and reviews the concepts of compensation and collaboration.

The Neuropsychological Perspective on Problem Solving

Problem-Solving as an Executive/Frontal Lobe Function

The term "executive function" refers to a heterogeneous group of skills involved in the structuring of goal-directed behaviors (Fuster, 1989). Specific components of the executive functions that have been outlined include: (a) goal formulation, or the process of determining what one needs or wants and conceptualizing some kind of future realization of that need or want; (b) planning, or the determination and organization of the steps and elements needed to carry out an intention or achieve a goal; (c) carrying out goal-directed plans, or the ability to initiate, maintain, switch, and stop sequences of complex behavior in an orderly and integrated manner; and (d) effective performance, or the ability to monitor, self-correct, and regulate the intensity,

tempo, and other qualitative aspects of delivery (Fuster, 1989; Lezak, 1983; Luria, 1966, 1980; Stuss, 1992; Stuss & Benson, 1989).

Included in the realm of executive function are such complex neuropsychological skills as the ability to shift from one idea to another, the ability to initiate planned action and predict the consequences of behavior, and the ability to maintain concentration and to construct serial goal-directed activities (Cummings & Benson, 1988). Behaviorally, deficits in this realm are revealed by lack of foresight and a tendency toward concrete, literal thought patterns (Cummings & Benson, 1988).

The executive functions are mediated by prefrontal cortex (Fuster, 1989; Luria, 1966, 1980), and in particular, the dorsolateral area, the ontogenetically most mature part of the frontal lobe (Russell & Roxanas, 1990). However, the executive functions are emergent properties of a distributed network, of which the prefrontal cortex is only one important component (Grigsby, Kaye, & Robbins, 1995).

Many studies of executive function following frontal lobe lesions have been conducted. The results of several problem solving studies indicated deficits in performance when frontal lobe patients were compared to healthy control participants and other brain-damaged groups (Eslinger & Grattan, 1993; Karnath & Wallesch, 1992; Karnath, Wallesch, & Zimmerman, 1991; Owen, Downes, Sahakian, Polkey, & Robbins, 1990; Vilkki, 1988).

This review of executive function will first focus on healthy older adults (without neurological impairment) and then address the Parkinsonian population.

Executive Function in Healthy Elderly Adults

Several studies employing behavioral tasks have concluded, on the basis of poor performance on prefrontal measures, that decline of frontal brain function is a consequence of normal aging (e.g., Libon & Goldberg, 1990; Mittenberg, Seidenberg, O'Leary, & Di Giulio, 1989; Whelihan & Leshner, 1985). The currently dominant neuropsychological model of normal brain aging postulates that cognitive functions dependent on the integrity of prefrontal brain regions are among the first to deteriorate (Albert & Kaplan, 1980; Hochanadel & Kaplan, 1984; Kaszniak, 1990) because catecholamine concentrations drop most markedly in that area (Fuster, 1989). Further, there is increasing evidence that the process of normal aging is associated with significant neuronal loss and cortical atrophy (Adams & Victor, 1989; Zatz, Jernigan, & Ahumada, 1982), particularly in the frontal cortex (Parkin & Walter, 1991). There also appears to be a decrease in cerebral blood flow in the frontal regions of older persons (Gur, Gur, Obrist, Skolnick, & Reivich, 1987), and an increased likelihood of eliciting primitive reflexes (Jacobs & Grossman, 1980).

Research will now be reviewed for two tasks that are measures of executive function: verbal fluency and the Wisconsin Card Sorting Test (WCST). Specifically, the results of studies with older adults will be detailed.

Fluency

Generative naming ability, as measured by verbal fluency tasks, requires subjects to produce words according to specific rules. These tasks typically fall into two categories: semantic retrieval (e.g., retrieval of words from the semantic category of "animals") and letter retrieval (e.g., retrieval of words that begin with the letter "F").

Thus, they measure the production of individual words under restricting search conditions, and load mainly on a "verbal knowledge" factor (Spreen & Strauss, 1991).

Verbal fluency tasks involve several cognitive processes: (a) attention and vigilance to maintain a controlled and selective mental search of stored verbal information, (b) a lexical or semantic store to be searched, (c) a retrieval mechanism (e.g., Auriacombe et al., 1993; Randolph, Braun, Goldberg, & Chase, 1993) and (d) a working memory device that keeps track of the items that have already been produced (Auriacombe et al., 1993).

Age effects on letter fluency have been minimal, or were evident only for subjects in the higher age range (Axelrod & Henry, 1992; Benton, Eslinger, & Damasio, 1981; Bolla, Lindgren, Bonaccorsy, & Bleeker, 1990; Boone, Miller, Lesser, Hill, & D'Elia, 1990; Daigneault, Braun, & Whitaker, 1992; Parkin, Walter, & Hunkin, 1995). However, significant age differences have been found in some studies (Parkin & Walter, 1991; Veroff, 1980). Comparisons of category and letter fluency indicate a decline in category fluency for healthy elderly adults and no age effects for letter fluency (Heller & Dobbs, 1993; Kozora & Cullum, 1995; Rich, 1993; Tomer & Levin, 1993).

Thus, the literature is fairly consistent in demonstrating that, while category fluency declines with age, letter fluency remains constant across the life span. However, qualitative aspects of fluency performance have been studied (e.g., Troyer, Moscovich, & Winocur, 1997) and there is evidence that elderly adults may repeat words (i.e., perseverations) and produce incorrect words (i.e., intrusions) on fluency

tasks (e.g., Montgomery & Costa, 1983). Most studies report no gender differences (Spreeen & Strauss, 1997).

Card Sorting

The Wisconsin Card Sorting Task (WCST) is probably one of the most frequently employed tests of executive functioning. It requires strategic planning, organized searching, the ability to use environmental feedback to shift cognitive sets, goal-oriented behavior, and the ability to modulate impulsive responding (Spreeen & Strauss, 1997). Ozonoff (1995) suggested that adequate performance on the WCST also requires a certain level of social awareness and motivation to attend to verbal feedback. It provides information on several aspects of problem solving behavior such as indices of the number of perseverative errors, failures to maintain set, and number of categories achieved (Heaton, 1981; Heaton, Chelune, Talley, Kay, & Curtis, 1993).

While Heaton et al. (1993) argued that age has the strongest relationship to WCST performance, studies have differed with regard to which WCST scores are affected by age, and at what age poorer scores emerge. Heaton (1981) documented poorer performance on all WCST variables in subjects aged 60 and older. A decline in number of categories and an increase in total errors, but no increases in perseveration were reported in subjects older than age 70 (Boone et al., 1990; Boone, Ghaffarian, Lesser, Hill-Gutierrez, & Berman, 1993). However, an increase in perseveration has been reported for subjects aged 45 to 65 years (Daigneault et al., 1992), but not until age 80 and beyond in the Haaland, Vranes, Goodwin, and Garry (1987) study. Improved performance with age for number of errors, perseverative errors, and

perseverative responses has also been found (Axelrod & Henry, 1992).

Overall, the evidence is inconclusive and may reflect sample differences in intelligence, education, and/or health. In this regard, recent research with older individuals (ages 45-83) has indicated that certain demographic variables may have an impact on WCST performance. Specifically, women were found to outperform men, and those with graduate-level education demonstrated better performance than high-school-educated subjects (Boone et al., 1993).

Cognitive Impairments in Parkinson's Disease

Originally characterised as a motor disorder with "senses and intellect uninjured" (Parkinson, 1817), PD is now receiving increasing attention for its cognitive concomitants (Boller et al., 1984; Boyd et al., 1991; Brown & Marsden, 1986; Brown & Marsden, 1987; Fisk & Doble, 1992; Morris et al., 1988; Taylor, Saint-Cyr, & Lang, 1986). It is generally agreed that many patients with PD who are not clinically demented exhibit deficits on neuropsychological tests of cognitive functioning, including those that affect intelligence, visual abilities, executive function, language, attention and memory, as well as emotion (e.g., Beatty et al., 1989; Brown & Marsden, 1990; Dubois et al., 1991; Fisk & Doble, 1992; Levin, Tomer, & Rey, 1992; Raskin, Borod, & Tweedy, 1990). Cummings (1988, p. 32) stated ". . . intellectual deterioration of at least mild proportions is ubiquitous in PD and can be regarded as a standard feature of the disorder."

Research has also examined the relationship between disease severity and neuropsychological impairments in PD. Huber, Freidenberg, Shuttleworth, Paulson,

and Christy (1989) administered a battery of neuropsychological tests to patients with mild PD, moderate to severe PD, and healthy controls. There was evidence of qualitative and quantitative differences in test performance across stages of the disease. The authors concluded that specific neuropsychological impairments do not develop in a uniform manner with respect to progression of PD. Other research has indicated that patients in the late stages of PD showed significantly greater cognitive impairments, primarily on tasks involving motor function, compared to patients in the early stages of PD (Starkstein, Bolduc, Preziosi, & Robinson, 1989). However, these were cross-sectional studies, and longitudinal data are needed to confirm these findings.

Several explanations for the cognitive deficits in nondemented PD patients have been proposed. These include: (a) an impaired ability to generate efficient strategies when forced to rely on self-directed task-specific planning (Taylor et al., 1986), (b) limited processing resources for attention to tasks guided by internal cues (Brown & Marsden, 1988, 1990), and (c) either general or specific working memory deficits (e.g., Cooper, Sagar, Jordan, Harvey, & Sullivan, 1991; Dalrymple-Alford et al., 1994; Della Sala, Pasetti, & Sempio, 1987). Additional factors suggested as possibly contributing to the appearance of cognitive deficits include deficiencies related to motor disturbance, age-related cognitive decline, inability to maintain attention due to being easily fatigued, and distraction by pain and dyskinesia (Brown & Marsden, 1988).

While some researchers have postulated that the anatomic locus for these cognitive deficits reflects a selective impairment of frontal lobe function (Caltagirone,

Carlesimo, Nocentini, & Vicari, 1989; Taylor et al., 1986), others have argued that there is no proof of selective dysfunction of the prefrontal areas (Goldenberg, Lang, Podreka, & Deecke, 1990) and that widespread pathology is more likely (Beatty, Staton, Weir, Monson, & Whitaker, 1989).

Generalized Cognitive Impairment in PD

Most contemporary authors agree that in an unselected population of PD patients, the prevalence of dementia is greater than in age-matched control subjects (Dubois et al., 1991). Estimates of the occurrence of dementia in PD vary dramatically, from a prevalence rate of about one in five PD patients (Brown & Marsden, 1984) to between 20% and 40% of persons with PD (Cummings, 1988; Mayeux, 1990). This variability in the frequency of dementia may be explained by methodological differences related to the criteria used for the definition of dementia in PD and the populations studied in each case (Cummings, 1988; Dubois et al., 1991).

It has also been repeatedly shown that the age at which PD is acquired is directly related to cognitive decline. Several authors have reported that demented patients were older, had a later age of onset of symptoms, and had more severe symptoms (Ebmeier et al., 1990; Hietanen & Teravainen, 1988; Martilla & Rinne, 1976; Mayeux et al., 1988; Portin & Rinne, 1984; Zetuskys, Jankovic, & Pirozzolo, 1985). In contrast, disease duration alone does not appear to have a negative impact on cognitive performance when patients have been assessed at a single point in time (Besson, Mutch, Smith, & Corrigan, 1985; Garron, Klawans, & Narin, 1972; Globus, Mildworf, & Melamed, 1985; Loranger, Goodell, McDowell, Lee, & Sweet, 1972; Piccirilli,

Piccinin, & Agostini, 1984; Talland, 1962).

Studies relating PD motor signs to cognitive performance tend to reveal consistent relationships. Specifically, when tremor is the predominant clinical sign, mental status is usually normal or near normal. In contrast, bradykinesia and rigidity are routinely associated with intellectual decline (Mayeux & Stern, 1983; Mortimer, Pirozzolo, Hansch, & Webster, 1982).

Thus, given the cognitive impairments and incidence of dementia in PD, as mentioned in the previous sections, mental status is an important consideration in the selection of research participants for studies of cognitive performance in PD. This point will be evident in upcoming sections reviewing executive functioning in PD individuals.

Influence of Depression on Cognitive Performance by PD Patients

In a review of 14 studies that included more than 1500 patients, Gotham, Brown, and Marsden (1986) estimated the mean prevalence of depression in PD to be 46%, although prevalence ranged from as low as 20% to as high as 90% in these studies. More recently, Dooneief et al. (1992) reported a prevalence rate of 47% in their survey of 339 patients with PD. Depression is a potential source of error variance in cognitive testing and could result in an overestimation of cognitive deterioration (Raskin et al., 1990). It has been noted that depression may also reduce cognitive effort (Speedie et al., 1989).

Some studies have reported that, while PD patients were more depressed than controls, depression was not associated with cognitive performance (Boyd et al., 1991;

Dalrymple-Alford et al., 1994; Litvan, Mohr, Williams, Gomez, & Chase, 1991). This finding was also observed in a sample of high functioning PD patients (Mohr et al., 1990). However, the presence of more severe cognitive deficits in PD patients with depression compared to a PD group without depression, depressed patients, and normal controls has also been reported (Wertman et al., 1993). Youngjohn, Beck, Jogerst, and Caine (1992) concluded from their research that "Depression remains a potential confound, but it is unlikely to account for all of the neuropsychological deficits associated with PD."

The relationship between severity of disease and depressive symptoms remains controversial. In a study that examined both the stage of PD (using the criteria developed by Hoehn & Yahr, 1967) and existence of depression in PD patients, it was found that the effect of depression on cognitive impairment was statistically significant only in late stages (i.e., stage 4 or 5) of the disease, suggesting an important interaction between the progression of the disease and the effect of depression on cognitive function (Starkstein et al., 1989).

In a follow-up study of PD patients re-examined 3-4 years after the initial evaluation (Starkstein, Bolduc, Mayberg, Preziosi, & Robinson, 1990), both depressed and non-depressed patients showed a significant decline in cognitive function during the follow up period. However, this decline was significantly more severe for the depressed group and they displayed a faster rate of progression of motor signs (primarily tremor) than the non-depressed group. The presence of depression was associated with a subsequent loss of intellectual function even when the depression

was no longer present.

Depression in PD may reflect biochemical and neuroanatomical changes that are intrinsic to the disease, an emotional reaction to the physical, cognitive, and social disabilities imposed by PD (Raskin et al., 1990), or both of these processes occurring concomitantly. Taylor and Saint-Cyr (1990) have found that patients who are younger than 50 at the onset of the disease are particularly vulnerable to developing a depressive affect because they are faced with threats to their careers, financial concerns, and a diminished quality of life during their most productive years.

Executive Functioning in PD Patients

According to some researchers, impaired executive functioning is: (a) a significant problem in patients with PD, (b) present in demented as well as non-demented PD patients, and (c) one of the earliest signs of cognitive deterioration (Gotham, Brown, & Marsden, 1988; Lees & Smith, 1983; Levin et al., 1992; Pillon, Dubois, Lhermitte, & Agid, 1986; Taylor et al., 1986). Executive functioning in PD patients will now be reviewed for two tasks: verbal fluency and card sorting as measured by the WCST.

Fluency. Earlier studies of verbal fluency in PD patients were quite consistent in observing deficits in either letter naming (e.g., Dubois, Pillon, Legault, Agid, & Lhermitte, 1988; Lees & Smith, 1983), category naming (e.g., Cools, Van Den Bercken, Horstink, Van Spaendonck, & Berger, 1984; Gotham et al., 1988; Matison, Mayeux, Rosen, & Fahn, 1982) or both (e.g., Gurd & Ward, 1989; Gurd, Ward, & Hodges, 1990). However, it has become apparent that there are confounding variables that may influence performance on generative naming tasks. For example, when

mental status was specifically examined and nondemented PD patients were tested, several studies failed to find a significant effect of PD on verbal fluency (e.g., Hanley, Dewick, Davies, Playfer, & Turnbull, 1990; Miller, 1985; Taylor et al., 1986; Weingartner, Burns, Diebel, & Lewitt, 1984).

Bayles, Trosset, Tomoeda, Montgomery, and Wilson (1993) used a mental status score to divide PD patients into demented and nondemented groups, and compared their performance on letter and semantic category naming tasks with healthy controls and individuals with Alzheimer's disease (AD). Of particular relevance, the results indicated that: (a) nondemented PD patients produced significantly fewer correct responses than did normal control subjects on both semantic and letter category naming tasks, and (b) demented PD patients performed like AD patients on generative naming tasks, after mental status and age were controlled.

Considering this potential confound, several authors have concluded that nondemented patients with PD demonstrate deficits on semantic fluency tasks, but normal levels of performance on letter fluency tasks (Auriacombe et al., 1993; Levin, 1990; Randolph et al., 1993; Raskin, Sliwinski, & Borod, 1992). Studies examining both category naming and letter fluency tasks with the same patients have generally confirmed the pattern of impairment for category naming in nondemented PD patients (Auriacombe et al.; Beatty, Staton, et al., 1989; Goldenberg, Podreka, Muller, & Deecke, 1989; Matison et al., 1982; Raskin et al., 1992).

However, this issue is far from resolved, as other authors report reduced letter fluency in PD individuals (Bayles et al., 1993; Dalrymple-Alford et al., 1994) and

impaired performance by PD patients on both letter and semantic category naming (Beatty & Monson, 1989; Gurd & Ward, 1989; Hanley et al., 1990). In these latter studies, the presence of deficits in PD patients was co-existent with reduced word finding (Gurd & Ward, 1989), naming (Beatty & Monson, 1989), and general verbal (Hanley et al., 1990) abilities.

Other factors that have been put forward to account for the verbal fluency impairment in PD include a retrieval deficit for semantic information (Raskin et al., 1992), a deficit in executive functioning (Matison et al., 1982), a lexical retrieval impairment (Auriacombe et al., 1993), and a working memory deficit (Dalrymple-Alford et al., 1994). To date, one particular explanation has not been favored over the others.

Card Sorting. In general, the results of many studies indicate that Parkinson's disease patients tend to have difficulty with the WCST (e.g., Beatty & Monson, 1990; Bowen, Kamienny, Burns, & Yahr, 1975; Dalrymple-Alford et al., 1994; Pillon et al., 1986; Starkstein et al., 1989), although the card sorting performance of high functioning PD individuals was similar to matched controls (Mohr et al., 1990).

While studies have quite consistently found a deficit in the number of categories achieved by PD patients, deficits have also been reported in achieving initial concepts (Taylor et al., 1986), in abandoning initially correct concepts (Cools et al., 1984; Lees & Smith, 1983; Levin, Llabre, & Weiner, 1989), in sorting correctly (Bowen, Burns, Brady, & Yahr, 1976), and in maintaining alternative concepts (Beatty, Staton, et al., 1989).

Some research has indicated that the nature of PD patients' difficulties in problem solving on the WCST varies as a function of their overall mental status. For example, Beatty, Staton, et al. (1989) found that only PD patients with evidence of generalized cognitive impairment displayed the classic frontal pattern on the WCST of poor overall performance in association with increased perseverative responding. Findings of fewer categories, more perseveration, and greater difficulty achieving even one category in a sample of demented PD individuals compared to controls have been reported in other studies (Beatty, Monson, et al., 1989; Litvan et al., 1991). However, these results have not been consistently obtained. In one study comparing demented and nondemented PD patients (Caltagirone et al., 1989), the only significant result was that the former group produced more total errors on the WCST than the latter group.

In addition to mental status, the age and intellectual ability of PD patients have been observed to affect performance on the WCST. Increasing age was associated with fewer categories achieved and a higher percentage of perseverative errors (Fukui et al., 1995). Older PD patients of lower intelligence displayed considerable deficits in WCST performance (Taylor et al., 1986).

The difficulties displayed by PD individuals on the WCST have been attributed to difficulty in inhibiting a prepotent (but inappropriate) response in favor of the (appropriate) alternative response (Goel & Grafman, 1995), impaired short term memory (Bowen et al., 1975), and deficits in anterograde memory (Beatty & Monson, 1990). However, recent research suggests that, for both normal elderly and PD groups, WCST scores did not significantly load with measures of memory and

attention (Paolo, Troster, Axelrod, & Koller, 1995), implying that WCST scores provide information about problem solving relatively independent of memory and attention functions for elderly persons.

Summary

This review of the neuropsychological perspective has emphasized that problem solving is an executive function that is mediated by prefrontal cortex. Two groups for which deficits in executive function have been postulated are healthy elderly adults and Parkinsonians. Research pertaining to executive function in these two groups was reviewed for two tasks: verbal fluency and card sorting. These tasks were also utilized in the present study. Further, given the evidence indicating a potential confound of mental status and depression on cognitive performance in PD, these two variables were measured and assessed as covariates in the analyses. Another perspective that has been useful to understanding the problem solving performance of older adults is that offered by social cognition theorists.

The Social Cognition Perspective on Problem Solving

Problem-Solving: An Overview of the Construct

According to Reese and Rodeheaver (1985), problem solving involves assessment of an initial state, definition of a desired state, and identification of ways of transforming the former into the latter. A broad literature -- experimental psychology, social psychology, cognitive aging, and neuropsychology -- is concerned with efforts to describe and prescribe the process of solving problems (Arlin, 1989; Crovitz, 1970; Light, 1992; Rabbitt, 1977). Some models identify phases of problem solving such as

general orientation, problem definition, generation of alternatives, decision making, and evaluation (e.g., Heppner & Petersen, 1982). Ultimately, successful problem solving involves breaking the mental set that has impeded recognition and appropriate definition of the problem, and that has interfered with the discovery and production of new and potentially successful solutions to the problem (Crovitz, 1970).

Everyday Problem Solving

Researchers of adult cognition have become increasingly aware that older adults' level of functioning as assessed via laboratory-type measures and their functioning in everyday situations may be quite discrepant (Dixon, 1995; Hybertson, Perdue, & Hybertson, 1982; Reese & Rodeheaver, 1985; Salthouse, 1990). Thus, there has been an increasing concern about the ecological validity of traditional laboratory measures of problem solving when these measures are used with middle-aged and older adults (Denney, 1985; 1989). This issue has been discussed vigorously in recent years (e.g., Light, 1992; Poon, Rubin, & Wilson, 1989) and has led researchers to examine older adults' problem solving performance with tasks that are designed to simulate situations of everyday life (e.g., Cornelius & Caspi, 1987; Denney & Pearce, 1989; Diehl, Willis, & Schaie, in press; Hertzog & Dunlosky, 1996; Park, 1992). Whether traditional problem solving tasks have greater or lesser predictive validity than everyday problem solving tasks is a topic of important concern in both neuropsychology and cognitive aging.

What is meant by the term "everyday problems"? Meacham and Emont (1989) contrasted the features of everyday problem solving with those of traditional research

on problem solving: (a) it is interpersonal, not individualistic, (b) it involves ill-structured problems, not well-defined tasks, (c) several interwoven problems may be present at once, not just one task at a time, (d) there are several possible solutions, not just one correct solution, and (e) it is permissible to ask for help, rather than striving to solve the problem alone. These features follow from the interpersonal basis of everyday problem solving (Meacham & Emont, 1989; Sinnott, 1989).

Denney has investigated practical or everyday problem solving in adulthood. This line of research suggests that practical problem solving in adulthood has a different developmental trajectory than does traditional problem solving. Instead of the linear decline that was typical of performance on tests of traditional problem solving in adulthood, a quadratic trend was found for performance on tests of practical problem solving, whereby middle-aged adults performed better than both young and elderly adults (Denney & Palmer, 1981; Denney & Pearce, 1989; Denney, Pearce, & Palmer, 1982). However, not all researchers have found such a quadratic relationship between age and practical problem-solving ability (e.g., Cornelius & Caspi, 1987; Hartley, 1989).

It has also been hypothesized that older adults might perform better relative to younger and middle-aged adults on social problems because of their greater cumulative experience with social problems (e.g., Denney, 1989). However, Camp, Doherty, Moody-Thomas, and Denney (1989) concluded from their research that older adults may not be more familiar with social problems than nonsocial problems, and that elderly adults may not be better at providing solutions to social problems than to other

types of problems.

Similarly, in comparing the performance of adults on social, practical or everyday, and traditional problem solving tasks, Heidrich and Denney (1994) concluded that the age function for social problem solving did not differ from that obtained for practical problem solving. That is, both social and practical problem solving abilities were highest during middle adulthood.

Thus, it appears that most studies of practical, everyday problem solving or social problem solving indicate that performance increases from early to middle-adulthood and declines sometime thereafter.

The 20 Questions Task

The 20 Questions task has been used in the cognitive and developmental literature as a measure of problem-solving ability. There is some suggestion that this task has more ecological validity than specific neuropsychological tasks such as the Category Test, Levine's Concept Formation Task, and the Wisconsin Card Sorting Task (Klouta & Cooper, 1990; Laine & Butters, 1982; Taylor & Faust, 1952). Unlike the WCST in which subjects sort cards according to three solution paths (color, form, or number), the 20 Questions task allows for divergent reasoning skills (e.g., grouping items according to features such as their function or perceptual salience) as well as the qualitative analysis of performance (types of questions asked) (Goldstein & Levin, 1991).

In the typical 20 Questions task, an array of items is displayed to the subject, of which one is a target item. In identifying the target item, subjects are allowed to ask

only "yes" or "no" questions. The stated goal of the task is to identify the target item in as few questions as possible, with the maximum being 20. The performance of subjects is scored in terms of two major variables. The first variable is the total number of questions asked, with greater number of questions indicating a less efficient problem-solving strategy.

The second variable is a three-category classification of spontaneous questioning strategies employed by the subject. The three categories correspond to the relative efficiency of the strategies adopted by the participants (Mosher & Hornsby, 1966). The most efficient questioning strategy is reflected in "constraint-seeking" questions. These questions eliminate sets of items and thus reduce the number of questions required (e.g., "Is it edible?"). A less efficient strategy is reflected by "hypothesis-scanning" questions. These questions refer to a single item in the array, and thus eliminate only one possible item at a time ("Is it the umbrella?"). A third kind of question is termed "pseudoconstraint-seeking", as it has the form of a constraint-seeking question, but the content of an hypothesis-scanning question (e.g., "Does it bark?"). It also represents a less efficient strategy than true constraint-seeking questions, as it eliminates only one item at once.

Early research showed that efficient questioning strategies are developed later in childhood (Mosher & Hornsby, 1966). Denney and her colleagues have conducted several studies utilizing the 20 Questions procedure with adults of different ages. Elderly adults have performed less well than younger adults (Denney, 1982, 1990; Denney & Denney, 1973; Denney & Denney, 1982; Denney & Palmer, 1981; Denney,

Pearce, & Palmer, 1982; Kesler, Denney, & Whitely, 1976). Specifically, older adults ask more questions overall, more hypothesis-scanning questions, and fewer constraint-seeking questions than younger adults (Denney & Denney, 1973; Denney & Denney, 1982; Kesler, Denney, & Whitely, 1976). Thus, performance on this task generally declines across adulthood. However, other research utilizing a variant of the 20 Questions procedure found that age differences were apparent only for a 75-80 year old group, but not for a 60-65 year old group, when compared to middle-aged participants (Hybertson et al., 1982). Age differences in the properties upon which participants base their grouping of items have been postulated as the mechanism responsible for the age differences in the use of CS questions (Denney & Denney, 1982).

The 20 Questions task has also been used in neuropsychological research with patient groups. In a study comparing the performance of normal controls and frontal lobe patients on the 20 Questions task, the results indicated that the frontal lobe patients used fewer constraint-seeking questions, more hypothesis-scanning questions, and more questions overall compared to the normal control subjects. Further, they began asking such inefficient hypothesis-scanning questions sooner, and the constraint-seeking questions that were asked were often inefficient ones that served to eliminate relatively few alternatives (e.g., "Is it white?") (Klouta & Cooper, 1990).

Laine and Butters (1982) examined the problem-solving strategies of detoxified long-term male alcoholics using three versions of the 20 Questions task. The results indicated that the alcoholics did not initiate and order problem-solving strategies with

the same efficiency as the nonalcoholic controls. The alcoholics were less likely than the normal subjects to ask questions that would eliminate a large number of alternative possibilities, and tended to resort to specific hypothesis scanning early in the problem-solving process.

The 20 Questions task has also been used to examine the problem solving strategies of survivors of severe head injury (Goldstein & Levin, 1991). Three trials of the 20 Questions task were administered to patients and controls. It was found that, compared to controls, patients required more questions to guess the items and asked more pseudoconstraint questions and fewer constraint questions. There was no difference between groups in the number of hypothesis seeking questions that were utilized. Patients' lack of preference for constraint seeking questions was not due to a failure to comprehend the conceptual nature of the task or to memory impairment.

Summary

This section has reviewed the construct of problem solving from a social cognition and aging perspective. The notion of everyday problem solving was discussed, with its emphasis on the interpersonal element. A frequently used task in this research is the 20 Questions task, and it was also included in the present study. The theoretical constructs underlying this research will be presented in the next section.

Theoretical Rationale

Compensation

After summarizing the research on compensation across a number of domains, Bäckman and Dixon (1992), proposed a general definition of the term:

"Compensation can be inferred when an objective or perceived mismatch between accessible skills and environmental demands is counterbalanced (either automatically or deliberately) by investment of more time or effort (drawing on normal skills), utilization of latent (but normally inactive) skills, or acquisition of new skills, so that a change in the behavioral profile occurs, either in the direction of adaptive attainment, maintenance, or surpassing of normal levels of proficiency or of maladaptive outcome behaviors or consequences" (p. 272).

In an explication of the definition, Dixon and Bäckman (1995) discussed the origins, mechanisms, forms, and consequences of compensatory behavior. First, they noted that compensation originates in an objective or subjective mismatch between the skills a person possesses and the demands of the environment. The rationale for compensation is to close the gap between expected level of performance and actual level of performance.

However, compensation might not occur when there is a high degree of support in the individual's environment and thus no need for self-initiated compensation. Generally, the probability of compensatory behavior decreases as a function of increasing contextual support (Bäckman & Dixon, 1992).

Another consideration is that compensation may not occur when the deficit is so severe that compensation is impossible to effect. In this regard, Bäckman & Dixon (1992) proposed an inverted U-shaped function to characterize the relationship between deficit severity and compensatory efforts. That is, moderately impaired people are more likely to compensate, mildly impaired people are unaware of the need

to compensate, and those with severe deficits lack the skills required to implement compensatory behavior.

The second component of the compensation definition reflects the means through which an alleviation or attenuation of the mismatch is pursued. Dixon and Bäckman (1995) identified several classes of compensatory mechanisms such that an individual may: (a) increase the time or effort expended at the task, (b) access a substitutable skill from the individual's present repertoire, (c) use or develop a new skill, (d) modify expectations about performance so that by reducing one's criterion of success the gap is less troubling, (e) separate the personal expectation of performance from the environmental demand, such that the former resides closer to the actual level of performance or ability, and (f) select alternative tasks or goals such that the original mismatch is reduced in prominence and perhaps eventually forgotten. From their review of the literature, Bäckman and Dixon (1992) suggested that substitution through use of latent, but typically inactive, skills is the most common form of compensation.

The third element of the definition refers to the notion of awareness. This dimension is viewed as a continuum. That is, compensation may be associated with awareness of a mismatch and with deliberate action intended to overcome the deficit. On the other hand, there may be an absence of awareness of the mismatch, or even the compensatory behavior, such that compensation may be relatively automatic. Further, awareness of the mismatch or compensatory mechanism may fade (or grow) with time such that compensatory behaviors may become relatively automatized and less effortful to execute.

The final component of the definition relates to the consequences of compensation. Compensation often results in adaptation and, where awareness is involved, is certainly intended to promote success. However, there is the possibility that compensatory behaviors may yield no change in the mismatch and no demonstrable consequence. Further, compensatory behavior may have a maladaptive outcome for the producer or for other people.

Dixon and Bäckman (1995) view compensation as a superordinate term for a related set of processes that represent different functions but that share family resemblance with one another and that can be subsumed under the umbrella of compensation. These include accommodation, assimilation, selection, substitution, and remediation. Excluded from the concept of compensation are psychological phenomena such as learning and coping with daily stresses.

The application of compensatory mechanisms to cognitive aging and prose processing (Dixon & Bäckman, 1993b), reading comprehension skills and aging (Dixon & Bäckman, 1993a), intelligence (Dixon & Bäckman, 1994), and general cognitive and methodological issues (Dixon & Bäckman, 1993b) has also been elaborated. In the area of aging and memory, Dixon (1992; Dixon & Bäckman, 1992/93) has discussed ways in which elderly adults use memory aids to compensate for difficulty in everyday remembering tasks. This may be accomplished through internal mnemonic techniques (such as method of loci, rhyming, or imagery) or external memory aids (such as writing notes in a calendar or collaborating with a spouse).

One frequently used form of external memory and problem-solving aid that has been largely ignored in the aging literature is the use of other people (e.g., asking a spouse to remind you of an upcoming appointment). Social compensation may be particularly important after the experience of losses, including health-related losses (Cobb, 1992; Cohen & Willis, 1985). Further, it may not always be the case that the person with the illness initiates the compensation. Rather, the network members could compensate to meet the needs of the ill person (Ferraro & Farmer, 1995).

Recent research has begun to explore the extent to which older adults use other people to compensate for age-related decrements in cognitive functioning (Dixon, 1992). In this regard, an interesting question is whether compensation can occur through processes of collaboration.

Collaboration

Research on small group problem solving and decision making has historical roots in social psychology (Samuelson, 1992). Much of the interest in this area was centered on whether groups were more productive than individuals. The current view is that collaborative groups may experience process gain or process loss, terms used to refer to the fact that group performance may not be a simple multiple of individual performance (Hill, 1982; Steiner, 1972). Although there are many complications in estimating optimal group productivity, the effectiveness of the collaboration is determined by: (a) the individuals involved (varying in abilities and motivation), (b) the tasks they perform (varying in difficulty and degree to which they can be shared), and (c) the goal(s) they pursue (e.g., the degree to which they are consonant) (e.g.,

Steiner, 1972).

Group productivity may be related to factors such as incidental learning during observation, and the superior hypothesis-evaluation and error-detecting strategies which have been observed in interactive groups engaged in problem-solving tasks (Hill, 1982). It may also be related to group cohesiveness, which refers mainly to members' attraction to the group, and liking for one another (Hogg, 1992). High cohesiveness is associated with high productivity (Hare, 1992). Studies suggest that people may contribute more effort to collaborative tasks when working with friends or spouses than when working with strangers (Karau & Williams, Exp. 2, 1992; Williams, 1981). Extending collaborative research to an older population has been the focus of recent investigation.

Cognitive Aging and Collaboration

The term collaborative cognition has been defined as cognitive activity that occurs in the context of more than one individual, where the activity is (a) typically directed at an identifiable set of tasks, (b) usually in pursuit of common goals, and (c) performed cooperatively (although not necessarily effectively) (Dixon, 1996; Dixon & Gould, 1996).

As mentioned above, collaboration may serve a compensatory function for individuals who have experienced aging-related or neurological cognitive decline. Through collaboration, individuals may be able to compensate by combining their available resources with cooperating individuals. Successful combinations of resources may be additive (e.g., in the sense of combining like skills or domains),

complementary (e.g., in the sense of combining different skills or domains), or perhaps emergent (e.g., performing multiplicatively or at a qualitatively new level) (Dixon, 1996).

Research in collaborative cognition and aging has only recently been undertaken (e.g., Dixon, 1992; Gould, Trevithick, & Dixon, 1991). Issues of interest in this research are whether (a) older adults can in fact collaborate effectively in complex cognitive tasks, (b) older adults' performance improves with the addition of collaborators, (c) composition or membership of the groups plays a role in performance, (d) older groups perform in the same manner (or process) as younger groups, and (e) older groups may be using the resources of members selectively such that they compensate for individual-level cognitive decline.

One area of investigation in aging is the collaborative telling or retelling of stories. For example, a study on collaborative storytelling asked younger and older married couples to tell a story about a vacation taken together (Gould & Dixon, 1993). When the structure and content of the stories, and the process of storytelling, were investigated, the findings reflected a strategy by the elderly storytellers to decrease the memory demands of the task and the cognitive demands of the collaboration.

Several studies have been conducted to explore performance on narrative remembering tasks by younger and older individuals in collaborative situations. In these studies, the task was to listen to stories and subjects then used their own words to remember as much information as possible from them. In one study with unacquainted collaborators, younger and older adults were assigned to same-age and

same-gender groups of one (individuals), two (dyads), and four (tetrads) members.

The results indicated that, across group size, young and old adults benefited equivalently from the presence of collaborators, but the younger individuals and groups remembered more information than older parallel units (Dixon & Gould, 1994).

In a subsequent set of two studies that examined young and old well-acquainted married couples collaborating on a story remembering task (Dixon & Gould, 1994), there was evidence indicating that older married couples performed as well as younger married couples in recalling an equivalent amount of propositions from the stories.

A follow-up study comparing the communication styles of younger and older unacquainted dyads and married couples indicated that as recall of information from the narrative began to decline, older married couples produced more strategy statements designed to boost or maintain remembering performance; for younger couples, the trend was similar to, but lower than, that of older couples. In contrast, older unacquainted dyads offered more statements of social support and younger unacquainted dyads did little to compensate for declining recall performance (Gould, Kurzman, & Dixon, 1994).

Gagnon (1995) examined the influence of age and collaborative experience on individual- and dyad-performed memory-related tasks. Participants were younger married couples, younger mixed-gender stranger dyads, older married couples, and older mixed-gender stranger dyads. It was found that collaborative expertise benefited older adults, if modestly, on sentence repetition and immediate story recall tasks. In contrast, collaboration, but not collaborative expertise, seemed important to the

performance of younger adults. Younger stranger dyads and younger couples performed similarly on working memory tasks and on story recall tasks.

Overall, this research suggests that there is a performance advantage to experienced collaborative cognitive performance. Thus, cognition in collaborative situations appears to be both a common expression of cognitive skills in everyday life and a skill for which older adults, particularly long-term married couples, may not be as disadvantaged as they are in individual laboratory settings.

Collaboration and the 20 Questions Task

Until recently, only one study had examined collaboration on a 20 Questions task. Taylor and Faust (1952) required their undergraduate participants, presumably young adults, to name one object from a pool of 60 objects, equally divided into three categories (animal, vegetable, and mineral). Their results indicated that group performance was superior to individual performance in terms of number of questions, number of failures, and elapsed time per problem. The authors suggested that a greater number of group members may reduce the likelihood of subjects persisting in inefficient questioning strategies.

The 20 Questions task was used in a collaborative problem solving study comparing young and old adults (Dixon, Fox, Trevithick, & Brundin, 1995). Subjects were randomly assigned to one of three group size conditions, namely, individuals, dyads, or tetrads. All groups were homogeneous with respect to age. Two trials of a fixed alternatives and one trial of an unrestricted alternatives 20 Questions task were presented. Results pertaining to individuals largely replicated previous research with

these tasks. Results concerning the group conditions indicated that, although often performing at different levels on different tasks, both older and younger adults showed some evidence of collaborating effectively in solving practical problems.

Summary

Theory and research pertaining to the two concepts underlying this research -- collaboration and compensation -- were elaborated. A collaborative paradigm was utilized to investigate the possibility that couples working together to solve problems might perform better than when working individually. Extending these paradigms to a neurological sample of elderly adults whereby collaboration was viewed as a possible compensatory mechanism was one focus of this research.

The Present Study

Collaborative problem solving was investigated with two groups of acquainted individuals. The control group consisted of healthy elderly couples and the experimental group comprised Parkinsonian men and their wives. Several measures were derived. All subjects completed a questionnaire composed of demographic and health information. They also filled in the Problem Solving Inventory, a questionnaire measuring self-reported problem solving efficacy. Indices of depression (Geriatric Depression Scale (GDS)) and of mental status (Mini Mental Status Examination (MMSE)) were included to be used as covariates in analysing the results. The three problem solving tasks were verbal fluency, the Wisconsin Card Sorting Test (WCST), and the 20 Questions task. Subjects completed these latter three tasks twice: once as individuals and once collaboratively with their spouse. This within-subjects group size

factor was counterbalanced so that half of the subjects were tested first as individuals and then as dyads and vice versa. The collaborative part of each testing session was videotaped.

There were two theoretical notions guiding this research. The first was that of compensation. Specifically, people who are having difficulty solving problems may rely on external aids in order to improve their performance. One such possible aid is to enlist the help of others. The second notion was that of collaboration. Long-term married couples working together on problem solving tasks may perform better than when solving such tasks individually. In the case of the Parkinsonian couples, this collaboration was viewed as a possible compensatory mechanism for individual PD deficits in problem solving. Further, it was argued that the interpersonal (collaborative) aspect of this research made it more ecologically valid than previous problem solving studies, especially for the couples in which one spouse had PD.

Several research questions were investigated as follows:

1. Are there differences across participant groups in WCST and verbal fluency scores?

It was expected that PD patients would perform more poorly than the other participants on both the WCST and verbal fluency tasks. Further, it was expected that group performance would be better than individual performance (i.e., dyads would outperform individuals) for both tasks. An interaction between group and group size was expected such that the difference between individual and dyad performance would be greater for the experimental PD couples than for the healthy control couples.

2. Are there differences across participant groups in performance on the 20 Questions task?

It was expected that the PD patients would ask more questions overall, more hypothesis-scanning and fewer constraint-seeking questions than the other participants. If dyads were more efficient than individuals, it was expected that the dyads would ask fewer questions and more constraint-seeking questions than individuals. Positing a compensatory effect of the spouse in the Parkinsonian dyads, the interaction between group and group size was expected to be significant. That is, the difference between individual and dyadic performance would be greater for the experimental PD couples than for the healthy control couples.

3. For the 20 Questions task, is there any difference between the control and experimental groups in the relationship between measures of group performance and group process?

It may be the case that more efficient questioning strategies were related to different process variables across the two groups.

4. How well does the 20 Questions task correlate with neuropsychological measures of executive/frontal lobe function?

If the 20 Questions task is a measure of executive/problem solving ability, then it should correlate moderately well with other measures of executive function such as WCST and verbal fluency scores.

5. What is the self-perception of PD patients' problem solving ability, as measured by their responses to the Problem Solving Inventory?

While PD patients typically perform worse than controls on neuropsychological measures of problem solving, studies have not addressed their perception of their own problem solving ability. Given that these patients generally have insight into the effects of the disease process, it was expected that if they were having difficulties with problem solving, they would rate their problem solving ability lower than that reported by normal controls.

6. Do scores on the depression and/or mental status tests influence any of the results that are obtained?

It would be necessary to show that any deficits in problem solving ability were likely not due to depression or low mental status, as previous research has indicated (a) more severe cognitive deficits in PD patients with depression compared to a PD group without depression, and (b) the importance of mental status as a predictor of problem-solving ability.

CHAPTER 3

Method

Participants

Two groups of married couples participated in the study. The healthy control couples consisted of 22 healthy elderly couples ($N = 44$ individuals) with neither partner having a medical diagnosis of Parkinson's disease (PD). The PD couples consisted of 24 older couples ($N = 48$ individuals) in which one spouse had a diagnosis of PD from a qualified neurologist. However, two healthy couples and four PD couples were not included in the final sample. One individual in each of the two healthy couples and in two of the PD couples had a score on the Mini Mental Status Examination that was below the standard cut-off (described later). One PD couple did not meet the age criterion (i.e., both partners aged 55 years or older), and one PD couple discontinued the testing session.

The experimental group consisted of 17 couples in which the husband had PD and three couples in which the wife had PD. This introduced a confound into the research design. It would not be possible to examine potential gender effects in the experimental group without confounding this with the presence/absence of PD. Two solutions became apparent. Analyses could be conducted on three groups such that the control group consisted of 20 healthy couples, one experimental group comprised 17 couples (where the Parkinsonian was male), and another comparison group consisted of three couples (in which the Parkinsonian was female). The other alternative was to eliminate the three couples in which the Parkinsonian was female from the inferential

statistics, and to include a separate descriptive section devoted solely to this group. The latter option was the preferred one, as a sample size of three was too small to afford any power to make substantive statements in a statistical analysis. Thus, the term "principal experimental group" was used to denote the 17 male Parkinsonians and their spouses. The "supplemental experimental group" referred to the three PD females and their spouses.

Healthy control couples were recruited from an elderly subject pool in the psychology department. Experimental couples were recruited from regional Parkinson's Associations and from referral by local neurologists. Participants volunteered their time and did not receive any monetary compensation for their involvement in the study.

The control and experimental participants were recruited with four selection criteria: (a) similar age range, (b) relatively well-educated for their age cohort, (c) above a criterion in MMSE, and (d) below the clinical criteria of depression. Overall, these goals were met. The experimental participants, however, were recruited on an availability basis. Therefore, it was not possible to match them perfectly to the control participants. Background characteristics, including age, level of education, MMSE scores, level of depression, length of marriage, marital satisfaction, and health status, are presented in Table 1.

Two (group) X two (gender) ANOVAs were conducted on these variables to test for differences between the control group and the principal experimental group. With respect to age, the means for the control group ($M = 68.47$ years, $SD = 7.72$)

and the experimental group ($\underline{M} = 71.15$ years, $\underline{SD} = 6.37$) were not significantly different ($F(1, 70) = 2.66$, $p = .107$, $\underline{MSE} = 131.22$). The gender effect was marginal, with men ($\underline{M} = 71.22$, $\underline{SD} = 6.37$) generally older than women ($\underline{M} = 68.19$, $\underline{SD} = 7.75$) ($F(1,70) = 3.69$, $p = .059$, $\underline{MSE} = 182.19$). Control subjects ($\underline{M} = 14.88$, $\underline{SD} = 2.90$) were more educated than experimental participants ($\underline{M} = 12.82$, $\underline{SD} = 3.86$) ($F(1,70) = 6.71$, $p < .05$, $\underline{MSE} = 77.35$). With respect to MMSE scores, there were significant main effects of gender ($F(1,70) = 10.33$, $p < .05$, $\underline{MSE} = 13.60$) and group ($F(1,70) = 17.39$, $p = .000$, $\underline{MSE} = 22.90$). That is, women ($\underline{M} = 28.57$, $\underline{SD} = 1.12$) scored higher than men ($\underline{M} = 27.76$, $\underline{SD} = 1.46$), and the control group ($\underline{M} = 28.68$, $\underline{SD} = 1.05$) scored higher than the experimental group ($\underline{M} = 27.56$, $\underline{SD} = 1.44$). These main effects were qualified by a significant interaction between gender and group ($F(1,70) = 5.20$, $p < .05$, $\underline{MSE} = 6.85$). A comparison of the means indicated that PD males had a significantly lower mental status score than did their spouses, the control males, and the control females. Nevertheless, the PD males performed above the exclusionary criterion.

The control group scored significantly lower on the depression scale than did the experimental group ($F(1,70) = 20.26$, $p = .000$, $\underline{MSE} = 301.45$), indicating that they were less depressed than the experimental group. The interaction between gender and group was also significant ($F(1,70) = 4.65$, $p < .05$, $\underline{MSE} = 69.25$), indicating that the PD males described themselves as more depressed than their spouses, the control males, and the control females. It should be noted, however, that the depression score for all groups was within the normal range.

There were no group differences or interactions observed for length of marriage, marital satisfaction, or self-rated hearing. Control participants rated their eyesight and overall health (as compared to their peers) more favorably than did the experimental group ($F(1,70) = 9.63, p < .05, \text{MSE} = 4.17$ and $F(1,69) = 7.44, p < .05, \text{MSE} = 3.97$, respectively).

Thus, given that education, mental status, and depression scores were not equivalent across groups and presented potential confounds, they were included as covariates in the analyses of problem solving performance.

Descriptive Information for the PD Participants

Table 2 highlights demographic characteristics for the 17 PD males and the three PD females. Isolating just the responses of the Parkinsonians, exploratory oneway ANOVAs were conducted on each variable, with gender as a between-subjects factor. The two groups were significantly different on four measures. PD females were younger, were diagnosed with PD at a younger age, were less satisfied in their marriages, and rated their eyesight as poorer in comparison to peers than the PD males. There were no significant differences between these two groups on variables such as years of education, mental status score, and level of depression.

The Parkinsonians also responded to other questions about aspects of their illness, such as their drug treatment, characteristics of their presentation (i.e., tremor, walking, rigidity, speech), and side effects of the disease (see Appendix A). Table 3 summarizes the responses of the Parkinsonian males and females to these questions.

Exploratory Analyses for the PD Group

In order to determine if there were any significant differences between the problem solving performance of PD males ($N = 17$) and PD females ($N = 3$), separate 2 (gender) X 2 (group) ANOVAs were conducted on the total number of words produced in the individual condition of the verbal fluency task, the various indices of performance in the individual condition of the card sorting task, and the types of questions asked in the individual condition of the 20 Questions task. The only significant interaction between group and gender was for the number of nonperseverative errors on the WCST ($F(1,39) = 9.24, p < .05, MSE = 863.20$). An examination of the means indicated that PD females made more nonperseverative errors on the WCST than their spouses, PD males, and the spouses of the PD males. However, a subsequent power analysis revealed that the sample size was not large enough to detect differences between the PD males and the PD females. Therefore, including the PD females in further analyses was not warranted because of the inability to conclude that their problem solving performance was similar to that of the PD males.

Materials

Demographic Questionnaire

All subjects were orally administered a questionnaire comprising demographic and health information (see Appendix B). The PD individuals responded to a lengthier version of the questionnaire that included questions specific to their illness. Subjects were interviewed individually with this questionnaire, which took between 30 and 45 minutes to complete.

MMSE

Cognitive status was assessed using the Mini Mental Status Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). The MMSE provides a gross estimate of cognitive functioning. It takes five to ten minutes to orally administer, and contains 11 items assessing orientation to time and place, immediate and delayed item recall, attention, language skills, and design copying (see Appendix C).

Folstein et al. (1975) have provided evidence for the reliability and validity of the MMSE. Test-retest reliability estimates for intervals of less than two months generally fall between .80 and .95; for lengthier retest intervals of one to two years, retest correlations are typically lower (less than .80) (Spren & Strauss, 1997). For example, Hopp (1993) studied adults who were older than 75 years, and reported test-retest correlations for the MMSE across five occasions of measurement, at six-month intervals. The correlations were quite high at the six-month ($r = .79$) and one-year ($r = .72$) intervals, and were somewhat lower at 18 months ($r = .58$) and 24 months ($r = .66$).

In terms of validity, Spren and Strauss (1997) report that the MMSE shows modest to high correlations with other brief screening tests such as the Blessed Test and the Dementia Rating Scale. For example, the correlation between the MMSE and the Blessed Test was -.83 in a sample of patients (M age = 65 years) who had received a diagnosis of probable Alzheimer's disease (Fillenbaum, Heyman, Wilkinson, & Haynes, 1987). In another sample of probable AD patients (M age = 72 years), the correlation between the MMSE and the Dementia Rating Scale ranged from

.62 to .84 across initial testing and in subsamples re-tested at one- and two-year intervals (Salmon, Thal, Butters, & Heindel, 1990).

In the present study, the MMSE was used as a screening measure for abnormal cognitive decline. It was administered to each individual, and anyone scoring below the standard cutoff of 24 out of 30 was not included in the study. This occurred for two of the control individuals and two of the PD individuals. In these four instances, the testing session was completed, but the resulting protocols were not included in the final sample.

Geriatric Depression Scale (GDS)

The GDS was developed by Brink, Yesavage, Lum, Heersema, Adey, and Rose (1982) explicitly for use with older adults. On this self-rating scale, subjects answer 30 yes-no questions about their current mood (see Appendix D). A total score out of 30 is obtained. Evidence of the scale's reliability and validity for use with older adult populations has been provided by the authors (Yesavage et al., 1983). For example, the scale's internal consistency was .94 and its split-half reliability was .94 (Brink et al., 1982). In one study (Koenig, Meador, Cohen, & Blazer, 1988), retest reliability after one week was .85. Spreen and Strauss (1997) report that the GDS has good discriminant validity, and its concurrent validity has been established by correlations of .73 with the BDI, of .84 with the Zung scale, and of .83 with the Hamilton scale. Criterion validity of .82 when measured against the Research Diagnostic Criteria was reported by the authors (Yesavage et al., 1983). In the present study, this scale was administered orally to each participant and used as a screening measure for depression.

Subjects obtaining a score in the severe range (i.e., a score of 20 or higher) were to be excluded from the sample. However, all of the participants that were tested had scores below this cut-off.

Problem Solving Inventory (PSI)

The purpose of the PSI is "to assess an individual's perceptions of his or her own problem-solving behaviors and attitudes" (Heppner, 1988, p. 1). It reflects the individual's awareness and evaluation of his or her problem solving abilities or style. In this context, problem solving is defined as "any goal-directed sequence of cognitive operations employed for the purpose of adapting to internal/external demands or challenges" (Heppner, 1988, p.1). "Problems" are referred to as personal problems that everyone experiences at times.

The PSI consists of 35 statements (see Appendix E). Using a 6-point Likert scale, respondents indicate the extent to which they agree or disagree with each statement ("1" = Strongly Agree; "6" = Strongly Disagree). Administration time is typically 10-15 minutes. Fifteen items are negatively worded and require reverse scoring.

The PSI comprises three scales that have been derived from a factor analytic procedure. Each subscale produces a separate score and these are summed to provide an overall scale score.

1. Problem-solving confidence (11 items): Self-assurance while engaging in problem-solving activities. Low scores on this scale indicate that individuals believe and trust in their own problem-solving abilities. A representative item is: When I

make plans to solve a problem, I am almost certain that I can make them work.

2. Approach-avoidance style (16 items): A general tendency to approach or avoid problem-solving activities. Low scores are associated with a style of approaching rather than avoiding problems. A representative item is: When confronted with a problem, I consistently examine my feelings to find out what is going on in a problem situation.

3. Personal control (5 items): The extent to which individuals believe that they are in control of their emotions and behavior while solving problems. Low scores indicate the perception of personal control in handling problems. A representative item is: I make snap judgments and later regret them.

Evidence for the reliability and validity of this inventory, principally with undergraduate students, is provided in the manual (Heppner, 1988). Only one study has examined the internal consistency of the PSI with an elderly population (Moss, 1983, cited in Heppner, 1988). In this sample of 66 older adults with a mean age of 70 years, the internal consistency for the total PSI score was estimated to be .90. No studies have been conducted to establish the validity of the PSI with an elderly population. Reviews of the inventory have been provided by several authors (e.g., Camp, 1992; LoBello, 1992).

In the current study, participants completed the PSI individually.

Word Fluency

This test measures the spontaneous production of words beginning with a given letter, or of a given class, within a limited amount of time. In this study, subjects

participated in this task twice. In the individual condition, they were asked to orally produce as many words as possible beginning with the letters F, A, and S. The time allotted for each letter was 60 seconds. They also had one minute to provide as many animal names as they could verbalize. In the dyad condition, the three letters were P, R, and W, the category was foods, and the time limit was the same (see Appendix F). Subjects were instructed that they could not use words that are proper names, and that they could not use the same word again with a different ending (e.g., eat, eating). In older adults, a retest reliability of 0.70 after a one year interval has been reported, and concurrent validity has been established in several studies (see Spreen & Strauss, 1991).

In this study, for each letter and category, three scores were calculated. First, the number of admissible words provided by the participants was summed. Then verbatim word repetitions (i.e., perseverations) and the number of inadmissible words (i.e., intrusions) were also tallied.

Wisconsin Card Sorting Test (WCST)

This test assesses the ability to form abstract concepts, and to shift and maintain a cognitive set. It consists of four stimulus cards, placed in front of the subject, the first with a red triangle, the second with two green stars, the third with three yellow crosses, and the fourth with four blue circles on it. The subject is then given two packs, each containing 64 response cards, which have designs similar to those on the stimulus cards, varying in color, geometric form, and number. The subject is instructed to match each of the cards in the decks to one of the four key cards. The

examiner explains that the object is to try to get as many right as possible and that there is no time limit. Each time the subject places a card, he or she is told whether it is right or wrong. The procedure continues until the subject has successfully completed six sorting categories (i.e., 6 sorts of 10 consecutive correct responses), or until all 128 cards have been placed. Re-test reliability of the WCST for 87 normal elderly persons after a one year interval ranged from .12 to .66 across several WCST indices (Paolo et al., 1995). Several studies have confirmed that the WCST is a sensitive measure of frontal lobe functioning (see Spreen & Strauss, 1991).

Performance on the WCST is scored in a number of ways (see Appendix G for a sample scoring sheet). In this study, the following measures were examined:

1. Number correct: number of correct responses
2. Categories achieved: the number of correct sorts, ranging from 0 for the subject who never gets the idea at all, to six, at which point the test is discontinued
3. Perseverative responses: responses that would have been correct in the previous stage. The perseverative response may reveal an inability to relinquish the old category for the new one, or the inability to see a new possibility. The perseverative response score is the most useful diagnostic measure that is derived from the test, as it predicts the presence or absence of brain damage and of frontal lobe involvement in focal cases (Heaton, 1981).
4. Nonperseverative errors: computed by subtracting the total number of perseverative errors from the total error score on the test
5. Number of trials to complete the first category: This provides an indication of

initial conceptualization before a shift of set is required.

6. Failures to maintain set: the number of times in the test that the subject makes five correct responses in a row but fails to get the 10 that are required to complete the category. It indicates an inability to consistently use a strategy that has been successful.

Participants in this study were administered the WCST twice, once as individuals and once collaboratively with their spouse.

20 Questions Task

This task consists of a pictorial array of 42 common objects reproduced from Mosher and Hornsby (1966) on 6.5 x 10.5 cm cards displayed in front of the subjects. The task is to identify a single object pictured on one of the cards. Subjects are allowed 20 questions that can be answered with a "yes" or "no" response. They are permitted to turn over cards as they are eliminated from consideration so as to minimize the memory load. Completion of the trial occurred when the correct item had been identified, even if that required more than 20 questions. However, in the latter case, they were still considered to have failed the task. Subjects participated in this task twice, once as individuals and once collaboratively with their spouse.

Reliability and validity information for the 20 Questions task is sparse. However, it has considerable face validity as a measure of planning/problem solving (Kafer & Hunter, 1997), and the results of a factor analysis indicated that it taps abilities that have been shown to be fairly representative of problem solving abilities in general (Kesler, Denney, & Whitely, 1976). Furthermore, it has been used

frequently with older adults and has been employed in the study of collaborative situations.

In scoring this task, all questions asked by the subjects were assigned to the three categories as discussed previously: (a) constraint-seeking questions that eliminate two or more items or possible solutions at once, (b) hypothesis-scanning questions that eliminate only one item at a time, and (c) pseudoconstraint-seeking questions that refer to only one item, but are phrased like constraint-seeking questions. The total number of questions asked was also recorded (see Appendix H for a sample scoring sheet).

In the dyad condition, all other statements made by the spouses during the process of solving the problem were coded as belonging to one of the following sets of categories. These represent qualitative characteristics of the collaborative process. The total number of statements in each category was recorded for each spouse in the dyad.

Clarifying negotiations. This is speech in which spouses negotiate and consult with each other about what specific objects are included in certain categories (e.g., Is a ruler a tool?).

Strategy statements. These are statements by a spouse which indicate part of a strategy-seeking process or which begin a discussion resulting in the next question (e.g., Let's organize all the cards into groups before we start.).

Productive commentary. These are statements that are not directly relevant to the task, but that lead directly or indirectly to an alternate strategy or solution (e.g., I

don't know, it's up to you.).

Reviews. These are statements indicating a review of what has already been asked or learned in the process of solving the task (e.g., We asked if it was edible.)

Admonitions. These are statements in which spouses actively discouraged each other from pursuing a line of questioning (e.g., You can't do that because it would be cheating) or admonished themselves for not thinking through a question more carefully (e.g., I should have asked if it was living, not just if it was an animal.)

Requests for help. These are information-seeking questions posed to the experimenter (e.g., Is it OK if we use this approach?).

Commentary to interviewer(s). These are statements that are in response to the interviewer's question or that are a result of what the interviewer has said (e.g., I see.).

Repeated questions. These are questions posed more than once within the same problem solving task.

Non-productive commentary. These are statements that are not directly relevant to the task. This category includes statements that cannot be included in any of the other categories and that have no direct bearing on solving the problem (e.g., I think my grandson would like this.).

Praise. This category refers to statements of praise to oneself or to one's spouse (e.g., That's a good one [question].).

Reliability. Three raters were trained on seven tapes (all control couples) to use the process variable categories to code the verbal protocols produced by the dyads. Interrater reliability was then established for three tapes (one control couple and two

experimental couples). Interrater agreement between pairs of raters across the three tapes ranged from 60% to 94% ($\underline{M} = 72\%$) for the 20 Questions task per se, and was somewhat more variable for pre-task (42% to 82%) ($\underline{M} = 67\%$) and post-task (33% to 100%) ($\underline{M} = 69\%$) coding. In order to correct for chance, Kappa coefficients were calculated. These ranged from .46 to .92 ($\underline{M} = .60$) for the 20 Questions task itself, from .18 to .76 ($\underline{M} = .53$) for pre-task coding, and from .25 to 1.00 ($\underline{M} = .57$) for post-task coding. Across the three tapes, the percentage of agreement between raters for each process variable was also tabulated. In general, these ranged from about 50% to 100% for each variable ($\underline{M} = 81\%$). The two exceptions were for clarifying negotiations (22% to 100%) ($\underline{M} = 62\%$) and for productive commentary (40% to 74%) ($\underline{M} = 62\%$). The final scoring of these three tapes reflected a consensus across the raters. All remaining tapes were independently scored by the three raters, who consulted among each other when problematic coding situations arose.

Procedure

Participants were brought into the testing session as dyads. All of the control couples were tested at the University of Victoria. Sixty-five percent of the experimental couples were tested in their homes, and 35% were tested at the university. Each session lasted from approximately 2 to 2.5 hours.

At the beginning of the session, the spouses were interviewed individually, in separate rooms, by two female testers. They were orally administered the demographic/health questionnaire, the Mini Mental Status Examination (MMSE), and the Geriatric Depression Scale (GDS). Their written responses to the inventory of

items measuring self-reported problem solving efficacy (Problem Solving Inventory) were then elicited.

Subsequently, they participated in the three problem solving tasks (word fluency, WCST, and 20 Questions task), and performed these tasks twice, once as individuals and once collaboratively with their spouse. This group size variable was counterbalanced so that half of the participants performed all three tasks first as individuals and then in dyads; the other half of the participants performed the tasks first in dyads and then as individuals. (see Appendix I for the exact order of task administration.) Counterbalancing of testers was also implemented so that, in administering the questionnaires to individuals at the beginning of the session, each tested 20 males and 20 females. Further, when the spouses worked together in the dyadic condition, counterbalancing of testers was performed such that each tester took the lead in administering the three problem solving tasks to half of the couples.

The collaborative part of each testing session was videotaped. A practice task (see Appendix J) preceded the collaboration and was included in order to (a) promote comfort in making oral responses and (b) encourage an initial level of dyad responsiveness.

The individuals and dyads received identical instructions, in that they were informed of the requirements and goals of the tasks only; they were not informed that they would be performing some of the same tasks twice. In the dyadic condition, it was emphasized to participants that they should work together on the tasks and that how they chose to do that was up to them. A brief pause between these instructions

and the start of the timed fluency task was given to allow participants the opportunity to discuss potential strategies before the timing started. The dyads were neither encouraged nor prohibited from discussing issues relevant to the tasks (e.g., strategies) or irrelevant to the tasks (e.g., their own experience).

CHAPTER 4

Results

Verbal Fluency Task

Participants in each couple performed the letter fluency task twice: once as individuals (with the letters F, A, and S), and once collaboratively with their spouse (with the letters P, R, and W). Similarly, the semantic fluency task was performed both individually (animals) and as a dyad (foods). The order in which the individual and dyadic tasks were performed was counterbalanced across subjects.

Two sets of analyses were conducted. First, to ascertain if there was a group level benefit of collaboration, between-subjects analyses were performed comparing the control and experimental groups on verbal fluency measures in both the individual and dyad conditions. Second, within-subjects analyses were conducted with the group size variable to examine if there was an individual-level benefit of collaboration. The dependent variables in these analyses were the number of words produced for the letter and semantic categories, the number of perseverations and intrusions produced for the letter categories, and the number of perseverations and intrusions produced for the semantic fluency task.

It should be noted that, in these analyses, performance across the three letters was summed to produce a total fluency score. Initial analyses examining the effect of each letter revealed no significant effects and no significant interaction with group. Thus, this letter factor was dropped from the analyses.

Between-subjects Analyses

Overview. Several analyses of variance were conducted. First, in order to determine whether education level, mental status, and depression scores might influence performance on the fluency task, analyses of covariance were conducted. For each of the analyses reported below, there were no significant effects of the mental status and depression covariates and these two variables were eliminated from further analyses of the fluency task. Education was a significant covariate in two of the analyses, and will be reported for those variables.

A repeated measures design for the gender factor has been employed in these analyses. Regardless of whether the participants completed the verbal fluency task individually or collaboratively with a spouse, they were not independently selected into the study and thus a procedure that accommodates matched groups (i.e., a repeated measures design) was necessary.

We expected that the PD individuals would perform more poorly than the other participants on both the letter and category fluency tasks. Overall, the results did not conform to expectation, but the pattern of means was in the expected direction. No predictions were made with respect to the analyses of perseverations and intrusions. When group differences emerged, the experimental group tended to make more perseverations and intrusions than the control group.

Comparisons of letter and category fluency. In order to directly compare performance across the two types of fluency tasks, two within-subjects MANOVAs were conducted. One analysis examined letter (FAS) and category (animal) fluency for the individual condition; one analysis examined letter (PRW) and category (foods)

fluency for the dyad condition. In both analyses, the dependent variable for letter fluency was the mean score across the three letters. The between-subjects factors were group (2), and order (2). The within-subjects factors were gender (2) and task (2).

For the individual condition, this analysis yielded significant main effects of group ($F(1,33) = 11.88, p < .005, \eta^2 = .26$), gender ($F(1,33) = 6.08, p < .05, \eta^2 = .15$), and task ($F(1,33) = 64.66, p = .000, \eta^2 = .65$). The control group ($M = 18.11, SD = 2.47$) produced more words than the experimental group ($M = 15.51, SD = 3.35$), women ($M = 17.43, SD = 3.58$) were more fluent than men ($M = 15.22, SD = 4.70$), and more words were provided for category fluency ($M = 18.42, SD = 3.94$) than letter fluency ($M = 14.23, SD = 3.20$). There were no significant interactions.

With respect to the dyad condition, a similar analysis yielded significant main effects of group ($F(1,33) = 11.06, p < .005, \eta^2 = .25$), gender ($F(1,33) = 6.43, p < .05, \eta^2 = .15$), and task ($F(1,33) = 101.91, p = .000, \eta^2 = .73$). The control group ($M = 12.91, SD = 1.99$) produced more words than the experimental group ($M = 10.52, SD = 2.34$), women ($M = 13.07, SD = 3.35$) were more fluent than men ($M = 10.55, SD = 3.96$), and more words were provided for category fluency ($M = 13.99, SD = 3.14$) than for letter fluency ($M = 9.64, SD = 2.33$). No other main effects or interactions were significant.

Perseverations and Intrusions (letter fluency task): Individual condition. A 2 (gender) X 2 (group) X 2 (order) ANOVA was conducted on the number of perseverations (repeated words) produced across the three letters (F, A, S) in the individual condition. The only significant result was a main effect of order ($F(1,33) =$

7.68, $p < .05$, $\eta^2 = .18$). More perseverations were made when dyadic performance preceded individual performance ($M = 2.00$, $SD = 1.24$) than when the order of task administration was reversed ($M = 1.00$, $SD = .90$).

The total number of intrusions (irrelevant words) summed across the three letters (F, A, S) was also subjected to an ANOVA. The factors were gender (2), group (2), and order (2). The main effect of order was significant ($F(1,33) = 10.95$, $p < .05$, $\eta^2 = .23$), as was the interaction between group and gender ($F(1,33) = 3.94$, $p = .055$, $\eta^2 = .09$). Regarding the order effect, more intrusions were made when dyadic performance preceded individual performance ($M = 2.25$, $SD = 1.56$) than when the order of task administration was reversed ($M = 0.94$, $SD = .73$). The interaction is presented in Figure 1, and follow-up t-tests indicated that experimental males ($M = 2.65$, $SD = 3.02$) produced more intrusions than experimental females ($M = 1.18$, $SD = 1.47$) ($p = .067$); there was no significant difference between the number of intrusions made by control males ($M = 1.30$, $SD = 1.22$) and control females ($M = 1.55$, $SD = 1.91$).

Perseverations and Intrusions (letter fluency task): Dyadic Condition. The number of perseverations made across the three letters (P, R, W) was examined in a 2 (group) X 2 (gender) X 2 (order) ANOVA. No main effects were significant. However, the interaction between group, order and gender was significant, ($F(1,33) = 6.00$, $p < .05$, $\eta^2 = .15$). Follow-up t-tests revealed no difference between order 1 and order 2 for control males ($M_s = 1.40, 2.4$; $SD_s = 1.78, 1.51$, respectively), control females ($M_s = 2.30, 1.70$; $SD_s = 2.31, 1.95$, respectively), and experimental males (M_s

= 1.86, 1.20; SDs = 2.80, 1.87, respectively). However, experimental females produced more perseverations in order 2 (M = 1.80, SD = 1.23) than in order 1 (M = .57, SD = .54).

The total number of intrusions across the three letters was also examined in a group (2) X gender (2) X order (2) ANOVA. Although the education level of the males was significant as a covariate, ($F(2,31) = 3.48$, $p < .05$, $\eta^2 = .17$), there were no significant main effects or interactions.

Perseverations and intrusions: Semantic fluency task: Individual condition. A 2 (group) X 2 (order) X 2 (gender) repeated measures ANOVA was conducted on the number of perseverations participants produced in the animal fluency task. There were no significant main effects or interactions.

A similar analysis to examine the number of intrusions produced in the animal fluency task yielded a significant interaction between group and order, $F(1,33) = 9.82$, $p < .005$, $\eta^2 = .23$. Follow-up t-tests revealed that, for the control group, a similar number of intrusions were produced in the individual-dyad order (M = .80, SD = 1.28) as in the dyad-individual order (M = .30, SD = .48). However, for the experimental group, more intrusions were produced in the dyad-individual order (M = .80, SD = 1.13) than in the individual-dyad order (M = .14, SD = .24).

Perseverations and intrusions: Semantic fluency task: Dyad condition. A repeated measures ANOVA was conducted for the number of perseverations produced in the foods fluency task. Group (2) and order (2) were the between subjects factors, and gender was the within-subjects factor. No significant main effects or interactions

were obtained. A similar analysis conducted for the number of intrusions produced in the foods fluency task yielded a significant effect of the education level of males as a covariate, $F(2,31) = 3.99$, $p < .05$, $\eta^2 = .16$. The main effect of group was the only significant result, $F(1,31) = 6.78$, $p < .05$, $\eta^2 = .14$. The experimental group ($M = 1.24$, $SD = 1.27$) produced more intrusions than the control group ($M = 0.80$, $SD = 0.92$).

Within-subjects Analyses

Overview. We expected that dyads would outperform individuals on both letter and category fluency tasks. We also expected an interaction between group and group size, such that the experimental PD couples would benefit more from collaboration than the healthy control couples. Contrary to expectation, individuals were found to be superior to dyads in both letter and category fluency. Although the group by group size interaction was significant for the letter fluency task, control couples benefited more from collaboration than the experimental PD couples.

Total Letter Fluency Score. A repeated measures ANOVA was conducted on the total number of words produced by men and women in the individual (i.e., FAS) and dyad (i.e., PRW) conditions. For both conditions, individual scores were derived after controlling for the number of redundancies produced by the spouses in each couple. This was done by subtracting a half point from each spouses' total score for each redundancy. These means are presented in Table 4. This method maintained the relative productivity of the spouses, and did not unduly penalize a less fluent spouse by giving credit to the partner who produced the redundancy first. The independent

variables were group (2), gender (2), group size (2), and order (2). There was a significant main effect of group ($F(1,33) = 11.99, p = .001, \eta^2 = .26$) and of group size ($F(1,33) = 307.24, p = .000, \eta^2 = .88$). Control subjects ($M = 38.84, SD = 6.57$) produced more words than experimental subjects ($M = 30.72, SD = 7.03$). Individual performance ($M = 41.31, SD = 9.21$) was superior to dyadic performance ($M = 28.91, SD = 7.00$). The interaction between group and group size was also significant, $F(1,33) = 6.49, p = .016, \eta^2 = .02$. Posthoc t-tests indicated that, in the individual condition, the control group ($M = 45.90, SD = 7.77$) was more fluent than the experimental group ($M = 35.91, SD = 7.87$). In the collaborative condition, the control group ($M = 31.78, SD = 5.96$) was again more fluent than the experimental group ($M = 25.53, SD = 6.76$).

Total Category Fluency Score. The same analysis was conducted for the semantic categories of animals (individual condition) and foods (dyad condition). That is, the sum of the total number of animal names produced by each spouse, corrected for redundancies, was compared to the total number of food names produced by the couples in the collaborative condition. A 2 (group) X 2 (order) X 2 (gender) X 2 (group size) repeated measures ANOVA was employed, with repeated measures on the last two factors. There were significant main effects of group ($F(1,33) = 10.84, p < .005, \eta^2 = .25$), gender ($F(1,33) = 7.56, p = .01, \eta^2 = .18$), and group size ($F(1,33) = 11.23, p < .005, \eta^2 = .22$). The control group ($M = 16.14, SD = 2.45$) was more fluent than the experimental group ($M = 13.24, SD = 2.80$), women ($M = 16.37, SD = 3.97$) were more fluent than men ($M = 13.24, SD = 4.83$) and individuals ($M = 15.62,$

SD = 3.59) produced more category exemplars than dyads (M = 13.99, SD = 3.14).

The interaction between order and group size was also significant, $F(1,33) = 5.85$, $p < .05$, $\eta^2 = .12$. Follow-up t-tests revealed that, in the individual-dyad condition, individuals (M = 16.53, SD = 3.66) were more fluent than dyads (M = 13.53, SD = 3.06). However, in the dyad-individual condition, there was no difference in semantic fluency between the individuals (M = 14.85, SD = 3.43) and the dyads (M = 14.38, SD = 3.23).

Perseverations and intrusions (letter fluency task). In this section, the individual data were not recoded to consider redundancies in the number of perseverations and intrusions produced in the letter fluency task. Rather, a 2 (group) X 2 (group size) X 2 (order) repeated measures ANOVA was conducted on the average number of perseverations produced by men and women in the individual condition and the total number of perseverations produced by couples in the dyad condition. There was a significant main effect of group size, $F(1,33) = 14.63$, $p = .001$, $\eta^2 = .29$. Dyads (M = 3.38, SD = 2.99) made more perseverations than did individuals (M = 1.54, SD = 1.05). There were no other significant main effects or interactions.

The average number of intrusions produced by men and women in the individual condition was compared to the total number of intrusions produced by couples in the dyad condition. The independent variables were group (2), group size (2), and order (2). The only significant result was a main effect of group size, $F(1,33) = 8.55$, $p < .01$, $\eta^2 = .19$. There were more intrusions produced by dyads (M = 2.68,

SD = 2.12) than by individuals (M = 1.65, SD = 1.07).

Perseverations and intrusions (category fluency task). For this section, the individual data was not recoded for redundancies in the production of perseverations and intrusions in the semantic fluency task. Similar to the previous analyses with the letter fluency task, the average number of perseverations produced by men and women in the individual condition was compared to the total number of perseverations produced by couples in the dyad condition. A repeated measures ANOVA was conducted, with group (2) and order (2) as the between subjects factors. Group size was the within-subjects factor. There was a significant main effect of group size, $F(1,33) = 4.00$, $p = .054$, $\eta^2 = .10$. More perseverations were produced by dyads (M = 1.04, SD = 1.15) than by individuals (M = .55, SD = .63).

The average number of intrusions produced in the individual category fluency task was compared to the total number of intrusions produced in the dyad category fluency task. The only effect to achieve significance was a main effect of group size, $F(1,33) = 30.64$, $p = .000$, $\eta^2 = .44$. Dyads (M = 2.04, SD = 1.60) made more intrusions than did individuals (M = .51, SD = .48).

The results of this section indicate that individual performance was better than dyadic performance when the sum of individual performance by males and females, corrected for redundancies, was used as the dependent measure. This was true for the number of words produced in both the letter and semantic fluency tasks. There were no significant interactions between group and gender to suggest differences in the individual-level effect of collaboration in dyads. Further, individual performance was

superior to dyadic performance when the scores of males and females were averaged for the number of perseverations and intrusions in the letter fluency task, and the number of perseverations and intrusions in the semantic fluency task.

Follow-up Exploratory Analyses

Several analyses were conducted to explore the unexpected group size effect indicating better performance by individuals than dyads across the verbal fluency measures. Initially, proportional analyses to compare the relative contribution of men and women in verbal fluency production were attempted. However, the analyses could not be completed because of the linear dependency in using proportions that sum to a value of one. Instead, for each verbal fluency measure, three analyses were performed: (a) ANOVAs on the total number of responses produced by each subgroup of participants, (b) difference ratios to compare the relative contribution of men and women, and (c) within-subject ratios to compare each subgroup's performance in the individual and the dyad conditions.

Collaborative Versus Individual Performance. Analyses of variance were conducted to better elucidate the nature of performance in the collaborative condition as compared to the individual condition. Specifically, the total number of responses produced in the individual and dyadic conditions was compared within each subject group (i.e., control males, control females, experimental males, experimental females) for each verbal fluency measure.

For the control males, a 2 (order) X 2 (group size) repeated measures ANOVA was conducted for the number of words produced by males in the individual and

dyadic conditions of the letter fluency task. The only significant result was a main effect of group size, $F(1,18) = 100.73$, $p = .000$, $\eta^2 = .83$. Control males were more fluent in the individual condition ($M = 45.10$, $SD = 12.79$) than when collaborating in the dyadic condition ($M = 29.70$, $SD = 9.72$).

A similar ANOVA on the number of words produced in the semantic fluency task also yielded a significant main effect of group size, $F(1,18) = 32.34$, $p = .000$, $\eta^2 = .61$. Control males produced more category exemplars when working alone ($M = 19.35$, $SD = 6.32$) compared to working with their spouse ($M = 13.35$, $SD = 5.03$).

Two additional ANOVAs on the number of perseverations and intrusions in the letter fluency task were also performed, and there were no significant main effects or interactions. Similarly, no significant main effects or interactions were obtained for two separate ANOVAs conducted on the number of perseverations and intrusions produced by control males in the individual and dyad conditions of the semantic fluency task.

For the control females, six separate ANOVAs were conducted on the number of words produced in the letter and semantic tasks, on the number of perseverations and intrusions provided in the letter fluency task, and on the number of perseverations and intrusions produced in the semantic fluency task. Group size was a repeated measures factor, and order was the one between-subjects factor. There was a significant main effect of group size for the number of letters produced in the letter fluency task ($F(1,18) = 77.58$, $p = .000$, $\eta^2 = .81$) and for the number of exemplars provided in the semantic fluency task ($F(1,18) = 6.46$, $p < .05$, $\eta^2 = .25$). Control

females produced more names in the individual condition ($\underline{M} = 50.10$, $\underline{SD} = 11.50$) of the letter fluency task than in the dyadic condition ($\underline{M} = 33.85$, $\underline{SD} = 7.11$). They also provided more category exemplars when working alone ($\underline{M} = 20.35$, $\underline{SD} = 3.39$) than when working collaboratively ($\underline{M} = 17.10$, $\underline{SD} = 5.29$). Nothing else was significant in these analyses.

In the other ANOVAs, there were no significant main effects or interactions for the number of perseverations or intrusions produced by control females in the letter fluency task and in the semantic fluency task.

When the six ANOVAs were conducted for the experimental males, there was a main effect of group size for the letter ($\underline{F}(1,15) = 15.77$, $\underline{p} = .001$, $\eta^2 = .50$) and semantic ($\underline{F}(1,15) = 11.43$, $\underline{p} < .005$, $\eta^2 = .43$) fluency tasks. More words were produced by experimental males in the individual condition of the letter fluency task ($\underline{M} = 33.12$, $\underline{SD} = 11.89$) than in the dyadic condition ($\underline{M} = 24.35$, $\underline{SD} = 12.49$). They also generated more category exemplars when working individually ($\underline{M} = 14.77$, $\underline{SD} = 4.71$) than when working collaboratively ($\underline{M} = 10.47$, $\underline{SD} = 5.19$). No other significant results were obtained in these analyses.

With respect to intrusions on the letter fluency task, there was a significant interaction between group size and order, $\underline{F}(1,15) = 9.10$, $\underline{p} < .01$, $\eta^2 = .34$. This interaction is depicted in Figure 2. Follow-up t-tests indicated no significant difference between the number of intrusions produced when working individually ($\underline{M} = .86$, $\underline{SD} = .90$) and collaboratively ($\underline{M} = 1.57$, $\underline{SD} = 1.72$) in the individual-dyad condition. However, more intrusions were produced by experimental males working

alone ($\underline{M} = 3.90$, $\underline{SD} = 3.38$) than collaboratively ($\underline{M} = 1.50$, $\underline{SD} = 2.12$) in the dyad-individual condition. There were no significant main effects or interactions for the number of perseverations produced by experimental males on the letter fluency task.

For the semantic fluency task, there were no significant results for the number of perseverations produced. However, in analysing the number of intrusions, there was a marginally significant main effect of group size, $\underline{F}(1,15) = 4.17$, $\underline{p} = .059$, $\eta^2 = .22$. More intrusions were produced by experimental males on the semantic fluency task when working collaboratively ($\underline{M} = 1.35$, $\underline{SD} = 1.54$) than when working alone ($\underline{M} = .47$, $\underline{SD} = .87$). There were no other significant main effects or interactions in this analysis.

The same six ANOVAs were conducted for the experimental females. There was a significant main effect of group size for the number of words produced on the letter fluency ($\underline{F}(1,15) = 100.65$, $\underline{p} = .000$, $\eta^2 = .87$) and category fluency ($\underline{F}(1,15) = 9.34$, $\underline{p} < .01$, $\eta^2 = .34$) tasks. Experimental females produced more words in the individual condition of the letter fluency task ($\underline{M} = 40.77$, $\underline{SD} = 10.25$) than in the dyadic condition ($\underline{M} = 26.71$, $\underline{SD} = 7.40$). They also generated more exemplars on the category fluency task when working alone ($\underline{M} = 18.71$, $\underline{SD} = 5.05$) than when working collaboratively ($\underline{M} = 14.59$, $\underline{SD} = 5.64$). No other main effects or interactions were significant in these analyses.

There was one significant result in the analysis of the number of perseverations produced in the letter fluency task. There was a main effect of order ($\underline{F}(1,15) = 8.57$, $\underline{p} = .010$, $\eta^2 = .36$) such that experimental females produced more perseverations in

the dyad-individual condition ($\underline{M} = 2.05$, $\underline{SD} = 1.64$) than in the individual-dyad condition ($\underline{M} = .43$, $\underline{SD} = .51$).

Further, no significant results were obtained in the analysis of intrusions produced by experimental females on the letter fluency task.

For the semantic fluency task, the analyses performed on the number of perseverations and intrusions produced by experimental females working collaboratively and alone yielded no significant main effects or interactions.

Difference ratios. A second way in which the group size effect was explored was through difference ratios. In each analysis, the difference in performance between women and men was divided by their total, combined performance. An analysis of variance was then conducted on each difference ratio, with group (2) and order (2) as between-subjects factors.

Twelve difference ratios were calculated for: individual letter fluency (FAS); the number of FAS perseverations; the number of FAS intrusions; dyadic letter fluency (PRW); the number of PRW perseverations; the number of PRW intrusions; individual category fluency (animals); the number of animal perseverations; the number of animal intrusions; dyadic category fluency (foods); the number of food perseverations; and the number of food intrusions. Table 5 presents the means and standard deviations for these difference ratios as a function of group and order. With one exception, the ANOVAs performed on these 12 variables yielded nonsignificant results.

However, the ANOVA for the number of PRW perseverations revealed a significant interaction between group and order, $\underline{F}(1, 29) = 7.14$, $p < .05$, $\eta^2 = .19$.

Follow-up t-tests indicated that, in the dyad-individual order, the difference in performance between experimental women and men was greater ($\underline{M} = .45$, $\underline{SD} = .57$) than the difference between control men and women ($\underline{M} = -.34$, $\underline{SD} = .69$). For the individual-dyad order, the difference between women and men was similar across the control ($\underline{M} = .17$, $\underline{SD} = .64$) and experimental ($\underline{M} = -.30$, $\underline{SD} = .78$) groups.

Thus, these results indicate that, with the exception of PRW perseverations, there was no difference between the control and experimental groups in the relative contribution of men and women to verbal fluency performance. Further, this was true for both the individual and dyad conditions.

Within-subject ratios. The third way in which the collaborative effect was examined was through ratios of the same individual's performance across individual and dyadic conditions. For each subgroup of participants, individual performance on each verbal fluency measure was divided by dyadic performance. Intra-individual ratios across individual and dyadic conditions were calculated for the following variables: letter fluency (FAS versus PRW), category fluency (animals versus foods), perseverations on the letter fluency task (FAS versus PRW), letter fluency intrusions (FAS versus PRW), perseverations on the semantic fluency task (animals versus foods), and semantic fluency intrusions (animals versus foods). Separate analyses of variance for men and women were conducted on each of these ratios. The two between-subjects factors were group (2) and order (2). Table 6 presents the means and standard deviations for the within-subject ratios across group and order.

Significant results were obtained only in two analyses. For the ratio of

perseverations produced by females in the individual versus the dyad condition of the letter fluency task, there was a significant main effect of order, $F(1,22) = 6.04$, $p < .05$, $\eta^2 = .20$. The ratio of individual to dyad perseverations (by females) was greater in the dyad-individual condition ($\underline{M} = 1.36$, $\underline{SD} = 1.24$) than in the individual-dyad condition ($\underline{M} = .31$, $\underline{SD} = .39$).

Analysis of the ratio of intrusions produced by men in the individual and dyadic letter fluency conditions revealed significant main effects of group ($F(1, 22) = 4.29$, $p = .050$, $\eta^2 = .10$) and order ($F(1, 22) = 9.35$, $p < .010$, $\eta^2 = .21$). This intrusion ratio was larger for the experimental group ($\underline{M} = 2.14$, $\underline{SD} = 2.36$) than for the control group ($\underline{M} = .77$, $\underline{SD} = .76$). Further, the ratio was larger in the dyad-individual condition ($\underline{M} = 2.06$, $\underline{SD} = 2.06$) than in the individual-dyad condition ($\underline{M} = .50$, $\underline{SD} = .77$). These main effects were qualified by a significant interaction between group and order, $F(1, 22) = 6.88$, $p < .05$, $\eta^2 = .16$. As can be seen in Figure 3, in the individual-dyad condition, the ratio was similar for the control ($\underline{M} = .64$, $\underline{SD} = .99$) and experimental ($\underline{M} = .34$, $\underline{SD} = .42$) groups. In the dyad-individual condition, the ratio was larger for the experimental group ($\underline{M} = 3.42$, $\underline{SD} = 2.34$) than for the control group ($\underline{M} = .88$, $\underline{SD} = .58$). This suggests that, for the control males, working collaboratively resulted in more intrusions than working alone, regardless of order. Perhaps there was an interfering effect from the verbal production of the spouse in the dyad condition. Regardless of order, the experimental males made more intrusions the second time they performed the task, suggesting an interfering effect of interpolated performance.

Thus, this section indicates that the pattern of within-subject performance across individual and dyad conditions of the verbal fluency task was similar for the experimental and control groups. The noted exception was for intrusions produced by men in the letter fluency task.

Wisconsin Card Sorting Test (WCST)

In this section, ANOVAs were calculated for the dependent variables, rather than utilizing a MANOVA approach. Typically a MANOVA is employed as an omnibus test for the purpose of protecting against too many Type 1 errors. However, there are logical arguments for doing separate ANOVAs, as is the case when data are missing for any of the dependent variables. This is because subjects missing data on any of the dependent variables are omitted from the MANOVA. Given that there are missing data for four subjects on one variable (the number of trials), it was determined to proceed with separate ANOVAs, as they usually are less affected by sample size. In addition, given that a larger mean indicates poorer performance for several of the dependent variables (e.g., perseverative responses, nonperseverative errors, failures to maintain set, and trials to completion of the first category), an ANOVA approach was deemed to be more meaningful to understanding significant effects.

The organization of this section is similar to the verbal fluency section. Between-subjects analyses were conducted to determine if there was a group-level benefit of collaboration. This was followed by within-subjects analyses to elucidate potential individual-level benefits of dyadic performance.

Between-subjects Analyses

Overview. We expected that the PD individuals would perform more poorly than the other participants on indices of WCST performance. Indeed, deficits in measures of perseverative responding, error counts, and categories achieved were revealed for the Parkinsonian men relative to the other groups.

Individual-level data. Six separate ANOVAs were calculated on the individual performance of men and women for the following dependent variables: number of correct sorts, number of perseverative responses, number of nonperseverative errors, number of categories achieved, number of failures to maintain set, and number of trials to completion of the first category. For each analysis, the independent variables were group (2), order (2), and gender (2). Gender was treated as a within-subjects factor. Education level, mental status, and depression scores of the males and females were also entered as covariates into each analysis. They will only be reported when significant. For all of the other dependent variables, the reported results reflect levels of significance without the influence of the covariates.

For the number of correct sorts, the education level of the males was significant as a covariate, $F(2,31) = 4.42$, $p < .05$, $\eta^2 = .17$. There were significant main effects of group ($F(1,31) = 6.75$, $p < .05$, $\eta^2 = .13$) and gender ($F(1,33) = 8.06$, $p < .01$, $\eta^2 = .18$). The control group ($M = 106.48$, $SD = 13.55$) made more correct sorts than the experimental group ($M = 87.88$, $SD = 19.88$), and women ($M = 103.27$, $SD = 20.02$) made a greater number of correct sorts than men ($M = 92.59$, $SD = 24.60$). The main effect of order was marginally significant, $F(1,31) = 4.11$, $p = .051$, $\eta^2 = .08$. More correct sorts were made when dyad performance preceded individual

performance ($\underline{M} = 100.38$, $\underline{SD} = 19.29$) than in the reverse order ($\underline{M} = 92.99$, $\underline{SD} = 22.10$). There were no significant interactions.

With respect to the number of perseverative responses, the education level of the males was again significant as a covariate, $\underline{F}(2,31) = 4.33$, $p < .05$, $\eta^2 = .15$. The main effects of group ($\underline{F}(1,31) = 5.92$, $p < .05$, $\eta^2 = .10$), order ($\underline{F}(1,31) = 8.68$, $p < .01$, $\eta^2 = .15$), and gender ($\underline{F}(1,33) = 7.96$, $p < .05$, $\eta^2 = .17$) were significant. The experimental group ($\underline{M} = 28.59$, $\underline{SD} = 19.62$) made more perseverative responses than the control group ($\underline{M} = 13.93$, $\underline{SD} = 10.55$). A greater number of perseverative responses were made in the individual-dyad condition ($\underline{M} = 25.44$, $\underline{SD} = 19.69$) than in the dyad-individual condition ($\underline{M} = 16.60$, $\underline{SD} = 13.23$). Men ($\underline{M} = 25.57$, $\underline{SD} = 25.95$) made more perseverative responses than women ($\underline{M} = 15.76$, $\underline{SD} = 14.30$). There was a significant interaction between group and gender, $\underline{F}(1,33) = 4.31$, $p < .05$, $\eta^2 = .09$. Follow-up t-tests revealed that there was no difference in the number of perseverative responses made by control males ($\underline{M} = 15.40$, $\underline{SD} = 14.44$) and control females ($\underline{M} = 12.45$, $\underline{SD} = 13.45$). However, experimental males ($\underline{M} = 37.53$, $\underline{SD} = 31.40$) made more perseverative responses than experimental females ($\underline{M} = 19.65$, $\underline{SD} = 14.68$).

For the number of nonperseverative errors, there was a significant main effect of group, $\underline{F}(1,33) = 7.39$, $p = .010$, $\eta^2 = .18$. The experimental group ($\underline{M} = 15.32$, $\underline{SD} = 7.83$) made more nonperseverative errors than the control group ($\underline{M} = 9.20$, $\underline{SD} = 5.05$). There was a significant three-way interaction between group, order, and gender, $\underline{F}(1,33) = 5.14$, $p < .05$, $\eta^2 = .12$. Follow-up t-tests indicated that for the control

group, there was no difference between the performance of men ($\underline{M} = 12.40$, $\underline{SD} = 7.95$) and women ($\underline{M} = 7.10$, $\underline{SD} = 5.28$) in the individual-dyad condition or between men ($\underline{M} = 9.20$, $\underline{SD} = 6.68$) and women ($\underline{M} = 8.10$, $\underline{SD} = 7.16$) in the dyad-individual condition. For the experimental group, men ($\underline{M} = 13.29$, $\underline{SD} = 6.73$) and women ($\underline{M} = 15.71$, $\underline{SD} = 10.42$) performed similarly in the individual-dyad condition. However, in the dyad-individual condition, men ($\underline{M} = 19.20$, $\underline{SD} = 10.47$) made more nonperseverative errors than women ($\underline{M} = 12.60$, $\underline{SD} = 8.04$). Following dyadic performance, Parkinsonian men committed more errors than did other groups.

With respect to the number of categories achieved, the range of possibilities is from zero to six. The education level of the males was significant as a covariate, $\underline{F}(2,31) = 5.14$, $p < .05$, $\eta^2 = .22$. The main effects of group ($\underline{F}(1,31) = 4.23$, $p < .05$, $\eta^2 = .09$) and gender ($\underline{F}(1,33) = 12.58$, $p = .001$, $\eta^2 = .25$) were significant. The control group achieved more categories ($\underline{M} = 5.35$, $\underline{SD} = .96$) than did the experimental group ($\underline{M} = 4.06$, $\underline{SD} = 1.58$). Men achieved fewer categories ($\underline{M} = 4.16$, $\underline{SD} = 2.18$) than did women ($\underline{M} = 5.35$, $\underline{SD} = 1.25$). These findings were qualified by a significant interaction between group and gender, $\underline{F}(1,33) = 4.37$, $p < .05$, $\eta^2 = .09$). Post-hoc analyses indicated that the experimental males ($\underline{M} = 3.06$, $\underline{SD} = 2.46$) achieved fewer categories than the experimental females ($\underline{M} = 5.06$, $\underline{SD} = 1.20$), the control males ($\underline{M} = 5.10$, $\underline{SD} = 1.37$) and the control females ($\underline{M} = 5.60$, $\underline{SD} = 1.27$).

In analysing the number of failures to maintain set, there was a significant effect of the covariates ($\underline{F}(4, 29) = 3.06$, $p < .05$, $\eta^2 = .27$). Specifically, both the

mental status and depression scores of the males were observed to covary with the ability to maintain a cognitive set. The only significant result was a main effect of gender, $F(1,33) = 5.44$, $p < .05$, $\eta^2 = .14$. Men ($M = 1.62$, $SD = 1.99$) had more failures to maintain set than women ($M = 0.76$, $SD = .93$).

Last, there were no significant main effects or interactions for the number of trials to completion of the first category.

Dyad-level data. Similar to the above analyses, separate ANOVAs were conducted for the six card sorting variables. However, the dependent variables reflected the combined performance of the spouses working collaboratively as a dyad. The independent factors were group (2) and order (2). Education level, mental status, and depression scores for the males and females were also entered into each analysis as covariates, and were reported only when significant. Thus, the majority of the reported results do not include the influence of the covariates.

With respect to the number of correct sorts, the education level of the males was significant as a covariate, $F(1,31) = 6.17$, $p < .05$, $MSE = 998.90$. The only significant result was a main effect of order, $F(1,31) = 5.51$, $p < .05$, $MSE = 892.64$. More correct sorts were made in the individual-dyad condition ($M = 112.18$, $SD = 11.74$) than in the dyad-individual condition ($M = 96.70$, $SD = 17.99$). This indicates that dyads benefited from prior individual experience with the task.

The analysis of perseverative responses indicated that the mental status of women was marginally significant as a covariate, $F(1,29) = 3.85$, $p = .059$, $\eta^2 = .09$. There was a main effect of order, $F(1,29) = 7.24$, $p < .05$, $\eta^2 = .17$. More

perseverative responses were made in the dyad-individual condition ($\underline{M} = 21.95$, $\underline{SD} = 17.69$) than in the individual-dyad condition ($\underline{M} = 8.00$, $\underline{SD} = 6.82$). This suggests that prior individual experience with the task resulted in less perseverative responding by dyads.

In the analysis of nonperseverative errors, the mental status score for women was significant as a covariate, ($\underline{F}(1,29) = 8.85$, $p < .010$, $\eta^2 = .18$), as was the education level of the men ($\underline{F}(1,31) = 4.58$, $p < .05$, $\underline{MSE} = 155.47$). There were no significant main effects or interactions.

In analysing the number of categories achieved, the education level of the men was significant as a covariate ($\underline{F}(1,31) = 7.17$, $p < .05$, $\underline{MSE} = 12.07$) and the main effect of group was no longer significant. No other main effects or interactions were significant.

For the failure to maintain set variable, when the education level of the men was entered as a covariate, it was not significant. However, its influence was to render the main effect of group no longer significant. There were no other significant main effects or interactions.

Last, with respect to the number of trials to completion of the first category, there were no significant main effects or interactions.

The results of these analyses indicated that, in the individual condition, the experimental group performed more poorly than the control group on several card sorting measures. Further, the group by gender interaction was significant for measures of perseverative responding, error counts, and categories achieved. The

pattern of means in these interactions suggested that the experimental males performed worse relative to the other participant groups.

In the dyad condition, the group effect was not significant for any of the card sorting variables. Thus, the collaborative situation was beneficial in reducing group differences in problem solving across the card sorting measures. For the number of categories achieved, however, the education level of the participants significantly affected performance. There were also several main effects of order that indicated a beneficial effect on dyadic performance of prior individual experience with the task.

Within-subjects Analyses

Overview. Potential individual-level benefits of collaboration were explored by conducting separate ANOVAs for each of the six card sorting variables for each group as follows: control males, control females, experimental males, experimental females. Within each group, individual card sorting performance was compared to the total performance of the dyad. For example, for each dependent variable, the individual performance of the control males was compared to the total performance of the control dyads; this was the pattern of analysis for the other three groups. The independent variables were group size (2) and order (2). Group size was treated as a repeated measures factor. The results are reported for each dependent variable separately.

We hypothesized that the benefits of collaboration would be evident in better performance by dyads than by individuals on indices of card sorting performance. Inferred individual-level benefits of collaboration were most apparent for the experimental males for measures of correct sorts, perseverative responding, and

categories achieved. The interaction between group size and order was often significant, providing intriguing results concerning the relative contributions of practice versus collaboration.

Correct sorts. In these analyses, the only significant main effect was of group size for the experimental males, $F(1,15) = 32.11$, $p = .000$, $\eta^2 = .56$. There were more correct sorts when experimental (PD) males worked in the dyads ($M = 98.41$, $SD = 18.10$) than when they performed individually ($M = 79.53$, $SD = 25.09$).

A significant interaction between group size and order was obtained for the control males ($F(1,18) = 15.23$, $p = .001$, $\eta^2 = .43$), control females ($F(1, 18) = 5.76$, $p < .05$, $\eta^2 = .24$), experimental males ($F(1,15) = 10.68$, $p = .005$, $\eta^2 = .18$), and experimental females ($F(1,15) = 7.41$, $p < .05$, $\eta^2 = .32$). These interactions are depicted in Figure 4. Follow-up t-tests indicated that, for the control participants, in the individual-dyad condition, men made fewer correct sorts working alone ($M = 99.00$, $SD = 19.84$) than in dyads ($M = 116.90$, $SD = 4.56$) and there was no difference in the number of correct sorts made by women working alone ($M = 110.40$, $SD = 15.77$) and in dyads ($M = 116.90$, $SD = 4.56$). In the dyad-individual condition, individuals made more correct sorts than dyads for both the men ($M_s = 108.40$, 99.90 ; $SD_s = 16.21$, 17.52 , respectively) and the women ($M_s = 108.10$, 99.90 ; $SD_s = 18.69$, 17.52).

For the experimental participants, follow-up t-tests revealed that dyads made more correct sorts than individuals in the individual-dyad order for both the men ($M_s = 105.43$, 72.29 ; $SD = 15.69$, 28.33) and the women ($M_s = 105.43$, 90.29 ; $SD_s =$

15.69, 24.48). However, as indicated in Figure 4, the PD men gained the most by dyadic experience when compared to previous individual-level performance. In the dyad-individual condition, dyads ($\underline{M} = 93.50$, $\underline{SD} = 18.80$) made more correct sorts than individuals ($\underline{M} = 84.60$, $\underline{SD} = 22.69$) for the Parkinsonian men. For the women, performance was similar for the individuals ($\underline{M} = 100.40$, $\underline{SD} = 19.56$) and the dyads ($\underline{M} = 93.50$, $\underline{SD} = 18.80$). The figure reveals that, of all the subgroups, the PD men lost the most in individual performance when it was preceded by dyadic performance.

Perseverative responses. For the experimental males, the main effect of group size was significant, $F(1,15) = 15.77$, $p = .001$, $\eta^2 = .37$. Experimental males made fewer perseverative responses when working in dyads ($\underline{M} = 18.94$, $\underline{SD} = 14.70$) than when working alone ($\underline{M} = 37.53$, $\underline{SD} = 31.40$). This was the only significant main effect that was obtained.

The group size by order interaction was significant for control males ($F(1,18) = 14.19$, $p = .001$, $\eta^2 = .43$), control females ($F(1,18) = 6.91$, $p < .05$, $\eta^2 = .28$), experimental males ($F(1,15) = 12.13$, $p = .003$, $\eta^2 = .28$), and experimental females ($F(1,15) = 11.27$, $p < .005$, $\eta^2 = .42$). These interactions are displayed in Figure 5. Posthoc analyses revealed that, for the control participants in the individual-dyad condition, men made more perseverative responses when working alone ($\underline{M} = 19.50$, $\underline{SD} = 16.17$) than in dyads ($\underline{M} = 5.40$, $\underline{SD} = 1.71$). For the women, there was no significant difference between the number of perseverative responses produced individually ($\underline{M} = 12.20$, $\underline{SD} = 14.54$) and in dyads ($\underline{M} = 5.40$, $\underline{SD} = 1.71$). However, dyads made more perseverative responses than individuals for both men ($\underline{Ms} = 19.90$,

11.30; SDs = 19.94, 11.89, respectively) and women (Ms = 19.90, 12.70; SDs = 19.94, 13.06, respectively) in the dyad-individual condition.

For the experimental participants, posthoc analyses indicated that both men and women made more perseverative responses as individuals (Ms = 53.00, 25.29; SDs = 41.75, 16.74, respectively) than as dyads (Ms = 11.71, SDs = 9.60) in the individual-dyad condition. However, there was no significant difference between the number of perseverative responses made by men and women working alone (Ms = 26.70, 15.70; SDs = 16.58, 12.41, respectively) and in dyads (Ms = 24.00, SDs = 15.92) in the dyad-individual condition. The figure highlights the fact that, for both orders, the PD men had the most to gain from the dyadic context and they did.

Non-perseverative errors. For control males, the interaction between group size and order was significant, $F(1,18) = 7.25$, $p < .05$, $\eta^2 = .27$. Follow-up t-tests indicated that, in the individual-dyad condition, individuals (M = 12.40, SD = 7.95) made more nonperseverative errors than dyads (M = 5.70, SD = 2.98). However, in the dyad-individual condition, individuals (M = 9.20, SD = 6.68) made a similar number of nonperseverative errors as dyads (M = 11.30, SD = 5.70).

This variable was not significant for the control females, experimental males, or experimental females.

Categories achieved. There was a significant main effect of group size for control males, $F(1,18) = 4.76$, $p < .05$, $\eta^2 = .17$. Performing individually, control males achieved fewer categories (M = 5.10, SD = 1.37) than when part of a dyad (M = 5.65, SD = .93). The interaction between group size and order was also significant,

$F(1,18) = 4.76, p < .05, \eta^2 = .17$. More categories were achieved by dyads ($M = 6.00, SD = .00$) than by individuals ($M = 4.90, SD = 1.52$) when individual performance preceded dyadic performance. Individuals and dyads performed similarly ($M_s = 5.30, SD_s = 1.25$) when the task order was reversed.

For experimental males, the only significant result was a main effect of group size, $F(1,15) = 9.42, p < .01, \eta^2 = .39$. When performing as part of a dyad ($M = 4.53, SD = 1.84$), PD individuals achieved more categories than when working alone ($M = 3.06, SD = 2.46$).

This variable was not significant for the control females or the experimental females.

Failures to maintain set. There was a significant main effect of group size for experimental females, $F(1,15) = 6.66, p < .05, \eta^2 = .27$. Dyads ($M = 2.06, SD = 1.95$) displayed a greater number of failures to maintain set than individuals ($M = 1.06, SD = .97$). No other main effects or interactions reached significance.

This variable was not significant for control males, control females, or experimental males.

Trials to completion of the first category. This variable was not significant for any of the participant groups.

Summary. Overall, the results of the card sorting analyses indicate that the PD men had very different patterns of performance across the individual- and dyad- level conditions in comparison to the other participant groups. While their performance improved substantially on the second trial in order 1, it did not improve on the second

trial in order 2. In contrast, the control males, control females, and experimental females improved from the first to second trial, although their improvement in performance across conditions in order 1 was greater than in order 2. This suggests that there may be greater benefit of individual experience prior to collaboration than when the task order is reversed. Also, given that this task required the same solution across both conditions, it is difficult to determine how much of the improvements that occurred were due to practise versus collaboration. The two interpretations are not easily disentangled.

20 Questions Task: Performance Variables

The questions posed by the participants were coded into three types of questioning strategies: constraint seeking (CS), hypothesis testing (HT), and pseudo-constraint seeking (PCS). Table 7 presents the mean numbers and proportions for each question type as produced by the control males, control females, experimental males, and experimental females.

The performance variables were first analysed with between-subjects analyses of variance to examine potential group level benefits of collaboration. This was followed by within-subjects analyses to elucidate possible individual-level benefits of group collaboration.

Individual-level Data

Overview. We hypothesized that PD individuals would ask more questions overall, more HT and fewer CS questions than the other participants. The results indicated that, contrary to expectation, the control and experimental individuals asked

equivalent numbers of questions. The experimental males asked the equivalent number of questions as their spouses.

ANOVAs. A 2 (group) X 2 (gender) X 2 (order) X 3 (type of question) repeated measures ANOVA was conducted on the number of questions participants posed when working individually to solve the 20 Questions task. Gender and question type were treated as within-subjects factors. The education level, mental status, and depression scores of the males and females were also entered as covariates. Only the depression score for the males covaried with the three questioning strategies ($F(4,29) = 3.13, p < .05, \eta^2 = .25$). There was also a significant main effect of type of question, $F(2,66) = 27.55, p < .001, \eta^2 = .37$. Follow-up t-tests revealed that the three question types were significantly different from each other. The most frequent questions were CS ($M = 5.00, SD = 2.13$), followed by HT ($M = 3.18, SD = 3.79$), and then by PCS ($M = 0.81, SD = 1.44$).

The two-way interactions between group and type of question, and group and order, were also significant, $F(2,66) = 4.09, p < .05, \eta^2 = .05$ and $F(1,29) = 6.25, p < .05, \eta^2 = .12$, respectively. Posthoc analyses indicated that, for the control individuals, more CS questions ($M = 5.38, SD = 1.50$) were produced than HT ($M = 2.30, SD = 2.61$) and PCS ($M = 0.95, SD = 1.06$) questions. There was no significant difference between the latter two questioning strategies. For individuals in the experimental group, there was no significant difference between the number of CS ($M = 4.62, SD = 1.78$) and HT ($M = 4.06, SD = 4.88$) questions produced. However, these two questioning strategies were used more frequently than PCS questions ($M =$

0.68, $SD = 1.16$). Follow-up t-tests of the group by order interaction failed to reveal any significant differences between means. However, this interaction was qualified by a three-way interaction between group, order, and type of question, $F(2,66) = 10.24$, $p < .001$, $\eta^2 = .14$. This is depicted in Figure 6. When subjects performed first as individuals and then as dyads, the individuals in the control group asked more CS questions than the experimental group ($M_s = 6.15, 3.72$; $SD_s = .85, 1.98$, respectively), but fewer HT questions than individuals in the experimental group ($M_s = 1.00, 6.57$; $SD_s = .71, 6.23$, respectively). The same number of PCS questions were posed in the individual condition by the control group ($M = 0.95$, $SD = .93$) and the experimental group ($M = 1.07$, $SD = 1.62$). When the order of task administration was reversed, there was no significant difference between the number of questions asked by individuals in the control and experimental groups. Overall, following dyadic performance, individuals in both experimental and control groups produced greater CS than HT than PCS questions. In contrast, without the dyadic experience, experimental individuals produced more HT questions.

Given that there was a significant main effect of question type, follow-up ANOVAs were conducted for each questioning strategy and for the total number of questions posed. For each ANOVA, the factors were group, order, and gender, with repeated measures on the last factor. Unless otherwise noted, the addition of education level, mental status, and depression scores as covariates did not change the pattern of findings that emerged.

The ANOVA for CS questions revealed a significant interaction between group

and order, $F(1,29) = 5.99$, $p < .05$, $\eta^2 = .15$. Follow-up t-tests indicated that, when individual performance preceded dyadic performance, the control individuals ($M = 6.15$, $SD = .85$) posed more CS questions than the experimental individuals ($M = 3.71$, $SD = 1.98$). However, when dyadic performance preceded individual performance, there was no difference between the number of CS questions produced by the control ($M = 4.6$, $SD = 1.65$) and experimental ($M = 5.25$, $SD = 1.40$) individuals. There were no other significant results in this analysis.

With respect to HT questions, the only significant result of the ANOVA was the interaction between group and order, $F(1,29) = 12.93$, $p = .001$, $\eta^2 = .23$. The posthoc analyses indicated that when individual performance preceded dyadic performance, the experimental individuals ($M = 6.57$, $SD = 6.23$) produced more HT questions than the control individuals ($M = 1.00$, $SD = .71$). However, when the order of task administration was reversed, there was no difference between the control ($M = 3.6$, $SD = 3.19$) and experimental ($M = 2.3$, $SD = 2.85$) individuals in the number of HT questions produced.

For the PCS questions, the interaction between order and gender was the only result to achieve significance, $F(1,33) = 4.16$, $p = .05$, $\eta^2 = .10$. Follow-up t-tests indicated that there was no significant difference between males and females in order 1 ($M_s = 1.41$, $.59$; $SD_s = 2.32$, $.80$ respectively) or in order 2 ($M_s = .35$, 1.00 ; $SD_s = 1.35$, 1.72 respectively).

When the total number of questions was analysed, there was a significant effect of the covariates, $F(4,29) = 3.13$, $p < .05$, $\eta^2 = .25$, that appeared to be due to the

depression score of the male participants. A significant interaction between group and order was observed, $F(1,29) = 6.25$, $p < .05$, $\eta^2 = .12$. The results of posthoc t-tests failed to indicate any significant differences between the control and experimental individuals in order 1 ($M_s = 8.1, 11.36$; $SD_s = .84, 6.70$, respectively) or in order 2 ($M_s = 9.15, 7.95$; $SD_s = 3.41, 2.59$, respectively). Overall, experimental individuals apparently benefited from dyadic experience by reducing the total number of questions asked.

The three questioning strategies were also analysed separately as proportions of the total number of questions posed by individuals. Again, ANOVAs were conducted with group, order, and gender as independent factors. Gender was treated as a within-subjects factor. These analyses produced the same pattern of results as those utilizing raw scores and will not be reported.

Dyad-level Data

An overall ANOVA was calculated on the three types of questioning strategies employed by the dyads. The independent variables were group (2), order (2), question type (3) and gender (2), with repeated measures on the last two factors. Education level, mental status and depression scores of the males and females were first entered as covariates, and no significant effects were observed. Thus, these covariates were eliminated from further consideration. The results of the ANOVA analysis revealed a significant main effect of question type, $F(2,66) = 44.48$, $p = .000$, $\eta^2 = .55$. Posthoc t-tests indicated that there were more CS questions ($M = 3.57$, $SD = 1.31$) produced in the dyads than HT questions ($M = 1.13$, $SD = 1.64$) and PCS questions ($M = .56$, SD

= .80); there was no significant difference between the latter two types of questions. There were no other significant main effects or interactions.

Separate follow-up ANOVAs were conducted on the three questioning styles. For each analysis, the independent factors were group, order, and gender, with repeated measures on the last factor.

For CS questions, there were no significant main effects or interactions, indicating that there was no effect of group, order, or gender in the production of CS questions by dyads. However, for comparison purposes, the group X order interaction means are as follows: for order 1, control ($\underline{M} = 3.65$, $\underline{SD} = 1.92$) and experimental ($\underline{M} = 3.57$, $\underline{SD} = 2.39$) groups and for order 2, control ($\underline{M} = 3.60$, $\underline{SD} = 2.12$) and experimental ($\underline{M} = 3.45$, $\underline{SD} = 2.47$) groups.

With respect to HT questions, the only significant result was an interaction between group and order, $F(1,33) = 5.82$, $p < .05$, $\eta^2 = .15$. However, posthoc t-tests did not indicate any significant difference between the number of HT questions produced by control or experimental dyads in order 1 ($\underline{Ms} = .40$, 1.93 ; $\underline{SDs} = .46$, 2.32 , respectively) or in order 2 ($\underline{Ms} = 1.60$, $.60$; $\underline{SDs} = 2.23$, $.57$, respectively). Further, there were no significant differences by order for the control or the experimental groups. The pattern of means suggested that the control dyads benefited from individual-level experience, whereas the experimental dyads did not.

The ANOVA on the number of PCS questions posed by dyads revealed a significant main effect of gender, $F(1,33) = 4.14$, $p = .05$, $\eta^2 = .11$. Females ($\underline{M} = .80$, $\underline{SD} = 1.09$) produced more PCS questions in the dyads than did males ($\underline{M} = .32$,

SD = .77). There were no other significant main effects or interactions.

With respect to the total number of questions asked by the dyads, the ANOVA indicated a significant interaction between group and order, $F(1,33) = 4.71$, $p < .05$, $\eta^2 = .12$. However, posthoc analyses failed to find a significant difference between the control and experimental dyads in order 1 (Ms = 4.5, 5.79; SDs = 1.27, 1.80, respectively) or in order 2 (Ms = 5.9, 4.85; SDs = 1.93, 1.45, respectively).

Two additional ANOVAs were calculated on the total time (number of seconds) that the dyads spent on-task and the rate of questioning (defined as the total number of questions asked in the dyad divided by the total time). Group (2) and order (2) were the two independent factors. The results of each analysis indicated no significant main effects or interactions. However, for comparison purposes, with respect to the total time variable, the means for the group X order interaction were: control (M = 368, SD = 176.72) and experimental (M = 329, SD = 107.17) groups in order 1; control (M = 279.9, SD = 95.28) and experimental (M = 352.89, SD = 192.81) groups in order 2. For the rate of questioning variable (number of questions per second), the means for the non-significant group X order interaction were: control (M = .03, SD = .03) and experimental (M = .04, SD = .01) groups in order 1; control (M = .05, SD = .02) and experimental (M = .04, SD = .02) groups in order 2.

Similar to the individual-level analyses, proportions were also calculated for each of the question types with respect to the dyad-level data. Specifically, the sum of each of the CS, HT, and PCS question types was divided by the total number of questions produced in the dyad. Three separate ANOVAs were then calculated, and

the independent factors were group, order, and gender. However, for each of these analyses, there were no significant main effects or interactions.

For comparison purposes, the means for the group X order interaction were presented for each proportional variable. For the proportion of CS questions, the means were: control ($\underline{M} = .80$, $\underline{SD} = .24$) and experimental ($\underline{M} = .70$, $\underline{SD} = .32$) groups in order 1; control ($\underline{M} = .63$, $\underline{SD} = .26$) and experimental ($\underline{M} = .69$, $\underline{SD} = .34$) groups in order 2. For the proportion of HT questions, the means were: control ($\underline{M} = .12$, $\underline{SD} = .23$) and experimental ($\underline{M} = .26$, $\underline{SD} = .34$) groups in order 1; control ($\underline{M} = .24$, $\underline{SD} = .29$) and experimental ($\underline{M} = .22$, $\underline{SD} = .35$) groups in order 2. Last, for the proportion of PCS questions, the means were: control ($\underline{M} = .08$, $\underline{SD} = .14$) and experimental ($\underline{M} = .04$, $\underline{SD} = .07$) groups in order 1; control ($\underline{M} = .13$, $\underline{SD} = .21$) and experimental ($\underline{M} = .08$, $\underline{SD} = .16$) groups in order 2.

Within-subjects Analyses

Overview. In order to examine possible individual-level benefits of group collaboration, repeated measures ANOVAs on the group size factor were conducted for each question type and for the total number of questions. Thus, four separate ANOVAs were performed, one each for CS, HT, PCS, and total questions. The factors were group (2), order (2), gender (2), and group size (2), with repeated measures on the last two factors.

We hypothesized that, if dyads were more efficient than individuals, dyads would ask fewer questions overall, but more CS questions than any other type of question. Further, the interaction between group and group size was expected to be

significant such that the difference between individual and dyad performance would be greater for the experimental PD couples than for the healthy control couples. That is, the experimental PD couples would benefit more from collaboration than the healthy control couples. The results indicated that dyads were effective in reducing the number of questions posed. Moreover, when proportions were utilized (i.e., number of CS questions divided by the total number of questions), there were more CS questions and fewer HT questions in the dyads than individually. Contrary to expectation, PD couples did not benefit more than their healthy counterparts from collaboration.

ANOVAs. The ANOVA conducted for CS questions produced individually and in dyads yielded a significant main effect of group size, $F(1,33) = 24.01$, $p = .000$, $\eta^2 = .36$. More CS questions were produced individually ($M = 4.93$, $SD = 2.13$) than in dyads ($M = 3.57$, $SD = 2.22$). The interaction between group and order was marginally significant, $F(1,33) = 3.85$, $p = .058$, $\eta^2 = .10$. However, the three-way interaction between group, order, and group size was significant, $F(1,33) = 8.08$, $p < .01$, $\eta^2 = .12$. As can be seen in Figure 7, for the control group, individuals ($M = 6.15$, $SD = .85$) produced more CS questions than dyads ($M = 3.65$, $SD = 1.27$) in order 1. However, there was no significant difference between control individuals ($M = 4.6$, $SD = 1.65$) and control dyads ($M = 3.6$, $SD = 1.31$) in order 2. For the experimental group, there was no difference between individuals ($M = 3.71$, $SD = 1.98$) and dyads ($M = 3.57$, $SD = 1.34$) in the production of CS questions in order 1. However, individuals ($M = 5.25$, $SD = 1.40$) produced more of these questions than dyads ($M = 3.45$, $SD = 1.54$) in order 2.

With respect to HT questions, the ANOVA indicated a significant main effect of group size, $F(1,33) = 13.04$, $p = .001$, $\eta^2 = .25$. More HT questions were produced by individuals ($M = 3.37$, $SD = 3.79$) than by dyads ($M = 1.13$, $SD = 1.79$). The interaction between group and order was also significant, $F(1,33) = 12.90$, $p = .001$, $\eta^2 = .26$. In order 1, the experimental group ($M = 4.25$, $SD = 3.52$) produced more HT questions than the control group ($M = .70$, $SD = .51$). However, there was no significant difference between the control ($M = 2.6$, $SD = 1.87$) and experimental ($M = 1.45$, $SD = 1.47$) groups in order 2. There were no other significant main effects or interactions. Although not significant, for comparison purposes the means for the three-way interaction are plotted in Figure 8. As can be seen in the figure, the pattern of collaborative effects for HT questions are quite different from those found for CS questions.

For PCS questions, the only significant result was an interaction between order and gender, $F(1,33) = 4.26$, $p < .05$, $\eta^2 = .11$. However, posthoc t-tests failed to identify a significant difference between males and females in order 1 ($M_s = .82$, $.56$; $SD_s = 1.16$, $.63$, respectively) or in order 2 ($M_s = .38$, 1.05 ; $SD_s = 1.12$, 1.32 , respectively).

The ANOVA performed on the total number of questions produced by individuals and dyads yielded a significant main effect of group size, $F(1,33) = 29.84$, $p = .000$, $\eta^2 = .46$. Individuals ($M = 9.14$, $SD = 3.96$) produced more total questions than dyads ($M = 5.26$, $SD = 2.84$). The interaction between group and order was also significant, $F(1,33) = 7.61$, $p < .01$, $\eta^2 = .18$. Follow-up t-tests indicated that, for the

control group, more questions were produced in order 2 ($\underline{M} = 7.5$, $\underline{SD} = 1.59$) than in order 1 ($\underline{M} = 6.3$, $\underline{SD} = .75$). For the experimental group, there was no difference between order 1 ($\underline{M} = 8.6$, $\underline{SD} = 3.24$) and order 2 ($\underline{M} = 6.4$, $\underline{SD} = 1.57$) in the total number of questions produced.

Proportional analyses were also conducted for each of the three question types. Again, the sum of each question type (CS, HT, PCS) was divided by the total number of questions produced by the dyad. Separate ANOVAS for each question type were performed, and the independent factors were group, order, gender, and group size, with repeated measures on the last two factors.

The ANOVA conducted for the proportion of CS questions produced by individuals and dyads yielded a significant main effect of group size, $\underline{F}(1,29) = 7.85$, $p < .01$, $\eta^2 = .17$. A greater proportion of CS questions were produced by dyads ($\underline{M} = .71$, $\underline{SD} = .29$) than by individuals ($\underline{M} = .61$, $\underline{SD} = .21$). The interaction between group and order was significant, $\underline{F}(1,29) = 7.23$, $p < .05$, $\eta^2 = .19$. In order 1, a greater proportion of CS questions was produced by the control group ($\underline{M} = .58$, $\underline{SD} = .04$) than the experimental group ($\underline{M} = .38$, $\underline{SD} = .17$). In order 2, there was no difference between the control ($\underline{M} = .42$, $\underline{SD} = .10$) and experimental ($\underline{M} = .53$, $\underline{SD} = .15$) groups. There was a significant three-way interaction between group, order, and group size, $\underline{F}(1,29) = 4.85$, $p < .05$, $\eta^2 = .11$. For the control group, individuals ($\underline{M} = .76$, $\underline{SD} = .08$) had a higher proportion of CS questions than dyads ($\underline{M} = .40$, $\underline{SD} = .04$) in order 1 and in order 2 ($\underline{Ms} = .54, .31$; $\underline{SDs} = .16, .11$, respectively). For the experimental group, there was no difference in the proportion of CS questions

produced by individuals ($\underline{M} = .42$, $\underline{SD} = .22$) or dyads ($\underline{M} = .33$, $\underline{SD} = .14$) in order 1. However, experimental individuals ($\underline{M} = .71$, $\underline{SD} = .22$) had a greater proportion of CS questions in order 2 than did dyads ($\underline{M} = .35$, $\underline{SD} = .10$).

With respect to the proportion of HT questions produced by individuals and dyads, there was a significant main effect of group size, $F(1,29) = 5.47$, $p < .05$, $\eta^2 = .14$. A greater proportion of HT questions were produced by individuals ($\underline{M} = .31$, $\underline{SD} = .23$) than by dyads ($\underline{M} = .21$, $\underline{SD} = .30$). The interaction between group and order was also significant, $F(1,29) = 5.72$, $p < .05$, $\eta^2 = .15$. In order 1, a greater proportion of HT questions was produced by the experimental group ($\underline{M} = .32$, $\underline{SD} = .18$) than the control group ($\underline{M} = .09$, $\underline{SD} = .06$). There was no difference between the experimental ($\underline{M} = .16$, $\underline{SD} = .13$) and control ($\underline{M} = .25$, $\underline{SD} = .13$) groups in order 2.

Last, for the proportion of PCS questions produced by individuals and dyads, the ANOVA indicated no significant main effects or interactions.

20 Questions Task: Process Variables

ANOVAs for Individual Variables

Overview. For the 20 Questions task, the transcripts of the dialogue occurring during the dyadic problem solving condition were coded for the presence of several process variables. A 2 (group) X 2 (order) X 2 (gender) ANOVA, with repeated measures on the last factor, was conducted separately on the total number of each of the process variables. Each variable was examined separately for its occurrence during pre-task, on-task, and post-task performance. One experimental couple was excluded from all analyses of the process variables, as their scores were as much as six to ten

standard deviations above the mean for some variables. No specific hypotheses were possible because of the dearth of research comparing these variables across healthy and neurological samples.

Pre-task commentary to the interviewer. The ANOVA revealed significant main effects of order, $F(1,32) = 56.70$, $p = .000$, $\eta^2 = .64$, and gender, $F(1,32) = 4.86$, $p < .05$, $\eta^2 = .07$. Order 2 ($M = 6.68$, $SD = 8.05$) was greater than order 1 ($M = 0.84$, $SD = 4.46$), and females made more comments to the interviewer ($M = 4.67$, $SD = 7.44$) than males ($M = 3.17$, $SD = 5.06$). Further, there was a significant interaction between group and gender, ($F(1,32) = 18.00$, $p = .000$, $\eta^2 = .26$), and between order and gender ($F(1,32) = 4.82$, $p < .05$, $\eta^2 = .07$). These two-way interactions were qualified by a significant three-way interaction between group, order, and gender, $F(1, 32) = 10.77$, $p < .05$, $\eta^2 = .15$. Follow-up t-tests revealed that, for the control group, there was no difference between males and females in order 1 ($M_s = 1.1$, $.40$; $SD_s = 1.85$, $.97$, respectively) or in order 2 ($M_s = 8.0$, 5.7 ; $SD_s = 5.42$, 3.23 , respectively). For the experimental group, there was no difference between males and females in order 1 ($M_s = .57$, 1.29 ; $SD_s = .79$, 1.50 , respectively). However, females ($M = 10.89$, $SD = 5.16$) made more comments to the interviewer in the pre-task than males ($M = 2.11$, $SD = 1.45$) in order 2.

Pre-task requests. The only significant result of the ANOVA was a main effect of order, $F(1,32) = 46.91$, $p = .000$, $\eta^2 = .59$. More pre-task requests were produced in order 2 ($M = 2.65$, $SD = 2.30$) than in order 1 ($M = .22$, $SD = .41$).

Pre-task reviews. The main effect of order was significant, $F(1,32) = 8.02$, $p <$

.01, $\eta^2 = .19$. More review statements were produced in order 1 ($M = .39$, $SD = .70$) than in order 2 ($M = .00$, $SD = .00$). There were no other significant main effects or interactions.

Pre-task non-productive commentary. The only effect to reach significance was a main effect of gender, $F(1,32) = 11.29$, $p < .005$, $\eta^2 = .24$. Females ($M = 2.81$, $SD = 3.79$) engaged in more non-productive commentary than did males ($M = 1.17$, $SD = 1.46$).

No significant main effects or interactions were observed for the following pre-task process variables: productive commentary, clarifications, admonitions, repetitions, strategies, or praise.

On-task productive commentary. The ANOVA revealed a significant main effect of gender, $F(1,32) = 15.09$, $p = .000$, $\eta^2 = .22$. The interaction between group and gender also achieved significance, $F(1,32) = 19.97$, $p = .000$, $\eta^2 = .29$. Follow-up t-tests indicated that there was no difference between control males ($M = 21.45$, $SD = 14.13$) and control females ($M = 20.20$, $SD = 12.80$) in the amount of productive commentary that was produced. However, experimental females ($M = 28.94$, $SD = 15.65$) engaged in more productive commentary than experimental males ($M = 10.63$, $SD = 8.85$). As shown in Figure 9, the pattern is consistent with the interpretation that the spouses of PD participants attempted to compensate for the deficits of their husbands. They generated more PC statements than either the control husbands or wives, and enough that the couple totals were equivalent. There were no other significant main effects or interactions.

On-task commentary to the interviewer. There was a significant main effect of gender, $F(1,32) = 4.47$, $p < .05$, $\eta^2 = .10$. More on-task commentary to the interviewer was produced by females ($M = 8.00$, $SD = 5.77$) than by males ($M = 5.58$, $SD = 4.96$). The interaction between group and gender also achieved significance, $F(1,32) = 6.44$, $p < .05$, $\eta^2 = .15$. While there was no difference between control males ($M = 6.85$, $SD = 6.47$) and control females ($M = 6.30$, $SD = 5.54$), experimental females ($M = 10.13$, $SD = 6.48$) produced more commentary to the interviewer than did experimental males ($M = 4.00$, $SD = 3.20$). There were no other significant results.

On-task clarifications. The only main effect to obtain significance was for group, $F(1,32) = 4.94$, $p < .05$, $\eta^2 = .11$. More clarifications were produced by the control group ($M = 5.75$, $SD = 5.97$) than by the experimental couples ($M = 2.13$, $SD = 2.39$). The interaction between group and order was also significant, $F(1,32) = 6.19$, $p < .05$, $\eta^2 = .14$. Post-hoc analyses indicated that, in order 1, the control group ($M = 8.60$, $SD = 7.63$) produced more clarifications than the experimental group ($M = .93$, $SD = 1.74$). In order 2, the control group ($M = 2.90$, $SD = 3.97$) and the experimental group ($M = 3.33$, $SD = 2.83$) produced a similar number of clarifications. As suggested in Figure 10, control couples may have benefited from individual-level experience by collaboratively monitoring and clarifying the problem space, whereas experimental couples did not. No other interactions achieved significance.

On-task requests. The ANOVA produced a significant main effect of gender, $F(1,32) = 7.38$, $p < .05$, $\eta^2 = .16$. Females ($M = 1.00$, $SD = 1.35$) made more

requests to the interviewer than did males ($\underline{M} = .36$, $\underline{SD} = .59$). The interaction between gender and group was also significant, $F(1,32) = 6.37$, $p < .05$, $\eta^2 = .13$. Follow-up t-tests revealed that there was no difference between control males ($\underline{M} = .55$, $\underline{SD} = .83$) and control females ($\underline{M} = .60$, $\underline{SD} = 1.14$) in the number of requests to the interviewer. However, experimental females ($\underline{M} = 1.50$, $\underline{SD} = 1.63$) made more such requests than experimental males ($\underline{M} = .13$, $\underline{SD} = .34$). There were no other significant main effects or interactions.

On-task admonitions. There was a significant two-way interaction between group and gender, $F(1,32) = 9.91$, $p < .005$, $\eta^2 = .22$. Post-hoc t-tests indicated that control males ($\underline{M} = 2.80$, $\underline{SD} = 3.04$) produced more admonitions than control females ($\underline{M} = 1.10$, $\underline{SD} = 1.86$). However, experimental females ($\underline{M} = 2.00$, $\underline{SD} = 1.93$) produced more admonitions than experimental males ($\underline{M} = .44$, $\underline{SD} = 1.09$). All other main effects and interactions failed to achieve significance.

On-task reviews. The only significant result was a main effect of gender, $F(1,32) = 6.34$, $p < .05$, $\eta^2 = .15$. Females ($\underline{M} = .58$, $\underline{SD} = .87$) produced more review statements than males ($\underline{M} = .19$, $\underline{SD} = .57$).

On-task strategy statements. The only significant finding was a two-way interaction between group and gender, $F(1,32) = 7.08$, $p < .05$, $\eta^2 = .17$. Follow-up analyses revealed that control males ($\underline{M} = .85$, $\underline{SD} = 1.46$) and control females ($\underline{M} = .45$, $\underline{SD} = 1.19$) made a similar number of strategy statements. Experimental males ($\underline{M} = .19$, $\underline{SD} = .40$) and experimental females ($\underline{M} = .56$, $\underline{SD} = .73$) also produced a similar amount of strategies. However, experimental males made significantly fewer

strategy statements than control males; the difference between control and experimental females was not significant.

There were no significant main effects or interactions for the following on-task process variables: repetitions, praise, and non-productive commentary.

Post-task productive commentary. The ANOVA revealed a significant main effect of group, $F(1,32) = 7.06$, $p < .05$, $\eta^2 = .18$. There was more productive commentary produced by control couples ($M = 3.05$, $SD = 2.77$) than by experimental couples ($M = 1.13$, $SD = 1.45$). Further, there was a significant interaction between group and gender, $F(1,32) = 9.29$, $p = .005$, $\eta^2 = .22$. Post-hoc analyses indicated that, while there was no difference between control males ($M = 3.45$, $SD = 3.22$) and control females ($M = 2.65$, $SD = 2.25$), experimental females ($M = 1.88$, $SD = 2.22$) engaged in more productive commentary than experimental males ($M = .44$, $SD = .73$). There were no other significant main effects or interactions.

Post-task commentary to interviewer. The main effect of gender was significant, $F(1,32) = 4.36$, $p < .05$, $\eta^2 = .10$. More commentary to the interviewer was produced by females ($M = 1.21$, $SD = 1.66$) than by males ($M = .50$, $SD = .56$). The interaction between group and gender also achieved significance, $F(1,32) = 7.17$, $p < .05$, $\eta^2 = .16$. While there was no difference between control males ($M = .95$, $SD = 1.23$) and control females ($M = .75$, $SD = 1.12$), experimental females ($M = 1.69$, $SD = 2.41$) produced more commentary to the interviewer than did experimental males ($M = .06$, $SD = .25$). All other main effects and interactions failed to achieve significance.

Post-task requests. The only result to achieve significance was a main effect of order, $F(1,32) = 8.33$, $p < .01$, $\eta^2 = .21$. More requests were produced in order 2 ($M = .84$, $SD = 1.13$) than in order 1 ($M = .23$, $SD = .45$).

Post-task non-productive commentary. The only significant result was a two-way interaction between group and gender, $F(1,32) = 11.12$, $p < .005$, $\eta^2 = .25$. Post-hoc t-tests revealed that there was no difference between control males ($M = 1.85$, $SD = 2.41$) and control females ($M = 1.10$, $SD = 1.55$) in the amount of non-productive commentary. However, experimental females ($M = 2.00$, $SD = 2.31$) engaged in more non-productive commentary than experimental males ($M = .25$, $SD = .58$).

No significant main effects or interactions were observed for the remaining post-task process variables: clarifications, admonitions, reviews, repetitions, strategy statements, and praise.

Period Comparisons

Additional analyses of variance were conducted on each type of process variable to compare pre-task, on-task, and post-task performance. Variables were expressed as rates (i.e., raw scores divided by the time spent in that phase of the task) for comparability across different phases of the 20 Questions task. For each ANOVA, the independent variables were group, order, gender, and task, with repeated measures on the last two factors. Of interest in these analyses were task effects and any interactions with the task variable.

Productive commentary. The ANOVA revealed significant main effects of task

($F(2,62) = 19.38, p = .000, \eta^2 = .37$) and gender ($F(1,31) = 6.11, p < .05, \eta^2 = .14$). More productive commentary was produced in the post-task ($M = .16, SD = .15$) than on-task ($M = .06, SD = .03$), which was significantly greater than the pre-task ($M = .05, SD = .03$). Women ($M = .10, SD = .08$) engaged in more productive commentary than men ($M = .07, SD = .05$). Further, the interaction between group and gender was significant, $F(1,31) = 5.15, p < .05, \eta^2 = .11$. There was no difference between control males ($M = .09, SD = .06$) and control females ($M = .09, SD = .06$). However, experimental females ($M = .13, SD = .11$) engaged in more productive commentary across the three task phases than experimental males ($M = .06, SD = .04$).

Commentary to interviewer. There were significant main effects of order ($F(1,31) = 27.48, p = .000, \eta^2 = .47$), gender ($F(1,31) = 9.84, p < .05, \eta^2 = .14$), and task ($F(2,62) = 36.41, p = .000, \eta^2 = .39$). More commentary to the interviewer was produced in order 2 ($M = .06, SD = .03$) than in order 1 ($M = .02, SD = .02$), by females ($M = .05, SD = .05$) than by males ($M = .03, SD = .03$), and in the post-task ($M = .08, SD = .07$) than in the pre-task ($M = .02, SD = .02$) and on-task ($M = .02, SD = .01$) phases. There were also significant two-way interactions between group and gender ($F(1,31) = 19.45, p = .000, \eta^2 = .29$), order and task ($F(2,62) = 25.46, p = .000, \eta^2 = .27$), and gender and task ($F(2,62) = 6.17, p < .005, \eta^2 = .08$). These were qualified by significant three-way interactions between group, order, and gender ($F(1,31) = 6.52, p < .05, \eta^2 = .07$), group, gender, and task ($F(2,62) = 13.28, p = .000, \eta^2 = .23$), and order, gender, and task ($F(2,62) = 7.61, p = .001, \eta^2 = .15$).

The four-way interaction between all of these variables was also significant,

$F(2,62) = 6.27, p < .005, \eta^2 = .08$. In order 1, there was no significant difference between control males and control females for the pre-task ($\underline{M}s = .01, .00$; $\underline{SD}s = .02, .01$, respectively), on-task ($\underline{M}s = .02, .03$; $\underline{SD}s = .02, .02$, respectively), or post-task ($\underline{M}s = .03, .01$; $\underline{SD}s = .06, .03$, respectively) phases. Further, there was no significant difference between experimental males and experimental females for the pre-task ($\underline{M}s = .00, .01$; $\underline{SD}s = .01, .01$, respectively), on-task ($\underline{M}s = .01, .03$; $\underline{SD}s = .01, .03$, respectively), or post-task ($\underline{M}s = .01, .04$; $\underline{SD}s = .03, .03$, respectively) phases. In order 2, the difference between control males and control females was not significant for the pre-task ($\underline{M}s = .04, .03$; $\underline{SD}s = .02, .02$, respectively), on-task ($\underline{M}s = .02, .02$; $\underline{SD}s = .02, .01$, respectively), or post-task ($\underline{M}s = .12, .10$; $\underline{SD}s = .07, .08$, respectively) phases. However, experimental females ($\underline{M} = .04, \underline{SD} = .03$) engaged in more commentary to the interviewer than experimental males ($\underline{M} = .01, \underline{SD} = .01$) during the pre-task and post-task ($\underline{M}s = .23, .05$; $\underline{SD}s = .13, .04$, respectively) phases. Experimental females ($\underline{M} = .03, \underline{SD} = .02$) produced marginally more ($p = .057$) commentary to the interviewer than experimental males ($\underline{M} = .01, \underline{SD} = .01$) during the on-task phase in order 2.

Clarifications. The only significant result was a main effect of task, $F(2,62) = 3.82, \eta^2 = .00$. Relatively more clarifications were produced on-task ($\underline{M} = .01, \underline{SD} = .01$) than in the pre-task ($\underline{M} = .00, \underline{SD} = .01$). A similar number of clarifications were produced in the post-task ($\underline{M} = .01, \underline{SD} = .03$) compared to the other two task phases.

Requests. The main effects of task ($F(2,62) = 32.09, p = .000, \eta^2 = .38$) and order ($F(1,31) = 29.27, p = .000, \eta^2 = .50$) were significant. More requests were

produced in the post-task ($\underline{M} = .03$, $\underline{SD} = .03$) than in the pre-task ($\underline{M} = .01$, $\underline{SD} = .01$), which was significantly different than on-task performance ($\underline{M} = .00$, $\underline{SD} = .00$). More requests were made in order 2 ($\underline{M} = .02$, $\underline{SD} = .01$) than in order 1 ($\underline{M} = .00$, $\underline{SD} = .00$). There was a significant interaction between order and task, $F(2,62) = 22.19$, $p = .000$, $\eta^2 = .25$. Post-hoc t-tests indicated that there was no difference in the number of requests made on-task in order 1 ($\underline{M} = .00$, $\underline{SD} = .00$) or in order 2 ($\underline{M} = .00$, $\underline{SD} = .00$). For the pre-task, more requests were produced in order 2 ($\underline{M} = .01$, $\underline{SD} = .01$) than in order 1 ($\underline{M} = .00$, $\underline{SD} = .00$). With respect to the post-task, more requests were made in order 2 ($\underline{M} = .05$, $\underline{SD} = .03$) than in order 1 ($\underline{M} = .01$, $\underline{SD} = .01$).

Admonitions. The only significant result was a main effect of task, $F(2,62) = 4.88$, $p < .05$, $\eta^2 = .00$. Significantly fewer admonitions were made in the pre-task ($\underline{M} = .00$, $\underline{SD} = .01$) than on-task ($\underline{M} = .01$, $\underline{SD} = .01$) or in the post-task ($\underline{M} = .01$, $\underline{SD} = .02$).

Reviews. There were significant main effects of order ($F(1,31) = 6.97$, $p < .05$, $\eta^2 = .00$) and of task ($F(2,62) = 4.11$, $p < .05$, $\eta^2 = .00$). Follow-up t-tests failed to elucidate any differences in performance between the pre-task ($\underline{M} = .00$, $\underline{SD} = .01$), on-task ($\underline{M} = .00$, $\underline{SD} = .00$), and post-task ($\underline{M} = .00$, $\underline{SD} = .01$) phases. While it is difficult to determine from such small means, more reviews were produced in order 1 ($\underline{M} = .00$, $\underline{SD} = .01$) than in order 2 ($\underline{M} = .00$, $\underline{SD} = .00$). The interaction between order and task was also significant, $F(2,62) = 7.67$, $p = .001$, $\eta^2 = .00$. Post-hoc t-tests revealed that, on the pre-task, more reviews were produced in order 1 ($\underline{M} = .00$,

SD = .01) than in order 2 (M = .00, SD = .00). There was no difference between order 1 (M = .00, SD = .00) and order 2 (M = .00, SD = .00) in the number of reviews produced on-task. For the post-task, more reviews were evident in order 1 (M = .01, SD = .01) than in order 2 (M = .00, SD = .00).

Strategy statements. The only significant result was a main effect of task, $F(2,62) = 6.19$, $p < .005$, $\eta^2 = .00$. Significantly more strategy statements were produced in the post-task (M = .01, SD = .02) than in either the pre-task (M = .00, SD = .01) or on-task (M = .00, SD = .00) phases.

Non-productive commentary. Significant main effects of task ($F(2,62) = 13.28$, $p = .000$, $\eta^2 = .27$) and gender ($F(1,31) = 8.51$, $p < .01$, $\eta^2 = .20$) were obtained. More non-productive commentary was produced in the post-task (M = .05, SD = .09) than in the pre-task (M = .01, SD = .02), which was significantly greater than during the on-task phase (M = .00, SD = .01). Women (M = .03, SD = .05) engaged in more non-productive commentary than men (M = .01, SD = .02). Further, there were significant two-way interactions between group and gender ($F(1,31) = 4.22$, $p < .05$, $\eta^2 = .10$) and gender and task ($F(2,62) = 8.32$, $p = .001$, $\eta^2 = .17$). These were qualified by significant three-way interactions between group, gender, and task ($F(2,32) = 4.08$, $p < .05$, $\eta^2 = .08$) and between group, order, and task ($F(2,62) = 3.27$, $p < .05$, $\eta^2 = .07$). Post-hoc analyses of the first three-way interaction indicated no difference between control males (M = .01, SD = .01) and control females (M = .02, SD = .02) in the amount of non-productive commentary provided over the pre-task, on-task (Ms = .00, .00; SDs = .01, .00, respectively), and post-task

(\underline{M} s = .03, .05; \underline{SD} s = .05, .07, respectively) phases. However, experimental females (\underline{M} = .00, \underline{SD} = .00) engaged in more non-productive commentary than experimental males (\underline{M} = .00, \underline{SD} = .00) during the on-task phase. There were marginally significant differences (p = .055) between the pre-task non-productive commentary of experimental males (\underline{M} = .01, \underline{SD} = .01) and females (\underline{M} = .02, \underline{SD} = .03). This marginally significant difference was also true of the post-task non-productive commentary (\underline{M} s = .02, .10; \underline{SD} s = .07, .18, respectively).

For the group by order by task interaction, the control group in order 1 produced more non-productive commentary post-task (\underline{M} = .04, \underline{SD} = .04) than pre-task (\underline{M} = .02, \underline{SD} = .02), which was significantly greater than on-task (\underline{M} = .00, \underline{SD} = .00). In order 2, they produced more non-productive commentary in the pre-task (\underline{M} = .01, \underline{SD} = .01) than on-task (\underline{M} = .00, \underline{SD} = .01). Performance in the post-task (\underline{M} = .05, \underline{SD} = .07) was not significantly different than the other two task phases. For the experimental group, there were no significant differences in non-productive commentary between the pre-task (\underline{M} = .02, \underline{SD} = .03), on-task (\underline{M} = .00, \underline{SD} = .00), and post-task (\underline{M} = .12, \underline{SD} = .18) phases in order 1. Significantly more non-productive commentary was produced in the post-task (\underline{M} = .02, \underline{SD} = .03) than in the pre-task (\underline{M} = .00, \underline{SD} = .01), which was larger than the on-task (\underline{M} = .00, \underline{SD} = .00) phase in order 2.

No significant main effects or interactions were observed in the period analyses for praise and repetitions.

Analyses with Process Variable Composite Scores

Analyses were also conducted on composite process variable scores. These scores reflected the verbal exchange that occurred only during the on-task segment of the 20 Questions task. A "positive" composite score was created by summing across the following on-task variables: productive commentary, commentary to the interviewer, clarifications, requests, and strategies. It was believed that these variables were indicative of useful collaboration. A "negative" composite score was derived by adding across three on-task variables: admonitions, repetitions, and non-productive commentary. It was hypothesized that these variables were indicative of poor collaborative process.

These analyses were conducted in three ways. First, the composite scores were created from the addition of raw scores. In the second analysis, the composite scores were derived as rate variables. That is, for each dyad, the sum of each process variable was divided by the time spent on-task, and then these scores were summed. Last, proportions were used such that, for each dyad, the sum of each process variable was divided by the total sum across all on-task process variables; the relevant proportions were then added to produce the composite score. Three analyses of variance were conducted, and the factors in each analysis were group, gender, and valence (positive versus negative), with repeated measures on the last two factors. The dependent variables were the composite positive and negative scores for males and females separately.

In the first ANOVA using the sum of raw scores to derive the composite scores, there were significant main effects of gender ($F(1,34) = 12.26$, $p = .001$, $\eta^2 =$

.18) and valence ($F(1,34) = 114.39, p = .000, \eta^2 = .77$). Females ($M = 20.57, SD = 11.74$) had larger composite scores than males ($M = 14.30, SD = 10.17$), and the positive composite score ($M = 32.34, SD = 19.38$) was larger than the negative composite score ($M = 2.53, SD = 2.53$). There were significant interactions between group and gender ($F(1,34) = 22.65, p = .000, \eta^2 = .33$) and gender and valence ($F(1,34) = 14.82, p = .000, \eta^2 = .23$). These were qualified by a significant three-way interaction between group, gender, and valence, $F(1,34) = 16.36, p = .000, \eta^2 = .25$. This interaction is presented in Figure 11. Posthoc analyses indicated that, for the positive composite score, there was no significant difference between the control males ($M = 35.65, SD = 22.67$) and the control females ($M = 33.10, SD = 22.42$). However, the positive composite score was larger for the experimental females ($M = 43.75, SD = 19.36$) than the experimental males ($M = 16.88, SD = 13.06$). For the negative composite score, the control males ($M = 4.00, SD = 3.71$) had a higher score than the control females ($M = 2.05, SD = 2.46$). For the experimental couples, the females ($M = 3.38, SD = 2.71$) had a higher negative composite score than the males ($M = .69, SD = 1.25$).

When the ANOVA was conducted using the composite scores as rate variables, identical results were obtained and will not be reported. These identical results were not surprising given that a previous analysis indicated that time in the on-task phase was not a differentiating factor between the control and experimental groups.

In the third ANOVA, proportions were used to derive the composite scores. The main effect of valence was significant, $F(1,34) = 736.54, p = .000, \eta^2 = .95$.

The positive proportional composite score ($\underline{M} = .91$, $\underline{SD} = .10$) was larger than the negative proportional composite score ($\underline{M} = .07$, $\underline{SD} = .10$). The only significant interaction was the three-way interaction between group, gender, and valence, $F(1,34) = 5.24$, $p < .05$, $\eta^2 = .13$. Post-hoc tests indicated that, for the positive proportional composite score, there was no difference between control males ($\underline{M} = .87$, $\underline{SD} = .13$) and control females ($\underline{M} = .91$, $\underline{SD} = .13$) or between experimental males ($\underline{M} = .94$, $\underline{SD} = .13$) and experimental females ($\underline{M} = .96$, $\underline{SD} = .12$). For the negative proportional composite score, control males ($\underline{M} = .12$, $\underline{SD} = .13$) had a higher score than the control females ($\underline{M} = .06$, $\underline{SD} = .09$). There was no significant difference between the negative proportional composite score of experimental males ($\underline{M} = .05$, $\underline{SD} = .13$) and experimental females ($\underline{M} = .07$, $\underline{SD} = .06$). The patterns of significance in this interaction are slightly different than for the previous two analyses, and likely reflect a smaller sample size when proportional scores could not be computed for all subjects.

Correlations between 20 Questions Performance and Process Variables

Overview

The relationship between the indicators of efficient (constraint-seeking) and inefficient (hypothesis-testing) problem solving strategies on the one hand, and indicators of process variables on the other hand, was explored. These correlations are presented in Table 8. Given the exploratory nature of these analyses, only significant ($p < .05$) on-task correlations were emphasized. Pseudo-constraint seeking questions were not included in these analyses, as they are not as conceptually clear as constraint-seeking and hypothesis-testing questions. As in the above ANOVA analyses, one

experimental couple was omitted from these correlations because they produced several times the number of process variables relative to the mean for the rest of the sample.

We speculated that more efficient questioning strategies might be related to different process variables for the control and experimental groups. This was indeed the case. In particular, the use of strategy statements and requests was differentially efficient for the control and experimental groups.

Constraint-seeking Questions

For the control group, constraint-seeking questions were significantly associated with non-productive commentary for males ($r = -.48$). That is, a greater number of constraint-seeking questions was associated with less non-productive commentary by male participants. For the experimental group, there was a significant association between constraint-seeking questions and productive commentary by males ($r = .71$), productive commentary by females ($r = .79$), requests made by males ($r = .60$), and strategies by females ($r = .69$). That is, more constraint-seeking questions were posed by experimental couples when both partners engaged in productive commentary, when the Parkinsonian male asked more questions of the experimenter, and the spouse produced more strategy statements.

Hypothesis-testing Questions

For the control group, several on-task process variables were significantly associated with hypothesis-testing questions: requests by males ($r = .53$), repetitions by females ($r = .68$), strategy statements by males ($r = .81$), and strategy statements by

females ($r = .75$). These correlations suggest that more hypothesis-testing questions were associated with more strategy statements by control males and females, more questions to the experimenter by males, and more repetitions of questions by females.

For the experimental group, hypothesis-testing questions were significantly related to productive commentary by males ($r = -.54$) and admonitions by females ($r = -.51$). Specifically, more hypothesis-testing questions were produced when both productive commentary by Parkinsonian males and admonitions by their spouses decreased.

Correlations Between Performance on 20 Questions and Other Tasks

Overview

In order to explore relationships among types of questions posed by individuals in the 20 Questions task and their performance in the other problem solving tasks, correlations were conducted. This was of interest for several reasons. First, the 20 Questions task has rarely been jointly administered with neuropsychological measures of problem solving ability (cf. Kafer & Hunter, 1997), and it is of some theoretical relevance to determine if it might be measuring a similar problem solving construct. Also, the psychometric properties of the 20 Questions task have not been thoroughly investigated, and it might be worthwhile to examine if, and how, it compares with standardized tests of problem solving ability.

We hypothesized that if the 20 Questions task is a measure of executive/problem solving ability, it should correlate moderately well with other measures of executive function such as WCST and verbal fluency scores.

Individual Condition

For each subgroup of participants, correlations were computed between the number of questions asked and the following variables: letter fluency score (for the letters F, A, and S); category fluency score (animals); and the six card sorting variables: correct sorts, perseverative responses, non-perseverative errors, categories, failures to maintain set, and trials to completion of the first category. These individual-level correlations are presented in Table 9. A significance level of $p < .05$ was employed.

Constraint Seeking (CS) Questions. For the control males and the control females, there were no significant correlations between the use of constraint seeking questions and other measures of problem solving ability as indicated by the fluency and card sorting tasks. However, for the experimental males, there was a significant correlation between number of CS questions and the number of animal words produced ($r = .62$). For the experimental females, CS questions were correlated with four of the seven card sorting variables (r range = .49 to .59). The direction of these correlations indicated that more CS questions were associated with more cards correct, more categories achieved, fewer perseverative responses, and fewer perseverative errors. Thus, for individuals in the experimental group, greater use of CS questions in the 20 Questions task was related to positive indices of problem solving performance on the category fluency and card sorting tasks.

Hypothesis Testing (HT) Questions. There were no significant correlations for control females. For the control males, the correlation between HT questions and

trials to completion of the first category was significant ($r = .51$). This correlation was also significant for the experimental males ($r = .85$) and experimental females ($r = .69$). Two further correlations were significant for the experimental females: HT questions with perseverative responses ($r = .51$) and HT questions with the number of categories achieved ($r = -.50$). The directions of these correlations indicated that, for the experimental group, more HT questions were associated with poorer performance as reflected by more trials to completion of the first category, more perseverative responses, and fewer completed categories.

Pseudo-Constraint Seeking (PCS) Questions. For the control males, PCS questions were correlated with four of the seven card sorting variables (r range = .46 to .51). The direction of the correlations indicated that more PCS questions were related to fewer correct card sorts, more perseverative errors and perseverative responses, and more nonperseverative responses. For the experimental females, the correlation between PCS questions and number of trials to completion of the first category was significant ($r = .53$). More PCS questions were associated with more trials to completion of the initial category. There were no significant correlations for the control females or experimental males.

Total Questions. For the control females, a significant correlation was observed between total questions and the letter fluency score ($r = -.45$). This suggested that, for the control females, asking more questions on the 20 Questions task was associated with the production of fewer total words on the letter fluency task. The correlation between total questions and number of trials to completion of the first

category was significant for both experimental males ($r = .68$) and experimental females ($r = .76$). This indicated that, for the experimental group, asking more questions was related to more trials to completion of the first category on the card sorting task. Correlations between the total questions on the 20 Questions task and other problem solving measures failed to achieve significance for the control males.

Summary of Individual-level Correlations. The results of these correlational analyses indicated that there were some significant relationships between the questioning strategies by individuals performing the 20 Questions task and their performance on the problem solving measures of fluency and card sorting. The pattern of results suggested that CS questions were related to positive indicators of problem solving performance on the fluency and card sorting tasks, while HT and PCS questions were associated with negative performance indicators on the card sorting task. This provides some evidence of convergence across tasks in measures of efficient and inefficient problem solving performance. This was observed to be true for both the control and experimental groups, and indicates that there was no group difference in the pattern of convergence across tasks.

Dyad Condition

The performance of dyads was examined through correlations between the three questioning strategies and the following fluency and card sorting variables: letter fluency score (for the letters P, R, and W); category fluency score (foods); and the six card sorting variables of correct sorts, perseverative responses, nonperseverative errors, categories achieved, failures to maintain set, and trials to completion of the first

category. These correlations are presented in Table 10. A significance level of $p < .05$ was employed.

Constraint Seeking (CS) Questions. For the experimental group, CS questions were correlated with category fluency scores ($r = .56$). This indicated that more CS questions produced by the experimental dyads was associated with their having higher category fluency scores. Further, nonperseverative errors ($r = -.58$) and failures to maintain set ($r = -.51$) were significantly correlated with the number of CS questions. The direction of these correlations indicated that more CS questions in the experimental dyads was related to fewer nonperseverative errors and fewer failures to maintain set in the collaborative context. There were no significant correlations for the control group.

Hypothesis Testing (HT) Questions. One significant correlation was obtained between HT questions and category fluency in experimental dyads ($r = -.61$). The direction of the correlation indicated that more production of the inefficient HT questions was associated with lower category fluency scores.

Pseudo-Constraint Seeking (PCS) Questions. For the control group, the number of PCS questions was correlated with four of the seven card sorting variables (r range = .60 to .76). The direction of the correlations revealed that, in the dyad condition, more PCS questions was associated with fewer correct card sorts, more perseverative errors and perseverative responses, and fewer categories achieved. For the experimental group, there was a significant correlation between the number of PCS questions and the letter fluency score ($r = -.52$). More PCS questions were associated

with reduced letter fluency.

Total Questions. There were no significant correlations between the total number of questions asked by the dyads and their performance on the fluency and card sorting tasks.

Summary of Dyad-level Correlations. The results of these correlational analyses indicated that, consistent with the individual condition, CS questions were associated with positive performance indicators on the fluency and card sorting tasks, while HT and PCS questions were related to negative performance on these tasks. This was true for both the control and the experimental groups and suggests that, working collaboratively in dyads, there is some convergence across the three problem solving tasks in indices of efficient and inefficient performance.

Self-rated Problem Solving Efficacy

Participants individually completed the Problem Solving Inventory (PSI), a questionnaire comprising 32 items. In addition to a total score, scores across three scales--Problem Solving Confidence (CON), Approach-Avoidance Style (AA), and Personal Control (PC)--were derived. Analyses were conducted to establish the reliability of the PSI scales, to test for group and gender differences in ratings of problem solving self-efficacy, and to determine the relationship between these scale scores and actual individual problem solving performance.

Reliability of the PSI Scales

Estimates of internal consistency were computed for each of the three scales and for the total scale score using Cronbach's alpha. The Problem Solving Confidence

scale was comprised of 11 items, the Approach-Avoidance scale consisted of 16 items, and the Personal Control scale contained 5 items. Alpha coefficients were conducted separately for the control group, experimental males, and experimental females. The results are presented in Table 11, which also includes the reliability estimates reported by Moss (1983, cited in Heppner, 1988) for a sample of elderly adults with a mean age of 70 years.

These coefficients indicate that the participants in this study produced internal consistencies that were similar to the 1983 sample reported in the PSI manual. With the exception of the PC scale for experimental females, the coefficients were within an acceptable range. This supports the use of these scales in this study and extends the psychometric information to a sample of PD participants.

Analyses of Variance

Overview. Previous research has not addressed PD individuals' perception of their own problem solving ability. Given that they generally have insight into the effects of the disease process, we expected that if they were having difficulties with problem solving, they would rate their problem solving ability lower than that reported by healthy controls.

Analyses. Two separate analyses were conducted for (a) the means for the three scale scores, and (b) the sum of the three scale scores. In interpreting these results, low scores on all scales (and for the total PSI score) represent positive appraisals of problem solving abilities.

First, a 2 (group) X 3 (scale) X 2 (gender) ANOVA was conducted on the

means for the three scale scores, with repeated measures on the last two factors.

Education level, mental status, and depression scores were also entered as covariates into the analysis. While the education covariate was not significant, its influence was to render the main effect of group nonsignificant. There was a significant main effect of scale, $F(2,70) = 43.62$, $p = .000$, $\eta^2 = .55$. The means for the three scale scores were all significantly different from each other. Scores were most positive for the CON scale ($M = 2.09$, $SD = .52$), followed by the AA scale ($M = 2.49$, $SD = .52$), and then the PC scale ($M = 2.91$, $SD = .80$). There were no significant interactions.

The total score on the PSI, summed across the three scales, was subjected to a 2 (group) X 2 (gender) repeated measures ANOVA. The total score was used so that comparisons with normative data could be conducted. Again, education level, mental status, and depression scores served as covariates. Similar to the previous analysis, the nonsignificant education covariate nullified the previously significant main effect of group.

Of interest, the interaction between group and gender was not significant ($p = .331$). The means for the four groups were as follows: control males ($M = 75.65$, $SD = 25.13$), control females ($M = 69.70$, $SD = 16.26$), experimental males ($M = 82.18$, $SD = 19.18$), and experimental females ($M = 84.18$, $SD = 15.78$). This suggests that the Parkinsonian males were not significantly different than any of the other participant subgroups in their appraisal of their problem solving abilities.

Participants' total PSI scores were also compared with normative data for 22 elderly men (M age = 79.6, $SD = 17.0$) and 57 elderly women (M age = 81.2, $SD =$

23.4) as presented in the PSI manual (Heppner, 1988). The resulting percentiles for the control males, control females, experimental males, and experimental females were 59th, 68th, 44th, and 45th, respectively. This suggests that the scores of all the participant groups were in the average range when compared to the normative sample.

Correlations

In order to determine what, if any, relationship existed between subjects' perceived problem solving efficacy and their scores on actual individual problem solving tasks, correlations between these variables were conducted. Each of the PSI scales was correlated with two fluency variables (letter fluency and category fluency scores), six card sorting variables (correct sorts, perseverative responses, non-perseverative responses, categories, failures to maintain set, and trials), and four 20 Questions measures (CS, HT, PCS, and total questions). The correlations were conducted separately for the control males, control females, experimental males, and experimental females, and a significance level of $p < .05$ was employed. These correlations are presented in Table 12. The results indicated no significant correlations for the control males or the experimental males. Only the significant correlations were reported for each PSI scale.

PSI Confidence Scale. For the control females, this scale was significantly correlated with the number of failures to maintain set ($r = -.46$). This indicated that higher ratings of confidence (i.e., smaller scale scores) were associated with a greater number of failures in maintaining a cognitive set.

PSI Approach/Avoidance Scale. For the control females, the AA scale was

significantly correlated with five of the seven card sorting variables (r range = .46 to .62). The direction of the correlations indicated that better card sorting performance was associated with a self-perceived tendency to approach, rather than avoid, problems. For the experimental females, six of the seven correlations with card sorting variables were significant, and the magnitude of the correlations ranged from .50 to .71. Again, the direction of the correlations suggested that the greater the experimental females rated their tendency to approach, rather than avoid, problems, the better was their actual card sorting performance. Thus, the same pattern of findings was observed for both control and experimental females.

PSI Personal Control Scale. There were no significant correlations between this scale and the measures of individual problem solving performance across the three problem solving tasks.

PSI Total Score. For the experimental females, the total score across the three PSI scales was significantly correlated with five of the seven card sorting variables. The magnitude of the correlations ranged from .61 to .67. Similar to the results with the AA scale, the direction of the correlations suggested that a more positive self-appraisal of problem solving ability was associated with better card sorting performance.

One other result was significant. For the experimental females, there was a significant correlation between the number of constraint seeking questions (CS) and the total PSI score ($r = -.49$). This indicated that a greater use of CS questions was related to a lower total scale score, and thus a more positive perception of their

problem solving abilities.

The results of this section indicated that the most significant associations between self-perception and actual problem solving ability were for measures of card sorting performance and the AA scale and the total scale score. Further, these correlations were only significant for the control females and the experimental females. This suggests that a greater tendency for older women to view themselves as approaching rather than avoiding problems, or to view their overall problem solving abilities positively, was associated with better performance on the card sorting task.

CHAPTER 5

Discussion

In this chapter, the hypotheses guiding the research will be addressed by discussing the results of each problem solving task. This is followed by discussions of applied implications, limitations of the study, and ideas for future research.

Verbal Fluency Task

Letter and category fluency were examined by comparing the performance of individuals working alone and in dyads, counterbalanced across the order of task administration. Several analyses were conducted to investigate a potential group level benefit of collaboration, as well as an individual-level benefit within the dyad.

First, between-subjects analyses of individual and dyad performance indicated significant main effects of gender, task, and group. In both the individual and dyad conditions, more words were generated by women than by men, category fluency was superior to letter fluency, and the control group outperformed the experimental group.

The gender effect is contrary to the review conducted by Spreen and Strauss (1997) concluding that most studies report no gender differences in verbal fluency performance. Differences in cerebral blood flow, verbal compensatory strategies associated with better verbal skills, or extent of cerebral specialization could be postulated to account for the greater fluency by women than men (e.g., Boone et al., 1993).

With respect to the task effect, differences in the results obtained across fluency studies are speculated to be, in part, a function of the specific semantic and

phonemic categories selected for use. The nominal difficulty of a generative naming task is dependent on the type of category (semantic or phonemic) (Hart, Smith, & Swash, 1988) and the choice of category (e.g., animals, fruits) (Bayles et al., 1993). Some authors have argued that letter naming is intrinsically more difficult than category naming (e.g., Nelson & McEvoy, 1979; Ober, Dronkers, Koss, Delis, & Friedland, 1986) because it is more retrieval-dependent than semantic tasks (e.g., Hodges, Salmon, & Butters, 1990) and semantic tasks provide more structure for non-impaired subjects who typically retrieve by semantic category (Lezak, 1993). The opposite view has also been expressed, in that category fluency makes more demands on semantic cognitive abilities than letter fluency, which relies on well-established spelling knowledge (Rich, 1993).

The control group performed better than the experimental group across the individual and dyad conditions. This result was expected given the contribution of the PD males to the experimental dyads. While generative naming tasks load mainly on a "verbal knowledge" factor (Spreeen & Strauss, 1991), the results of the covariate analyses indicated that differences in the educational levels of the control and experimental individuals can not explain this group effect. The interaction between group and gender was not significant in the individual condition, although the pattern of means was in the expected direction. Nevertheless, the hypothesis that the Parkinsonian males would display lower fluency scores than the other groups was not statistically supported. One reason for this may be that the experimental females performed more similarly to their husbands than to the control group across the

fluency tasks.

The between-subjects analyses also indicated that more perseverations and intrusions occurred for all participants in the individual condition of the letter fluency task when dyad performance preceded individual performance than in the reverse order. This may represent interference from the letters presented in the dyad condition.

It is also interesting to note that all of the group effects that were obtained for intrusions and perseverations reflected deficits by the experimental group and not by the control group. For example, the experimental couples made more intrusions on the semantic category task than did the control couples. Parkinsonian men made more intrusions in the individual condition of the letter fluency task than did other participant groups (see Figure 1). Thus, although PD men did not do worse on quantitative measures of fluency, they appeared to be selectively worse in their production of this kind of error. There were some significant interactions involving order and group for intrusions in the individual condition of the category task and perseverations in the dyad condition of the letter fluency task. That is, the detrimental effect of working individually after having been in the dyad was apparent in the number of intrusions made by experimental individuals for the animals category. Also, experimental females made more perseverations in the dyad condition of the letter fluency task than any of the other participant groups when dyad performance preceded individual performance.

Within-subjects analyses were also conducted to better elucidate individual-

level performance within the dyad. For each of the letter and category fluency analyses, across both conditions, the performance of individuals was summed after controlling for the number of redundancies produced by each spouse. In the analyses of the perseverations and intrusions, the average number of responses produced by the spouses when working alone was tabulated and compared with the total performance of individuals in the dyad. These analyses indicated that: (a) individuals were superior to dyads in both letter and category fluency, (b) dyads made more intrusions and perseverations in the letter and category tasks than did individuals, (c) individual performance was superior to dyad performance when comparing the individual performance of each participant group with their individual contribution to the dyad, and (d) with one exception, there was no difference in the relative contribution of men and women to the total fluency score, to the number of perseverations, or to the production of intrusions.

There are several interesting implications of these findings. The fact that each subgroup performed better individually than in the dyad indicates that there was no individual-level benefit of collaboration within the dyad for any particular subgroup. Further, the greater number of intrusions and perseverations in the dyads as compared to individual performance, for both control and experimental groups, suggests that the dyad was not an efficient problem solving unit. Why might this be? Individuals in the dyad may have experienced interference from the competing stimuli being produced by their spouse. Alternatively, individuals may have approached the dyadic situation in a similar way to what they did individually and simply listed words

without regard for the production of their spouse, at times engaging in simultaneous speech. Anecdotal observation indicated that both of these scenarios did indeed occur on several occasions.

However, the latter strategy was not necessarily an unproductive one given the requirements and constraints of the task itself. The objective was to produce as many words as possible in a limited time period, and there was no one correct solution. Reconciling the time-limitation factor with the requirement that the spouses share in performing the task was a challenge to collaborating partners. In the context of such speeded tasks, collaboration may in fact be detrimental to achieving at high (or higher) levels. This suggests that there are certain conditions under which collaborative benefit may not be observed, and one of these could be in the pressure of a timed situation. It should be noted, however, that if the couple had had a greater opportunity to plan a more coordinated strategy, their performance likely could have improved in the dyad.

The finding that the men and women contributed equally to the fluency tasks in the dyad condition, across both the control and experimental groups, suggests that they did indeed work together and one spouse did not monopolize the task. Anecdotal observation indicated that two other strategies that were frequently adopted was for the spouses to alternate word-for-word, or for one spouse to start, say as many words as possible, and then allocate the task to the other spouse who would then take over for a while.

Given that the experimental group produced fewer words than the control

group, but yet the relative ratio of the contribution of each spouse was equal and the group by gender interaction was not significant, it may be that the rate of production in the experimental dyads was slower than in the control dyads. In this regard, it could be speculated that the Parkinsonian spouse may be slowing down the production of the dyad as a whole. It would be interesting to determine if this was indeed the case.

Wisconsin Card Sorting Test

The results of between-subjects analyses of variance indicated that, in the individual condition, women performed better than men, consistent with previous research (Boone et al., 1993). The experimental group performed more poorly than the control group on several card sorting measures. Further, the group by gender interaction was significant, and revealed deficits in measures of perseverative responding, error counts, and categories achieved for the Parkinsonian men relative to the other groups. This was consistent with predictions, and some literature in this area (e.g., Beatty & Monson, 1990; Cools et al., 1984; Dalrymple-Alford et al., 1994; Lees & Smith, 1983; Levin et al., 1989; Starkstein et al., 1989). Given this deficit, the potential for compensation, through collaboration, was available.

It is interesting to note that, in the individual condition, the experimental females did not perform as well as the control females or males. Rather, their performance was often at a level between the control group and their Parkinsonian husbands. This suggests that there may be something inherently different about these caregivers that sets their cognitive performance apart from their healthy peers. One

could speculate about the effect that their husband's illness has on their cognitive resources. One could also speculate about intellectual distribution patterns in marriage, or bidirectional effects of cognitive pathogenesis. In any event, future research should be circumspect in assuming that the spouses of Parkinsonians necessarily represent a normative healthy control group against which to draw comparisons with the performance of their Parkinson spouses.

When dyad performance was examined, group differences were no longer evident. Thus, a group level benefit of collaboration was evident for measures of correct sorts, perseverative responding, and non-perseverative errors. The analyses of covariance indicated that when level of education was controlled for, there was no difference between the control and experimental couples in the number of categories achieved. This suggests that education, rather than neurological status, affected performance on this card sorting variable.

There were also several main effects of order in the dyad condition that indicated a benefit of prior individual experience with the task. This is not unexpected given that there were correct answers that did not change across the individual and dyad conditions. Thus, it appears that the potential for practise effects and learning to occur were realized for some participants.

Within-subjects analyses were conducted to examine potential individual-level benefits of collaboration in the dyads. However, as there were no measures of individual responding in the dyad situation, this was inferred from comparisons between each subgroup's individual level of performance and the performance by the

dyad.

The inferred individual-level benefits of collaboration were most apparent for the experimental males for measures of correct sorts, perseverative responding, and categories achieved. For them, dyad performance was generally better than performing the task a second time, as they did not appear to benefit as much from practise when they worked first in the dyad and then alone. This suggests that when they had previous dyadic experience with the task, whatever performance was achieved in the dyad did not translate into similar subsequent individual performance. That is, they did not learn the card sorting rules well enough the first time to make a significant improvement when they performed the same task alone a second time.

Control males achieved more categories working collaboratively than alone when individual performance preceded dyad performance. This is likely due to the influence of working with their spouse, rather than practise per se, as the control females out-performed their husbands when working alone.

From these analyses, one cannot reach definitive conclusions about how much of the inferred benefits are a result of practise or collaboration. Task familiarity was a potential influence on performance the second time that participants completed the task, irrespective of whether they were working collaboratively or not. One way to disentangle practise effects would be to fill out the design so that in addition to counterbalancing the order of the individual and dyad contexts, there are two other conditions: individual performance followed by individual performance, and dyad performance followed by dyad performance.

Thus, there was evidence of a group-level benefit of collaboration for the experimental dyads. Further, individual-level benefit of group performance was inferred indirectly, was most suggestive for the experimental males, and was implicated for one measure for control males. Additional qualitative analyses with the card sorting task are being considered to examine the interaction that occurred in the experimental dyads for possible evidence of direct instruction and modelling by the healthy spouses.

20 Questions Task

Performance Variables

The three questioning strategies--constraint-seeking (CS), hypothesis-testing (HT), and pseudo-constraint-seeking (PCS)--were examined with between-subjects analyses of variance for both individual- and dyad- level data, and with within-subjects analyses to examine potential individual-level benefits of collaboration.

Between-subjects Analyses. With respect to the individual condition, the results of an ANOVA conducted on the number of questions posed for each question type indicated that, contrary to expectation, there was no significant main effect of group. Thus, the control and experimental individuals asked the same total number of questions.

This analysis also indicated that individuals asked more CS questions than HT questions, followed by PCS questions. Thus, all individuals were capable of using the most efficient CS strategy. This was qualified by an interaction between group and question type such that control individuals asked more CS than HT questions, while

experimental individuals asked an equal number of CS and HT questions.

Further, the significant three-way interaction between group, question type, and order (see Figure 6) revealed that, when individual performance preceded dyad performance, the control individuals produced more CS questions and fewer HT questions than the experimental individuals. There was no difference between the control and experimental individuals across question types when the order of task administration was reversed. This suggests that, without any prior experience with the task, the control individuals had a more efficient problem solving strategy than the experimental individuals. However, the experimental individuals benefited more than the control individuals from prior dyadic experience with the task, resulting in no group differences.

It should also be noted that there was no significant interaction between group, gender, and question type. Thus, the individual data failed to find any evidence that PD individuals performed differently than their spouses. Rather, experimental males and females performed similarly, and both displayed a more inefficient questioning strategy than control males and females upon completing the 20 Questions task individually without any prior task experience.

With respect to the dyad condition, an overall ANOVA conducted on the three types of questioning strategies revealed that there was no main effect of group. Thus, control and experimental dyads asked a similar number of questions in solving the task. The only significant result that emerged in this analysis was a main effect of question type, which indicated that more CS questions were posed than HT or PCS

questions. This indicates that the dyads were capable of generating an efficient questioning strategy. Further, there was no significant interaction between group and question type, which indicates that, when working in dyads, control and experimental groups did not differ in their use of questioning strategies. The main effect of gender (and the group by gender interaction) was non-significant, suggesting that men and women performed similarly in the dyads. They appeared to "work together" as instructed, and asked an equal proportion of questions.

It is also of interest that when total time on task and time per question were analysed, there were no significant results. It was speculated that the bradykinesia and bradyphrenia (i.e., slowing of action and thought) characteristic of PD might have negatively influenced the performance of experimental dyads. However, this did not appear to be the case.

In summary, the results of the between-subjects analyses provided some evidence for a group level benefit of collaboration in that the group differences that were apparent at the individual level in the efficiency of questions asked when individual performance preceded dyad performance were not evident at the dyad level. Thus, the control and experimental dyads displayed equally efficient questioning strategies.

Within-subject Analyses. To determine if there was an individual-level benefit of collaboration, analyses of variance were conducted to compare individual- and dyad- level performance for each questioning strategy. It was found that more CS, HT and total questions were produced individually than in the dyads, suggesting that dyads

were effective in reducing the number of questions posed. Further, when proportions were utilized, there were proportionately more CS questions and fewer HT questions posed in the dyads than individually. These results suggest that dyadic performance was more efficient than individual performance.

In general, the same pattern of results was evident as for the individual- and dyad-level analyses. There was only one significant interaction with group size, and this was between group, order, and group size for CS questions (see Figure 7). Consistent with the earlier results, for the individual-level data, when individual performance preceded dyad performance, the control group produced more CS questions than the experimental group; there was no difference between the control and experimental groups when the task order was reversed. In the dyads, there was no difference in the number of CS questions posed by control and experimental groups in either order of task administration.

It is noteworthy that the absence of a gender by group size interaction suggests that the group level benefit of collaboration for experimental dyads was not accompanied by individual level benefits specific to one spouse. Rather, in terms of performance variables, both spouses benefited equally from the dyadic experience.

Process Variables

Pre-task, on-task, and post-task analyses. Separate ANOVAs were calculated for each process variable for pre-task, on-task, and post-task performance. The most noteworthy result is that there were few significant effects of group, suggesting that the control and experimental dyads performed similarly across the process variables.

However, there were many significant interactions between group and gender, and the pattern of means was identical across the variables. That is, there was no significant difference between control males and control females, but experimental females performed at a significantly higher level than experimental males. In fact, in the majority of the analyses, the mean for the experimental females was the largest of the four means, and the mean for the experimental males was inevitably the smallest.

The implications of this result are fascinating, as it suggests that the absence of an overall group difference for many of the process variables reflects the fact that the experimental females are performing at a high level to compensate for the low performance by their spouses. Combined with the results from the performance analyses indicating equal benefits of collaboration to both spouses, it may be that, while there is no difference between the control and experimental groups in the total number of questions that are asked, the experimental females may be responsible for contributing more than the experimental males to the process of solving the task; control males and females appear to contribute equally to this problem solving process.

Period comparisons. Analyses of variance were conducted to examine the effect of task phase on the production of the process variables. In order to compare directly across pre-, on- and post- task phases, ratios were computed by dividing raw scores by the time the dyad spent in each phase. For several variables (i.e., productive commentary, commentary to the interviewer, requests, strategy statements, and non-productive commentary), post-task performance was greater than performance in the

other task phases. This likely reflects the fact that this was the shortest phase of the task and therefore any verbal production during this time would be given more weight relative to the other task phases.

The task phase effect was also influenced by order for three process variables (commentary to the interviewer, requests, and review statements). In general, it was the pre- and post- task phases in which order was relevant, as performance was equivalent across order during the on-task phase. A greater production of commentary to the interviewer and request statements occurred when dyad performance preceded individual performance than in the reverse order. This likely reflected the fact that when the dyad was doing the task for the first time, they entered into more dialogue with the interviewer in the pre- and post- task phases than when they had previous experience with the task. For review statements, dyads produced more in the pre- and post- task phases when individual performance preceded dyad performance than in the reverse order. Given that they had already done the task individually, they had experience to then share in the dyad.

There was no significant main effect of group for any of the process variables. However, the group by gender interaction was significant for three variables (productive commentary, commentary to the interviewer, and non-productive commentary), and indicated that experimental females produced a greater number of these variables than their spouses, while there was no difference between the control males and the control females. As suggested above, the absence of a group effect indicates that the experimental females may be compensating for the relatively poorer

performance of their spouses to enable the performance of experimental dyads to be similar to that of the control dyads.

Positive Versus Negative Composite Scores. Several on-task process variables were summed to obtain a positive composite score. These variables were: productive commentary, clarifications, commentary to the interviewer, requests, and strategy statements. The three variables that comprised the negative composite score were: admonitions, repetitions, and non-productive commentary. An analysis of variance was conducted on these scores to examine the potential effects of group and gender. The results indicated that there was more positive process than negative process, and the interaction between group and gender was significant. This was qualified by a significant three-way interaction between group, gender, and valence (i.e., positive versus negative composite scores) (see Figure 11). For the positive score, there was no difference between control males and control females. However, there was significantly more positive process expressed by experimental females than experimental males. With respect to the negative score, control males expressed more negative process than control females, and experimental females expressed more negative process than experimental males. Consistent with previous analyses, this suggests that, overall, the experimental males participated less than the experimental females in the vocal process of solving the 20 Questions task.

Relationship Between Performance and Process Variables

Given that, in principle, group process should affect group performance (Hill, 1982), correlational analyses were conducted between the on-task process variables

and the two types of questioning strategies (see Table 8). Use of constraint-seeking (CS) questions was indicative of efficient performance and, for the control couples, the only on-task process variable related to this questioning style was non-productive commentary by males. That is, less non-productive commentary by males was associated with a greater production of CS questions. For the experimental couples, however, more CS questions were related to more productive commentary and strategy statements by females, and to more productive commentary and more requests to the interviewer by Parkinsonian males. Thus, for the experimental couples, a combination of dialogue relevant to solving the task, asking questions of the interviewer by the Parkinsonian males, and the formulation of potential strategies to organize the problem solving process by female spouses lead to greater use of efficient CS questions.

With respect to the less efficient hypothesis-testing (HT) questions, for the control couples, use of this questioning style was related to more requests and strategies by the males, and to more repetitions and strategies by the females. This suggests that inefficient performance was associated with the use of strategy statements by both spouses, to requests for information from the interviewer by males, and to repeated questions by females. This latter finding is inconsistent with previous research indicating that repeat statements were related to CS questions for older adults (Dixon, Fox, Trevithick, & Brundin, 1995). For the experimental couples, this inefficient questioning style was related to less productive commentary by Parkinsonian males and to fewer admonitions by female spouses.

It is interesting to note from these analyses that the usefulness of certain

process variables differed across groups. For example, while strategy statements and requests were associated with efficient problem solving performance in the experimental couples, they were related to an inefficient questioning style for the control couples.

Why would this be the case? Several possible explanations can be postulated. For the experimental couples, the explication of strategy statements by the female spouses may have served to organize the task. Perhaps the use of strategy statements by both spouses in the control couples introduced an element of conflict or competitiveness that interfered with task performance. Alternatively, the strategy statements that the control couples produced may have been less efficient than those produced by the experimental females. Or perhaps the strategy statements produced by the control couples were only enunciated, and not acted upon, whereas the strategies produced by the experimental females may have been either readily accepted by the Parkinsonian and acted upon, or imposed by the spouse.

With respect to the request statements, the Parkinsonian males may have asked information of the interviewer that was in some way facilitative of an efficient questioning strategy. However, for the control males, the information that they requested may have been less relevant to an efficient questioning strategy.

Correlations Between Performance on 20 Questions and Other Problem Solving Tasks

Correlational analyses were computed between the types of questions asked on the 20 Questions task and measures of fluency and card sorting performance in both the individual and dyad conditions. The purpose of these analyses was to investigate

how well the 20 Questions task correlates with neuropsychological tests purported to measure executive function. The results indicated that there were some moderately significant correlations (r range = .45 to .85) demonstrating convergence across tasks in indices of efficient and inefficient problem solving performance. Further, this pattern was apparent for both the control and experimental groups. Thus, the 20 Questions task does appear to correlate moderately well with some other measures of executive function.

While these results were promising, they do not imply that the 20 Questions task must necessarily be measuring executive function. Kafer and Hunter (1997) have noted the difficulty of measuring the latent construct of planning/problem solving. In the context of the Wisconsin Card Sorting Test, for example, there is insufficient evidence to conclude that it is a test specifically sensitive to frontal lobe pathology (Costa, 1988; Mountain & Snow, 1993). Costa wrote that "it is easy to find tests that are sensitive to frontal-lobe dysfunction and very difficult to find tests that are specific for it!". Thus, while the 20 Questions task has face validity as a measure of planning/problem solving, further analyses (e.g., factor analysis, structural equation modeling) are necessary to provide evidence of its construct and discriminant validity. This is beyond the scope of the present research, but the purpose was to raise the issue briefly in the current context.

Self-Perceived Problem Solving Ability

Participants rated their problem solving abilities on a six-point Likert-type scale for the 32 items of the Problem Solving Inventory (Heppner, 1988). Scores were

derived for three sub-scales -- problem solving confidence, approach-avoidance style, and personal control -- and the three scale scores were summed to obtain a total score. Of interest was whether the Parkinsonian men would rate their abilities any differently than the other participant groups.

The results of analyses of variance indicated that both experimental males and females appraised their problem solving abilities similarly to the control participants. Further, the scores of all participant groups did not differ significantly from a normative sample indicating that there was nothing unusual in the response profiles of these participants. Thus, all participants appeared to have a relatively positive perception of their problem solving abilities.

There were no significant correlations between PSI scores and actual problem solving performance for the experimental males or the control males. This suggests that, for the men in this sample, there was no significant relationship between their self-perception of problem solving abilities and actual performance measures. For the women, modestly significant correlations were obtained indicating that more positive appraisals of problem solving performance were related to better card sorting performance.

Influence of the Covariates

Throughout the analyses, education level, mental status, and depression scores of the participants were entered as covariates to determine their potential impact on problem solving performance. While the mental status and depression scores were significant in some instances, there was no overall definitive pattern to these results.

This likely reflects the effect of the selection criteria employed in recruiting participants. That is, anyone scoring below 24 out of 30 on the Mini Mental Status Examination or above 20 on the Geriatric Depression Scale was not included in the study. The education level of participants significantly affected the group variable in only two instances: (a) by producing a significant main effect of group for the number of intrusions on the dyadic semantic fluency task, and (b) by rendering the group effect for the number of categories achieved on the card sorting test nonsignificant in the dyad condition. The latter result suggests that education level, rather than neurological status, may affect the number of categories achieved by dyads on the WCST.

Applied Implications

What do the results of this study suggest in terms of assisting Parkinsonians in their problem solving efforts? The use of a more everyday, collaborative context to examine problem solving indicated that collaboration can indeed boost individual level performance. As many life problems are solved collaboratively, it is reassuring to observe that collaboration has some beneficial effect.

With respect to individual-level benefit, in some instances, the wives of the Parkinsonian men appeared to compensate for the relatively poorer performance of their husbands. However, the effect of the healthy spouse taking the lead in the dyad was both beneficial and detrimental to the subsequent individual performance of their husbands. Certainly the potentially negative consequences of compensation have been noted in several domains (Bäckman & Dixon, 1992; Wilson & Watson, 1996).

In the 20 Questions task, for example, given the order effects and interactions that occurred for the performance variables, it is possible that the improved individual performance by Parkinsonians after having been in the dyad may reflect, in part, the use of modelling by the healthy spouse. However, in the card sorting task, there was no transfer of learning to the individual condition for the Parkinsonian men after having been in the dyad. From anecdotal observation, in some cases the healthy spouses allowed their partners to continue in an unproductive mode in the dyad (while they were performing the task adequately), and did not provide the correction necessary to foster learning by the PD men. In these instances, motivated by the best intentions, the healthy spouses may have inadvertently promoted dependency in their Parkinsonian spouses that could have prevented the latter from developing strategies leading to greater independence in their problem solving efforts.

The type of problem solving task that one is engaging in will also determine, in part, how useful collaboration might be. The constraints of the timed verbal fluency task were not conducive to collaboration, and it is likely that the less externally imposed constraints there are on the situation, the greater the likelihood that collaboration will be helpful to both healthy older individuals and those with PD. Certainly in everyday problem solving situations there are not the same time pressures there are in laboratory tasks and the benefits of collaboration may become more manifest.

Further, the goal of the problem solving task also dictates how individual dyad members might best collaborate. If the task requires providing as many answers as

possible, then a useful strategy may be to let the more fluent person take control. However, if productivity is not the goal, but rather the elucidation of the best answer, then an equal contribution by both members may be more beneficial.

Limitations of this Study

There are several sample characteristics that limit the generalizability of these findings. Although demographic data indicate that PD is equally prevalent in men and women, this sample was biased so strongly in favor of men (85%) that it was determined to proceed with data analyses utilizing a principal experimental group comprised solely of men. This gender bias was largely a function of the recruiting strategy whereby caregiver support groups were visited, and more contacts were made through the caregiving females. Thus, it would be difficult to generalize these findings to female Parkinsonians and their male caregivers.

In addition, given the selection criteria of the study requiring that the sample not be demented or significantly depressed, the findings are relevant to a reasonably healthy PD group. However, they can only be generalized to persons with idiopathic PD, and not to those with other Parkinsonian-like syndromes. Further, the results are not applicable to early-onset Parkinsonians, as the participants were all 55 years of age and older.

With respect to the measures employed, marital satisfaction was rated on a five-point scale, and a more comprehensive index could be incorporated, such as the Dyadic Adjustment Scale (Spanier, 1976). This would provide a broader measure of marital satisfaction in a number of different areas, and would increase the variability

of scores.

The PD demographic questionnaire could be revised to include questions about how well the PD subject is functioning on the day of testing. While general questions about functioning are useful, the incorporation of health questions referring specifically to the day of testing may provide some information about the validity of cognitive measures taken on that day. This is particularly relevant given the "on-off" phenomenon experienced by Parkinsonians.

As an aid to interpreting the WCST results, the inclusion of an attributional measure would be useful. Anecdotal observation of the responses made by subjects while completing the task indicated that whether they recognized that the category shifts were intrinsic to the task may be a function of whether their attributional style is internal or external. That is, those participants who berated themselves for not understanding when the category shift would occur may have an internal attributional style; those participants who "blamed" the experimenters for "changing it on them" may have an external attributional style.

Ideas for Future Research

There are several ways that the current research could be expanded. First, it would be particularly interesting to contrast male and female Parkinsonians in one study to determine what, if any, differences occur in the dyadic interaction when the caregivers are male.

Second, it would be interesting to include open-ended questions about how couples have problem solved to adapt to PD since their spouse was diagnosed. An

alternative would be to ask the caregiver and the PD person separately how they each have compensated for the illness, and the positive and negative consequences of their compensatory efforts. This would provide a meta-cognitive measure of awareness of adaptation to deficits. In the present research, many couples discussed the environmental adaptations they had made to compensate for the physical effects of PD, but they were less forthcoming about the social and psychological compensatory strategies they may have employed.

The inclusion of marital satisfaction as an independent variable could be fruitful, as it would allow examination of potential differences in collaboration between satisfied and dissatisfied couples. This variable has been studied with respect to patterns of affect displayed by healthy couples in discussions of a marital problem (e.g., Carstensen, Gottman, & Levenson, 1995; Levenson, Carstensen, & Gottman, 1994), and in collaborative memory tasks (Gagnon, 1995).

Qualitative research focusing on the kinds of modelling and instruction provided by the healthy spouses when working collaboratively with their PD partners would be useful. Ultimately, this knowledge could contribute to the formulation of training programs to instruct caregivers on how best to foster problem solving performance in their PD spouses.

Conclusion

This research represents a first step in the scientific investigation of the factors influencing whether, and how, collaboration can be a useful aid to compensating for individual problem solving deficits in a neurological population. This is a promising

avenue of investigation, and with further research we can strive to better understand and ultimately predict the circumstances facilitating optimal collaborative problem solving performance in a diverse range of subject populations.

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Table 1

Demographic Information for the Control and Experimental Groups

	<u>Control Group</u>		<u>Principal Experimental Group</u>		<u>Supplemental Experimental Group</u>	
	<u>Males</u> (N=20)	<u>Females</u> (N=20)	<u>PD Males</u> (N=17)	<u>Spouses</u> (N=17)	<u>PD Females</u> (N=3)	<u>Spouses</u> (N=3)
Age*	69.30 (7.15)	67.65 (8.36)	73.47 (4.56)	68.82 (7.17)	64.67 (5.03)	70.67 (8.02)
Educ*	15.30 (3.11)	14.45 (2.69)	12.35 (4.42)	13.29 (3.29)	13.67 (3.22)	13.00 (4.36)
MMSE*	28.55 (1.05)	28.80 (1.06)	26.82 (1.33)	28.29 (1.16)	26.67 (2.08)	27.00 (1.73)
GDS*	2.95 (2.84)	3.95 (3.28)	8.94 (5.54)	6.06 (3.47)	11.00 (1.73)	2.00 (2.00)
Marriage	42.15 (10.23)		47.24 (6.55)		26.00 (19.08)	
Satisfac	5.80 (.52)	5.80 (.52)	5.77 (.44)	5.41 (.87)	4.67 (.58)	5.67 (.58)
Eye*	4.45 (.61)	4.15 (.67)	3.76 (.66)	3.88 (.70)	2.67 (.58)	4.00 (1.00)
Hear	3.95 (.89)	4.05 (.69)	3.59 (.80)	4.12 (.78)	2.67 (1.16)	4.50 (.71)

Table 1 (Continued)

Demographic Information for the Control and Experimental Groups

Health*	4.53	4.35	3.76	4.18	3.67	4.00
	(.61)	(.75)	(.66)	(.88)	(.58)	(.00)

Note. Standard deviations are in parentheses. Educ=Education; MMSE=Mini Mental Status Examination; GDS=Geriatric Depression Scale; Marriage=Length of Marriage; Satisfac=Marital satisfaction; Eye=Self-report of eyesight compared to peers; Hear=Self-report of hearing compared to peers; Health=Self-report of overall health compared to peers.

*Differences between the control group and the principal experimental group of 17 males PD and their spouses are significant at $p < .05$.

Descriptive Information for the Parkinson Males and Females

	<u>Parkinson Group</u>	
	<u>Males</u> (N=17)	<u>Females</u> (N=3)
Age*	73.47 (4.56)	64.67 (5.03)
Educ	12.35 (4.42)	13.67 (3.22)
MMSE	26.82 (1.33)	26.67 (2.08)
GDS	8.94 (5.54)	11.00 (1.73)
Satisfaction*	5.77 (.44)	4.67 (.58)
Doctor	7.53 (5.56)	8.67 (5.51)
Length PD	7.29 (4.01)	8.00 (8.72)
Age PD*	66.24 (4.72)	57.33 (13.87)
Eye*	3.76 (.66)	2.67 (.58)
Hearing	3.59 (.80)	2.67 (1.16)
Health	3.76 (.66)	3.67 (.58)

Note. Standard deviations are in parentheses. Educ=Education; MMSE=Mini Mental Status Examination; GDS= Geriatric Depression Scale; Satisfac=Marital Satisfaction; Doctor=Number of doctor visits in last year; Length PD=Number of years since PD was diagnosed; Age PD=Age when PD was diagnosed; Eye=Self-report of eyesight compared to peers; Hear=Self-report of Hearing compared to peers; Health=Self-report of overall health compared to peers.

*Differences are significant at $p < .05$.

Characteristics of the Parkinson Males and Females

	<u>PD Males</u> (N = 17)	<u>PD Females</u> (N = 3)
<u>Drug Treatment</u>		
Receiving drug treatment	94%	100%
Drugs helping moderately/considerably	94%	100%
Experiencing unwanted side effects	29%	100%
<u>Tremor on worst days</u>		
Can hold a cup normally	76%	100%
Difficulty writing	76%	67%
Difficulty doing up buttons and zippers	65%	67%
Difficulty reaching and picking things up	29%	67%
Difficulty opening bottles	18%	67%
<u>Walking on worst days</u>		
Can only walk limited distances/slower pace	47%	33%
Require use of a wheelchair	0%	33%
Difficulty climbing stairs	41%	33%
Difficulty starting to walk	29%	67%
Difficulty negotiating doorways and confined spaces	24%	100%
Difficulty with "freezing"	29%	0%

Characteristics of the Parkinson Males and Females

	<u>PD Males</u> (N = 17)	<u>PD Females</u> (N = 3)
<u>Rigidity</u>		
Difficulty sitting down and getting up again	53%	33%
Difficulty getting in and out of bed	35%	100%
Difficulty turning over in bed	53%	67%
<u>Speech on worst days</u>		
Difficulty with speech	59%	67%
Strangers would be unable to understand them	12%	33%
Difficulty with dribbling	53%	67%
Difficulty swallowing	41%	33%
Dry mouth	53%	33%
<u>Frequent side effects of PD</u>		
Severe fatigue	53%	67%
Constipation	65%	67%

Mean Number of Words Produced on the Verbal Fluency Task^a

Condition	Participants			
	Control Males	Control Females	Exp. Males	Exp. Females
Letter Fluency				
Ind. (FAS)	43.40 (12.65)	48.40 (11.22)	32.09 (11.94)	39.74 (9.86)
Dyad (PRW)	29.70 (9.72)	33.85 (7.11)	24.35 (12.49)	26.71 (7.40)
Semantic Fluency				
Ind. (Animals)	16.55 (5.97)	17.55 (3.59)	11.97 (3.90)	15.91 (4.92)
Dyad (Foods)	13.35 (5.03)	17.10 (5.29)	10.47 (5.19)	14.59 (5.64)

Note. Standard deviations are in parentheses.

^a Scored for redundancies.

Table 5

Difference Ratios as a Function of Group and Order

	Control-Order 1		Exp-Order 1		Control-Order 2		Exp-Order 2	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
FAS total	.06	.20	.07	.22	.05	.18	.15	.22
FAS - per	-.17	.51	-.75	.42	-.12	.63	-.14	.58
FAS - int	.20	.76	-.13	.73	.10	.28	-.40	.58
PRW total	.05	.20	.06	.33	.10	.15	.11	.33
PRW - per*	.17	.64	-.30	.78	-.34	.69	.45	.57
PRW - int	.20	.80	.04	.51	-.25	.80	.12	.68
Animals total	.04	.22	.11	.17	.04	.17	.14	.21
Animals - per	-.50	1.00	-.40	.89	.27	.68	.13	.96
Animals - int	-.22	.98	1.00	.00	.00	1.10	-.04	1.01
Foods total	.13	.32	.10	.41	.11	.29	.24	.35
Foods - per	-.67	.58	-.40	.89	.17	.75	-.36	.85
Foods - int	-.06	.90	.29	.46	.04	.79	-.30	.85

Note. Per = perseverations; Int = intrusions.

* Significant results obtained at $p < .05$.

Table 6

Within-Subject Ratios as a Function of Group and Order

	Control-Order 1		Exp-Order 1		Control-Order 2		Exp-Order 2	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
FAS/PRW tot-men	1.45	.20	1.67	.73	1.68	.37	1.52	.58
FAS/PRW tot-women	1.47	.23	1.54	.12	1.51	.27	1.56	.29
An/Food tot-men	1.70	.56	2.85	4.05	1.47	.60	1.90	1.67
An/Food tot-women	1.36	.41	1.79	.79	1.24	.47	1.22	.41
FAS/PRW per-men	1.38	1.52	1.13	1.11	.98	.67	1.60	1.47
FAS/PRW per-women*	.35	.35	.25	.50	1.00	.86	1.59	1.43
FAS/PRW int-men*	.64	.99	.34	.42	.88	.58	3.42	2.34
FAS/PRW int-women	1.00	.89	.42	.49	1.20	1.04	1.69	1.84
An/Food per-men	.33	.58	1.25	1.50	.50	1.00	.25	.42
An/Food per-women	.00	--	.50	.71	.58	.50	.19	.17
An/Food int-men	1.25	1.89	.00	.00	.42	.49	.52	1.03
An/Food int-women	.25	.50	.30	.45	.11	.17	.87	1.76

Note. Tot = total; Per = perseverations; Int = intrusions; An = animals.

* Significant results obtained at $p < .05$.

Table 7

Mean Number and Proportion of Questions Produced on the 20Q Task

Condition	Control Males		Control Females		Experimental Males		Experimental Females	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Individual								
(Raw scores)								
CS questions	5.20	1.67	5.55	2.28	4.82	2.79	4.41	2.29
HT questions	2.00	1.84	2.60	3.98	4.00	4.21	4.12	7.69
PCS questions	0.80	1.64	1.10	1.55	0.88	2.23	0.47	1.07
Total questions	8.00	1.75	9.25	4.38	9.71	4.45	9.00	6.45
Dyad								
(Raw scores)								
CS questions	3.35	2.32	3.90	1.68	3.29	2.85	3.71	2.05
HT questions	1.25	2.10	0.75	1.59	1.35	2.69	0.94	1.71
PCS questions	0.35	0.99	0.80	0.95	0.29	0.59	0.88	1.58
Total questions	4.95	2.91	5.45	2.46	4.94	3.54	5.53	2.83
Individual								
(Proportions)								
CS questions	0.66	0.18	0.63	0.21	0.57	0.29	0.61	0.29
HT questions	0.25	0.20	0.25	0.24	0.35	0.27	0.34	0.31

Table 7 (Continued)

Mean Number and Proportion of Questions Produced on the 20Q Task

Condition	Control Males		Control Females		Experimental Males		Experimental Females	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
PCS questions	0.09	0.18	0.12	0.17	0.07	0.16	0.05	0.11
Dyad (Proportions)								
CS questions	0.67	0.34	0.74	0.18	0.66	0.34	0.71	0.29
HT questions	0.27	0.35	0.11	0.18	0.29	0.36	0.18	0.29
PCS questions	0.07	0.18	0.15	0.17	0.05	0.11	0.11	0.17

Note. CS = constraint seeking; HT = hypothesis testing; PCS = pseudo-constraint seeking.

Table 8

Correlations between 20 Questions Process and Performance Variables

Process Variable	No. of CS Questions				No. of HT Questions			
	CM (N=20)	CF (N=20)	EM (N=16)	EF (N=16)	CM (N=20)	CF (N=20)	EM (N=16)	EF (N=16)
PC	.40	.18	.71*	.79*	.12	-.15	-.54*	-.44
CI	.30	.10	.25	-.39	.11	-.05	-.24	.16
CLA	.16	.31	.42	.41	-.34	-.27	-.37	-.40
REQ	-.10	-.11	.60*	-.04	.53*	.01	-.22	.07
AD	.31	-.34	.27	.20	.05	-.01	-.25	-.51*
REV	.39	.31	-.09	-.02	-.07	-.17	-.19	-.04
REP	.40	.00	-.04	.06	.33	.68*	-.19	-.25
STR	-.16	-.18	.28	.69*	.81*	.75*	-.20	-.34
PR	.36	.24	.09	.18	-.09	-.14	-.11	.05
NPC	-.48*	.08	--	-.03	.18	-.11	--	.28

Note. CS = Constraint-seeking; HT = Hypothesis-testing; CM = Control Male; CF = Control Female; EM = Experimental Male; EF = Experimental Female; PC = productive commentary; CI = commentary to interviewer; CLA = clarifications; REQ = requests to interviewer; AD = admonitions to self or spouse; REV = reviews; REP = repetitions; STR = strategy statements; PR = praise; NPC = non-productive commentary.

* $p < .05$.

Table 9

Correlations Between 20 Questions Performance Variables and Other Problem Solving Tasks for Individuals

Problem Solving Measure	CS Questions				HT Questions				PCS Questions				Total Questions			
	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF
FAS	-.10	-.22	.46	.10	.27	-.28	-.18	-.24	-.24	-.23	.06	-.10	-.04	-.45*	.15	-.27
Animals	.16	.13	.62*	.07	-.15	-.15	-.47	-.16	.10	-.37	-.18	.25	.08	-.20	-.15	-.12
Correct Sorts	.11	.16	.33	.51*	.38	-.11	-.43	-.46	-.51*	.11	-.06	-.14	.02	.02	-.23	-.39
PR	-.17	-.11	-.37	-.59*	-.34	.10	.45	.51*	.50*	-.16	.13	.07	-.05	-.02	.26	.41
NPE	-.02	-.21	.08	-.43	-.40	.14	-.04	.44	.46*	-.00	-.10	.18	-.00	.01	-.03	.40
Categories	.24	.04	.29	.49*	.13	-.00	-.34	-.50*	-.36	.23	-.02	-.22	.02	.10	-.15	-.46
FMS	-.16	.18	.16	.19	.14	.35	.10	-.03	.04	.00	-.15	-.15	.03	.41	.13	.01
Trials	.01	.20	-.37	-.43	.51*	-.10	.85*	.69*	-.18	.19	.24	.53*	.38	.08	.68*	.76*

Note. CS = Constraint seeking; HT = Hypothesis testing; PCS = Pseudo-constraint seeking; CM = Control males; CF = Control females; EM = Experimental males; EF = Experimental females; PR = Perseverative responses; NPE = Non-perseverative errors; FMS = Failures to maintain set; Trials = Trials to completion of the first category.

* $p < .05$.

Table 10

Correlations Between 20 Questions Performance Variables and Other Problem Solving Tasks for Dyads

Problem Solving Measure	CS Questions		HT Questions		PCS Questions		Total Questions	
	Control	Exp	Control	Exp	Control	Exp	Control	Exp
PRW	.12	.33	-.18	-.43	-.24	-.52*	-.19	-.43
Foods	-.01	.56*	.05	-.61*	.06	-.10	.07	-.18
Correct Sorts	.08	.48	.12	.14	-.62*	-.36	-.09	.36
PR	-.08	-.26	-.18	-.24	.76*	.33	.09	-.29
NPE	-.05	-.58*	.09	-.00	.10	.35	.09	-.31
Categories	.20	.44	.17	-.16	-.60*	-.13	.05	.15
FMS	-.17	-.51*	.18	.37	.16	-.24	.12	-.20
Trials	-.25	-.33	-.00	.13	-.11	-.10	-.23	-.21

Note: CS= Constraint seeking; HT= Hypothesis testing; PCS= Pseudo-constraint seeking; PR= Perseverative responses; NPE= Non-perseverative errors; FMS= Failures to maintain set; Trials= Trials to completion of the first category.

* $p < .05$.

Table 11

Estimates of Internal Consistency (Cronbach's Alpha) for the PSI Scales

Scale	Moss (1983)* (N = 66)	Control Group (N = 40)	Experimental Males (N = 17)	Experimental Females (N = 17)
Problem -Solving Confidence (11)	.78	.85	.87	.80
Approach-Avoidance Style (16)	.90	.84	.76	.79
Personal Control (5)	.74	.80	.64	.39
Total PSI (32)	.90	.92	.89	.85

*Estimates are based on an elderly sample (M age = 70 years) (cited in Heppner, 1988).

Table 12

Correlations Between PSI Scale Scores and Individual Problem Solving Measures

Problem Solving Measure	CON				AA				PC				Total			
	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF
FAS	-.34	-.12	-.40	.18	.03	-.16	-.45	-.36	-.02	-.16	-.24	.01	-.10	-.17	-.44	-.15
Animals	-.23	.11	.09	.05	-.09	-.20	.00	-.32	.04	.23	.06	-.24	-.12	.02	.05	-.23
Correct Sorts	.17	.03	-.00	-.27	.30	-.62*	-.28	-.70*	.12	-.15	.16	-.34	.24	-.34	-.10	-.63*
PR	-.13	-.13	.02	.25	-.23	.59*	.25	.70*	-.14	.07	-.11	.39	-.20	.26	.10	.63*
NPE	-.22	.08	-.12	.31	-.38	.60*	.04	.67*	-.12	.19	-.18	.24	-.30	.38	-.07	.61*
Categories	.25	.24	.06	-.37	.30	-.46*	-.32	-.68*	.20	-.05	.11	-.38	.29	-.15	-.11	-.67*
FMS	-.30	-.46*	.16	.20	-.33	-.12	.12	.08	-.25	-.43	-.12	.47	-.34	-.38	.09	.24
Trials	-.18	-.31	-.03	.41	-.32	-.05	.08	.50*	-.26	-.20	-.14	-.11	-.29	-.21	-.00	.46
CS Questions	.37	-.35	.19	-.43	.04	-.28	.10	-.47	.05	-.43	.28	-.08	.16	-.42	.19	-.49*
HT Questions	-.05	-.18	-.08	.46	.21	-.14	-.08	.31	.05	-.02	-.27	-.02	.11	-.14	-.14	.39
PCS Questions	-.03	.08	.05	.05	-.03	-.20	-.03	.18	.05	-.11	-.17	-.38	-.02	-.10	-.04	.05

Table 12 (Continued)

Correlations Between PSI Scale Scores and Individual Problem Solving Measures

Problem Solving Measure	CON				AA				PC				Total			
	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF	CM	CF	EM	EF
Total Questions	.27	-.32	.07	.41	.23	-.35	-.03	.23	.14	-.28	-.16	-.11	.25	-.38	-.03	.29

Note. CON = Problem solving confidence; AA = Approach-avoidance; PC = Personal control; CM = Control males; CF = Control females; EM = Experimental males; EF = Experimental females; PR = Perseverative responses; NPE = Non-perseverative errors; FMS = Failures to maintain set; Trials = Trials to completion of the first category; CS Questions = Constraint seeking questions; HT Questions = Hypothesis testing questions; PCS Questions = Pseudo-constraint seeking questions.

* $p < .05$.

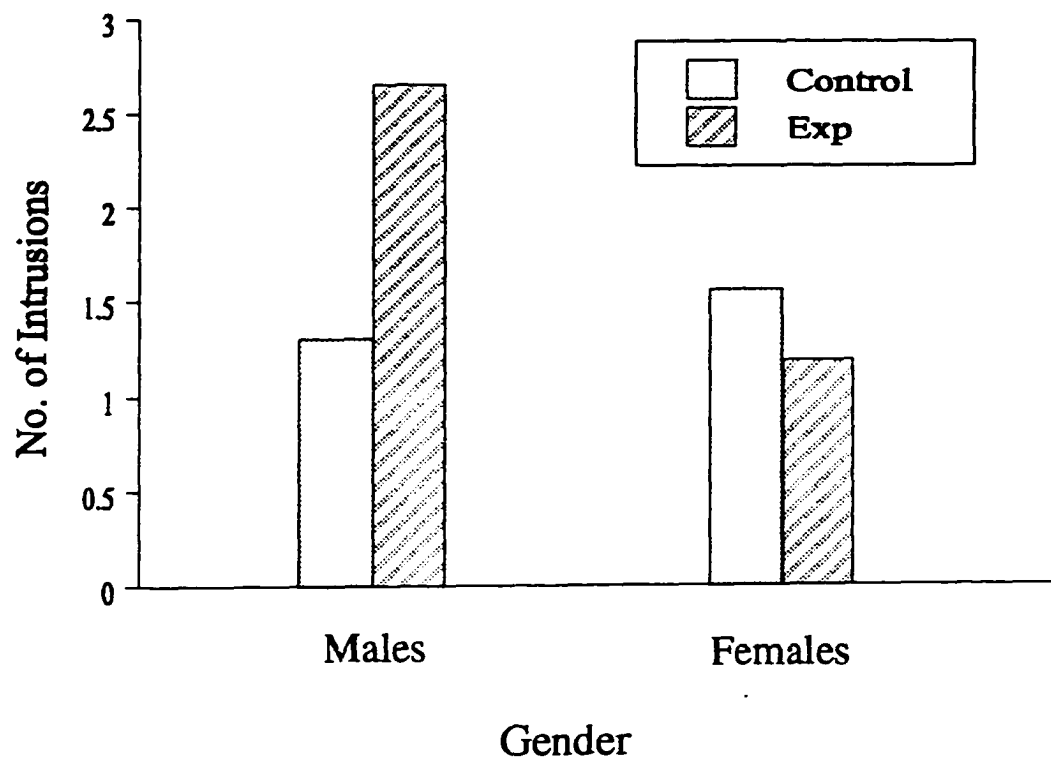


Figure 1. Group by gender interaction for FAS intrusions

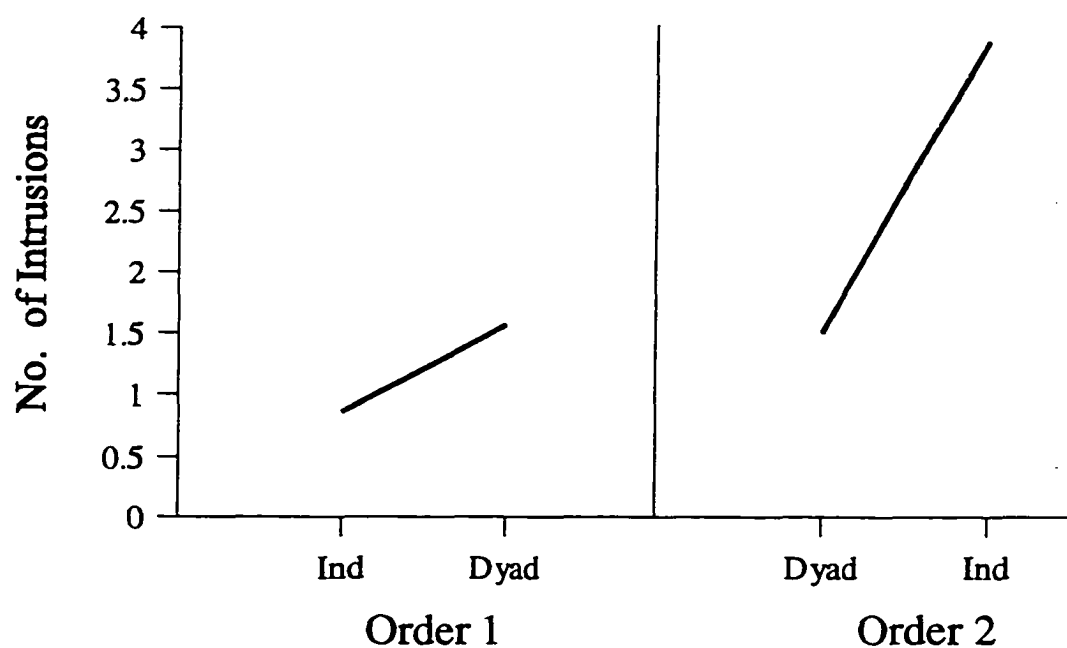


Figure 2. Group size by order interaction for experimental males in the number of intrusions produced on the letter fluency task.

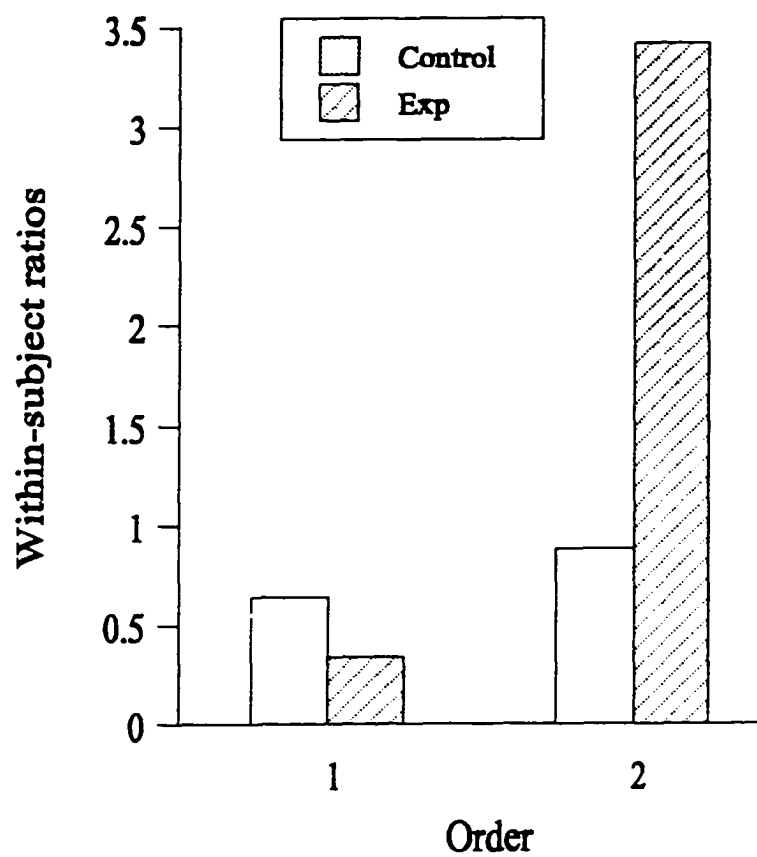


Figure 3. Group by order interaction for intrusions by men in the letter fluency task.

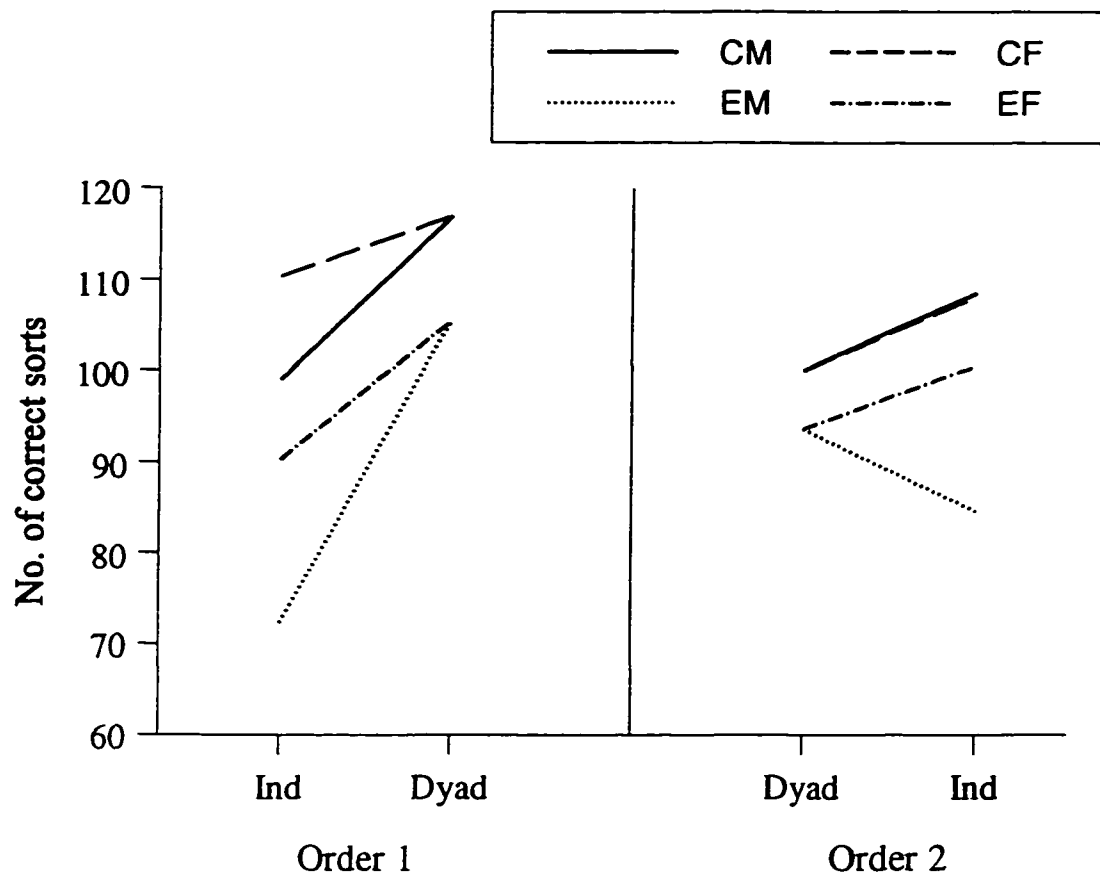


Figure 4. Group size by order interactions for correct sorts by each participant group.

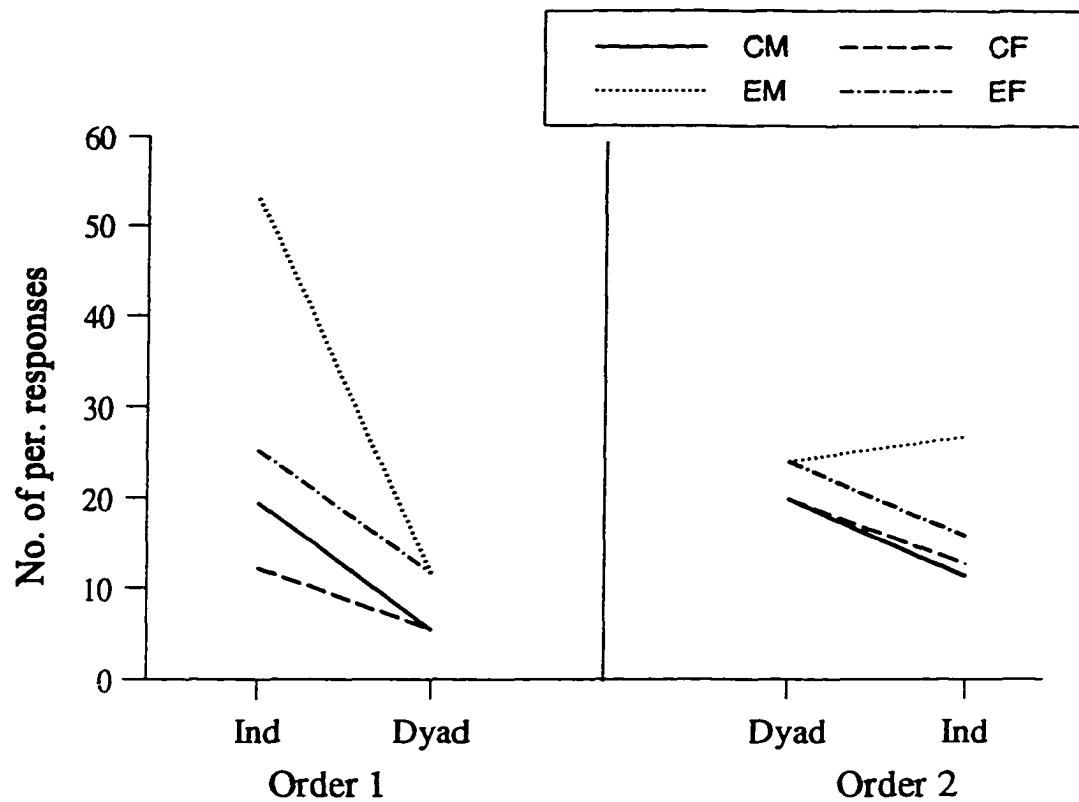


Figure 5. Group size by order interactions for perseverative responses by each participant group.

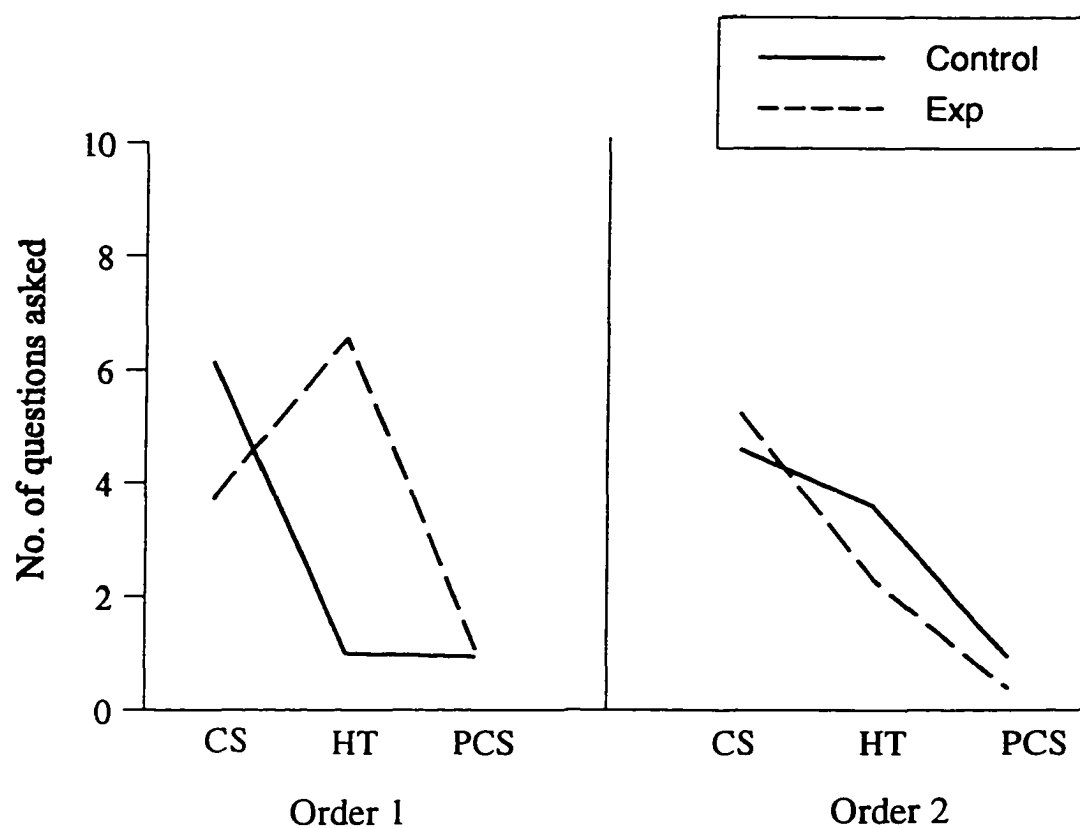


Figure 6. Group by question type by order interaction for the individual condition.

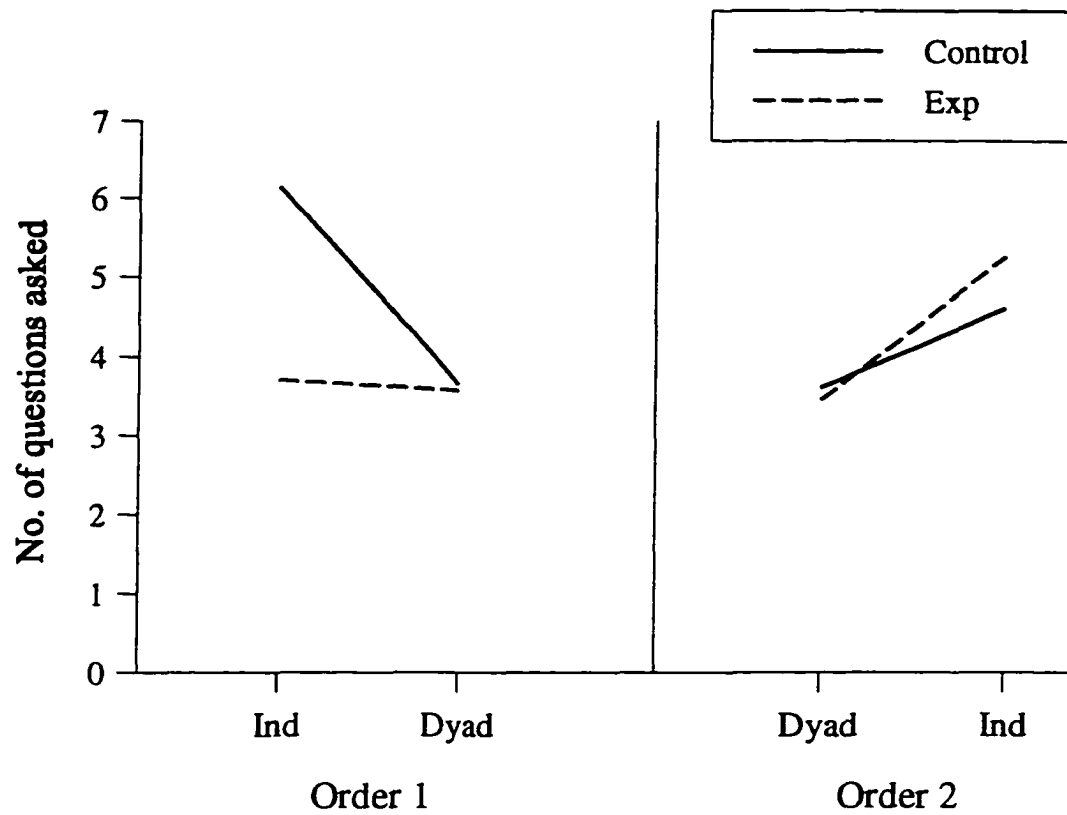


Figure 7. Group by order by group size interaction for CS questions.

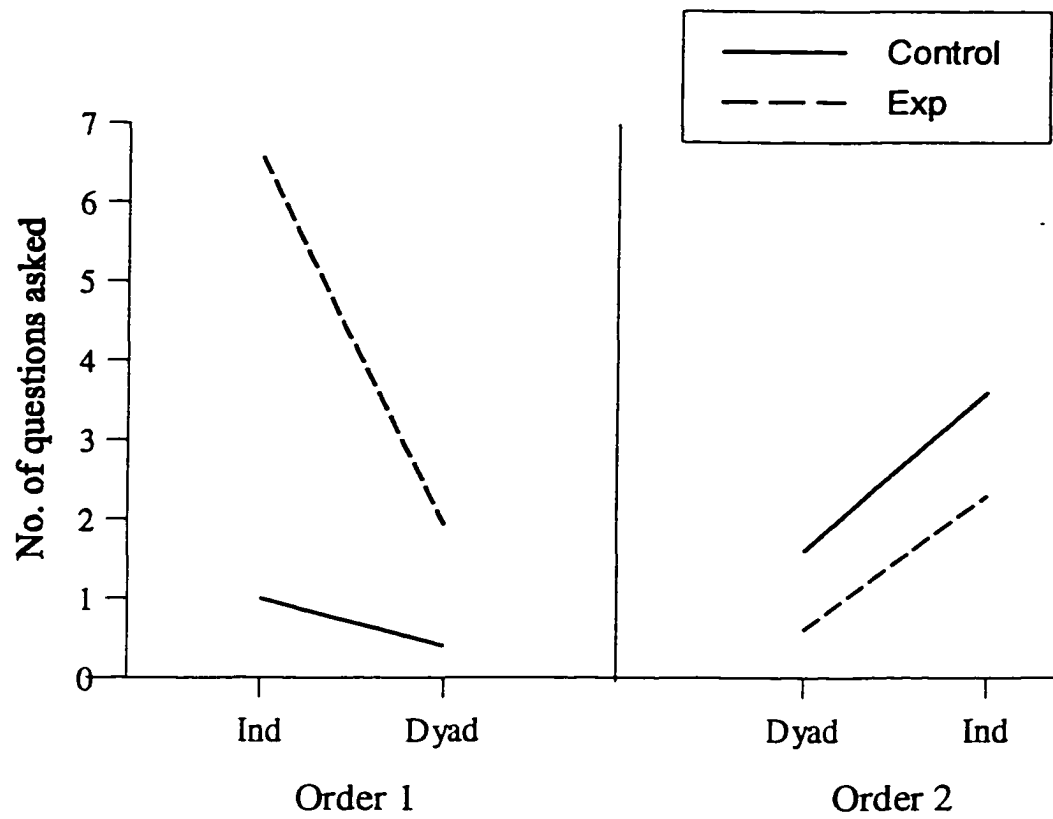


Figure 8. Group by order by group size interaction for HT questions.

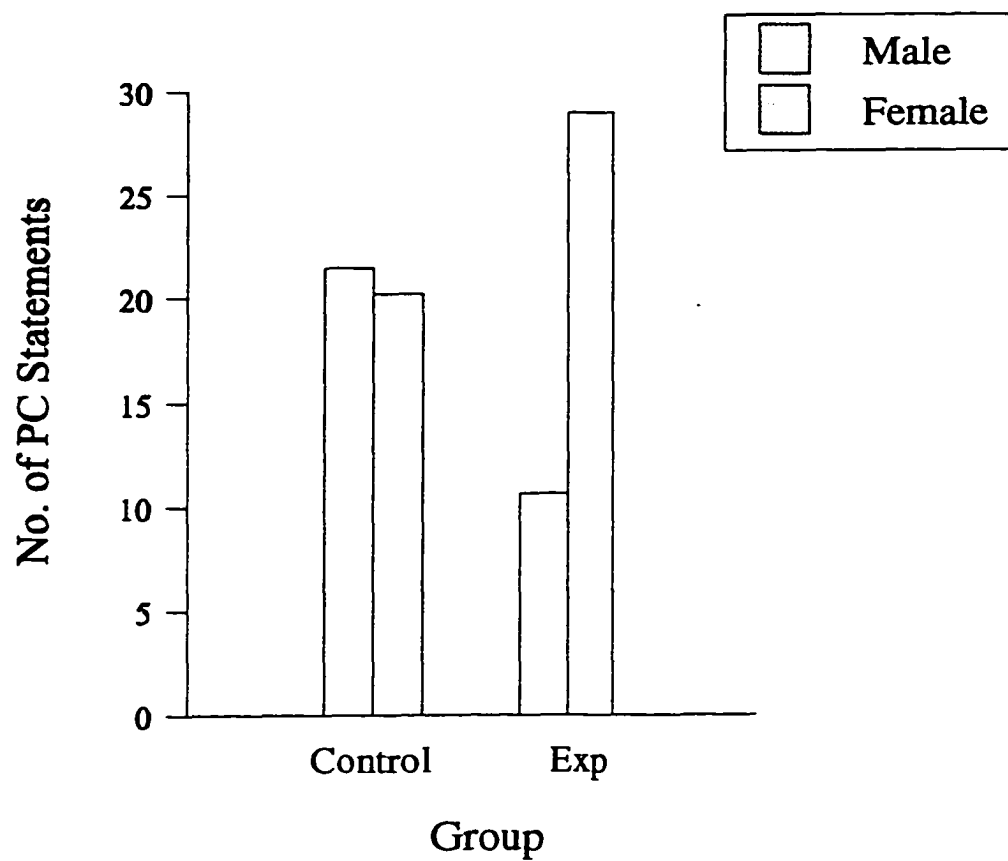


Figure 9. Group by gender interaction for on-task PC statements.

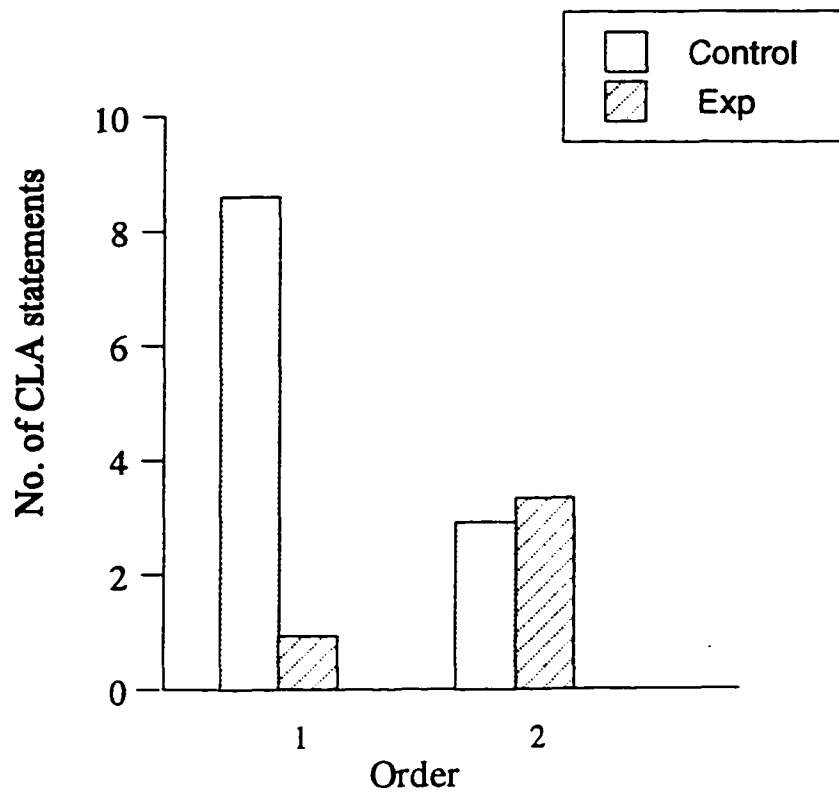


Figure 10. Group by order interaction for on-task CLA statements.

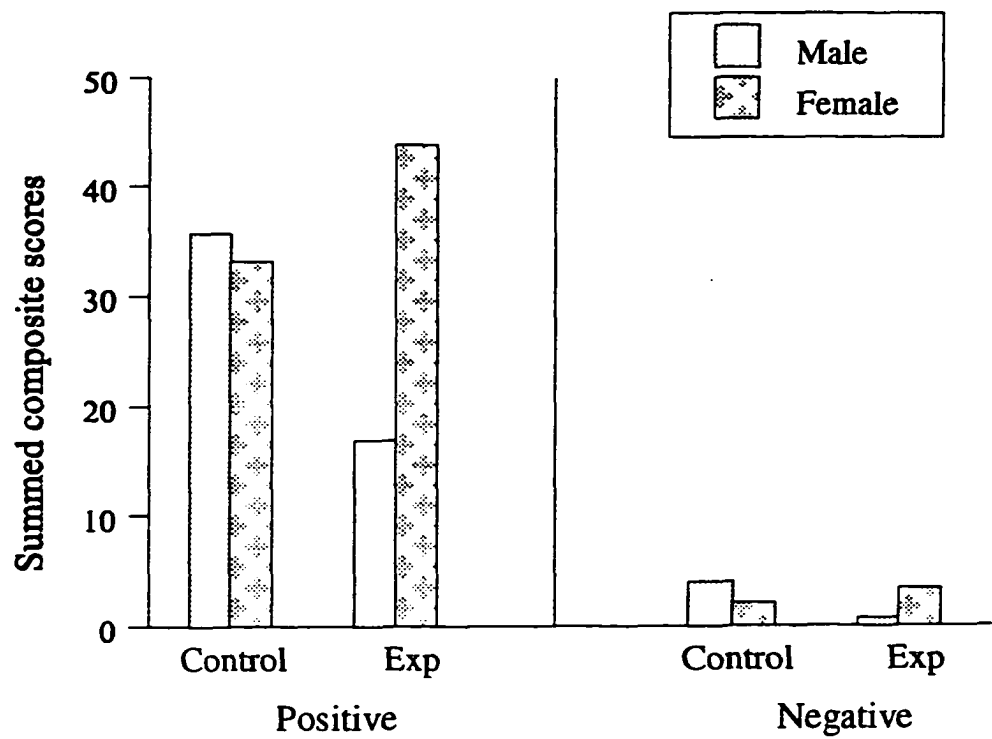


Figure 11. Group by gender by valence interaction for the composite process variable scores

APPENDIX A

Demographic Questions Specific to Parkinson's Disease

1. How old were you when you were told that you had PD?
_____ years old
2. How many years have you lived with PD since it was diagnosed?
_____ years
3. Are you receiving any drug treatment for PD at the present time?
(circle yes or no)
 - a. Yes

What are the names of the medications you are receiving?

- b. No
4. Do you feel that your present drug treatment is: (circle one)
 - a. Helping considerably?
 - b. Helping moderately?
 - c. Making no difference?
 - d. Making you worse?
 - e. Making you very much worse?
 - f. No answer
5. What side or unwanted effects do you feel you are getting from your present treatment, if any?

I would like you to think about various aspects of your health during the last six months. Think throughout these questions of how you are when you are feeling at your worst.

6. With respect to tremor:

(a) On your worst days (circle one):

- a. Can you hold a cup normally?
- b. Do you have a bit of difficulty holding a cup without spilling anything?
- c. Do you have a lot of difficulty holding a cup without spilling anything?

d. No answer

(b) Do you have difficulty with (circle all that apply):

- a. Doing up buttons and zippers
- b. Doing your hair/shaving
- c. Opening bottles, etc.
- d. Writing
- e. Reaching and picking things up
- f. Using switches and handles

7. With respect to walking:

(a) On your worst days (circle one):

- a. Can you walk normally?
- b. Can you walk normal distances but a little slowly?
- c. Can you walk only limited distances?
- d. Can you only take a few steps without help?
- e. Can you walk only with help?
- f. Are you unable to walk?
- g. No answer

(b) Do you have difficulty with (circle all that apply):

- a. Starting to walk
- b. "Freezing"
- c. Climbing stairs or steps
- d. Negotiating doorways or walking in confined spaces
- e. Answering the door

(c) Do you have difficulty with (circle all that apply):

- a. Getting to the bathroom
- b. Managing alone in the bathroom
- c. Bathing
- d. Sitting down and getting up again
- e. Getting in and out of bed
- f. Turning over in bed

8. With respect to speech:

(a) On your worst days (circle one):

- a. Do you have difficulty with your speech?
 - b. Do strangers have some difficulty in understanding you?
 - c. Are strangers unable to understand you?
 - d. No answer
- (b) Do you also have difficulty with (circle all that apply):

- a. Swallowing
- b. Dribbling
- c. Dry mouth

9. There are some other, more general problems which sometimes affect people with PD. Please indicate any which cause you difficulty (circle all that apply).

- a. Severe fatigue
- b. Poor eyesight
- c. Loss of hearing
- d. Constipation
- e. Incontinence

APPENDIX B

General Demographic Questionnaire

In order to better understand the results of our study, I'd like to ask you a few questions about yourself and your background. We will use this information for research purposes only, and it will be kept strictly confidential.

1. Gender (circle one): Male Female
2. What is your birthdate? _____
 What is your current age? _____ years
3. Which hand do you write with? (circle one) Right Left Both
4. What is the highest level of full-time education that you have completed?
 (circle one)
 (Do not include part-time or extension courses taken for interest.)

Grade School	1 2 3 4 5 6 7 8
High School	9 10 11 12 13
Technical, trade, nursing or business school	1 2 3 4 5 6 7 8
University (B.A./B.Sc.)	1 2 3 4 5 6 7 8
Graduate School (M.A./M.Sc./Ph.D.)	1 2 3 4 5 6 7 8
5. What is your first language? _____
6. Currently, are you (check all that apply):
 - (a) _____ employed? (circle one) Full-time Part-time
 - What is your occupation/present job?

 - How long have you held your present position?

(b) _____ retired?

At what age did you retire from full-time employment? _____

What was your main occupation? _____

(c) _____ a homemaker? (circle one) Full-time Part-time

(d) _____ doing volunteer work?

(e) _____ other? _____

7. How long have you been married? _____ years

8. Overall, do you feel that your marital relationship is:

- a. very satisfying?
- b. satisfying?
- c. somewhat satisfying?
- d. somewhat unsatisfying?
- e. unsatisfying?
- f. very unsatisfying?

Now I would like to ask you some questions about your health.

9. During the past four weeks did you have any sickness or health problem?

(a) Yes (b) No

If yes, did it:

- a. require you to go to the hospital?
- b. require you to see a doctor?
- c. keep you in bed most of the time for a day or more?
- d. keep you at home but in a chair most of the time?
- e. keep you at home but still able to get around?
- f. let you get out but still remained a real bother?

10. About how many times have you seen a doctor in the past year? (circle one)

- a. none
- b. once
- c. 2-6 times
- d. 7-12 times

e. over 12 times

11. Are you presently taking any drugs or medications (prescription or other)?
(circle one)

a. Yes

What are your current medications?

b. No

12. Do you now have, or have you ever had, any of the following? (check all that apply)

- ☐ hearing or visual problems
- ☐ brain tumor
- ☐ cancer
- ☐ heart disease or heart attack
- ☐ head injury
- ☐ loss of consciousness for any reason other than head injury
- ☐ stroke or transient ischemic attack
- ☐ encephalitis or meningitis
- ☐ carbon monoxide poisoning
- ☐ Alzheimer's disease or other dementia
- ☐ Huntington's disease
- ☐ Parkinson's disease
- ☐ Multiple sclerosis
- ☐ seizures or epilepsy
- ☐ treatment by a neurologist or neurosurgeon
- ☐ brain surgery
- ☐ special brain tests such as EEG, CAT, MRI
- ☐ depression
- ☐ hospitalization for any other reason
- ☐ learning disabilities in school
- ☐ unusual memory complaint

13. Compared to other people your age, how would you rate your eyesight? (circle one)

- a. very good
- b. good
- c. fair
- d. poor

e. very poor

14. Compared to other people your age, how would you rate your hearing? (circle one)

- a. very good
- b. good
- c. fair
- d. poor
- e. very poor

15. Compared to other people your age, how would you rate your overall health?
(circle one)

- a. very good
- b. good
- c. fair
- d. poor
- e. very poor

APPENDIX C**Mini Mental Status Examination****Orientation**

What is the (date) (day) (month) (year) (time)? 5 points

Where are we? (city) (province) (country) (building) (floor) 5 points

Registration

I am going to name 3 objects. Then I want you to repeat all 3 after I have said them.
(light bulb, ashtray, fork) 1 point for each correct. 3 points

Attention and Calculation

Count backwards from 100 by 7's; start with 100 and subtract 7 each time (93, 86, 79, 72, 65). 1 point for each correct. Stop at 5 answers. 5 points

OR: Spell WORLD backwards (DLROW). 1 point for each correct. 5 points

Recall

What were the three objects I asked you to name a while ago? 1 point for each correct. 3 points

Language Tests

What is this? (pencil/pen, watch) 2 points

Repeat after me: "No ifs, ands, or buts" 1 point

Follow this command: "Take the paper in your right hand, fold it in half, and put it on the table." 3 points

Read and obey what it says on this card: CLOSE YOUR EYES. 1 point

Write a short sentence that contains a subject, a verb, and that makes sense. 1 point

Copy the design that is on this card. 1 point

TOTAL 30 POINTS

APPENDIX D

Geriatric Depression Scale

1. Are you basically satisfied with your life? yes/no
2. Have you dropped many of your activities and interests? yes/no
3. Do you feel that your life is empty? yes/no
4. Do you often get bored? yes/no
5. Are you hopeful about the future? yes/no
6. Are you bothered by thoughts you can't get out of your head? yes/no
7. Are you in good spirits most of the time? yes/no
8. Are you afraid that something bad is going to happen to you? yes/no
9. Do you feel happy most of the time? yes/no
10. Do you often feel helpless? yes/no
11. Do you often get restless and fidgety? yes/no
12. Do you prefer to stay at home rather than going out and doing new
things? yes/no
13. Do you frequently worry about the future? yes/no
14. Do you feel you have more problems with memory than most? yes/no
15. Do you think it is wonderful to be alive now? yes/no
16. Do you often feel downhearted and blue? yes/no
17. Do you feel pretty worthless the way you are now? yes/no
18. Do you worry a lot about the past? yes/no
19. Do you find life very exciting? yes/no
20. Is it hard for you to get started on new projects? yes/no
21. Do you feel full of energy? yes/no
22. Do you feel that your situation is hopeless? yes/no
23. Do you think that most people are better off than you are? yes/no
24. Do you frequently get upset over little things? yes/no
25. Do you frequently feel like crying? yes/no
26. Do you have trouble concentrating? yes/no
27. Do you enjoy getting up in the morning? yes/no
28. Do you prefer to avoid social gatherings? yes/no
29. Is it easy for you to make decisions? yes/no
30. Is your mind as clear as it used to be? yes/no

APPENDIX E

The Problem Solving Inventory

Directions

People respond to personal problems in different ways. The statements on this inventory deal with how people react to personal difficulties and problems in their day-to-day life. The term "problems" refers to personal problems that everyone experiences at times, such as depression, inability to get along with friends, choosing a vocation, or deciding whether to get a divorce. Please respond to the items as honestly as possible so as to most accurately portray how YOU handle such personal problems. Your responses should reflect what you ACTUALLY do to solve problems, not how you think you SHOULD solve them. When you read an item, ask yourself: Do I ever behave this way? Please answer every item.

Read each statement and indicate the extent to which you agree or disagree with that statement, using the scale provided. Mark your responses by circling the number to the right of each statement.

1	2	3	4	5	6
Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Agree	Agree	Agree	Disagree	Disagree	Disagree

1. When a solution to a problem has failed, I do not examine why it didn't work
... 1 2 3 4 5 6
2. When I am faced with a complex problem, I don't take the time to develop a strategy for collecting information that will help define the nature of the problem.
... 1 2 3 4 5 6
3. When my first efforts to solve a problem fail, I become uneasy about my ability to handle the situation ... 1 2 3 4 5 6
4. After I solve a problem, I do not analyze what went right and what went wrong.
... 1 2 3 4 5 6
5. I am usually able to think of creative and effective alternatives to my problems.
... 1 2 3 4 5 6
6. After following a course of action to solve a problem, I compare the actual outcome with the one I had anticipated ... 1 2 3 4 5 6

7. When I have a problem, I think of as many possible ways to handle it as I can until I can't come up with any more ideas . . . 1 2 3 4 5 6
8. When confronted with a problem, I consistently examine my feelings to find out what is going on in a problem situation . . . 1 2 3 4 5 6
9. When confused about a problem, I don't clarify vague ideas or feelings by thinking of them in concrete terms . . . 1 2 3 4 5 6
10. I have the ability to solve most problems even though initially no solution is immediately apparent . . . 1 2 3 4 5 6
11. Many of the problems I face are too complex for me to solve . . . 1 2 3 4 5 6
12. When solving a problem, I make decisions that I am happy with later . . . 1 2 3 4 5 6
13. When confronted with a problem, I tend to do the first thing that I can think of to solve it . . . 1 2 3 4 5 6
14. Sometimes I do not stop and take time to deal with my problems, but just kind of muddle ahead . . . 1 2 3 4 5 6
15. When considering solutions to a problem, I do not take the time to assess the potential success of each alternative . . . 1 2 3 4 5 6
16. When confronted with a problem, I stop and think about it before deciding on a next step . . . 1 2 3 4 5 6
17. I generally act on the first idea that comes to mind in solving a problem . . . 1 2 3 4 5 6
18. When making a decision, I compare alternatives and weigh the consequences of one against the other . . . 1 2 3 4 5 6
19. When I make plans to solve a problem, I am almost certain that I can make them work . . . 1 2 3 4 5 6
20. I try to predict the result of a particular course of action . . . 1 2 3 4 5 6
21. When I try to think of possible solutions to a problem, I do not come up with very many alternatives . . . 1 2 3 4 5 6

22. When trying to solve a problem, one strategy I often use is to think of past problems that have been similar . . . 1 2 3 4 5 6
23. Given enough time and effort, I believe I can solve most problems that confront me . . . 1 2 3 4 5 6
24. When faced with a novel situation, I have confidence that I can handle problems that may arise . . . 1 2 3 4 5 6
25. Even though I work on a problem, sometimes I feel like I'm groping or wandering and not getting down to the real issue . . . 1 2 3 4 5 6
26. I make snap judgments and later regret them . . . 1 2 3 4 5 6
27. I trust my ability to solve new and difficult problems . . . 1 2 3 4 5 6
28. I use a systematic method to compare alternatives and make decisions . . . 1 2 3 4 5 6
29. When thinking of ways to handle a problem, I seldom combine ideas from various alternatives to arrive at a workable solution . . . 1 2 3 4 5 6
30. When faced with a problem, I seldom assess the external forces that may be contributing to the problem . . . 1 2 3 4 5 6
31. When confronted with a problem, I usually first survey the situation to determine the relevant information . . . 1 2 3 4 5 6
32. There are times when I become so emotionally charged that I can no longer see the alternatives for solving a particular problem . . . 1 2 3 4 5 6
33. After making a decision, the actual outcome is usually similar to what I had anticipated . . . 1 2 3 4 5 6
34. When confronted with a problem, I am unsure of whether I can handle the situation . . . 1 2 3 4 5 6
35. When I become aware of a problem, one of the first things I do is try to find out exactly what the problem is . . . 1 2 3 4 5 6

APPENDIX F

Word Fluency

[illegible]

APPENDIX H

20 Questions Answer Sheet

Check trial:

Individual: saw _____

Dyad: clock _____

	<u>Question asked</u>	<u>No. turned over</u> <u>(1 or >1)</u>	<u>Response of tester</u> <u>(Y or N)</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____
13.	_____	_____	_____
14.	_____	_____	_____
15.	_____	_____	_____
16.	_____	_____	_____
17.	_____	_____	_____

<u>Question asked</u>	<u>No. turned over</u> <u>(1 or >1)</u>	<u>Response of tester</u> <u>(Y or N)</u>
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____

APPENDIX I

Order of Task Administration

I. Individually, all subjects completed:

1. Informed Consent Form
2. Demographic Questionnaire
3. Mini Mental Status Exam
4. Geriatric Depression Scale
5. Problem Solving Inventory

II. Order 1: 1/2 the Ss:i. Individually:

6. Fluency (FAS, Animals)
7. WCST
8. 20 Questions Task

ii. In Dyads:

9. Fluency (PRW, Foods)
10. WCST
11. 20 Questions Task

Order 2: 1/2 the Ss:i. In Dyads:

6. Fluency (PRW, Foods)
7. WCST
8. 20 Questions Task

ii. Individually:

9. Fluency (FAS, Animals)
10. WCST
11. 20 Questions Task

APPENDIX J

Practice Talk Aloud Problem-Dyad Condition

To give you practice in working through a problem and talking out loud while you do that, we would like you to work together to count how many windows there are where you live. As you are counting out loud, talk about what you are thinking and how you are doing the counting. For example, [if I think about how many windows are in my house, when I walk in the front door and turn to the right, there are 2 windows in the living room . . .]. Any questions? Again, you should work together to count out loud the number of windows there are where you live.