

Dementia occurs as a primary component of Senile Dementia of the Alzheimer's type (SDAT) and as a secondary component of Parkinson's Disease (PD) in a subset of PD patients. We compared caregiver distress subsequent to the unique features of these dementing illnesses. Self- and other-rated depression was compared in spousal caregivers for 23 SDAT patients, 23 PD with dementia patients, and 23 control subjects. The two caregiving groups were similar in the length of time they had been providing assistance and in caregiver distress, and both caregiver groups were more depressed than comparison subjects.
Key Words: Spousal caregivers, Caregiver distress, Depression

Spousal Caregivers of Persons With Alzheimer's and Parkinson's Disease Dementia: A Preliminary Comparison¹

Jason R. Dura, PhD,² Elizabeth Haywood-Niler, MA,³
and Janice K. Kiecolt-Glaser, PhD²

The prevalence of progressive dementia varies by type and age. The most common form of progressive dementia is Senile Dementia of the Alzheimer's type (SDAT) that occurs in 5–20% of people aged 65 and over (Council on Scientific Affairs, 1986; Mortimer, Schuman, & French, 1981). Much less common is the dementia that is found in a subgroup of persons with Parkinson's Disease (PD; Marttila, 1987). In contrast to SDAT caregiving, PD dementia caregiving has not been studied. This may simply reflect the greater accessibility of SDAT caregivers. Current prevalence estimates, however, suggest there are 360,000 cases of PD in the U.S. (Marttila, 1987), and estimates of dementia in PD range from 10% (Rajput et al., 1984) to 35–40% (Lieberman et al., 1979; Mayeux et al., 1981). As such, caregiving for PD patients with dementia merits empirical investigation. Furthermore, research comparing dementing conditions may offer insight into critical events in the caregiving process.

In addition to differences in prevalence, SDAT and PD dementia victims vary in the progression of cognitive, personality, and motoric changes, as well as in etiology and symptom features. Motoric symptoms appear first in PD patients, whereas memory loss and personality changes appear first in SDAT patients. The appearance of cognitive and personality changes most often occurs in PD long after a definitive diagnosis has been made.

Consultation is frequently sought as a direct result of the easily observable physical symptoms in PD. In contrast, SDAT has an insidious onset, with subtle personality and cognitive changes appearing months or years before evaluation. Prior to a thorough diagnostic evaluation, the frequent assumption is that the SDAT victim's behavior is voluntary or malicious (Mace & Rabins, 1981). The subsequent conflict often experienced between caregiver and SDAT victim may permanently damage their relationship (Robinson & Thurnher, 1979). These differences in clinical features at the dementia's onset may have important differential consequences for SDAT and PD caregivers.

The present study was designed to compare caregivers for SDAT or PD family members with each other and also with a sociodemographically matched control group without similar responsibilities. PD with dementia caregivers were hypothesized to have sought evaluation earlier than SDAT caregivers, even though overall length of caregiving and current patient impairment were expected to be comparable. Because SDAT caregivers appear to experience a more insidious, conflict-laden onset, we hypothesized that SDAT caregivers would have greater distress related to caregiving than PD caregivers, and that both groups of caregivers would be more distressed than peers without similar responsibilities.

Method

Subjects

Subjects were 23 caregivers for a spouse with SDAT, 23 caregivers for a spouse with PD with dementia, and 23 married control subjects matched for sex, age, and education. All subjects were white. Given the smaller prevalence of PD than SDAT as well as the infrequency of dementia occurring among PD

¹This research was supported by grant #MH42096 from the National Institute of Mental Health to the third author, and by funds from the Office of Geriatrics and Gerontology, The Ohio State University College of Medicine. We thank Betty Lindstrom, Executive Director of the Central Ohio Chapter of the Parkinson's Disease Society. Please address correspondence to: Jason R. Dura, Department of Psychology, Bowling Green State University, Bowling Green, OH 43403-0228.

²Department of Psychiatry, Ohio State University College of Medicine.

³Department of Psychology, Ohio State University.

victims, the limited availability of PD with dementia spousal caregiver and patient dyads determined sample size. All caregivers were providing assistance to their spouse in their home. Caregivers were assessed at the university when possible and at home when caregiving demands prevented travel.

All subjects were recruited from the Columbus, Ohio metropolitan area as part of a larger study on stress, immunity, and health in caregivers. Caregivers were recruited from multiple sources, including neurologists' referrals, hospital dementia evaluation units, dementia caregiver support groups, respite care programs, and governmental caregiver support programs. Control subjects were recruited through advertisements in local newspapers, area newsletters, churches, posters in community centers, referrals from other control subjects and caregivers, and university alumni publications. All participants were self-referred in response to announcements and were paid \$30 for participation. Potential participants were screened for serious health problems, including recent surgery (within 18 months) and immunosuppressive medication.

Caregiver Assessment

The Hamilton Depression Rating Scale (HDRS; Guy, 1976) was used to assess current depressive symptomatology. The scale includes 24 items that are rated by the interviewer based on observation and the subject's response to probes. A postdoctoral fellow in clinical psychology and two advanced clinical psychology graduate students served as primary raters. A third clinical psychology graduate student established reliability through blindly rating randomly chosen audiotapes; interrater reliability, assessed for 15% of tapes, was $r = .85$.

The short form of the Beck Depression Inventory (BDI; Beck & Beck, 1972) provided data on self-reported depressive symptomatology. In using this form, the subject chooses the sentence for each of 13 items that best describes his or her feelings during the past week. Scores range from 0 to 39, with higher scores reflecting greater depression. This short form has been used with older populations because it has fewer somatic items than other depression scales (Hammen, 1980).

The Brief Symptom Inventory (BSI; Derogatis & Spencer, 1982) measures psychological distress during the past week. This 53-item self-report scale provides data on nine dimensions of psychopathology. The depression subscale functioned as a dependent measure in the present study.

Dementia Evaluations

Family members' ratings provide one source of reliable data on dementia patients' functioning (Reifler, Cox, & Hanley, 1981). For example, in a sample of 82 elderly patients, the majority of whom were demented, a high degree of concordance occurred between family and staff members ratings among 10 areas of patient functioning (Reifler, Cox, & Hanley, 1981). In the present study, caregiving

spouses were interviewed regarding the neurological examination of their demented spouse with detailed questioning regarding the diagnostic procedures used and current caregiving circumstances. Time spent caregiving included time directly providing personal care combined with time spent supervising activities. Average hours spent caregiving per day were determined by multiplying the average weekday caregiving hours times five combined with the weekend day caregiving hours multiplied times two; the total was then divided by seven for an average per-day figure.

The date of the first neurological evaluation served as the end point of the time before evaluation (many patients had received multiple evaluations). Prodromal physical and emotional changes were traced backwards from the date of the neurological evaluation to the nearest month to determine time to evaluation. Caregivers were required to provide examples of specific deficits (e.g., memory loss, motor tremors) for prodromal changes to be scored as present. Length of caregiving was determined by summing the total number of months between the first month of assistance to the date of study participation. For many of the PD with dementia caregivers, caregiving did not begin until long after the diagnosis of PD had been made.

Patient diagnosis was based on spouses' reports of patients' diagnosis, as well as the site, nature, and extent of neurological evaluation. In the case of SDAT patients, all had received neurological evaluations that satisfied the National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association work-group standards for diagnosis of probable SDAT (McKhann et al., 1984). PD patients were diagnosed by a neurologist following procedures outlined by Koller (1987), in which a diagnosis of probable PD is made following the exclusion of alternative diagnoses, combined with a diagnosis of Presenile or Senile Dementia Not Otherwise Specified (American Psychiatric Association, 1987).

The Blessed Dementia Scale (BDS; Blessed, Tomlinson, & Roth, 1968) measures negative changes in a demented person's abilities in daily living, self-care, and personality domains. Higher scores on this 22-item scale denote greater decrements in ability, with a potential range of 0–28. Items are read to the caregiver, who then chooses the best response to characterize their demented spouse's current functioning and degree of negative change. BDS scores correlate with senile plaque count during postmortem histological examination (Blessed, Tomlinson, & Roth, 1968; Erkinjuntti et al., 1988). In addition, the BDS correlates with neuropsychological testing and can be used to differentiate degree of dementia (Erkinjuntti et al., 1988).

The Memory and Behavior Problem Checklist (MBPC; Zarit, Reever, & Bach-Peterson, 1980) measures behavioral excesses and deficits in dementia patients, and the caregiver's reaction to those problems. The 29 items include some of the problems most distressing to caregivers (e.g., the patient's

inability to dress and feed him- or herself, incontinence, inability to communicate, hiding things, and inability to recognize familiar people). The scale provides three scores: a measure of the frequency of problem behaviors, a measure of associated caregiver distress, and a third score that combines frequency and reaction to produce a summary measure. The MBPC frequency score was used in the present study to measure the extent of current behavioral manifestations of dementia.

The Global Deterioration Scale (GDS; Reisberg et al., 1982) provides a rating of dementia stage in patients who have been previously diagnosed with dementia. The scale has seven well-described anchor points, from 1 (no cognitive decline) to 7 (very severe cognitive decline). Ratings were based on caregivers' reports of the affected family members' history and current functioning. Interrater reliability using the GDS was assessed by comparing the ratings made by the first author (JD), a clinical psychologist with geriatric assessment experience, with those of senior graduate students who had done the interview. The first author, blind to the prior rating, based his ratings on information from the caregivers' ratings of their spouse on the BDS and MBPC. Reliability was computed for 18 randomly chosen cases (35%); the Pearson product-moment correlation between the original and comparison GDS scores was excellent, $r = .92$.

Results

Means for the demographic variables are shown in Table 1. Each group had 16 women and 7 men. Multivariate analysis of variance (MANOVA) showed no significant differences between groups on education and income, $F < 1$. Analysis of variance (ANOVA) showed no significant differences between groups on age, $F < 1$. At the time of evaluation, all caregivers cared for their demented spouse in their home. ANOVA was chosen as the preferred statistical procedure throughout due to its robust nature in the presence of variations from the underlying assumptions (Keppel, 1982). This robustness was important due to the limits in sampling imposed by availability of subjects caring for spouses with PD and dementia at home. (Full ANOVA tables are available upon request from the first author.)

Comparisons of the time between the disease's onset and the formal diagnosis for the two caregiver groups showed a mean difference of well over one year; PD with dementia caregivers reported significantly less elapsed time prior to diagnosis, $F(1,44) = 4.43, p < .04$. Total number of months providing assistance demonstrated no significant group difference, $F(1,44) = 1.31, p < .26$. To determine if daily caregiving responsibilities were different for the PD and SDAT groups, we compared number of hours per day spent caregiving. SDAT caregivers were caregiving over five more hours per day and the difference was significant, $F(1,44) = 10.35, p < .002$. Means on patient impairment and caregiving variables are presented in Table 2.

Table 1. Demographic data by group and sex for caregivers of SDAT and PD with dementia patients

Characteristic	AD		PD		Controls
	caregivers ^a		caregivers ^a		
Age (<i>M, SD</i>)	68.83	(5.82)	68.17	(6.89)	66.91 (4.81)
Education (<i>n, %</i>)					
Graduate or					
professional	5	(21.74)	3	(13.04)	5 (21.74)
College degree	2	(8.70)	4	(17.39)	7 (30.43)
Partial college	9	(39.13)	7	(30.43)	4 (17.39)
High school	6	(26.09)	8	(34.78)	4 (17.39)
Partial H.S.	1	(4.35)	1	(4.35)	3 (13.04)
Yearly Income (<i>n, %</i>)					
\$40,000 or more	4	(17.39)	3	(13.04)	9 (39.13)
\$30,000–39,999	1	(4.35)	1	(4.35)	2 (8.70)
\$20,000–29,999	8	(34.78)	9	(39.13)	5 (21.74)
\$10,000–19,999	8	(34.78)	10	(43.48)	6 (26.09)
\$9,999 or under	2	(8.70)	0		1 (4.35)

^aAD = Alzheimer's disease; PD = Parkinson's disease.

Table 2. Mean and Standard Deviations for Patient Impairment and Caregiving Variables

Variable ^a	AD caregiver ^b		PD caregiver ^b	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
MBPC frequency**	58.13 ± 8.84	(19.82)	39.04 ± 8.84	(20.48)
BDS total**	16.61 ± 2.17	(4.91)	12.30 ± 1.93	(4.44)
GDS***	5.96 ± .41	(0.98)	4.00 ± .75	(1.71)
Hours/day spent caregiving**	13.01 ± 2.71	(6.29)	7.65 ± 2.13	(4.93)
Months prior to diagnosis*	36.35 ± 13.00	(30.14)	20.57 ± 8.47	(19.62)
Months spent caregiving	47.04 ± 14.59	(33.82)	65.61 ± 30.20	(69.97)

^aMBPC = Memory and Behavior Problem Checklist (Zarit, Reever, & Bach-Peterson, 1980); BDS = Blessed Dementia Scale (Blessed, Tomlinson, & Roth, 1968), and GDS = Global Deterioration Scale (Reisberg et al., 1982).

^bAD = Alzheimer's disease; PD = Parkinson's disease; ± indicates confidence interval for mean with 22 *df* and alpha = .05.

* $p < .04$; ** $p < .003$; *** $p < .0001$.

A MANOVA comparing the two caregiving groups on patient impairment measures (the GDS, the MBPC frequency score, and the BDS total score) was significant, $F(3,42) = 7.31, p < .0005$. Subsequent ANOVAs showed significantly less impairment in PD patients on the GDS, $F(1,44) = 22.80, p < .0001$, the MBPC frequency measure, $F(1,44) = 10.32, p < .003$, and BDS total score, $F(1,44) = 9.51, p < .004$.

Relationships among average daily caregiving hours, BDS total score, MBPC frequency score, and GDS were explored by calculating Pearson product-moment correlations. These results are presented in Table 3. All variables were significantly correlated, $p < .01$.

A group by sex MANOVA compared the three groups on depression, using the HRDS and the Depression Subscale of the BSI; sex was included because of the well-documented gender differences in depression (Beck, Steer, & Garbin, 1988). This MANOVA demonstrated a significant main effect for

group (Wilkes Criterion $F(4,22) = 4.43, p < .002$), and for sex, $F(2,61) = 3.30, p < .04$, but not for the interaction, $F(4,122) = 1.43, p < .23$. The main effect for sex on distress measures was explored with ANOVA on the HDRS and BSI Depression Scale. Women demonstrated significantly greater depression on the HDRS, $F(1,67) = 5.01, p < .03$, but not on the BSI Depression Subscale ($F < 1$). As regards the group effect, subsequent ANOVAs found significant group differences on the HDRS, $F(2,66) = 5.35, p < .007$, but not on the BSI Depression Subscale, $F(2,65) = 1.07, p < .35$. Post hoc pair-wise comparisons using Tukey's test showed that PD with dementia and SDAT caregivers scored significantly higher on the HDRS than comparison subjects, $p < .05$, but did not differ from each other. It is possible that the HDRS is a clinically more sensitive measure, especially because its length and breadth contrasts with the brevity of the BSI Depression Subscale. Means for depression measures are presented by group in Table 4.

To determine if SDAT caregivers differed from PD with dementia caregivers on distress measures when the level of patient impairment was controlled, a MANCOVA was computed with the PD with dementia and SDAT groups by using the GDS, MBPC frequency scores, and BDS total scores as covariates. A significant group effect was demonstrated, $F(2,38) = 3.39, p < .04$. Subsequent analysis of covariance (ANCOVA) found no group difference on the HDRS ($F < 1$) or the BSI Depression subscale, $F(4,39) = 2.49, p < .06$.

Table 3. Pearson Product-Moment Correlations Among Patient Impairment Variables and Average Daily Caregiving Hours

Measure ^a	MBPC frequency	GDS	Caregiving hours
BDS total score	.64***	.67***	.42*
MBPC frequency		.72***	.57***
GDS			.50**

^aBDS = Blessed Dementia Scale (Blessed, Tomlinson, & Roth, 1968); MBPC = Memory and Behavior Problem Checklist (Zarit, Reever, & Bach-Peterson, 1980), and GDS = Global Deterioration Scale (Reisberg et al., 1982). $n = 46$.

* $p < .004$; ** $p < .0005$; *** $p < .0001$.

Discussion

As predicted, PD with dementia caregiver dyads sought evaluation earlier than SDAT caregiver dyads. Additionally, although the chronicity of caregiving was comparable between caregiver groups, SDAT caregivers were providing more hours of care per day and were caring for more dependent, less able spouses. A strong association between the level of spouse impairment and daily caregiving hours was found. Given the comparable length of caregiving, it appears that SDAT caregivers were coping with a more precipitous decline in their spouses' abilities, in addition to a more insidious onset.

In contrast to predictions, SDAT and PD with dementia caregivers did not differ on distress measures, but both caregiver groups showed greater distress than the control group. It could be argued that a substantially larger sample size might show statistically significant differences between SDAT and PD caregivers' mean depression scores. Although this is potentially true, the differences appear clinically irrelevant and sequelae appear comparable: both caregiver groups appeared mildly depressed.

Because the onset of SDAT is thought to be more insidious, we had hypothesized that differences in caregiver distress would appear secondary to the more ambiguous onset of SDAT. Mean time between appearance of symptoms and formal diagnosis was used as an analogue measure of process differences between the two disorders. It was thought that earlier evaluation, through offering an organic reason for negative changes in the patient, might reduce the likelihood of assumed malice on the part of the dementia victim. This in turn could spare families the relationship damage associated with the insidious onset of SDAT (Robinson & Thurnher, 1979), and would make a strong case for greater screening and earlier diagnosis of at-risk individuals.

The differences in time to evaluation did not correspond to late process differences in distress. Our sample, however, included SDAT and PD with dementia caregivers who were late in their caregiving process. It is possible that initial differences had decreased as caregiving extended past the early years. Although no SDAT versus PD differences in

Table 4. Means and Standard Deviations on Distress Measures by Group

Measure	AD caregiver		PD caregiver		Comparison subjects	
	Male	Female	Male	Female	Male	Female
HDRS^a						
Mean	4.86	9.06	5.29	7.88	.43	3.81
Confidence interval	± 5.34	± 4.15	± 3.41	± 3.15	± 1.05	± 1.85
SD	5.76	7.79	3.68	5.91	1.13	3.49
BSI depression						
Mean	47.14	55.44	58.43	54.80	52.71	51.88
Confidence interval	± 5.10	± 5.28	± 8.55	± 5.95	± 7.74	± 4.92
SD	5.49	9.92	9.24	9.43	8.36	9.25

Note. Confidence intervals for means are calculated at alpha = .05 with 15 *df* for males and 6 *df* for females. HDRS = Hamilton Depression Rating Scale (Guy, 1976); BSI = Brief Symptom Inventory (Derogatis & Spencer, 1982).

^aAD (Alzheimer's disease) and PD (Parkinson's disease) caregivers significantly different from comparison subjects but not each other at $p < .05$.

sequelae were found, the difference between groups in time to evaluation merits further exploration, especially as it may relate to differences in early onset process changes within a family.

Level of spouses' impairment and extent of problem behaviors had negligible effects on caregiver distress, even though PD with dementia victims likely had much more limited mobility. This finding is consistent with prior research showing that caregiver characteristics rather than patient characteristics are the best predictors of caregiver distress (Haley et al., 1987; Quayhagen & Quayhagen, 1988). The similarity in distress between caregiver groups regardless of the patient's diagnosis and level of impairment argues that the findings regarding SDAT caregivers may generalize to caregivers of PD with dementia patients in middle- to late-stage dementia.

In summary, the results indicate that both SDAT and PD with dementia caregivers caring for middle-stage demented spouses are significantly distressed and comparably so. It appears that caring for a family member with middle-stage progressive dementia, regardless of specific subtype of dementia and associated onset characteristics, is associated with dysphoria that sometimes falls within a clinically significant range. Further research aimed at establishing the significant events within caregiving, regardless of progressive dementia subtype, is needed. The present results suggest further investigation of early caregiving differences relative to time to evaluation could be instructive. Though the present results provided only weak support for differences, the potential benefit to families when the cause of negative changes are known argues for additional study.

References

- American Psychiatric Association (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., Revised). Washington, DC: Author.
- Beck, A. T., & Beck, R. W. (1972). Screening depressed patients in family practice: A rapid technique. *Postgraduate Medicine*, *52*, 81-85.
- Beck, A. T., Steer, R. A., & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review*, *8*, 77-100.
- Blessed, B. E., Tomlinson, B. E., & Roth, M. (1968). The association between

- quantitative measures of dementia and of senile change in cerebral grey matter of elderly subjects. *British Journal of Psychiatry*, *114*, 797-811.
- Council on Scientific Affairs (1986). Dementia. *Journal of the American Medical Association*, *256*, 2234-2238.
- Derogatis, L. R., & Spencer, P. M. (1982). *The Brief Symptom Inventory (BSI). Administration, scoring and procedures, manual I*. Baltimore: Clinical Psychometrics Research.
- Erkinjuntti, T., Hokkanen, L., Sulkava, R., & Palos, J. (1988). The Blessed Dementia Scale as a screening test for dementia. *International Journal of Geriatric Psychiatry*, *3*, 267-273.
- Guy, W. (1976). *ECDEU assessment manual for psychopharmacology*. Washington, DC: U.S. Department of Health, Education, and Welfare.
- Haley, W. E., Levine, E. G., Brown, S. L., & Bartolucci, A. A. (1987). Stress, appraisal, coping and social support as predictors of adaptational outcome among dementia caregivers. *Psychology and Aging*, *2*, 323-330.
- Hammen, C. L. (1980). Depression in college students: Beyond the Beck Depression Inventory. *Journal of Consulting and Clinical Psychology*, *48*, 126-128.
- Keppel, G. (1982). *Design and analysis: A researcher's handbook* (2nd ed.) (pp. 85-87). Englewood Cliffs, NJ: Prentice-Hall.
- Koller, W. C. (1987). Classification of Parkinsonism. In W. Koller (Ed.), *Handbook of Parkinson's disease*. New York: Marcel Dekker.
- Lieberman, A., Dziatolowski, M., Kupersmith, M., Cerb, M., Goodgold, A., Lorein, J., & Goldstein, M. (1979). Dementia in Parkinson's disease. *Annals of Neurology*, *6*, 355-359.
- Mace, N., & Rabins, P. (1981). *The 36-hour day: A family guide to caring for persons with Alzheimer's disease, related dementing illnesses, and memory loss in later life*. Baltimore: Johns Hopkins University Press.
- Marttila, R. J. (1987). Epidemiology. In W. Koller (Ed.), *Handbook of Parkinson's disease*. New York: Marcel Dekker.
- Mayeux, R., Stern, Y., Rosen, J., & Leventhal, J. (1981). Depression, intellectual impairment, and Parkinson's disease. *Neurology*, *31*, 645-650.
- McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. (1984). Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology*, *34*, 939-944.
- Mortimer, J. A., Schuman, L. M., & French, L. R. (1981). Epidemiology of dementing illness. In J. A. Mortimer & L. M. Schuman (Eds.), *The epidemiology of dementia* (pp. 3-23). New York: Oxford University Press.
- Quayhagen, M. P., & Quayhagen, M. (1988). Alzheimer's stress: Coping with the caregiving role. *The Gerontologist*, *28*, 391-396.
- Rajput, A. H., Offord, K., Beard, C. M., & Kurland, L. T. (1984). Epidemiological survey of dementia in Parkinsonism and control population. In R. G. Hassler & J. F. Christ (Eds.), *Parkinson-specific motor and mental disorders* (pp. 229-234). New York: Raven Press.
- Reifler, B. V., Cox, G. B., & Hanley, R. J. (1981). Problems of mentally ill elderly as perceived by patients, families, and clinicians. *The Gerontologist*, *21*, 165-170.
- Reisberg, B., Ferris, S. H., DeLeon, M. J., & Crook, T. (1982). The Global Deterioration Scale for assessment of primary degenerative dementia. *American Journal of Psychiatry*, *139*, 1136-1139.
- Robinson, B., & Thurnher, M. (1979). Taking care of aged parents: A family cycle transition. *The Gerontologist*, *19*, 586-593.
- Zarit, S. H., Reever, K. E., & Bach-Peterson, J. (1980). Relatives of the impaired elderly: Correlates of feelings of burden. *The Gerontologist*, *20*, 649-655.