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Age and Extent of Surgery Affect Attention in Women Treated for Breast Cancer

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Abstract: Women treated for breast cancer have shown attentional fatigue manifested as a decreased capacity to concentrate or direct attention in daily life activities. This study was conducted to determine if age and extent of surgery increase the risk of early development of attentional fatigue in 74 women newly diagnosed with Stage I or II breast cancer. Measures of capacity to direct attention (CDA) were obtained at two time points, about 12 days before, and 15 days after, breast-conserving surgery or mastectomy. ANOVA showed significant age and age by time interaction effects ($p < .05$). Women aged 65–79 showed a significant mean decline ($p < .05$) in CDA over time regardless of extent of surgery. Women aged 46–64, who underwent mastectomy, showed a mean loss in CDA, whereas those having breast-conserving surgery showed a significant mean gain ($p < .05$). Women aged 25–45 showed no significant mean change in CDA over time. Older age and more extensive surgery increase the likelihood of loss of attention due, in part, to greater risk of attentional fatigue. © 1998 John Wiley & Sons, Inc. Res Nurs Health 21:229–238, 1998.

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Of the estimated 181,600 American women who will be diagnosed with breast cancer in 1997 (American Cancer Society [ACS], 1997), about 77% will be over the age of 50 (ACS, 1996). Although older women are disproportionately afflicted by breast cancer, little research has been done to identify the specific functional changes associated with aging and breast cancer treatment. One key area, often overlooked in assessing the impact of life-threatening illness, involves changes in normal cognitive function. In dealing with a life-threatening illness such as breast cancer, even slight changes in cognitive function can have a significant detrimental impact on the recovery process following diagnosis and treatment of breast cancer. The purpose of this study was to examine the effects of age and extent of breast surgery on cognitive functioning, specifically, the capacity to focus and concentrate, or direct attention, in women newly diagnosed with breast cancer.

One cognitive capacity that is essential for effective functioning, particularly in a demanding life situation, is the capacity to focus and concentrate or direct attention. In daily life, the capacity to direct attention (CDA) is used when carrying out purposeful cognitive activity such as following a train of thought, learning new information, listening, and even planning a meal or balancing a checkbook. In carrying out such activities, CDA underlies cognitive control of distractions or competing stimuli that might arise from the external environment (noise or other people) or from the internal environment (worries, concerns, James, 1983; S. Kaplan, 1995). It also plays a pivotal role in many other aspects of cognitive functioning

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such as short-term memory (Mesulam, 1985; Posner & Dehaene, 1994), planning, deciding, and problem solving (Lezak, 1982; VanZomeren & Brouwer, 1994). However, because CDA must be sustained by continuous application of mental effort, it is susceptible to fatigue (S. Kaplan, 1995; S. Kaplan & R. Kaplan, 1982). Here, fatigue is labeled *directed attentional fatigue (DAF)* to distinguish it from other potential types of fatigue.

Aging has been associated with declines in CDA in healthy, cognitively intact, older individuals in a number of experimental studies. Older adults (≥ 65 years old) had more difficulty than younger adults in attending to a stimulus in the presence of distraction (Madden, 1986; Rabbitt, 1965; Rogers, 1992), were less able to ignore distracting stimuli when performing various tasks (Barr & Giambra, 1990; McDowd & Filion, 1992; Zacks & Hasher, 1994), and were less able to sustain directed attention in an effortful task over time (Quilter, Giambra, & Benson, 1983). These findings suggest that aging is associated with loss of efficiency in directing attention, particularly when experiencing multiple demands or high distraction. As a result, it is likely that when confronted with a life-threatening illness such as breast cancer, older persons might be more susceptible to DAF because their available CDA may not be sufficient to deal with the many demands inherent in diagnosis and treatment.

S. Kaplan and R. Kaplan (1982) provided a theoretical view of DAF with a framework for examining the problem in the context of life-threatening illness (Cimprich, 1992a, 1993a). That framework links attentional requirements or demands for use of CDA with increased risk for development of DAF. When dealing with a life-threatening illness such as breast cancer, multiple demands—informational, affective, and behavioral—may be experienced with little respite for prolonged periods of time. Because CDA is needed to help a person think clearly, problem solve, and carry out necessary tasks such as treatment activities or self-care, even under conditions of psychological distress or physical discomfort, this normally limited capacity can be overused in responding to the inherent demands of illness and treatment. Thus, DAF is thought to result from overuse of the central brain mechanisms underlying active (effortful) suppression of competing stimuli or distractions (S. Kaplan, 1995; S. Kaplan & R. Kaplan, 1982). At the most basic level, such fatigue would be manifested as an observable decline in the capacity to inhibit a competing stimulus or to direct attention (CDA). This typically is experienced as increased distractibility or loss of focus and concentration. On a broader functional level, a person experiencing DAF would have difficulty performing mental or physical activities that require directed attention resulting in impairment in purposeful functioning. In the context of life-threatening illness such as breast cancer, development of DAF could compromise ability to acquire information about the diagnosis and treatment, make effective treatment decisions, carry out self-care, and adhere to a complex treatment plan.

To date, limited research has been done to examine effects of a life-threatening illness such as breast cancer on cognitive functioning (Silliman, Balducci, Goodwin, Holmes, & Leventhal, 1993). In a population-based study of 799 elderly patients (≥ 65 years old) newly diagnosed with cancer, including 194 breast cancer patients, Goodwin, Hunt, and Samet (1991) found that 40% had some problem with cognitive functioning. In a study focusing specifically on attentional problems in 32 women, 29–84 years of age and newly diagnosed with breast cancer, persistent attentional problems of varying severity were observed over the 3 months following surgery (Cimprich, 1992b). A greater impairment in CDA, however, was observed in women over 60 years of age as compared to younger women. This finding suggested that older women treated for breast cancer may be at greater risk of decline in CDA due, at least in part, to attentional fatigue. However, as all data were collected after surgery, it is not known whether there were age-related differences in the early pattern of change in CDA or whether the change in CDA over time was influenced by extent of surgery such as breast-conserving surgery versus mastectomy. Thus, the purposes of this study were: (a) to examine levels of CDA in younger, middle-aged, and older women awaiting surgery for breast cancer, (b) to determine any age-related pattern of change in CDA from the presurgical to the postsurgical period before any adjuvant treatment; (c) to determine the change in CDA based on extent of surgery, that is, breast-conserving surgery versus mastectomy; and (d) to examine the combined influence of age and extent of surgery on CDA over time.

METHOD

Sample

A convenience sample of 74 female volunteers with newly diagnosed, early stage breast cancer was drawn from the population of patients at two

Table 1. Demographic and Medical Characteristics of Total Sample and Age Groups

	Total Sample (N = 74)		Age Groups: Younger (n = 14)		Age Groups: Middle (n = 44)		Age Groups: Older (n = 16)	
Characteristics	*M*	*SEM*	*M*	*SEM*	*M*	*SEM*	*M*	*SEM*
Age	55.9	1.37	37.4	1.49	56.5	0.81	70.6	1.00
Education	14.0	0.34	14.0	0.77	14.0	0.43	14.0	0.85
	n	%	*n*	%	*n*	%	*n*	%
Current Marital Status								
Married	57	77	12	86	31	71	14	88
Divorced/Separated	11	15	2	14	9	20	0	0
Widowed	5	7	0	0	3	7	2	12
Single	1	1	0	0	1	2	0	0
Stage of Disease[a]								
Stage I	41	56	3	27	27	61	11	69
Stage II	33	44	11	73	16	36	5	31
Extent of Surgery								
BCS[b]	36	49	4	29	22	50	10	63
Mastectomy	38	51	10	71	22	50	6	37

Note. Stage of Disease × Age Group, χ^2 (2, N = 74) = 8.66, p = .01.

[a]Stage of disease missing for 1 woman in the middle age group. [b]BCS = breast-conserving surgery.

midwestern university medical centers that had comprehensive cancer treatment programs. Only those patients who were newly diagnosed with Stage I or II with a proposed treatment plan of breast conservation surgery (BCS) or mastectomy were eligible for study participation. Individuals were excluded for preexisting medical conditions that could affect attentional capacity or performance of the measures, specifically, documented cognitive, mental, or affective disorder, prescribed medication known to enhance or impair attention (e.g., amphetamines, psychoactive drugs), and insufficient command of the English language. Eligible patients were recruited during a scheduled clinic visit either for second opinion or treatment planning. Of 129 patients who met eligibility requirements, 94 individuals initially agreed to participate; of those, 20 were lost to follow-up, mainly because they had decided to be treated closer to home. Thus, the attrition rate was 21%.

The 74 women ranged in age from 25 to 79 years old and were relatively well educated, with an average of 14 years of formal education (see Table 1 for selected demographic and medical characteristics of the total sample). The majority of participants were currently married, and 98% were Caucasian. Based on surgical pathological staging criteria, almost equal numbers were classified as having Stage I or Stage II disease. Similarly, the sample was almost equally divided between those having BCS (segmentectomy or lumpectomy) versus mastectomy; all participants had an axillary lymph node dissection.

To permit examination of possible age differences, the sample was stratified into three age groups: younger (n = 14) 25–45 years old, middle (n = 44) 46–64 years old, and older (n = 16) 65 to 79 years old (see Table 1 for characteristics of the three age groups). The strata were formed taking into account the following variables that might affect cognitive responses: (a) adult life stages as described by Rowland (1990): (b) perimenopausal hormonal (estrogen) changes (middle age group): and (c) normal functional changes associated with primary aging (older age group). There were no significant differences among the three groups in educational level or extent of surgery. There was a significant association between stage of disease and age group; however, stage of disease was not related to performance on the attention tests and, thus, was not included in further analyses. To permit examination of possible differences in CDA based on extent of surgery, the sample also was stratified for certain analyses into two surgical groups: BCS (n = 36), and mastectomy (n = 38) including simple (n = 8) and modified radical mastectomy (n = 30). The two surgical groups did not differ significantly in mean age or educational level (mean age ± *SEM* = 58 ± 1.79 vs. 54 ± 2.01; mean years of education ± *SEM* = 14 ± 0.55 vs. 14 ± 0.42, BCS and mastectomy groups, respectively).

Measures

Four tests of CDA, or the ability to inhibit a competing stimulus while focusing on a task, were used: Digit Span Forward (DSF), Digit Span Backward (DSB), the Symbol Digit Modalities Test (SDMT), and the Necker Cube Pattern Control Test (NCPC). These tests were selected because they are theoretically congruent, appear to be sensitive to DAF, have established normative values for various age groups, and can provide an index of directed attentional performance (Cimprich, 1992a, 1993a).

Digit Span. This is a standardized test of attention consisting of two separate measures, DSF and DSB (Lezak, 1995; Wechsler, 1955). DSF measures the bits of information that a person can attend to at one time in a task requiring repetition of a random series of digits. DSB, a more rigorous test, requires sustained directed attention to mentally track, manipulate, and reverse a random series of digits. When testing for cognitive dysfunction, a forward span of 5 on DSF is considered marginal to normal and 4 is borderline, whereas on DSB, a score of 3 is considered impaired (Lezak, 1995). Higher educational level has been associated with higher scores on Digit Span (Lezak, 1995). Standard administration and scoring procedures (Wechsler, 1955) were used, with the scores being the number of digits repeated correctly in forward (DSF) and backward (DSB) sequences before two failed trials.

SDMT. This standardized test (Smith, 1973), requires use of directed attention in substituting numbers for various geometric symbols including three mirror image pairs. The score is based on the number of correct responses within a 90-s interval (Smith, 1973). Normative data are available for comparison on adult age groups and educational levels (Lezak, 1995; Smith, 1973).

NCPC. This test was designed to directly measure the ability to inhibit competing stimuli (Cimprich, 1993a). The Necker cube is a three-dimensional wire cube that can be viewed in two different orientations due to spontaneous reversals of the foreground and background. To maintain focus on one pattern or orientation requires inhibition of the active alternative (James, 1983). Thus, a decreased CDA would be manifested in a decreased ability to inhibit the pattern reversals. The test score is the percent reduction in pattern reversals from a 30-s baseline condition to a 30-s holding condition when the respondent is instructed to focus on and hold one pattern for as long as possible. Healthy adults have shown an average reduction in pattern reversals of 47% in the holding condition (Cimprich, 1993b). Baseline scores of pattern reversals in samples of 84 healthy adults (Cimprich, 1993b) and 32 breast cancer patients (Cimprich, 1993a) have been shown to be highly reliable. In previous work in women treated for breast cancer, the NCPC appeared to be a sensitive indicator of changes in CDA over time (Cimprich, 1993a).

Procedure

Participants were tested at two time points: at a mean of 12 days before surgery (Time 1) and at about 15 days after surgery (Time 2). The mean interval between the two time points was 27 days. The measurement at Time 1 provided an assessment of CDA before any treatment was initiated. The second time point was selected to coincide with the surgical follow-up period before the start of adjuvant chemotherapy or radiation therapy. Testing was conducted in a quiet private consultation or examination room in the ambulatory care areas. The measures were administered in random order using standard testing procedures.

Data Analysis

There were missing test data for one participant in the older and BCS groups at Time 1. Scores for this woman were imputed using the Time 1 mean test scores for the older and BCS groups (Tabachnick & Fidell, 1989). Test scores were examined using descriptive statistics; selected test scores were compared with published normative data to determine deviations from the norm. Differences by time, age group, and extent of surgery were tested by analysis of variance (ANOVA), *t* tests, and multiple linear regression. To permit computation of a composite index of attentional performance for selected analyses, raw scores of the measures were transformed to *Z* scores, and a total attentional score (TAS) was derived from the sum of the standardized tests (DSF + DSB + SDMT + NCPC).

RESULTS

When compared with published norms (Lezak, 1995), mean test scores before surgery fell within

Table 2. Attentional Test Scores of Total Sample at Time 1

Test	*M*	*SEM*	Range
Digit Span Forward (DSF)	6.46	0.15	4–9
Digit Span Backward (DSB)	4.70	0.14	2–7
Symbol Digit Modalities Test (SDMT)	50.22	1.23	29–75
Necker Cube Pattern Control Test (NCPC) (% reduction)[a]	33.81	3.74	92–+71

[a]Maximum value in NCPC test range indicates an increase rather than reduction in pattern reversals, that is, an inability to inhibit pattern reversals.

normal ranges for healthy adults (see Table 2). However, the frequency distributions tended to be negatively shifted toward the lower end of the range. The number of years of education was not correlated to scores on any of the tests of CDA in this sample.

To test differences in the mean scores among the three age groups at Time 1 (see Table 3), one-way ANOVA using the Scheffé method for post hoc comparisons was performed. There was a significant difference in mean SDMT scores, $F(2, 71) = 21.59$, $p < .01$. Post hoc comparisons showed that the SDMT mean scores of the three groups (young, middle, older) differed significantly ($p < .05$) from each other. There were no significant mean differences among the three age groups on the individual tests of DSF, DSB, or NCPC at Time 1. However, an examination of the pattern of the mean scores of the three groups revealed that, on most of the measures, the mean scores decreased as the age of the group increased. Thus, on the composite index of attentional performance, the standardized TAS, the groups differed significantly, $F(2, 71) = 8.10$, $p < .01$. Post hoc comparisons showed that the older age group scored significantly ($p < .05$) lower than both the younger and middle age groups; the TAS mean scores of the middle and younger groups were not significantly different.

To determine possible differences in attentional performance in participants *anticipating* BCS versus mastectomy, mean scores of the two surgical groups were compared at Time 1 using *t* tests for independent samples. Before surgery, the group awaiting BCS scored significantly lower on one measure, DSB, $t(72) = 2.29$, $p = .03$, than the group awaiting mastectomy. There were, however, no other significant differences in mean scores of the two surgical groups on the tests of CDA or on the standardized index, the TAS, before surgery.

Test scores for the three age groups at Time 2 are displayed in Table 3. An examination of overall changes in the mean standardized TAS from Time 1 to Time 2 showed age-related differences in the pattern of attentional performance over time (see Figure 1). The older age group showed a significant mean loss in overall attentional performance from Time 1 to Time 2, paired $t(15) = 2.31$, $p = .04$. In contrast, the mean TAS scores of the middle and younger age groups did not change significantly from Time 1 to Time 2. A one-way ANOVA using the Scheffé method for post hoc comparisons showed that the mean change scores from Time 1 to Time 2 differed significantly by age group, $F(2, 71) = 3.17$, $p = .05$. Specifically, the older age group had a significantly ($p < .05$) greater mean loss in TAS over time as compared to the middle and younger age groups.

An examination of overall change in the mean TAS from Time 1 to Time 2 by surgical group (BCS vs. mastectomy) showed a small but not statistically significant variation in the pattern of attentional performance based on extent of surgery. The BCS group showed a small mean gain in the TAS from Time 1 to Time 2, whereas the mastectomy group showed a small mean loss in the TAS. A comparison of the mean difference scores of the two groups did not reach statistical significance.

To determine the possible interacting effects of age and extent of surgery on CDA over time, repeated measures ANOVA was performed using a 3 (older age vs. middle age vs. younger age groups) $\times$ 2 (BCS vs. mastectomy groups) $\times$ 2 (TAS scores at Time 1 and Time 2) factorial model. There were significant age ($p < .01$) and age by time interaction ($p = .03$) effects (see Table 4). There were no other statistically significant main or interaction effects.

A further examination of the pattern of overall change in the mean TAS from Time 1 to Time 2 revealed certain differences in attentional performance based on age group and extent of surgery (see Figure 2). In the younger age group, there was no significant mean change in TAS from Time 1 to Time 2, regardless of extent of surgery. In contrast,

Table 3. Attention Test Scores at Times 1 and 2 by Three Age Groups[a]

Test	Measurement Time Points			
	Time 1		Time 2	
Age Group	*M*	*SEM*	*M*	*SEM*
Digit Span Forward (DSF)				
Younger	6.71	0.30	6.71	0.35
Middle	6.50	0.20	6.93	0.18
Older	6.13	0.33	6.00**	0.32
Digit Span Backward (DSB)				
Younger	5.00	0.31	4.79	0.30
Middle	4.75	0.17	4.91	0.16
Older	4.33	0.33	4.27	0.36
Symbol Digit Modalities Test (SDMT)				
Younger	60.79*	2.44	64.21**	2.66
Middle	50.39*	1.33	52.39**	1.30
Older	40.40**	1.59	42.00**	1.78
Necker Cube Pattern Control (NCPC) (% reduction)				
Younger	34.31	11.0	32.04	8.97
Middle	33.86	4.34	19.69	6.28
Older	32.59	8.61	−10.94**	12.66
Standardized Total Attention Score (TAS)[b]				
Younger	1.47	0.46	1.54	0.61
Middle	0.09	0.34	0.31	0.33
Older	−1.53*	0.39	−2.91**	0.72

[a]Younger age = 25–45 years ($n = 14$); middle age = 46–64 years ($n = 44$); older age = 65–79 years ($n = 16$).

[b]Standardized Total Attention Score (TAS) = sum of standardized test scores (DSF + DSB + SDMT + NCPC).

*Age group differences, Time 1, $p < .05$: SDMT = older age < middle age < younger age; TAS = older age < middle age and younger age.

**Age group differences, Time 2, $p < .05$: DSF = older age < middle age; SDMT = older age < middle age < younger age; NCPC = older age < middle age and younger age; TAS = older age < middle age and younger age.

the middle age BCS subgroup showed a significant mean gain in TAS of almost one standard deviation from Time 1 to Time 2, paired $t(21) = 2.76$, $p = .01$, whereas the middle age mastectomy subgroup showed a small but not significant mean loss in TAS. Thus, the TAS mean change scores of the BCS and mastectomy subgroups differed significantly, $t(42) = 2.27$, $p = .03$. Finally, in the older age group, both the BCS and mastectomy group showed a mean loss in TAS from Time 1 to Time 2. Notably, the older mastectomy subgroup showed a significant mean loss in TAS of more than two standard deviations from Time 1 to Time 2, paired $t(5) = 2.44$, $p = .05$.

To further determine the predictive value of age and extent of surgery on CDA over time, a regression analysis was conducted using the standardized TAS at Time 2 as the dependent variable. In the regression model, the TAS at Time 1 was entered as the first variable in the analysis, because, as expected, attentional scores at Time 1 were significantly and positively correlated with scores at Time 2 (Pearson $r = .61$, $p < .01$); this was followed by age (as a continuous variable), extent of surgery (BCS, mastectomy), and the interaction term of age and extent of surgery. Because the interaction term did not approach significance ($p = .85$) it was dropped from the model. TAS at Time 1 and age were significant predictors of TAS at Time 2, whereas extent of surgery approached significance (p = .059); see Table 5. These three predictor variables accounted for 48% of the variance in attentional performance after surgery in this sample, $R = .69$, $F(3, 70) = 21.12$, $p < .01$.

DISCUSSION

Previous findings suggested that, following surgery for breast cancer, older women may be more vulnerable to changes in cognitive functioning involving the capacity to direct attention. The findings from this study provide new evidence of a complex pattern of early and significant loss in CDA observed over a 1-month interval extending

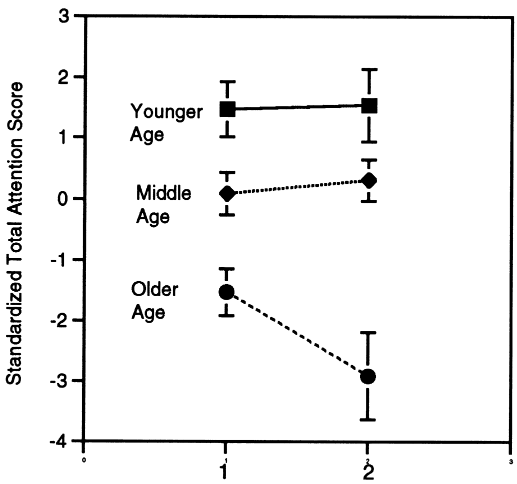

FIGURE 1. Mean total attention scores (TAS ± *SEM*) of the younger ($n = 14$), middle ($n = 44$), and older ($n = 16$) age groups at Time 1 and Time 2.

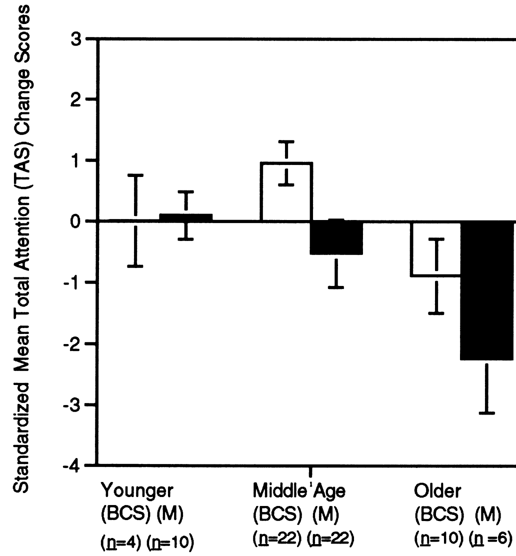

FIGURE 2. Pattern of overall changes in mean TAS ± *SEM* by age and extent of surgery from Time 1 to Time 2 (BCS = breast-conserving surgery; M = mastectomy).

from the presurgical period to the start of adjuvant chemotherapy or radiation therapy, based on age and extent of surgery.

Younger women (≤ 45 years old) consistently showed higher levels of performance on measures of CDA than those in older age groups and, in general, showed little change in CDA over the course of the study interval, regardless of extent of breast surgery. This finding is consistent with the idea that younger age is associated with a stronger CDA; thus, there is greater likelihood that CDA could be sustained in response to the early demands of diagnosis and treatment of a life-threatening illness such as breast cancer.

Middle-aged women (46–64 years old) showed similar levels of CDA prior to surgery as compared with the younger group, but showed an inconsistent attentional performance over time, partly related to extent of surgery. In particular, middle-aged women having BCS demonstrated an improvement in CDA over the study interval, indicating some recovery of CDA following surgery. On the other hand, women who underwent mastectomy showed no improvement in attentional performance, and even some difficulty in sustaining pretreatment levels of CDA. These findings suggest that the physical and psychological sequelae of loss of a breast may place added demands on available CDA and that, with increasing age, the added demands of more extensive surgery might lead to greater attentional difficulties. In fact, a trend toward greater loss of CDA with mastectomy also was observed in the older age group. Because it is assumed that the middle age group was comprised of peri- and postmenopausal women, the findings raise a question

Table 4. Repeated Measures ANOVA for Standardized Total Attention Score TAS

Effect	*df*	*F*
	Between Subjects	
Age	(2, 68)	15.91**
Surgery	(1, 68)	0.77
Age × Surgery	(2, 68)	1.45
	Within Subjects	
Time	(1, 68)	1.98
Age × Time	(2, 68)	3.86*
Surgery × Time	(1, 68)	2.28
Age × Surgery × Time	(2, 68)	0.62

$^*p < .05$. $^{**}p < .01$.

Table 5. Multiple Regression Analysis of Standardized Total Attention Score (TAS) at Time 2 on Presurgical TAS (Time 1), Age, and Extent of Surgery

Variables	*B*	*SE B*	β
TAS, Time 1	.62	.12	.50*
Age	−.08	.02	−.33*
Surgery	−.94	.49	−.17†

Note. $R^2 = .48$ for predictor variables TAS at Time 1, age, and extent of surgery (breast-conserving surgery, mastectomy), $F(3, 70) = 21.12$, $p < .01$.

†$p = .059$. $^*p < .01$.

about the possible compounding effects of lowered estrogen (and abrupt cessation of estrogen replacement therapy at time of breast cancer diagnosis) on cognitive function, specifically CDA, in demanding circumstances. Research on the possible detrimental effects of lowered estrogen on cognitive functioning has produced inconsistent findings (e.g., Barrett-Connor & Kritz-Silverstein, 1993; Sherwin, 1988). Because menopausal state was not determined, it is not clear whether the observed attentional difficulties in middle-age women undergoing mastectomy were in any way influenced by menopausal status.

Older women (65–79 years old) demonstrated lower levels of CDA prior to treatment than middle-age or younger women. This is consistent with research findings of healthy, cognitively intact adults that indicate a normal loss of efficiency in directing attention with increasing age, particularly under demanding conditions. Importantly, the older women in the study also were less able to sustain attention and experienced significant losses in the capacity to direct attention over the 1-month study interval regardless of the extent of surgery. The greatest losses in CDA, however, were observed in the group of older women who underwent mastectomy, suggesting that this group is especially vulnerable to early compromise of attentional functioning following surgery.

One factor that must be considered in interpreting the findings is the possible long-term effects of anesthesia on cognitive function, particularly in the elderly. It is commonly recognized that anesthetic agents produce short-term decrements in cognitive function (Jones, 1988). However, in a study of immediate and long-term effects of general anesthesia on mental performance in patients 60 years old or older who underwent total hip replacement arthroplasty, a return to preoperative levels of functioning on attentional measures was observed by the 4th postoperative day, and performance was better than preoperative levels on the 7th postoperative day (Riis et al., 1983). In this study, participants were tested about 2 weeks after surgery. The length of anesthesia was not correlated to any of the attention test scores. Thus, anesthesia effects cannot explain the pattern of findings of loss of CDA here.

A salient factor in loss of CDA under demanding life circumstances is the development of DAF. Women newly diagnosed with breast cancer are confronted with multiple informational, affective, and behavioral demands requiring considerable use of directed attention over the pretreatment and early postsurgical periods. These demands have been well described in the literature (e.g., Northouse, 1989; Scott, 1983), and include making sense of the diagnosis and treatment decisions under time pressure and high emotion, dealing with existential concerns and family distress, adjusting to the daily realities of the loss of a breast with mastectomy, responding to needs for radiation therapy or adjuvant chemotherapy in the early postsurgical recovery period, and modifying life activities to enable treatment. Although women often negotiate such demands with great skill, there is a potential high cost in overuse and fatigue of directed attention. Given that CDA is a pivotal resource that supports key aspects of cognitive functioning, such fatigue can have widespread detrimental effects on recovery and the ability to deal with a life-threatening illness. Development of DAF would affect all mental and physical activities that require use of directed attention, including such activities as the ability to think clearly, solve problems, plan, and carry out treatment activities or self-care. Under conditions requiring further expense of mental effort, lowered CDA could lead to a declining sense of personal effectiveness and ability to cope with a situation, thus significantly increasing levels of psychological distress. The findings suggest that older women may be especially susceptible to early DAF in response to the prolonged and multiple demands inherent in diagnosis of breast cancer, and the physical and psychological effects of more extensive breast surgery. In fact, the findings from this study suggest that, even in middle age, women may have more difficulty in sustaining directed attention under these demanding circumstances.

Further research on the questions addressed and raised in this study is needed. For example, in this small convenience sample it is not possible to determine the generalizability of the findings. Studies of larger and more racially diverse samples of women treated for breast cancer are needed to examine changing patterns of CDA over the course of treatment and recovery in younger, middle, and older age groups. The effects of abrupt hormonal changes, such as discontinuing hormone replacement therapy at time of diagnosis and effects of more gradual changes in estrogen levels with menopause on attentional functioning, need to be clarified. The interacting effects of age and specific forms of treatment for breast cancer including radiation therapy and/or adjuvant chemotherapy on CDA over time need to be studied. Also, the observed trend of less effective performance on the attentional measures in a significant portion of women awaiting surgery warrants further investigation. Do these findings reflect a beginning level of DAF even before surgery, given women's reports of the exceptional demands experienced during the pretreatment period?

The findings provide direction for development of interventions to improve cognitive functioning in women treated for breast cancer. Given the current demands being placed on patients and families to learn new information, make complex treatment decisions, and assume major responsibilities for self-care, a key intervention approach would focus on helping to conserve and maintain attentional capacity. In women newly diagnosed with breast cancer, such interventions are critically needed to support decision making about treatment and to facilitate learning of important health and self-care information. The findings suggest that interventions aimed at conserving attentional capacity need to be initiated in the pretreatment period. Finally, interventions should be tailored to the specific needs of more vulnerable populations of middle-aged and older women, and particularly those women who are undergoing more extensive surgery for breast cancer.

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