SCREENING MAMMOGRAPHY AND CONSTRUCTS FROM THE TRANSTHEORETICAL MODEL: ASSOCIATIONS USING TWO DEFINITIONS OF THE STAGES-OF-ADOPTION[1,2]

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ABSTRACT

The two purposes of this investigation were: (a) to examine whether an association existed between stages of adopting regular mammography and decision-making constructs from the Transtheoretical Model (TTM) of behavior change, and (b) to determine whether any such associations would be found for each of the two ways of defining the stages-of-adoption. One method integrated past screening history with a report of future intention for screening; the other method used a single item with predetermined response categories. Data were from the baseline survey of 1,323 women aged 50–74 who were recruited as part of an intervention study through a local Health Maintenance Organization. Results showed that both ways of defining stages of adopting regular mammography were associated with decisional balance and processes-of-change. The method that integrated past history plus intention provided somewhat better discrimination among stages. Women who were labeled as being at "Risk of Relapse," and those who said they waited for a "Provider's Recommendation," may be useful groups to add to the set of stages that have been employed so far by the TTM. In addition, a tendency to avoid the health care system in general was used as a process-of-change to complement the mammography-specific processes.

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INTRODUCTION

Mammography has been established as an effective means of preventing mortality due to breast cancer among women aged 50 through 75 (1,2). The existence of benefits for women over age 75 is unknown due to the absence of sufficient numbers of older women in clinical trials (3). Debate currently exists regarding the value of routinely screening asymptomatic women aged 40–49 (1,4–6). Two other prominent themes in the literature have been the search for barriers which can prevent women from receiving mammograms on a regular basis and the testing of interventions to address those barriers. The list of potential barriers is extensive, including lack of physician recommendation, personal belief that the test is not needed due to absence of symptoms, lack of knowledge regarding the guidelines, cost and insurance considerations, long-standing access issues among poor women and women of color, unfavorable experiences with prior mammograms, fear of radiation, and perceived inconvenience for one's schedule (e.g. 2,8–14). Intervention strategies have included targeting physicians and the medical practice in general, addressing women's beliefs and knowledge, providing mobile vans, offering low cost/no cost screening, developing posters and printed materials, using telephone counselors, conducting media campaigns, and organizing local communities for grass roots mobilization (e.g. 15–22).

The creativity, energy, and positive outcomes of these interventions have often been frustrated by the fact that women still do not appear to be receiving regular mammograms in numbers which would allow reaching national goals of breast cancer control (23). Analyses of the 1990 National Health Interview Survey of Health Promotion and Disease Prevention have shown that while certain screening rates have risen since the mid-1980s (e.g. screened in past two years), less than 40% of women are receiving regular screening, defined as past behavior combined with intention to continue having mammograms (24,25).

Theoretically-based studies have applied systematic approaches to examining at least some of the barriers to mam-

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mography. The Health Belief Model has been one of these conceptual strategies (26,27), as well as an expanded Theory of Reasoned Action (28). A third approach, and the subject of this article, is the Transtheoretical Model (TTM) of behavior change (29–31). The TTM proposes that persons pass through a series of stages in the course of changing a health-related behavior. The stages used for lifestyle behaviors such as smoking cessation and exercise are Precontemplation (presently not doing the behavior and not intending to start in a given time period), Contemplation (not doing the behavior but considering starting in a given time period), Preparation (taking the first basic steps to change behavior), Action (has initiated a change for a specified period of time), and Maintenance (has sustained the change beyond the Action period, indicating long-term commitment). As noted later, we have adapted the model somewhat to suit the periodicity which is characteristic of screening behaviors such as mammography. A more extensive discussion of adaptation of the TTM to mammography can be found in Rakowski, Dube, and Goldstein (32).

The TTM also has a cyclical feature which recognizes that persons often reach Preparation or Action, but do not succeed completely, thereby returning to Precontemplation or Contemplation (i.e. a process of Relapse) to attempt another progression through the stages. In addition to the stages-of-adoption, equally important elements of the model are the pros, cons, and processes-of-change. The pros and cons denote perceptions about the positive (pros) and negative (cons) aspects of the target behavior and of trying to change (30,31). The processes-of-change denote cognitive and behavioral strategies by which change is actually accomplished, such as consciousness-raising, stimulus control, and self-reevaluation. There are ten processes-of-change in smoking cessation, although not each process operates at each stage of transition. Therefore, it is movement on the pros, cons, and processes-of-change which in turn promotes movement along the more directly observable stages of change.

Two prior investigations by the first author and colleagues found an association between stages of adopting regular mammography screening and the "decisional balance" (pros versus cons) construct of the Transtheoretical Model. As the stages progressed toward greater commitment to regular screening (Precontemplation through Maintenance), the decisional balance summary score became progressively more positive as predicted by the model (33,34). Champion (26) also demonstrated an association between stages-of-adoption and mammography-related scales based on constructs derived from the Health Belief Model.

The present report is an extension of those earlier investigations. First, these prior reports dealt only with the decisional balance construct of the TTM (i.e. the pros score minus the cons score). The current study expands the variables under investigation to include several potential processes-of-change, which are also a central component of the TTM. Secondly, the present study employs two different ways of defining stages of adopting mammography. Evidence for the presence (or absence) of an association among stages-of-adoption and TTM constructs, when stages are defined in various ways, can be important for application to interventions. If associations are not found across definitions, then the generality of the TTM for mammography may be limited.

METHODS

Sample

Data for this report come from the baseline survey of 1,323 women aged 50–74, who were recruited through the five sites of a staff-model Health Maintenance Organization (HMO) in Rhode Island and southeastern Massachusetts. The women were participants in a study on mammography behavior and ways of increasing rates of regular screening. The women were asymptomatic at the time of the baseline survey (i.e. preintervention) and had no personal history of breast cancer. Other exclusions are noted below.

The age distribution of the sample was: 50–59, N = 678 (51.2%); 60–69, N = 463 (35.0%); 70–74, N = 183 (13.8%). Just under one-fifth of the sample (18.5%) had less than a high school education, while another 38.6% had at least some college experience. The sample had a slight balance toward women who worked for pay (53.7%), and two-thirds were married (66.7%). Reflecting the demographics of the region, the predominant portion of the sample was of White, non-Hispanic background (94.9%).

Sample Recruitment

Sample recruitment began in June 1993 and ended in April 1994. Names of potential participants were provided to project staff by the records management division of the HMO. These women had a record of a medical visit, for any reason, in the Departments of Family Practice, Internal Medicine, or Ob/Gyn during the eight months prior to the date of selection and were not listed in the HMO's cancer tumor data base. This procedure generated a pool of active patients in the HMO.

Women's names were then randomly selected for contact. An introductory cover letter with basic information about the project was sent on joint letterhead of the HMO and the university under the signature of the Medical Director of the HMO. A subsequent telephone call was conducted using computer-assisted interviewing (CATI), so that interviewers were prompted with all text and responses on the screen. If the woman consented, the baseline survey was completed at that time or rescheduled for a more convenient time shortly thereafter. Interview data were directly entered into the central analysis file by the CATI system. Randomization of the participant into one of the study's three intervention groups occurred by a computer-based algorithm after all of a day's baseline interviewing was completed.

Women were excluded from the project if: (a) they had a personal history of breast cancer or were currently under observation for possible breast cancer; (b) they were pregnant or nursing; or (c) they worked in one of the primary care departments of the HMO in which intervention was going to occur. All interviews were done in English. Therefore, this report is based on a sample with certain restrictions needed for the intervention rather than on a random population survey. The interview rate for eligible women reached by phone was 73.5%.

Transtheoretical Model: Decisional Balance and Processes-of-Change

Decisional Balance: Decisional balance is a summary value derived by subtracting a standardized cons T-score from a standardized pros T-score. The pros and cons each have a Mean = 50 and Standard Deviation = 10. Higher scores represent stronger positive or negative opinions. Therefore, when sub-

TABLE 1
Statements Comprising the Pros and Cons Indices

Pro/Con Index	Statement Wording[a]
A. Pros Index:	Those people who are close to me will benefit if I have a mammogram.
	I would be more likely to have a mammogram if my doctor told me how important it was.
	Having a mammogram every year or two will give me a feeling of control over my health.
	Mammograms are a very routine medical test.
	Regular mammograms give you peace of mind about your health.
	A mammogram is part of good overall health care.
	Mammograms are necessary even when there is no history of breast problems in a family.
	Mammograms are most helpful when you have one every year or two.
	Mammography is a safe procedure.
B. Cons Index:	If I have a breast exam from a doctor or nurse, I don't need to have a mammogram.
	Mammograms have a high chance of leading to breast surgery that is not needed.
	I would probably not have a mammogram if the place that did them was more than a few minutes drive away.
	Once you have a couple of mammograms that are normal, you don't need to have any more for a few years.
	I would probably not have a mammogram if my doctor seemed to doubt that I really needed one.
	I would probably not have a mammogram unless I had some breast symptoms or discomfort.
	If I eat a healthy diet, I will lower my risk of getting cancer far enough that I probably do not need to have a mammogram.
	If a mammogram finds something, then whatever it is will be too far along to do anything about it anyway.
	Mammograms are not trustworthy because some radiology facilities are better than others in how they do them.
	The risk from the radiation of several mammograms over a few years is really quite high.
	I am too busy to have a mammogram.
	People who tell you not to bother with having a mammogram are right.
	If I have a Pap test performed this year, I do not need to have a mammogram.
	Mammography is not a useful procedure for women my age.
	Mammograms are too expensive for me.
	All it takes is a little bit of doubt about the safety of a mammogram to keep me from having one.

[a] Statements are assessed on a five-point Likert-type scale ranging from Strongly Disagree (1) to Strongly Agree (5).

traction occurs, negative decisional balance values represent relatively more unfavorable opinions about the target behavior (i.e. cons > pros), while positive values represent favorable assessments (pros > cons). Therefore, women in the more committed stages of mammography adoption should have more positive scores on the summary decisional balance index.

Respondents' perceived pros of mammography were assessed by a set of nine items in the baseline survey (Cronbach alpha = .80). The perceived cons were assessed by a set of 16 items (Cronbach alpha = .83). Statements were responded to on a scale of Strongly Disagree (1) through Strongly Agree (5). Items are shown in Table 1.

Processes-of-Change: A total of four process-of-change measures were examined. Three process-of-change indices, each of which had six items, were specific to mammography. Response was on a scale of Strongly Disagree (1) to Strongly Agree (5), and each scale was transformed to T-scores for analysis (mean = 50, SD = 10). Higher scores indicated that the process was more favorable towards mammography. Therefore, women in the more committed stages-of-adoption should have had more positive T-scores.

These items, shown in Table 2, were based on a sample of 105 women from a prior pilot survey (unpublished data). They are: (a) Commitment to Regular Screening: items which represent a behavioral and attitudinal interest in having regular mammograms (Cronbach alpha = .80); (b) Information Sharing and Communication: items which represent seeking out information about mammography and talking about the procedure with others (Cronbach alpha = .68); and (c) Thinking Beyond Oneself: items which represent placing mammography in a context broader than one's own direct experience with, or reasons for screening (Cronbach alpha = .69).

In addition, a fourth process-of-change indicator is examined in this paper. This is a four-item variable which represents a tendency to avoid regular medical visits when feeling healthy and to attempt self-treatment when ill rather than go to a doctor. It was not specific to mammography. This index (i.e. Avoids Contact with Health Care) is also shown in Table 3 and was analyzed as a T-score. However, in this case, higher scores represented a greater tendency to avoid the health care system, so that women in the more committed stages-of-adoption should have had lower T-scores.

The four items for this index were designated before-the-fact, during survey design. This general scale was innovative because all process-of-change measures in TTM applications to smoking cessation and other behaviors have been behavior-specific. However, due to the context in which mammograms are recommended and obtained, unless women make contact with the health care system they will not receive mammography. Therefore, we believed that mammography-specific processes-of-change might need to be supplemented by a more general tendency to avoid the health care system. The Avoids Contact index has a slightly lower alpha reliability (.59) than the six-item scales, but was retained due to the conceptual interest of the question of mammography-specific versus general processes.

Transtheoretical Model: Stages-of-Adoption

Two distinct ways of defining stages-of-adoption were used. They were chosen to differ according to the amount of

TABLE 2
Statements Comprising Processes-of-Change Scales for Mammography

Process-of-Change Index	Statement Wording[a]
A. Commitment to Regular Screening:	I am disappointed with myself if I know I am late scheduling a mammogram. I think about how much mammograms help women's health. If the doctor said I did not need a mammogram, I would ask again at another visit. I arrange my schedule to give me enough time for a mammogram. I know I feel better about myself if I have a mammogram. I try to make having a mammogram a regular part of my life.
B. Information Sharing and Communication:	I can talk with at least one other person about mammography. If I have questions about mammography, I try to get information to answer them. I give my friends encouragement when they say they are planning to have a mammogram. Having a mammogram every year or two shows that you are keeping up with the latest advances in health care. I know that even if a mammogram finds nothing, I am much better off than if I did not have one. If I hear something unfavorable about mammography, I try to get information and decide for myself.
C. Thinking Beyond Oneself:	I am disappointed if my doctor does not remind me to schedule a mammogram. I talk about mammography with friends. I sometimes think of ways that could get more women to have mammograms. I think I could come up with some ideas that could get doctors to recommend mammograms more regularly. People will be pleased if I have a mammogram. The more I know about mammography, the more I can help other women who want to know about it.
D. Avoids Contact with the Health Care System	When I'm sick, I try to cure myself rather than go to the doctor. I rely more on home remedies than on doctors. If I feel healthy, I do not go to the doctor for a routine check-up. I keep a record so that I know when to schedule my next doctor's appointment. (Reversed coding for scale)

[a] Statements are assessed on a five-point Likert-type scale ranging from Strongly Disagree (1) to Strongly Agree (5).

information that was used for staging. Different items could lead to somewhat different stages, even if each definition created a continuum of commitment to screening. Therefore, while some of the stage labels may be similar between the two definitions, they are not based on exactly the same information. For example, groups such as "Relapse Risk" and "Contemplation" can be formed when intention is used as a part of the stage algorithm, but not when past history only is used as a basis for staging. [*Note:* A third definition was used but not reported here in the interest of length. It was based solely on the two screening history items, without consideration of the respondent's future intention. That definition was therefore similar to one used in an earlier study (33). Results for this third definition followed the same pattern as the two definitions reported upon in Tables

TABLE 3
Criteria for the Stages-of-Adoption Which Use Intention for Future Screening as a Part of the Definition

Stage-of-Adoption	Criterion for Staging
Precontemplation	Has never had a mammogram, and does not plan to have one within the next two years.
Relapse	Has had one or more mammograms in the past, but is now off-schedule and does not plan to have a mammogram within the next two years.
Risk of Relapse	Has had one or more mammograms in the past, and is now on-schedule, but does not plan to have a mammogram within the next two years.
Provider's Recommendation	Has had one or more mammograms in the past, but says that the next one will be "when MD recommends" *AND* also says she has mammograms "when MD recommends."
Contemplation	Has never had a mammogram, but plans to have one in the coming year. (or) Is off-schedule after having a prior mammogram, but intends to have one in the coming year.
Inconsistent/Early Action	Has had two or more mammograms in the past but not on a regular schedule. Intention *does* exist to have a mammogram in the next 1–2 years. Also includes women with no recent history but who reported having a mammogram scheduled.
Action	Has had one mammogram on yearly schedule, and intends to have another on a time frame that will keep the woman on schedule.
Maintenance	Has had at least two mammograms on yearly schedule, and intends to have another on a time frame that will keep the woman on schedule.

TABLE 4

Results of Analysis of Variance for the Definition of the Stages-of-Adoption that Uses Intention for Future Screening[a]

Model Constructs	PreCon/ Relapse N = (51)	Relapse Risk N = (30)	Provider Recommendation N = (38)	Contemplation N = (59)	Inconsistent Action N = (153)	Action N = (237)	Maintenance N = (735)
Decisional Balance							
M	−43.39	−19.52	−12.80	−2.85	−2.29	1.39	5.54
SD	33.49	26.17	17.24	18.47	16.02	12.66	11.00
	F = 110.28, *df* = 6, 1,316, *p* < .0001						
Commitment							
M	23.78	40.54	42.36	45.15	49.04	50.54	53.23
SD	15.07	15.91	11.80	11.77	8.97	7.73	6.22
	F = 123.92, *df* = 6, 1,316, *p* < .0001						
Information Sharing							
M	25.85	42.02	45.09	47.72	47.95	50.18	52.39
SD	18.80	13.40	12.60	11.64	10.43	8.33	7.21
	F = 76.21, *df* = 6, 1,316, *p* < .0001						
Thinking Beyond							
M	35.82	44.04	43.91	47.72	48.70	49.86	51.27
SD	11.98	12.39	10.00	10.61	10.78	9.81	9.50
	F = 24.09, *df* = 6, 1,316, *p* < .0001						
Avoids Contact							
M	57.89	58.71	52.13	54.91	50.47	49.96	47.38
SD	11.99	10.73	11.53	12.42	10.73	8.81	8.81
	F = 21.58, *df* = 6, 1,314, *p* < .0001						

[a] Precontemplation (PC) versus Relapse (R) differences: Decisional Balance, PC = −53.43 (SD = 29.72), R = −37.43 (SD = 34.61); Commitment, PC = 17.29 (10.35), R = 27.63 (16.22); Information sharing, PC = 16.91 (13.94), R = 31.16 (19.47); Thinking beyond, PC = 30.42 (8.23), R = 39.02 (12.78); Avoids contact, PC = 54.76 (11.86), R = 59.76 (11.85).

TABLE 5

Results of Analysis-of-Variance for the Definition of the Stages-of-Adoption Based on a Single Item

	Stages of Adoption					
Model Constructs	Never Had or One Only N = (85)	On No Schedule N = (60)	Provider Recommendation N = (42)	Every Other Year N = (93)	Between 1–2 Years N = (62)	Yearly N = (979)
Decisional Balance						
M	−24.62	−15.92	−12.60	−1.38	−2.31	4.64
SD	30.17	30.74	19.91	15.34	15.05	11.71
	F = 78.30, *df* = 5, 1,317, *p* < .0001					
Commitment						
M	35.44	39.26	42.08	49.38	47.69	52.69
SD	16.55	15.83	13.15	7.69	9.34	6.87
	F = 90.44, *df* = 5, 1,317, *p* < .0001					
Information Sharing						
M	36.97	40.94	44.98	49.75	48.96	51.72
SD	18.51	15.53	13.28	9.26	9.89	7.76
	F = 49.96, *df* = 5, 1,317, *p* < .0001					
Thinking Beyond						
M	40.81	45.71	44.01	48.08	46.69	51.16
SD	11.76	11.31	9.82	10.61	10.61	9.71
	F = 23.65, *df* = 5, 1,317, *p* < .0001					
Avoids Contact						
M	54.55	58.96	52.51	53.37	50.79	47.68
SD	11.91	10.91	12.47	10.76	8.93	8.86
	F = 28.20, *df* = 5, 1,315, *p* < .0001					

4 and 5. The full set of data for this third definition are available upon request.]

The present study was not intended to determine which of the two definitions was the best algorithm for staging readiness to adopt regular mammography. The intent of this investigation was to examine whether associations could be observed with both methods of defining stage-of-adoption. We did not have a predetermined set of stages. Each stage was defined by the two methods. We believed that stage definitions in other studies would be based on varying degrees of information about a woman's prior screening history and future intention, so that application of the TTM to mammography would benefit most from knowing that associations consistent with the TTM were found across those different types of definitions.

Stages-of-Adoption with Intention Included: The most comprehensive definition for staging employed both past mammography behavior (i.e. timing of the two most recent mammograms) plus intention to continue having mammograms in the future. The criteria for staging are presented in Table 3. The stages were Precontemplation, Relapse, Risk of Relapse, Provider's Recommendation, Inconsistent and Early Action, Action, and Maintenance.

The Precontemplation, Relapse, Contemplation, Action, and Maintenance stages have been used in prior reports (25,26,33,34) and were also used for intervention purposes by Skinner and colleagues (35). The three other groups were new in this investigation. We did not know exactly where Relapse Risk, Provider's Recommendation, and Inconsistent Action would fit along the stage continuum, although we expected them to be less positive than women in Action and Maintenance. The "Risk of Relapse" group was defined separately here due to the number of women whose history of prior screenings placed them on schedule, but whose intention for future screening indicated that they were not planning to have another one on that same schedule.

The possible need for a "Provider's Recommendation" group was suggested by the relatively large number of women who said both that they would have their next mammogram when the physician recommended and that they usually had their mammograms when the physician recommended. We did not simply want to place these women in the Contemplation stage, because many of them did have a recent past mammogram. However, their future intention seemed to depend upon the physician and implied a reactive rather than a proactive orientation.

Finally, the "Inconsistent and Early Action" group was created because many women reported an inconsistent past mammography history but still intended to have a mammogram in the next year or two. For example, a woman might have had a mammogram in the past two years, but the next prior one was more than two years before that. This group also included women who never had a mammogram, but said that they had one scheduled. Again, we did not want to place these women

in Contemplation, because some action toward mammography was evident; but we did not think that they had yet shown an Action-level commitment.

Stages Based on a Single Item: The second way of defining stages-of-adoption was based on a single item, "Generally speaking, how often do you have a mammogram?" The stage groups were formed from the following preestablished response categories: Never Had a Mammogram or Had One Mammogram Only; Has Had Prior Mammograms but on No Particular Schedule; On My Provider's Recommendation; Every Other Year; Between One and Two Years; and Yearly. This one-item version of staging was seen as the minimum of information that might be available, such as a patient's self-report survey at a medical office or her response to an opening question in a provider–patient conversation about mammography. The "Provider's Recommendation" group in this version of staging did not have the same number of women as did the group with the corresponding stage label in the first definition. This is because the first version was based on giving that response to two items (i.e. expected next mammogram, how regularly mammograms are obtained), as opposed to only one question in this version.

RESULTS

Tables 4 and 5 present the results of analyses for each of the definitions of the stages-of-adoption, with the five TTM decisional balance and process-of-change constructs as dependent variables. It is not a requirement of the TTM that each stage-of-adoption must differ from every other stage-of-adoption on each decisional balance and process-of-change measure.

However, there is the *a priori* directional hypothesis that as stage-of-adoption proceeds from Precontemplation through Contemplation to Maintenance, decisional balance and process-of-change indices will also become progressively more positive. Some adjacent stages might not differ statistically, but we would not expect to find extensive plateaus where several consecutive stages were similar on both decisional balance and processes-of-change. Nor should there be reversals of expected associations such as Contemplation having more positive decisional balance or processes-of-change than Action or Maintenance.

Stages of Adoption with Intention Included

Table 4 presents results from analyses-of-variance that examined the association between TTM constructs and the stage-of-adoption definition that included future intention. Results for all five dependent variables were statistically significant at $p < .0001$ and are discussed in turn. The Precontemplation ($N = 19$) and Relapse ($N = 32$) stages were combined in Table 4 in order to preserve sample size because "Precontemplators" were the smallest group in the sample. Other analyses (not reported here) showed that even though Precontemplation and Relapse were each significantly more negative than Action and Maintenance, "Precontemplators" were also significantly more unfavorable than the "Relapse" group. Therefore, despite being combined for analysis, the separate means and standard deviations for Precontemplation and Relapse are provided in a footnote to Table 4.

Decisional Balance: The summary decisional balance score yielded a strong association with stage ($F = 110.28$; $df = 6,1316$). Because this first definition employed seven stages, there were 21 possible pairwise comparisons. With only two exceptions, all pairwise comparisons were significant. Specifically, the follow-up Newman-Keuls analysis revealed no difference between Contemplation and Inconsistent/Early Action (means = −2.85 and −2.29), although both were slightly negative. In addition, the "Relapse Risk" and "Provider's Recommendation" groups did not differ (means = −19.52 and −12.80). Of interest was the extremely low decisional balance score for women in the combined "Precontemplation/Relapse" group (mean = −43.39).

Processes-of-Change: Results for Commitment to Screening were also strong ($F = 123.92$; $df = 6,1316$), showing a linear association with stage-of-adoption. Three comparisons did not differ; all others were significant. As also occurred with decisional balance, the "Relapse Risk" and "Provider's Recommendation" groups did not differ (means = 40.54 and 42.36). The "Provider's Recommendation" group also did not differ from "Contemplation" (mean = 45.15). Finally, the "Action" and "Inconsistent/Early Action" groups did not differ (means = 50.54 and 49.04).

The Information Sharing and Communication process was also strongly related to stage ($F = 76.21$, $df = 6,1316$). As in the prior two analyses, the "Relapse Risk" and "Provider's Recommendation" groups did not differ (means = 42.02 and 45.09). In addition, the "Provider's Recommendation" group, the "Contemplation" group, and "Inconsistent/Early Action" did not differ (means = 45.09, 47.72, and 47.95). "Relapse Risk" *did* differ from these latter two groups. Overall, therefore, there were several groups in the middle portion of the continuum of adoption which were underusing the process of information sharing and communication. However, all of these intermediate groups still had significantly higher scores than the combined "Precontemplation/Relapse" group, which was very low (mean = 25.85).

Results for Thinking Beyond Oneself were not as strong as the other two processes ($F = 24.09$; $df = 6,1316$), but the expected trend across stages was still observed in that more positive scores occurred when moving from Precontemplation/Relapse (mean = 35.82) through Maintenance (mean = 51.27). The pattern for this process appeared to be one of clear differences at the extreme stages. The "Precontemplation/Relapse" group was significantly lower (less favorable) than the other six groups, and Maintenance was significantly higher than all other stages except Action.

At intermediate stages, Contemplation was a pivotal point between the Relapse Risk and Provider's Recommendation stages versus the Inconsistent Action and Action stages. That is, Relapse Risk, Provider's Recommendation, and Contemplation did not differ (means = 44.04, 43.91, and 47.72); and Contemplation, Inconsistent Action, and Action did not differ (means = 47.72, 48.70, and 49.86). However, Relapse Risk and Provider's Recommendation *did* differ from Inconsistent Action and Action.

Finally, an association with stage was observed for the variable of Avoids Contact with Health Care ($F = 21.58$; $df = 6,1314$). The "Precontemplation/Relapse" group, the "Relapse Risk" group, and the "Contemplation" group did not differ statistically (means = 57.89, 58.71, and 54.91). They had the highest scores on this index, indicating a greater tendency to avoid physicians when ill or healthy. Women in Maintenance had the lowest group average compared to each of the other six

stages (mean = 47.38), suggesting less of a tendency to stay away from the health care system. Action, Inconsistent Action, and Provider's Recommendation were closer to the T-score mean of 50 and did not differ (means = 49.96, 50.47, 52.13). This was the only analysis in Table 4 where the "Provider's Recommendation" group differed (i.e. had a more favorable score) than the "Relapse Risk" group.

Stages-of-Adoption Defined by A Single Question

Table 5 presents results from analyses-of-variance that examined the association between TTM constructs and the stage-of-adoption definition that used only the single question. Results for all five dependent variables were statistically significant at $p < .0001$ and are discussed in turn.

Decisional Balance: Results for the overall decisional balance score were strong (F = 78.30; *df* = 5,1317) and suggested than even a single question with several distinct response options could help to distinguish women's opinions about mammography. This second definition used six stages-of-adoption, so that there were 15 possible pairwise comparisons. All but two pairwise comparisons were significant. The "Provider's Recommendation" group did not differ from women who said they were on no particular schedule (means = −15.92 and −12.60), although both were negative. In addition, the "Every Other Year" group did not differ from the women who said they had a mammogram every one to two years (means = −1.38 and −2.31). These latter two groups were close to the zero-value point on the decisional balance index but were significantly higher than the "Provider's Recommendation" and "On No Particular Schedule" groups.

Processes-of-Change: The same pattern of results occurred for the process-of-change variable Commitment to Screening (F = 90.44; *df* = 5,1317). The "Provider's Recommendation" group did not differ from the women who said they were on no particular schedule, although both were unfavorable (means = 39.26 and 42.08). The "Every Other Year" group did not differ from the women who said they had a mammogram every one to two years (means = 49.38 and 47.69). These latter two groups were significantly higher than the "Provider's Recommendation" and "On No Particular Schedule" groups. All other comparisons were significant.

The Information Sharing and Communication process-of-change also was significantly associated with stage (F = 49.96; *df* = 5,1317). In this case, no differences were found between the "Every Other Year," "Every 1–2 Years," and "Yearly" groups (means = 49.75, 48.96, and 51.72). All other pairwise comparisons were significant. These results suggested lower information-sharing when screening occurred less than every other year.

The results for Thinking Beyond Oneself (F = 23.65; *df* = 5,1317) and for Avoids Contact with Health Care (F = 28.20; *df* = 5,1315) followed a very similar pattern. For Thinking Beyond Oneself, women in the "Never Had Mammogram" or "Only One Mammogram" group had lower scores than women in all other stages, except for Provider's Recommendation (means = 40.81 and 44.01). Women who said that they had mammograms yearly had higher scores than women in all other stages (mean = 51.16). Women in the intermediate stages did not differ (i.e. No Particular Schedule, Provider's Recommendation, Every Other Year, Between 1–2 Years).

For the variable Avoids Contact with Health Care, women who said that they had a mammogram yearly had significantly lower (more positive) scores than women in the other five groups (mean = 47.68), suggesting less of a tendency to stay away from the health care system. In contrast, women who said that their mammograms occurred on no particular schedule had significantly higher (more negative) scores (mean = 58.96). Women in the other stages did not differ from one another (i.e. None or Only One Mammogram, Every Other Year, Provider's Recommendation, Between 1–2 Years).

DISCUSSION

The results of the analyses presented in Tables 4 and 5 support the application of the Transtheoretical Model to screening mammography, as earlier studies have suggested (25,26,33–35). However, this report extends that prior work in two ways. First, two definitions of TTM stages-of-adoption were employed. These definitions varied in whether or not intention for future screening was used to create the stages and also in whether the stage definition was based on several questions or on a single question. Secondly, the present study included processes-of-change indices, while prior reports had been limited to decisional balance. Moreover, a process-of-change that was not specific to mammography appeared to be a useful addition to the traditionally behavior-specific approach of the TTM.

There were no instances where the expected order across staging groups was violated. For example, Precontemplation/Relapse never exceeded any of the action-based stages on decisional balance or processes-of-change (Table 4). Similarly, women who had no more than one prior mammogram or those who said that their mammograms were on no particular schedule were always more negative than women who said that their mammograms were at least every other year (Table 5). The most committed stage was consistently the most favorable on each definition. Instances of similar mean values tended to occur in those less committed stages.

Stages-of-adoption are a central feature of the TTM, but having a large number of stages-of-adoption may not improve the model. Stages should be empirically supported. For example, we did not know prior to analyses whether the "Every Other Year," "Between 1–2 Years," and "Yearly" groups would differ for the single-item definition in Table 5. The "Yearly" group did tend to have a higher average on all indices except for Information-Sharing. However, the "Every Other Year" and "Between 1–2 Years" groups did not differ on decisional balance and processes-of-change. Perhaps this distinction is not necessary in future research studies and intervention projects.

For the stage definition that included intention for future screening, it appears that the "Relapse Risk" group (Tables 3 and 4) may be a useful addition to the stages-of-adoption for mammography. Women in this group differed from women in "Action" and "Maintenance" based simply on their stated lack of intention for future screening. Screening mammography is a periodic activity with at least one year elapsing between screenings. One of the few ways to anticipate who may relapse before the next screening date is to obtain an estimate of the woman's risk of lapsing by asking future intention. The fact that significant differences emerged for all five dependent variables is a strong indication that adding intention to past behavior provides an important additional insight into views about the value of screening.

The "Provider's Recommendation" group may also be a useful addition for the TTM's application to mammography. Decision-making for health-related practices such as smoking cessation, physical activity, dietary control, and sun exposure is almost always carried out on a daily basis. These behaviors also can be, and very routinely are, modified by the individual without extensive control by medical care providers. In contrast, although self-referral is possible, most women obtain their mammograms in conjunction with a provider's recommendation. One of the ways to estimate which women may have a passive approach to scheduling their mammograms is to identify those who seem to rely heavily on their physicians to provide the timetable. The fact that the "Provider's Recommendation" group was more negative than the Action and Maintenance stages (Tables 4 and 5) supported this categorization. These are women who may benefit from interventions that teach them about the guidelines and cue them to be committed to their own schedule.

In most of the analyses, the "Relapse Risk" group did not differ from the "Provider's Recommendation" group. Both groups expressed less favorable views about mammography than did women in "Action" and "Maintenance." The one difference between them occurred for the variable of Avoiding Contact with the Health Care System, where the "Relapse Risk" group was more negative than the "Provider's Recommendation" group. This difference is understandable, insofar as women who say they will rely on their physician's cue are presumably anticipating some contact with the health care system, while women not expressing an intention for future screening may or may not be planning another visit. Therefore, intervention applications might well consider both "Relapse Risk" and "Provider's Recommendation" groups to be relatively negative towards mammography, but the "Relapse Risk" group has the additional overlay of a less favorable tendency to contact the health care system.

One of the consistent findings of the analyses was the very unfavorable decisional balance and process-of-change status of women in the least committed groups. These were the combined Precontemplation/Relapse stage (Table 4) or those who reported none or only one prior screening (Table 5). In a very real sense, these women were "a group apart" from the rest of the sample. Because of human subject guidelines, all women who were contacted knew that the present study was specific to mammography. Consequently, it could be expected that any Precontemplators or women who had never had a mammogram, yet who volunteered for the study, might still be positive about the procedure. Perhaps other factors had intervened to prevent their regular screening. However, their relative negativity was still clearly evident. Moreover, this report was specific to women aged 50 and over—a group of women who have been repeatedly exposed to media messages about mammography. The fact that these relatively negative opinions continue to be expressed suggests that there are still some extremely skeptical women whose concerns about mammography need to be addressed.

The analyses also suggest that having two or more prior mammograms is not sufficient to ensure favorable opinions about the procedure. Women with two or more mammograms comprised 93% of both the "Inconsistent/Early Action" group and the "Relapse Risk" group (Table 4). Over 50% of these women reported four or more prior mammograms. Yet, these two groups were consistently less favorable than women in "Maintenance." In addition, the "On No Particular Schedule" group (Table 5) was comprised exclusively of women who had two or more prior mammograms. The relatively more negative decisional balance and processes-of-change for these groups indicate that the regularity of timing in a woman's report of her screening history is important. An irregular pattern should not be ignored, even if she reports multiple past exams.

Although the results of this study are promising, there is still a potential to refine the pros, cons, and process measures. The pros and cons scales used to derive the overall decisional balance index were relatively long (i.e. 9 and 16 items). At present, there is no established set of core statements that has been used across several studies to assess opinions about mammography, although several groups of investigators now are using similar items. It would have been possible to employ a pros scale and a cons scale derived by a components analysis of the items, performed after the baseline survey was completed. These indices would be shorter than the 9- and 16-item versions. Our choice for this paper was to use the items as initially defined before the survey, rather than use the shorter indices. Use of these latter scales does not change the pattern of results, and the indices are available upon request.

However, it is also possible that there will be no single, standard set of statements. A woman's screening status and past history may need to be considered. For example, studies of women who have had to deal with the sequelae of abnormal mammograms may require a somewhat different set of pros and cons items about the value of mammography than studies of women who have not had this happen to them. Similarly, studies limited to women in "Precontemplation" and "Relapse" may not utilize the same set of pros and cons items as studies of women solely in "Action" and "Maintenance." In the former case (Precontemplation/Relapse), the objective is to achieve at least one mammogram, whereas the objective in the latter case (Action/Maintenance) is to promote continued mammography.

Also, further work is needed to determine the extent to which the results reported here can be extended to minority women. Only about 5% of the present sample were members of racial and ethnic minority groups. Stage-of-adoption information is needed for women of color. In addition, the content of pros, cons, and processes-of-change statements may be affected by their life experiences and current circumstances, particularly if socioeconomic status and access issues are involved.

Finally, the processes-of-change may also be further refined. In regard to the four processes-of-change measures, there was consistent evidence that some of the intermediate stages had similar group averages, particularly for Information Sharing and Communication, Thinking Beyond Oneself, and Avoids Contact with Health Care. These intermediate groups were relatively more favorable than the least committed stages-of-adoption but were also less favorable than the most committed stages. Interventions will have to address movement along processes, not only along the decisional balance dimension.

It is important to note that the coefficient alphas for three of the indices show room for improvement towards tighter constructs. Part of the difficulty in establishing well-defined processes-of-change rests in the fact that most literature does not report on how women think about mammography (if at all) or issues of breast cancer between medical visits and screening appointments. The impression, by default, is that mammograms are discrete events with little attention given to events in the

period of time between them. On the other hand, the periodicity of mammography may imply that there will not be as well-defined mechanisms of change as there appear to be for behaviors that must be dealt with on a regular and even day-to-day basis (e.g. exercise, smoking cessation, weight control). One intent of this report is to bring these mammography process-of-change scales into wider use, so that other investigators can elaborate upon them. Data need to be collected on how women think about mammography in between regular visits.

In summary, an association was observed between two different definitions of mammography stage-of-adoption and the decisional balance and process-of-change measures of the Transtheoretical Model of behavior change. It appears that even a single question can be used to derive a basic staging of women (Table 5), although the more detailed staging based on past history plus future intention (Table 4) provided greater discrimination at the extremes of the least and most committed. This consistency of association between definitions supports the validity of the TTM stages-of-adoption constructs as applied to screening mammography. The more detailed definition is preferable, in that it is consistent with staging algorithms used for other behaviors and therefore allows better comparisons across both mammography-related studies and different behaviors.

In addition, the results for the single-item definition (Table 5) suggest that staging is possible even in busy clinical settings. A single question for staging, with preestablished response options, should be something that clinicians can implement with only a modest amount of training. A simple report of mammography regularity, given by a woman in a clinical setting, can be an important cue to the clinician to follow up with an assessment of her opinions about the value of the procedure and potential barriers to screening. The ultimate value of the TTM lies not only in aiding researchers and practitioners to understand breast screening behavior but also in serving as a guide for the development of practical interventions. The data presented here provide further evidence that the TTM can make an important contribution in both of these areas.

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