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The Identification of Cognitive Profiles among Women Considering *BRCA1/2* Testing through the Utilization of Cluster Analytic Techniques

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Abstract

Based on the Cognitive-Social Health Information Processing model, we identified cognitive profiles of women at risk for breast and ovarian cancer. Prior to genetic counseling, participants ($N = 171$) completed a study questionnaire concerning their cognitive and affective responses to being at genetic risk. Using cluster analysis, four cognitive profiles were generated: (a) high perceived risk/low coping; (b) low value of screening/high expectancy of cancer; (c) moderate perceived risk/moderate efficacy of prevention/low informativeness of test result; and (d) high efficacy of prevention/high coping. The majority of women in clusters one, two and three were unaffected, whereas cluster four consisted almost entirely of affected women. Women in cluster one had the highest number of affected relatives and experienced higher levels of distress than women in the other three clusters. These results highlight the need to consider the psychological profile of women undergoing genetic testing when designing counseling interventions and messages.

Keywords

breast and ovarian cancer risk; cluster analysis; cognitive profiles; genetic testing; psychological distress

The availability of genetic testing for *BRCA1/2* mutations has not only made it possible to identify individuals at increased risk for breast and/or ovarian cancer, but now additionally offers the promise of providing medical risk reduction options for eligible individuals (Daly, 1999). However, genetic cancer risk information poses psychological challenges that can lead to distress, including dealing with high levels of threat and uncertainty, the need to make difficult risk management decisions, and the challenge of communicating risk information to family members (Miller, Bowen, Croyle, & Rowland, 2009; Miller, McDaniel, Rolland, & Feetham, 2006). Studies show that among women undergoing genetic counseling and testing, baseline distress is one of the strongest predictors of distress experienced post-genetic counseling and/or post-genetic testing (Schlich-Bakker et al., 2008; Smith et al., 2008). Further, levels of distress have been associated with genetic testing decision making, risk reduction decisions, and screening adherence (Miller & Roussi, in press; Schwartz, Peshkin, Tercyak, Taylor, & Valdimarsdottir, 2005). Thus, in order to facilitate quality decision making regarding genetic testing and risk management, it may be important to assess, *prior* to testing, which women are vulnerable to distress. In this study, we delineated cognitive profile subtypes of women at putative hereditary risk for breast and/or ovarian cancer who were undergoing genetic counseling, and examined the relationship between these profiles and distress levels.

We based our hypotheses on the Cognitive-Social Health Information Processing (C-SHIP) model, which proposes that how individuals process and emotionally respond to health information is a function of a network of cognitive and affective units, consisting of the mental representations of a person's encoding constructs, beliefs and expectancies, goals and values, and self-regulatory strategies (see Table 1) (Miller, Shoda, & Hurley, 1996; Shoda & Mischel, 2006). Based on relevant theory, literature and findings, the model holds that individuals' encodings (e.g., perceived risk), beliefs and expectancies (e.g., about the efficacy of available courses of action), health-related values and goals (e.g., the importance of different courses of action), and self-regulatory competencies (e.g., perceived competencies to handle health-related distress) combine with cancer-specific and general levels of distress to produce a multifactorial response to health challenges such as genetic risk testing (Bandura, 1986; Leventhal, Diefenbach, & Leventhal, 1992; Miller & Diefenbach, 1998; Miller, Fang, Manne, Engstrom, & Daly, 1999; Miller et al., 1996).

The literature regarding levels of distress in women at high risk is equivocal, with some studies showing that they experience higher levels of distress, compared to the general population, particularly anxiety and cancer-specific distress (Dorval et al., 2008; Erblich, Bovbjerg, & Valdimarsdottir, 2000; Hopwood et al., 1998; Valdimarsdottir et al., 1995), while others show no differences (Butow et al., 2005; Coyne, Benazon, Gaba, Calzone, & Weber, 2000). Some of the conflicting findings may be reconciled by the fact that the samples vary on both medical and background psychosocial variables (Lerman & Schwartz, 1993). For example, previous studies have shown that the cognitive factors experienced by women at high risk for breast and/or ovarian cancer, including encodings [high perceived risk (Cull, Fry, Rush, & Steel, 2001; Mellon et al., 2008)], beliefs and expectancies [low perceptions of personal control and high perceptions of chance control (Cull et al., 2001), low self-efficacy (Mellon et al., 2008)], and self-regulatory competencies [low levels of comforting thoughts (Pieterse et al., 2007; for a review see Thewes, Meiser, Tucker, & Schnieden, 2003)], are predictably related to distress.

Hence, it may be useful to systematically delineate the profiles of cognitions that are related to distress to further help explain variations in response (Hurley, Miller, Rubin, & Weinberg, 2006). By proposing that the network of cognitive and affective units are activated in a predictable yet unique pattern within a given person as a result of the individual's current

and past experiences (Shoda & Mischel, 2006), the C-SHIP model is well-suited to this task. Individuals with common life experiences tend to be characterized by a cognitive network with similar profiles, and thus may constitute a “psychological subtype” (Mendoza-Denton, Ayduk, Shoda, & Mischel, 1997). One of the primary factors that has been taken into consideration in past studies examining psychological adjustment among high risk women seeking genetic counseling is whether or not women have had a personal experience with cancer (affected/unaffected), but also whether they have witnessed the disease in their relatives (Cameron & Reeve, 2006; Erblich et al., 2000; MacDonald, Sama, Uman, Grant, & Weitzel, 2005; Mellon et al., 2008). Affected and unaffected high risk women share common concerns, including the salient threat of cancer and the possible implications of their mutation status for other family members. Indeed, several studies show that there are no differences in psychological distress between unaffected and affected women diagnosed for more than a year (Cameron & Reeve, 2006; Coyne et al., 2000; Dorval et al., 2008; Schlich-Bakker, ten Kroode, Warlan-Rodenhuis, den Bout, & Ausems, 2007; Smith et al., 2008; Wood, Mullineaux, Rahm, Fairclough, & Wenzel, 2000). However, differences have been reported in cognitive responses: for example, perceived risk is higher among unaffected women (Cameron & Reeve, 2006; MacDonald et al., 2005; Mellon et al., 2008). In addition, unaffected women are more likely to report that a family history of cancer is a personal risk factor, when compared to affected women (Mellon et al., 2008). In fact, the extent to which one’s family has been affected by cancer has been positively related to distress (Lodder et al., 1999). Taken together, the findings suggest that affected and unaffected at risk women may be characterized by a pattern of overlapping but distinctive constellations of cognitions, which reflect their specific personal and familial histories with cancer (Hurley et al., 2006), and may have implications for their levels of distress.

While the findings to date suggest that specific cognitions associated with personal and family history of cancer are related to distress, the studies mainly rely on the use of bivariate analyses (e.g., the relationship between perceived risk and distress), which may provide an incomplete picture regarding the psychological profile of women who are likely to experience high levels of distress (Thewes et al., 2003). It is important to better understand these profiles, since negative affect has been associated with impulsive decision making (Gillis, 1993; Miller et al., 1999; Schwartz et al., 2005) and has been found to influence the execution of health behaviors (Schwartz et al., 2005). The identification of specific cognitive profiles would allow for the design of targeted or tailored interventions for distress management which should ultimately lead to optimal decision making among high risk women. The C-SHIP model proposes that how individuals process health information is a function of a *network* of cognitive units, reflecting personal and common life experiences, and that the implications for distress depend on the cognitive networks that are activated in the processing of cancer risk. Further, the types of messages that women may benefit from vary, depending on the specific cognitions activated. For example, women characterized by high perceived risk and low ability to regulate affect may benefit from interventions aimed at facilitating the deeper processing of the health threat involved, since the processing of threat helps to undermine interfering negative affect and foster more adaptive self-regulatory skills (Foa & Kozak, 1991). Conversely, women with unrealistically low perceived risk and high perceived ability to manage risk-related distress may benefit from more extensive education regarding their actual risk.

Cluster analysis is a method that has been widely used in different areas of psychology to identify similar subgroups within a larger heterogeneous group (Henry, Tolan, & Gorman-Smith, 2005; Mun, Eye, Bates, & Vaschillo, 2008), but has not been as frequently used in health psychology (Fox & Lyon, 2007; Maibach, Maxfield, Ladin, & Slater, 1996; Scharff et al., 2005; Smith & Wallston, 1996). This analytic method can be helpful in testing hypotheses generated by the C-SHIP model, because it allows the simultaneous

consideration of multiple cognitive units as specified in the model. The identification of subtypes of women who are similar to one another is particularly important in genetic risk assessment, if one is to develop interventions that are better targeted and tailored to specific groups which share important psychosocial characteristics (Kreuter, Lukwago, Bucholtz, Clark, & Sanders-Thompson, 1999).

The overarching aim of this study was to characterize the cognitive profile subtypes of women at high risk for breast and/or ovarian cancer who were seeking genetic counseling, and to explore how these profiles are related to distress, both general and cancer-specific. In addition, consistent with the C-SHIP model (which proposes that these profiles reflect personal and common life experiences), we hypothesized that one or more subtypes would be identified, associated with whether or not women had experienced a personal history of cancer, as well as with their number of affected first-degree relatives. In order to test these hypotheses, we used cluster analysis to identify the cognitive profile subtypes of women at putative hereditary risk for breast and/or ovarian cancer seeking genetic counseling, and examined the associations between cognitive profile subtypes and demographic variables, personal history of cancer (affected vs. unaffected), family history of cancer (number of affected relatives), and levels of distress.

Method

Participants and Procedures

The present study is part of a larger research effort that was conducted with women at putative hereditary risk for breast and/or ovarian cancer seeking genetic counseling. Women ($N=171$) were recruited from the Family Risk Assessment Program (FRAP) at Fox Chase Cancer Center (FCCC) and four affiliated Fox Chase Network hospitals, during their first self-initiated telephone contact to the program. Following the initial call, women who had verbally consented to participate were mailed a packet of questionnaires and were asked to return the completed packet during their first visit to FRAP (one week later), at the beginning of the first counseling session. Recruitment occurred between May 1998 and October 2000.

Women eligible for the study had to be at least 21 years of age, have a family history consistent with a putative hereditary pattern of breast and/or ovarian cancer, have the ability to communicate in English, competency to provide informed consent, and to live within one hour from the clinic. The study was approved by the Institutional Review Board at FCCC. One hundred and ninety seven women out of 315 who were invited to participate in the study gave consent and returned the questionnaires (63%). Of those, 26 (13%) were excluded because they returned questionnaires with incomplete data on the cognition variables, the variables used for the cluster analysis. Women who refused to participate differed from those who consented in that they were less likely to have a college education, $\chi^2 = 8.18, p < .01$, less likely to have children, $\chi^2 = 4.05, p < .05$, and less likely to be Caucasian, $\chi^2 = 5.75, p < .01$. Women who had incomplete data sets were more likely to be older, $t(197) = 1.98, p = .05$; incomplete data: $M = 49.93, SD = 12.02$; complete data: $M = 45.05, SD = 12.12$, and more likely to be affected, $\chi^2 = 10.05, p < .01$.

Measures

Background variables—Participants were assessed on relevant sociodemographic variables, including age, education, marital status, number of children, and ethnic status. Categorical variables (education, marital status, and ethnic status) were dichotomized for the analyses, based on the distribution of responses. In addition, information regarding personal history of cancer and family history of breast and ovarian cancer was collected. Reflecting

the clinic demographics, the mean age was 45.05 ($SD = 12.12$), and 59% of the women had a college education or higher. The majority were Caucasian (96%), married or living with a partner (71%), and had children (80%). Thirty three percent had been affected by breast or ovarian cancer. The average time since diagnosis was seven years and seven percent of the women had been diagnosed in the 12-month period prior to study participation. Eighty percent (79.5%) had at least one first-degree relative affected by breast and/or ovarian cancer, $M = 1.12$, $SD = .84$.

Cognition variables—Questionnaire items were developed specifically for this research, based on cognitive-affective theory (Miller et al., 1996; Shoda & Mischel, 2006) and on prior research within the breast/ovarian cancer context (Lerman et al., 1996). Based on theory, the items were categorized into encoding, beliefs and expectancies, values, and self-regulatory variables. For each variable, factor analysis was performed to empirically derive the subscales. The same types of questions have been used in other cancer contexts and have exhibited good validity (Miller et al., 2009). For women affected with breast or ovarian cancer, the cognition variables were calculated based on the type of cancer women were at risk to incur for the first time, ovarian or breast cancer, respectively.

Encoding—To estimate perceived risk of cancer, we used a measure based on prior research within the breast/ovarian cancer context (Lerman et al., 1996). The scale comprised six items, three relating to breast cancer risk and three relating to ovarian cancer risk. For example, women were asked to state the degree to which they believed they were likely to get breast or ovarian cancer compared to other women with or without a family history of breast or ovarian cancer on a five-point scale. Cronbach's alpha for the scale was adequate at .62.

Beliefs and Expectancies—Three separate subscales were used to measure expectancies. The first comprised two items that asked women to state the degree to which they expected they would get breast or ovarian cancer if they received a positive genetic test result, on a five-point scale. Cronbach's alpha for the scale was .95. The second consisted of two items that asked women to state the degree to which they expected they would not get breast or ovarian cancer if they received a negative genetic test result, on a five-point scale. Cronbach's alpha for the scale was .98. The third (efficacy of prevention measures) comprised seven items where women were asked to state the degree to which they expected they could reduce cancer risk by various means such as screening, uptake of risk-reduction surgery, or lifestyle changes, on a five-point scale. Cronbach's alpha for the scale was .71.

Values—Two separate subscales were used to measure the personal importance and value of screening and genetic testing. The first subscale comprised five items where participants were asked to state how important screening for breast and ovarian cancer was for them (i.e., mammograms, ultrasounds, CA125 tests, clinical breast exams, and breast self-exams), on a five-point scale. Cronbach's alpha for the scale was .64.

The second subscale comprised two items whereby participants were asked to state, on a five-point scale, how important genetic testing for breast and ovarian cancer was for them and their family. Cronbach's alpha for the scale was .74.

Self-regulatory Skills—The subscale comprised seven items whereby women were asked to state, on a five-point scale, the degree to which they were able to calm themselves when they thought about their chances of developing breast and/or ovarian cancer, when they became anxious about their breast or ovarian risk, or when they were screened for breast or ovarian cancer. Cronbach's alpha for the scale was .85.

Outcome variables—Two distinct measures of distress were used (Fletcher et al., 2006). We included both commonly used measures of cancer-specific affective responses to awareness of enhanced risk (intrusive ideation and specific cancer worry) and a measure of general distress, which is thought to tap more enduring affective levels, which are influenced by a variety of ongoing life stressors (Fletcher et al., 2006).

Cancer-specific distress (affective responses)—Two scales were used. The first scale was based on an instrument developed by Lerman et al. (1991) and comprised six items where women were asked to rate their intensity of worry on a five-point scale. Specifically, participants were asked how worried they were about their own chances of developing breast or ovarian cancer, how often thoughts about their own chances of developing breast or ovarian cancer affected their mood, and how often thoughts about their own chances of developing breast or ovarian cancer affected their daily activities. Cronbach's alpha for the scale was .76. Second, intrusive ideation related to one's genetic risk for breast and/or ovarian cancer was assessed using the Impact of Events Scale (IES, Horowitz, Wilner, & Alvarez, 1979). This instrument has been used extensively in the genetic testing literature (Schwartz et al., 2002). Cronbach's alpha for the intrusion subscale in the present study was .86.1

General distress—The Beck Depression Inventory (BDI, Beck, Ward, & Mendelson, 1961), a well-validated instrument for depression, was used to measure more persistent negative mood symptoms. It comprises 21 symptoms characteristic of depression; participants were asked to indicate the degree to which they experienced each symptom during the past two weeks, on a four-point scale. Cronbach's alpha for the present study was .87.

Results

Cluster Analysis of Cognition Variables

The intercorrelations among the cognition variables are shown in Table 2. In order to explore the subtypes of cognitive profiles, we conducted hierarchical cluster analysis, which allows the partition of the sample into homogeneous groups on designated variables. In this instance, the variables used for cluster formation were the cognition variables (risk perceptions, beliefs and expectancies, value of genetic testing and of screening, and self regulation). All variables were standardized for the cluster analysis. Ward's minimum variance was used as the grouping method and squared Euclidean distance was used as the proximity measure in clustering the data; the tree diagram indicated a four-cluster solution. Multivariate analysis, followed by univariate tests, confirmed that the four clusters differed on all seven cognition variables, $F(21, 489) = 21.82, p < .01$. The means by cluster are shown in Table 3 and Figure 1 (z scores are used for all variables to ensure that the scale used is comparable for all cognition variables).2

In order to verify that the four clusters reflected distinct subtypes within our sample, the analyses were repeated four times with randomly selected 60% samples. *Chi-square* analyses indicated that the majority of participants were classified in the same cluster each time, with χ^2 values varying between 54.89 and 83.29, $p < .000$. In addition, changing the order in which the data were entered into the analyses did not affect the results of the cluster analyses, as all women were classified in exactly the same way each time. K-means cluster

¹Intrusive ideation, perceived risk, and worry have been used in earlier publications as baseline covariates (Miller et al., 2005; Roussi et al., 2010).

²The same analysis was conducted including only women affected with breast cancer and unaffected women. The cluster analysis results were essentially equivalent.

analysis, with a forced four-cluster, solution also yielded similar results, $\chi^2 = 89.00, p < .000$.

Description of Cognitive Profile Subtypes

High perceived risk/low coping subtype (Cluster One)—Women in the first cluster ($N=47$) had significantly higher levels of perceived risk of cancer than the rest of the sample and had high expectations that they would get cancer if they received a positive genetic test result. They had the highest level of endorsement of the value of cancer screening and genetic testing, and the second highest rating of the efficacy of prevention measures. Notably, they had the lowest rating of perceived ability to regulate emotion, significantly different from the other three clusters.

Low value of screening/high expectancy of cancer subtype (Cluster Two)—The second cluster ($N=37$) was characterized by moderately high ratings of perceived risk (though less extreme than those observed with Cluster One), and had significantly lower ratings for the value of both cancer screening and genetic testing than the rest of the sample. They were less confident than the other three groups regarding the efficacy of prevention measures and believed in the predictive utility of a positive and a negative test result. Further, their perceived ability to regulate their cancer-related distress was lower than that for Cluster Four (see below).

Moderate perceived risk/moderate efficacy of prevention/low informativeness of test result subtype (Cluster Three)—The third cluster ($N=71$) was the largest group. It was characterized by moderately high ratings of perceived risk (less extreme than those observed with Cluster One), and value of cancer screening and genetic testing was significantly less than Clusters One and Two. Compared to the rest of the sample, they held moderate views regarding the efficacy of prevention measures and the predictive utility of a positive genetic test result. Further, they did not believe in the predictive utility of a negative test result or in their ability to regulate their cancer-related distress.

High efficacy of prevention/ high coping subtype (Cluster Four)—The fourth cluster ($N=16$) was the smallest group, and differed markedly from the rest of the sample in several ways. Their perceived risk of cancer and their expectations to have cancer in the event of a positive genetic test result were much lower than the other three groups. In addition, their perceived ability to regulate their emotions was significantly higher than all the other groups. They also had the highest level of confidence in the efficacy of prevention measures, and more favorable ratings for the value of both cancer screening and genetic testing than Cluster Two.

Demographic Differences among Cluster Subtypes

A series of ANOVA's and *chi*-square analyses were performed for continuous and categorical variables, respectively, to identify whether the four clusters differed on any of the demographic variables. Women in the four clusters differed on age, $F(3, 167) = 5.06, p < .01$, partial $\eta^2 = .08$, and education level, $\chi^2 = 7.92, p < .05$ (see Table 3), such that women in Cluster Four were older than women in the other clusters, and women in Clusters Two and Three were more likely to be college educated than women in Clusters One and Four. Since one would expect affected women to be older than unaffected women, we tested whether the four clusters differed on age among affected women only. Although affected women in Cluster Four were older than affected women in the other clusters, the difference was not significant, $F(3, 48) = 1.73, p = .17$.

Personal and Family History of Cancer Differences among Cluster Subtypes

Personal history of cancer (affected vs. unaffected women): Differences were detected for disease status, in that Cluster Four consisted mainly of affected women, whereas Clusters One and Two consisted mainly of unaffected women; Cluster Three was comprised of both affected and unaffected women, $\chi^2 = 32.70$, $p < .01$ (see Table 4). Although affected women in Clusters Four and Two had been diagnosed for longer periods of time than women in Clusters One and Three, the differences in time since diagnosis did not reach statistical significance.

Family history of cancer (number of first-degree relatives affected): The total number of first-degree relatives diagnosed with breast and/or ovarian cancer differed by cluster, $\chi^2 = 26.64$, $p < .01$. Women in Cluster One had the highest number of first-degree relatives, followed by Cluster Three, then Cluster Two and finally Cluster Four, which had the lowest number.

General and Cancer-Specific Distress Differences among Cluster Subtypes

We examined whether the four clusters differed on intrusive ideation, worry, and depression, using an ANOVA. The clusters differed on all three variables, intrusive ideation: $F(3, 155) = 3.60$, $p < .05$, partial $\eta^2 = .07$; worry: $F(3, 167) = 10.52$, $p < .01$, partial $\eta^2 = .16$; and depression: $F(3, 162) = 4.60$, $p < .01$, partial $\eta^2 = .08$. Bonferroni post hoc tests were used to detect differences between clusters (see Table 5 and Figure 2 [z scores are used for all variables to ensure that the scale used is comparable for all affect measures]). Cluster One (high perceived risk/low coping subtype) was the most distressed. No differences were detected among the remaining three clusters.

Discussion

Guided by the Cognitive-Social Health Information Processing model (Miller et al., 1996), we asked women to report on their encoding construals, beliefs and expectancies, values, and self-regulatory abilities regarding their genetic cancer risk. We hypothesized that women would form relatively homogeneous subtypes, based on their personal and familial experiences, each characterized by a unique profile of cognitions (Shoda & Mischel, 2006). Using cluster analysis, we identified four distinct cognitive profile subtypes among at risk women seeking genetic counseling for breast and ovarian cancer. The first cognitive profile subtype (Cluster One: high perceived risk/low coping) consisted virtually of unaffected women with a higher number of affected first-degree relatives, whereas Cluster Four (high efficacy of prevention/high coping) consisted almost entirely of older affected women with a lower number of affected relatives. Two other subtypes (Cluster Two: low value of screening/high expectancy of cancer; and Cluster Three: moderate perceived risk/moderate efficacy of prevention/low informativeness of test result) contained both affected and unaffected women. These results suggest that both personal and family history exert an influence on cancer-related cognitions.

The four cognitive subtypes were differentially related to distress, both general and cancer specific. Subtype 1 (high perceived risk/low coping) appeared particularly vulnerable, reporting higher levels of distress than women in any of the other three subtypes. This finding is consistent with studies showing that first-degree female relatives of women with breast cancer experience elevated levels of cancer-specific and general distress (Thewes et al., 2003). Subtypes two (low value of screening/high expectancy of cancer) and three (moderate perceived risk/moderate efficacy of prevention/low informativeness of test result) also reported less distress than subtype one (high perceived risk/low coping), even though they had elevated levels of perceived risk. However, their levels of perceived risk were

lower than those of subtype one and were combined with different types of cognitions. Overall, subtype three was characterized by moderate beliefs regarding the efficacy of preventive measures and the value of screening and of genetic testing. Women in subtype two had lower confidence in preventive measures to reduce cancer risk, but were more optimistic regarding the predictive utility of a negative test result. These beliefs thus appear to moderate the uncertainty associated with high perceived risk of cancer, an issue which merits further exploration in future studies (Cameron & Reeve, 2006; Mellon et al., 2008).

Women in subgroup four, characterized by low perceived risk and high perceived ability to regulate cancer-related affect, also experienced lower levels of both cancer-specific and general distress. They were mainly older women who had been affected by cancer. It may be that having had a personal experience with cancer gives women the opportunity to cognitively and affectively process health information in depth, which in turn makes them more confident that they can handle their distress (Shoda et al., 1998). Critical to this issue is the time that has elapsed since diagnosis (Schwartz et al., 2002). Since few women in the sample had been diagnosed in the past year (only 7% of the total sample), we were not able to compare women who had been diagnosed recently (less than a year) with those who had been diagnosed for more than a year. However, the presumption is that the longer the time since diagnosis, the greater the cognitive processing of the health challenge and hence the lower the distress.

The findings are consistent with the existing literature which documents the relationship between psychological distress and demographic, medical, and psychosocial variables among women at genetic risk for breast and/or ovarian cancer (Dorval et al., 2008; Mellon et al., 2008; Pieterse et al., 2007). This study extends the existing evidence by showing how women's experiences with regard to their risk status for breast and/or ovarian cancer are more complex than bivariate analyses can capture. The findings provide support for the Cognitive-Social Health Information Processing model (Miller et al., 1996; Miller et al., 1999), since they suggest that it is useful to move beyond simple differences in the reactions and emotions of arbitrarily formed groups, such as between affected and unaffected women, and to examine *profiles* of cognitions and how they relate to medical history and emotional reactions.

The study has a number of limitations. First, there are issues regarding the generalizability of the results. Participants were a self-selected group of women with limited variability regarding racial and ethnic background. In addition, women who agreed to participate in the study were more educated, more likely to be Caucasian, and more likely to have had children than non-participants. Second, the study was cross-sectional and thus we could not test the effect of baseline cognitive profiles on post-testing affective and behavioral responses. Third, some of the measures (notably perceived risk and value of screening for cancer) did not have high reliability; in the future it will be important to improve these measures. Fourth, since women diagnosed for less than a year typically experience more distress than women diagnosed for more than a year, it is unfortunate that we were not able to examine whether there were any differences between the cognitive profiles of women diagnosed with breast or ovarian cancer in the past year and those diagnosed for more than a year (Schwartz et al., 2002). Fifth, it will be important in the future to examine the relationships among the cognitive and affective units that characterize each subgroup. Our limited sample size did not allow us to explore these intercorrelations within each subtype.

Finally, we did not have information regarding the exact nature of the familial relationship between participants and their first-degree relatives affected by cancer (Erblich et al., 2000). The findings are also limited by the exploratory nature of cluster analysis (van der Kloot, Spaans, & Heiser, 2005). However, confirmation of the subtypes formed using random sub-

samples for the cluster analysis and validation of their distinctiveness by confirming their variability with regard to demographic, medical, and distress variables, suggests that the subtypes formed are true clusters within the sample.

The study findings may have clinical implications as both cognitions (perceived risk, beliefs and expectancies, values and goals and perceived competencies) (Miller et al., 2006; Miller et al., 2005; Schwartz et al., 2005) and distress (Miller et al., 2006; Schwartz et al., 2005) have been related to behavioral outcomes regarding decisions about genetic testing uptake, risk reduction, and surveillance behaviors. The present results indicate that interventions should be designed to address the specific needs and concerns of identified subtypes of women, in order to personalize the management of individuals at genetic risk for breast and/or ovarian cancer. For example, women presenting for breast and/or ovarian cancer genetic testing who fit the profile for Cluster One (unaffected, high number of affected first-degree relatives, high perceived risk, positive beliefs about the value of testing and screening) may benefit from exploration of their experience of their relatives' illness as a potential source of their relatively high levels of distress. Vivid memories of a relative's suffering and negative experiences with cancer may lead to stress-related intrusive ideation accompanied by avoidance in an effort to reduce distress (Foa & Kozak, 1991; Miller, Rodolitz, Mangan, Schroeder, & Sedlacek, 1996). In such cases, addressing traumatic memories by facilitating deeper processing in a supportive environment may lead to better integration of the experience and lower distress (Foa & Kozak, 1991). This processing, in turn, should increase the probability that at risk women with this profile will make less impulsive decisions, such as immediately deciding to undertake prophylactic surgery as a means of reducing unpleasant levels of distress (Schwartz et al., 2005).

In contrast, women who fit the profile for Cluster Four (affected, older, high perceived coping ability, low perceived risk), may be underestimating their risk. If that is the case, then they may need more intensive genetic education that alerts them to their risk and the need to remain vigilant, without undermining their identity as a cancer survivor. Women who fit the profile for Cluster Two may benefit from interventions that are designed to increase their confidence regarding the efficacy of risk reduction measures, delineate the pros and cons of genetic testing and screening, and improve their skills for regulating risk-related affect. Finally, women who fall into the profile for Cluster Three may benefit from interventions that modify their beliefs regarding the meaning of a negative test result (e.g., a negative test result does not mean that one will never get breast or ovarian cancer) and improve their skills for regulating risk-related affect.

Thus far, targeted and tailored interventions have been designed based on the assumption that there is homogeneity within a demographically defined subpopulation, an assumption that is not universally accepted (Kreuter, Strecher, & Glassman, 1999). The use of cluster analytic approaches can address this issue by identifying subtypes of individuals who are *psychosocially* similar to one another. This study demonstrates the feasibility and applicability of the cluster analytic technique to the health psychology setting, particularly in the context of genetic cancer risk. The findings indicate that, using theory-driven cluster analyses, at-risk populations can be segmented into homogeneous subtypes in a meaningful way, such that distinct constellations of cognitions are formed. Interventions can then be targeted and/or tailored to address specific cognitions and to minimize distress, in order to optimize quality of life and to reach optimal decision making regarding genetic testing and risk reduction and surveillance options.

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Figure 1.
Cognition variable means by cluster

Figure 2.
Cancer-specific affective responses and depression by cluster

Table 1
Key Psychosocial Mediators of Behavioral and Emotional Responses to Health Threats

Health-relevant encodings, such as perceived risk, refer to appraisals regarding one’s own health, personal health risks and vulnerabilities, and illness and disease. Includes appraisals of incoming threat and risk-relevant information (e.g., cancer risk feedback).
Health-relevant beliefs and expectancies refer to the individual’s beliefs about the health-threat and outcome and efficacy expectancies (eg., outcomes of prophylactic behaviors, being confident that one is able to adhere to a medical regimen or a lifestyle change).
Health-relevant values and goals refer to desires and values about health outcomes (eg., importance of personal and family health, passing on information to children and other family members).
Health-relevant affects refer to emotional states activated when processing health-relevant information (e.g., cancer risk-related worries and anxieties).
Health-relevant self-regulatory competencies and skills refer to the skills necessary to manage both practical (eg., financial constraints to deal effectively with a health problem) and psychological barriers (eg., active avoidance to manage anxiety). Self-control skills are particularly important in the management of anxiety.

Note. Adapted from Miller, Fang, Manne, Engstrom, & Daly, 1999.

Table 2

Intercorrelations Among Cognition Variables

Cognition variable	Perceived risk	Expectations regarding			Importance of		
		Reduction measures	If positive	If negative	Screening	Genetic testing	Affect regulation
Perceived risk	1.00						
Expectations if:							
One adopts risk reduction measures	-0.11	1.00					
Test is positive	0.33**	-0.05	1.00				
Test is negative	-0.06	0.09	0.34**	1.00			
Importance of:							
Screening	0.30**	0.10	-0.02	-0.03	1.00		
Genetic testing	0.08	0.05	0.13	0.00	0.22**	1.00	
Self-regulatory skills							
Affect regulation	-0.28**	0.12	-0.21**	0.06	0.00	-0.07	1.00

*
 $p = .05$;**
 $p < .01$.

Table 3

Cognition Variable Means by Cluster

Cognition variable	Cluster 1 N = 47		Cluster 2 N = 37		Cluster 3 N = 71		Cluster 4 N = 16	
	M	SD	M	SD	M	SD	M	SD
Perceived risk ^{1,2,3,4}	21.53	3.68	19.11	3.27	19.75	3.50	10.31	3.61
Expectations if:								
One adopts risk reduction measures ^{1,2,2,3,4}	26.23	4.51	22.22	4.61	24.54	4.07	28.06	3.53
Test is positive ^{1,2,3,4}	7.89	1.63	6.70	1.68	5.51	2.32	3.75	2.18
Test is negative ^{1,2,3,4}	5.19	1.90	5.84	1.64	2.75	1.01	3.50	1.86
Importance of :								
Screening ^{1,2,3}	22.15	2.71	18.35	4.62	20.41	2.73	20.56	4.10
Genetic testing ^{1,2,3,4,2}	8.98	1.45	5.81	1.85	7.70	1.82	8.69	1.70
Self-regulatory skills								
Affect regulation ^{4,1,2,3}	25.87	5.58	27.84	5.46	26.86	4.96	32.31	2.36

Note. Numbers refer to clusters. Numbers separated by a comma signify a significant difference.

Table 4

Cluster Differences on Medical Variables and Demographics

Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Disease status				
Affected	6	8	24	14
Unaffected	36	25	44	1
Education level				
More than college	22	22	49	7
Less than college	25	15	21	9
Age ^{123,4}	43.02 (12.39)	44.22 (12.62)	44.41 (10.53)	55.75 (12.42)

Note. Numbers refer to clusters. Numbers separated by a comma signify a significant difference.

Table 5

Cancer-specific Distress and General Distress by Cluster

Cluster	Worry ^{1,2,4}		Intrusive ideation ^{1,2,3}		Depression ^{1,2,4}	
	M	SD	M	SD	M	SD
Cluster 1	12.94	4.95	12.37	8.92	9.13	7.25
Cluster 2	8.97	3.18	7.03	7.31	5.14	4.75
Cluster 3	10.20	3.69	8.23	7.50	5.93	4.77
Cluster 4 ^a	7.56	4.08	8.67	7.14	5.25	4.84

Note. Numbers refer to clusters. Numbers separated by a comma signify a significant difference.

^aDifferences in levels of depression between clusters one and four were significant at the .10 level.