DYNAMICS OF EXPECTANCY CHANGES IN BEHAVIORAL AND
PHARMACOLOGICAL TREATMENT OF MIGRAINE

A thesis presented to
the faculty of
the College of Arts and Sciences of Ohio University

In partial fulfillment
of the requirements for the degree
Master of Science

Elizabeth K. Seng
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This thesis titled
DYNAMICS OF EXPECTANCY CHANGE IN THE BEHAVIORAL AND
PHARMACOLOGICAL TREATMENT OF MIGRAINE

by
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ABSTRACT

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Director of Thesis: Kenneth A. Holroyd

This study examines changes in migraine-related self-efficacy (confidence to effectively engage in migraine management behaviors) and locus of control (expectations regarding who determines the outcome of one’s migraines) over the course of behavioral and pharmacological treatment of migraine. 232 severe migraine sufferers were randomized into a 2 (preventative medication, placebo) X 2 (behavioral migraine management, no behavioral migraine management) treatment design. Mixed models analyses revealed that self-efficacy and internal locus of control increased more in the behavioral migraine management than drug therapy only groups. Chance locus of control decreased more in both behavioral migraine management groups, and the preventative medication group than in the placebo group. Health care professional locus of control increased in both groups that did not receive behavioral migraine management. Although higher pretreatment chance locus of control expectancies were associated with lower self-efficacy at pretreatment, they were also associated with greater self-efficacy change with behavioral treatment. Thus, individuals with high pretreatment chance locus of control were not handicapped in achieving high levels of self-efficacy with behavioral treatment as might be predicted.
This study also examines the relationships between migraine related expectancies before and after behavioral and pharmacological treatment. Generally, higher self-efficacy was related to less disability, but the relationship leveled off as self-efficacy increased. Higher internal locus of control was associated with higher levels of emotional distress before treatment, but was no longer associated with emotional distress after behavioral migraine management. Higher health care professional locus of control was associated with greater disability before treatment, but not after.

Approved: _____________________________________________________________

Kenneth A. Holroyd

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CHAPTER 1: DYNAMICS OF EXPECTANCY CHANGE IN THE BEHAVIORAL AND PHARMACOLOGICAL TREATMENT OF MIGRAINE

Introduction

Migraine is a lifelong, sometimes progressive disorder characterized by episodic headache attacks. Migraine has a large impact on quality of life (Leonardi, Steiner, Scher, & Lipton, 2005) and requires long-term management. Social Learning Theory (Bandura, 1997; Rotter, 1966) and the literature on self-management of chronic disease (Bodenheimer, Lorig, Holman, & Grumbach, 2002; Marks, Allegrante, & Lorig, 2005) suggest that migraine sufferers’ expectations about factors that determine migraine onset, course and severity and their confidence to take actions to manage migraine are important determinants of migraine sufferers’ adaptation to and self-management of chronic disease. Behavioral migraine treatments teach migraine management skills and are postulated to increase participants’ confidence in their ability to self-manage migraine (Bandura, 1997; Nicholson, Hursey, & Nash, 2005), and may also influence expectations about factors that determine migraine onset, course and severity.

Expectancies

This study will examine two types of headache-specific expectancies: outcome expectancies (expectations about who or what determines an outcome), and efficacy expectancies (expectations that one is capable to engage in behaviors necessary to produce the desired outcome). Headache-specific locus of control, an outcome expectancy, refers to the extent to which a one expects that the onset, course and severity of one’s migraines are influenced by his or her own actions (internal locus of control),
fate or chance (chance locus of control), or the actions of a health care professional (health care professional locus of control) (Martin, Holroyd, & Penzien, 1990). Headache management self-efficacy refers to the expectation that one is able to take actions to prevent and manage migraines (Bandura, 1997; French et al., 2000).

*Expectancies Function in Behavioral Treatment*

Individuals who expect their migraines to be contingent upon their own behavior are postulated to be more likely to engage in health behaviors, whereas individuals who expect migraines to be contingent on fate or chance are postulated to be less likely to engage in these behaviors (K. A. Wallston, 2005). However, as migraine is influenced by a range of factors both internal (self-management behaviors) and external (genetics, situational triggers) to the individual, realistic expectations regarding the extent to which each factor contributes to migraine are likely more adaptive than unrealistic expectations. For example, although an internal locus of control is thought to be a precondition for engaging in health behaviors (Bandura, 1997), if a migraine sufferer expects her migraines to be entirely determined by her own actions, she may feel responsible for her migraines, and guilty for not being able to manage her pain. In this way, an unrealistically high internal locus of control could lead to hopelessness and lack of engagement in self-management behaviors.

Although often conceptualized as a factor external to the individual, health care professional locus of control may consist of an individual’s realistic reliance and overdependence on the physician. Health care professional locus of control may indicate overdependence on medical professionals at higher levels, and inadequate use of health
care resources at lower levels, therefore it is likely that a moderate level of health care professional locus of control is necessary for engaging in self-management behaviors recommended by health care providers.

Self-efficacy to manage migraine may decrease migraine-related disability through influencing attention to and vigilance for physical symptoms (Cioffi, 1991) and through the initiation and persistence of adaptive coping and self-management efforts (French et al., 2000; Martin, Holroyd, & Rokiki, 1993; Martin et al., 1990; Scharff, Turk, & Marcus, 1995). Self-efficacy may also be associated with adaptive physiological responses that serve to lessen the experience of pain (Bandura, Cioffi, Taylor, & Brouillard, 1988; Maswood, Barter, Watkins, & Maier, 1998).

Self-management behaviors are best predicted by the influence of both locus of control and self-efficacy. Although a higher internal locus of control is postulated to be a pre-condition for engaging in behaviors to manage migraine, and is therefore likely related to confidence to effectively perform those behaviors, self-efficacy and locus of control are distinct, separable constructs (Bandura, 1997; French et al., 2000). For example, a migraine sufferer may believe that her behaviors influence her migraines (internal locus of control), but that she is unable to effectively engage in self-management behaviors (low self-efficacy). In this case, her high internal locus of control may lead to feelings of responsibility and guilt rather than adaptive self-management behaviors.

Behavioral Treatment Effects on Expectancies

There is evidence that confidence to engage in behaviors necessary to manage certain chronic diseases, particularly arthritis, is influenced by interventions that aim to
increase self-management behavior. Many chronic disease studies demonstrate increases in disease-management self-efficacy during behavioral interventions, but have no comparison group(s), and therefore the changes observed cannot be unequivocally attributed to the interventions themselves (Coughlin, Badura, Fleischer, & Guck, 2000; Lipchik, Milles, & Covington, 1993; Lorig, Sobel, Ritter, Laurent, & Hobbs, 2001; Wells-Federman, Arnstein, & Caudill, 2002). However, there are also a number of well-controlled studies indicating that behavioral interventions that teach self-management skills for chronic diseases, particularly arthritis, increase self-efficacy in both the short- and long-term (Buszewicz et al., 2006; Lorig, Ritter, Laurent, & Plant, 2006; Marks et al., 2005; Parker et al., 1995). For example, one of the most recent and largest arthritis studies demonstrated that a self-management program for osteoarthritis (6 group sessions based on Social Learning Theory) increased confidence to self-manage arthritis-related pain and other symptoms at four and twelve months after initial contact relative to a control group that received an arthritis self-management booklet (Buszewicz et al., 2006; n = 812).

There is less evidence for expectancy changes over the course of behavioral interventions to teach headache self-management, and the best evidence is in studies which include tension-type headache sufferers, who may not react to treatment in the same way as migraine sufferers. One study found that external headache-specific locus of control decreased, and headache-management self-efficacy increased relative to an assessment-only control group over the course of biofeedback therapy for chronic tension-type headache (Rokicki et al., 1997). This study did not include a long-term
follow-up to examine maintenance of these changes, and used a fairly small sample of college students ($n = 45$) limiting generalizability of the findings.

Another study demonstrated that a cognitive intervention including restructuring, coping, and muscle relaxation, in a fairly small sample ($n = 40$) of both migraine and tension-type headache sufferers increased headache-management self-efficacy relative to a wait-list control group over a 10 week intervention, and 12 month follow-up period (Thorn et al., 2007). In a randomized clinical trial for the treatment of chronic-tension type headache, Holroyd and colleagues (unpublished; $n = 203$) demonstrated that stress management increased self-efficacy and internal locus of control, and decreased chance locus of control, whereas antidepressant medication did not influence headache-related expectancies. Changes were maintained at a 12-month follow-up. Although this well-controlled clinical trial demonstrated the differential effect behavioral, pharmacological, and multidisciplinary treatment programs have on headache-related expectancies, it cannot be generalized to a migraine population.

Only two studies have focused exclusively on migraine, neither of which was controlled. An early study demonstrated that health-related locus of control (B. S. Wallston, Wallston, Kaplan, & Maides, 1976) became more internal over the course of thermal biofeedback therapy for migraines, although most of the change occurred between the psychoeducational orientation and the first biofeedback session, and may be attributed to the psychoeducational component (Mizener, Thomas, & Billings, 1988). This study was limited by the use of general health locus of control measure (B. S. Wallston et al., 1976); migraine sufferers expect that different factors influence their
general health than influence migraines. This study was also limited by the lack of a comparison group and small sample size ($n = 25$), and does not provide clear information about locus of control changes in biofeedback, as locus of control change occurred before the first biofeedback session. Nonetheless, study findings are consistent with the premise that a reasonably internal locus of control is necessary for behavioral treatment to appear relevant to participants. Therefore orientation to a behavioral intervention focused on changing these expectations and might reasonably be expected to change locus of control prior to treatment. More recently, Nicholson and colleagues (2005) demonstrated increases in headache-management self-efficacy over the course of an individually-tailored self-management intervention (including psychoeducation, relaxation and stress management) for migraine sufferers. This study did not find a change in headache-specific internal locus of control. This study was also limited by a small sample size and lack of a comparison group, limiting generalizability and the ability to rule out non-treatment factors (e.g., symptom monitoring) as explanations for observed changes in self-efficacy.

*Medication Effects on Expectancies*

Although little research has focused on the subject, drug therapy may also influence expectancies. In particular, the expectation that one’s migraines are contingent upon health care professionals’ behaviors may be enhanced over the course of drug therapy as the migraine sufferer begins to trust her provider’s expertise, especially if she experiences a reduction in migraine symptoms. Experiencing benefits from drug therapy
may also serve to decrease expectations that migraines are contingent upon chance or fate as the success of drug therapy would demonstrate a pattern to migraine relief.

It is unclear what impact, if any, drug therapy would have on self-efficacy to self-manage migraines. It is possible that successful drug therapy could enhance a migraine sufferer’s expectations that she is capable of managing migraine. This would be relevant for understanding the mechanisms of self-efficacy change during both behavioral and drug therapies, as it could imply that the improvement in migraine, rather than factors specific to behavioral treatment, was responsible for changes in self-efficacy. However, it has been suggested that medication could undermine efforts to increase self-efficacy (Bandura, 1997; Hollon & DeRubeis, 1981) by increasing expectations that external factors are responsible for improvement in headache, rather than bolstering expectations that the migraine sufferer is able to self-manage migraines. Existing evidence indicates that pharmacologic treatment of headache may not improve self-efficacy in the same manner as behavioral treatment, but does not provide evidence for a decrease in self-efficacy due to medication use alone in the treatment of migraine (Lee, Park, & Kim, 2005) or in concert with behavioral treatment, at least for chronic tension-type headache (Holroyd, et al., unpublished).

Moderators of Self-efficacy Change in Behavioral Treatment

Self-efficacy is considered the best candidate for a change mechanism of behavioral treatment (Nicholson, Nash, & Andrasik, 2005). A locus of control which is more focused on factors that the individual can influence (e.g., self-management behaviors), rather than on factors outside of the individual’s realm of influence (e.g.,
genetics, chance), is postulated to be a precondition for the belief that self-management behaviors will influence migraines (Bandura, 1997) and therefore is likely related to confidence to effectively engage in those behaviors. Indeed, in cross-sectional studies of headache sufferers, internal locus of control has demonstrated a positive relationship with self-efficacy, while chance locus control has demonstrated a negative relationship (French et al., 2000; Nash, Williams, Nicholson, & Trask, 2006). Thus, an individual’s initial locus of control may be able to predict responsiveness to self-efficacy changes induced by behavioral treatment. The competency model, which postulates that individuals who have competency in an area targeted by treatment will receive more benefit from treatment, predicts that individuals with higher initial internal locus of control would exhibit greater changes in self-efficacy over the course of behavioral treatment. The deficiency model postulates that individuals who are deficient in an area targeted by a treatment will receive the most benefit because they have more room to change; therefore, individuals who initially expect their migraines to be contingent on external factors would experience greater treatment-related gains in self-efficacy. Unlike internal and chance locus of control, health care professional locus of control has not demonstrated a relationship with headache-related self-efficacy in previous studies (French et al., 2000; Nash et al., 2006), and would not be expected to show any simple relationship with self-efficacy change, therefore no predictions can be made regarding potential moderation. Additionally, because self-efficacy is not postulated to change during drug therapy, moderation would not be relevant.
Current Study

The current study is a randomized clinical trial in which participants received a preventative migraine medication (a $\beta$-Blocker) or placebo, and received or did not receive a behavioral migraine management program (BMM). In addition, all participants received an optimal acute therapy at the outset of the study. Participants were followed during the four-month BMM treatment/medication dose adjustment period, and for a subsequent 12 months evaluation period.

Hypotheses

We hypothesized that BMM would selectively alter participants’ expectations about the controllability of the factors influencing their migraines, increasing internal locus of control beliefs, and decreasing chance locus of control beliefs across the course of treatment and throughout the follow-up period. Similarly, we hypothesized that BMM, but not pharmacotherapy alone, would increase participants’ confidence to take the actions necessary to influence their migraines across the course of the study. To examine the competency and deficiency models of self-efficacy moderation, we hypothesized that both internal and chance locus of control would moderate any treatment effects observed for self-efficacy.
Methods

Study Design

A five-week (in order to include a menstrual cycle) run in period of optimal acute therapy (OAT) was conducted to exclude those individuals who responded well to OAT and would not need the additional elements of the treatment. OAT consisted of individually tailored acute pharmacologic treatment and training in the effective use of acute medication. After completing the OAT run-in, participants who continued to meet migraine severity criteria (≥ 3 migraines with disability per 30 days) were stratified by sex and randomized via a computerized randomization procedure to the four “additive” treatments: OAT + β-Blocker (β-B), OAT + Placebo (PL), OAT + BMM + PL (BMM), and OAT + BMM + β-B (BMM + β-B).

232 individuals with current migraine were recruited and met inclusion criteria for this study. Inclusion criteria were age between 18 and 65 years and International Classification of Headache Disorders (ICHD) diagnosis of migraine (with or without aura) at 2 separate evaluations, with diary confirmed migraine severity criteria during the Optimal Acute Therapy (OAT) run-in of 3 or more migraines with disability in 30 days. Exclusion criteria were ICHD diagnosis of probable medication overuse headache, another pain disorder as primary presenting problem, 20 or more headache days per month, contraindication or sensitivity to any study medication, current use of migraine preventive medication (with participant preference or welfare contraindicating withdrawal), current psychological treatment, psychiatric disorder requiring immediate or priority treatment, and inability to read and understand study materials; for women,
current or planned breastfeeding or pregnancy, or unwillingness to use an established contraceptive method were also exclusion criteria. 176 individuals completed the three month treatment/dose adjustment dose adjustment period. As this study is examining the process of change in expectancies during treatment, the sample of 176 participants who received treatment will be used for the majority of the analyses, unless otherwise indicated. All participants provided written informed consent according to procedures approved by the Ohio University Human Subjects Committee.

*Intervention*

All four treatment protocols had equivalent numbers of clinic visits and contacts (4 treatment sessions, 3 phone contacts and 4 follow-up sessions; *ns* remaining in study through treatment period by group: PL = 44, β-B = 42, BMM + PL = 42, BMM+ β-B = 48). All participants first received optimal acute therapy, consisting of abortive medication and education regarding migraine triggers. Participants randomized into the active medication received propanolol HCL, or nadolol HCL if the propanolol was not well tolerated or migraines unimproved. These β-blocking medications served as preventative drug therapy for migraine. Dosage was increased and stabilized according to an established protocol. Participants randomized to the placebo only condition were treated in the exact same manner as participants in the active medication condition, including dosage adjustment and medication change procedures. This was a double blind protocol.

Participants randomized to receive Behavioral Migraine Management (BMM) or BMM + β-B received the same treatment as described above, respective to their active or
placebo medication condition. In addition, these participants received limited-contact BMM treatment at the same clinic visits as their neurologist appointments. The BMM program (Lipchik, Holroyd, & Nash, 2002) is a Social Learning Theory based behavioral treatment program consisting of 12 modules, each of which focuses on a different facet of migraine management (Figure 1). The BMM treatment protocol used a similar format as previous studies have used (Holroyd et al., 1988; Holroyd, Nash, Pingel, Cordingley, & Jerome, 1991), but which had been modified using a focus group consisting of individuals with severe migraines (Cottrell et al., 2002). Modifications included the discussion of a wider range of triggers, and increased instruction on effective medication use. Other skills taught included relaxation, identification and management of triggers, reducing the impact of a migraine on daily life, stress management, and thermal biofeedback. Management skills most appropriate for each participant were selected and demonstrated during four clinic visits, and applied between sessions in the participants’ homes through readings, audiotapes, and practice of skills (Behavioral Management for Migraine Headaches: A Treatment Program). During the first 6 to 8 weeks, the modules focus on developing the skills necessary to prevent and manage migraine. Integrating these skills into a migraine management plan is the focus of the last 4 to 6 weeks. Through BMM, participants should not only learn effective coping behaviors, but should also feel more competent to use those behaviors in prevention and management of their own headaches.
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Figure 1. Overview of the Behavioral Migraine Management program.

Measures

**Headache Management Self-Efficacy Scale (HMSE).** The HMSE (French et al., 2000) is a self-report, 25-item scale (7-points, ranging from 1= strongly disagree to 7=strongly agree), which measures an individual’s self-efficacy to manage headache pain and prevent headache episodes. Questions include, “I can reduce the intensity of a headache by relaxing,” and “Nothing I do will keep a mild headache from turning into a bad headache (reverse).” It has demonstrated excellent internal consistency, (Cronbach’s $\alpha = .90$; French, et al., 2000). Support has been provided for the construct validity of the HMSE (French et al., 2000). The HMSE demonstrated positive correlations with internal locus of control, and negative correlations with chance locus of control. Although
significant, these correlations were appropriately low ($r=0.40$, and $r=-0.64$, respectively) indicating that the measures are discriminating between the constructs. Also, a high score on the HMSE was positively associated with positive psychological coping for the management and prevention of headaches. The HMSE was negatively related to measures of headache severity and disability.

*Headache Specific Locus of Control Scale (HSLC).* The HSLC (Martin et al., 1990) is a 33-item scale designed to assess the extent to which individuals with recurrent headache believe their headaches are under their own influence, the influence of chance, or of health care professionals. Items are coded on a 5-point Likert-type scale ranging from “strongly disagree” to “strongly agree.” Items include the following: “My actions influence whether or I have headaches,” (Internal); “My headaches are beyond all control,” (Chance); and “Following the doctor’s medication regimen is the best way for me not to be laid-up with a headache,” (Health Care Professionals). The internal subscale is scored so that low scores indicate high internality of control beliefs. This subscale will be reversed for the analyses. Each subscale demonstrates good internal consistency ($\alpha = .80-.89$) (Martin et al., 1990; VandeCreek & O'Donnell, 1992). All three subscales also demonstrated adequate three-week test-retest reliability ($rs = .72-.78$; Martin et al., 1990). Subscales demonstrated significant expected relationships with related measures. Chance LOC was related to catastrophizing ($r = .44$) while Internal LOC was related to a preference for self-regulation treatments ($r = .21$). Health Care Professionals was related to a preference for medical treatment ($r = .45$).
Procedures

Participants first completed the pretreatment phase, during which they received a structured headache interview and psychosocial history, a neurological and medical evaluation, psychosocial testing, and optimal acute therapy. Participants then recorded their headache activity, disability, and medication use daily for five weeks. The structured headache interview focused on headache and general medical history. This data was used to facilitate the assessment of disability due to migraines and psychiatric diagnoses. Individuals ineligible for participation were also screened during the structured interview. Participants received a neurological and medical evaluation from one of two neurologists, which included a history of headache problems, a physical examination, and a complete neurological examination. The psychosocial testing included the HMSE and the HSLC.

Participants completed the daily headache diary for 5 weeks, having only received optimal acute therapy. Those participants who still met the severity inclusion criteria after the one-month period were each randomized into one of the four treatment groups. Contact during the 4 month treatment period consisted of 4 monthly clinic visits, and a phone contact two weeks before the next scheduled clinic visit (3 in total). At each of the four treatment visits, participants completed the psychosocial questionnaires. Medication management protocol continued past the four month treatment interval for the remainder of the study. Participants were asked to return for scheduled evaluations 1, 3, 6, 9, and 12 months after termination of behavioral treatment. Each of these evaluations included a
neurologist visit and completion of psychosocial questionnaires. Participants also continued to record headache activity in daily diaries until the completion of the study.

Statistical Analyses

ANOVA was used to determine if the groups differed on any of the outcome variables. Four mixed models for repeated measures analyses were used to evaluate the hypotheses that each of the HSLC subscales and the HMSE changed over time, and changed differentially according to treatment group. A first-order autoregressive covariance matrix was chosen for these analyses. Group differences were examined between the β-blocker and placebo groups, and the BMM and no BMM groups. The log_{10} of time was used as the time variable. First-order relationships and all interactions were entered in the first step. The least significant, highest-order interaction was dropped in each of the following steps, until all interactions were significant at \( p < .05 \), or were being used in a higher-order relationship. -2 log likelihood \( \chi^2 \) tests were performed at each step to determine if removing a variable significantly decreased the amount of variance being accounted for by the model. If so, the variable would remain in the model. Interactions were followed-up by within-group mixed models for repeated measures analyses to determine if HMSE and each of the HSLC subscales changed over the course of the study within treatment groups.

The second set of analyses examined whether internal, chance, or health care professional HSLC moderated any treatment effects found for HMSE. In each mixed model analysis, HMSE served as the outcome variable, while the log_{10} of month and the baseline measurement of the relevant HSLC subscale served as fixed variables. Group
differences found in the HMSE treatment effect analysis would also serve as fixed
variables. A significant interaction between baseline HSLC, group status, and time would
indicate that the HSLC subscale was moderating change in HMSE differentially among
different groups. All statistics were run using SAS 9.1.

Results

Treatment groups did not differ on any variables at baseline, \( ps > .05 \) (Table 1).

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*Note. P < .05*
Effects of Treatments on Expectancies

Figure 2. Changes in internal headache-specific locus of control over the course of both Behavioral Migraine Management and drug therapy.

For internal HSLC, a significant main effect of Time, $F(1, 1075) = 84.89, p < .001$, was qualified by a BMM X Time interaction, $F(1, 1075) = 37.01, p < .001$, indicating greater increases in internal HSLC in participants who received BMM than participants who received only drug therapy. As seen in Figure 2, within group analyses revealed that internal HSLC increased approximately seven points during the treatment phase in individuals who received BMM, $t(551) = 10.15, p < .001$, constituting a large effect, $d = .88$. Although individuals who received only drug therapy increased by approximately one point, BMM $t(524) = 2.53, p < .05$, this constituted a very small effect, $d = .09$. The differences in both groups were maintained throughout the follow-up period.
For chance HSLC, the three-way BMM X β-blocker X Time interaction was marginally significant, F(1, 1073) = 2.79, p = .095, qualifying significant BMM X Time, F(1, 1073) = 10.21, p < .01, and β-blocker X Time interactions, F(1, 1073) = 5.95, p < .05, as well as significant main effects of BMM, F(1, 1073) = 4.52, p < .05, and Time, F(1, 1073) = 29.61, p < .001. As can be seen in Figure 3, within-group analyses revealed that chance HSLS decreased in all groups except placebo + OAT. The change in the β-blocker group constituted small effect, t(252) = -2.54, p < .05, d = -0.28, whereas the changes in both BMM groups constituted large effects, BMM + PL t(256) = -6.54, p < .001, d = -0.913, BMM + β-B t(294) = -9.34, p < .001, d = -0.969.
Figure 4. Changes in health care professional headache-specific locus of control over the course of Behavioral Migraine Management and drug therapy.

For the health care professional subscale of the HSLC, there was a significant Time effect, F(1, 1075) = 10.92, p < .01, which was qualified by the BMM X Time interaction, F(1, 1075) = 8.15, p < .01. The drug therapy only groups showed a greater increase in health care professional HSLC over the course of the study than the BMM groups (Figure 4). Indeed, within-group analyses demonstrated significant increases in health care professional HSLC in the drug therapy only groups, t(524) = 4.16, p < .001, d = .30, but no change in the BMM groups, t(551) = 0.31, p = .760, d = .09.
For HMSE, a significant Time effect, $F(1, 1074) = 287.53, p < .001$, was qualified by a BMM X Time interaction. HMSE changed more quickly and to a greater degree during treatment in BMM groups than in the drug therapy only groups, $F(1, 1074) = 91.95, p < .001$ (Figure 5). Within-group analyses revealed large increases in the HMSE in the BMM groups, $t(550) = 16.75, p < .001, d = 1.50$, and small to medium increases in the drug therapy only groups, $t(524) = 6.23, p < .001, d = .43$.

**Moderation of Self-efficacy Treatment Effect**

Of the HSLC subscales, only baseline chance moderated the BMM effect on HMSE, $F(1, 1067) = 6.00, p < .05$. Regardless of initial levels of chance HSLC, the
HMSE increased more in the BMM than drug therapy only groups. However, as initial levels of chance HSLC increased, increases in the HMSE were larger in the BMM, rather than drug therapy only, groups (Figure 6). It is notable that all groups were at approximately the same level of HMSE at the end of treatment. Neither internal HSLC, $F(1, 1067) = 2.39, p = .122$, nor health care professional HSLC, $F(1, 1067) = 0.20, p = .659$, were moderators of the BMM treatment effect on the HMSE.

*Figure 6a. Changes in Headache Management Self-Efficacy over the course of BMM and drug therapy at high initial chance locus of control (1 standard deviation above the mean).*
Figure 6b. Changes in Headache Management Self-Efficacy over the course of BMM and drug therapy mean initial chance locus of control.

Figure 6c. Changes in Headache Management Self-Efficacy over the course of BMM and drug therapy at low initial chance locus of control (1 standard deviation below the mean).
Discussion

This was the first study to examine migraine-related expectancy changes and their long-term maintenance in both BMM and drug therapy. Both BMM and drug therapy increased the expectation that one’s own actions influence migraine and confidence in one’s ability to self-manage migraine, although only BMM resulted in clinically significant increases in self-efficacy and internal locus of control over the course of the study. BMM, and to a lesser extent preventative drug therapy, but not OAT alone, decreased the expectation that migraines were random or due to fate. Individuals in the BMM group maintained the same level of health care professional locus of control throughout treatment, while individuals in the drug therapy groups increased expectations that their migraines were contingent on their health care provider’s actions over the course of treatment. Individuals who initially endorsed high chance locus of control expectancies also endorsed lower self-efficacy, but were not handicapped by their initial locus of control, experiencing greater gains in self-efficacy over the course of BMM and catching up to individuals who endorsed lower initial chance locus of control expectancies.

Pharmacological Migraine Treatment Influences Chance HSLC, but not HMSE

In this study, individuals who took medication without BMM experienced increases in the expectation that migraines are primarily influenced by the actions of one’s health care provider. Taking preventative medication without BMM also decreased expectations that migraines were random or due to fate; experiencing reductions in migraine frequency and severity through taking preventative medications demonstrated
that there is a pattern to migraine that can be influenced by medication. Medication without BMM exerted a small positive effect on migraine sufferers’ confidence in their ability to self-manage migraine. However, given the increased expectation that health care professionals’ actions influenced migraine, and the small increases in internal locus of control and self-efficacy, there were few signs that individuals treated using solely drug therapy took more responsibility for their migraine management over the course of treatment. It should be noted that the HMSE scale measured only confidence in one’s ability to self-manage migraine using non-pharmacological means. It is possible that medication self-efficacy, confidence in one’s ability to effectively use medication, increased during drug therapy, but was not measured in this study. A measure that examined efficacy expectancies surrounding use of medication would be useful to develop for assessing migraine sufferers’ confidence in their ability to take medication effectively.

Distinctions between External Locus of Control Constructs

A number of cross-sectional studies have demonstrated positive correlations among chance and health care professional locus of control and measures of disability (French et al., 2000; Martin et al., 1990; Scharff et al., 1995). This could suggest chance and health care professional locus of control both function similarly as external control constructs, but this study highlighted differences between these two subscales in response to migraine treatments. Chance locus of control diminished in all “active” treatment groups (keeping in mind that even the placebo group received active abortive, but not preventative medication). Chance locus of control represented a true “external” control
orientation, as expectations that migraines were random or due to fate was lessened in all conditions that demonstrated some connection between a self-controlled event, such as taking medication or engaging in self-management behaviors, and migraine-related disability. Health care professional locus of control exhibited a very different pattern of changes over treatment, as it did not diminish in any treatment condition, but increased in individuals who received only medication. Thus, it is evident that chance and health care professional locus of control are measuring separable constructs, and should not be combined into an aggregate external locus of control measure in studies of migraine.

In this study, individuals in the BMM groups maintained pretreatment expectations regarding health care professional control of migraine, whereas individuals who received only medication and no BMM experienced increases in their expectation that health care professionals’ actions influenced their migraines. These may indicate appropriate levels of reliance and overdependence on health care professionals, respectively. As mentioned previously, health care professional locus of control may confound realistic reliance and overdependence on one’s health care provider. A realistic reliance on one’s health care provider is likely necessary for compliance with medical treatment, therefore a very low health care professional locus of control may not be adaptive. However, high levels of health care professional locus of control, as demonstrated post-treatment in the medication-only groups, may reflect overdependence and unrealistic expectations of the health care provider.
Moderation of HMSE

This study sought to determine initial characteristics (locus of control) which predispose participants to experience greater or lesser increases self-efficacy during behavioral treatment. A deficiency model of moderation was supported, in which individuals who initially expected that their migraines were primarily influenced by chance experienced a greater increase in self-efficacy during BMM. These results suggest that individuals with high chance or fate control orientations are not handicapped by their initial locus of control, and are able to develop confidence in their ability to manage migraine, attaining similar post-treatment levels of self-efficacy as individuals with high initial internal control orientations.

Medication Effects

Several authors (Bandura, 1997; Hollon & DeRubeis, 1981) have suggested that use of medications may undermine self-efficacy by creating reliance on an external health management tool. In this study, drug therapy alone was not associated with a decrease in self-efficacy, as participants in all groups experienced increases in self-efficacy. Additionally, drug therapy in conjunction with BMM did not undermine participants’ abilities to increase self-efficacy, as participants in the BMM + β-B group experienced similar increases in HMSE over the course of the study as individuals in the BMM + PL group. While this study indicates that medications do not undermine self-efficacy, acute pharmacotherapy for migraine requires active self-monitoring and decision-making. Additionally, neurologists routinely engage in brief discussions of trigger management
with their patients. Therefore, the active components of medical migraine management may have contributed to the increase in HMSE in all treatment groups.

**Limitations**

This study did not examine relationships between expectancies and improvement in migraine severity or disability, limiting conclusions about the roles that expectancies may play in the treatment effects of migraine characteristics and migraine-related disability. Additionally, this study did not include a no-treatment control group, therefore all conclusions were referenced to pharmacological treatment comparison groups rather than a true control group.

This study also did not take into account optimal levels of migraine expectancies. As migraine is not entirely within an individual’s control, and one is not fully able to self-manage and prevent migraines, unrealistically high expectations of personal control or efficacy may not be adaptive. Indeed, one cross-sectional study (Seng & Holroyd, unpublished) using these data demonstrated a plateau effect in which, as HMSE increased, the negative relationship between HMSE and headache disability slowly leveled off. In the current study, increases in HMSE in both BMM groups plateaued at approximately the same level of HMSE, potentially indicating an optimal level of HMSE, after which further increases in HMSE offer little benefit.

The domain of self-efficacy measured in this study was efficacy to behaviorally manage migraines, and did not include any items regarding the proper use of pharmacological treatment. It is possible that individuals in the medication groups increased in efficacy for their ability to take medications properly, or collaboration with
their physician to manage their migraines, and that this change was not captured in the measurement of self-efficacy.
CHAPTER 2: RELATIONSHIPS AMONG MIGRAINE-RELATED EXPECTANCIES AND DISABILITY

Introduction

Migraine is a prevalent recurring headache disorder that is associated with significant reductions in quality of life due to pain, associated symptoms of phono- and photo-sensitivity and nausea, and reductions in social and work-related activities (Leonardi et al., 2005). Migraine-associated disability is not solely accounted for by migraine features (Stewart, Lipton, & Kolodner, 2003). Beliefs and expectations surrounding migraine are hypothesized to account for portions of the unexplained variation in headache-related disability (Bandura, 1997).

Expectancies and Disability

Migraine-related expectancies include expectations about factors that determine migraine onset, course and severity (locus of control) (Rotter, 1966) and expectations about the capability to self-manage migraine (self-efficacy) (Bandura, 1977, 1997). Locus of control consists of two factors: internal (the extent to which a migraine sufferer believes that the factors influencing her migraines are potentially within her control) and external (the extent to which a migraine sufferer believes her migraines are contingent upon factors she cannot influence). External locus of control is commonly divided into two very different, even uncorrelated domains: health care professional locus of control, the belief that one’s migraines are influenced by the actions of one’s health care provider and the medical system, and chance locus of control, the belief that one’s migraines occur randomly or are predetermined by genetics or fate. In general, first-order correlations
indicate that higher chance and health care professional locus of control are associated with greater headache-related disability (French et al., 2000; Martin et al., 1990; Nash et al., 2006). In some studies, higher internal locus of control is associated with higher levels of headache-related disability (French et al., 2000; Martin et al., 1990) but other studies have found no relationship between internal locus of control and headache-related disability (Nash et al., 2006). Internal (French et al., 2000) and health care professional locus of control (Nash et al., 2006) account for variance in headache-related disability beyond that explained by headache severity. Self-efficacy, the confidence to engage in migraine management behaviors, has been associated with lower levels of migraine-related disability (French et al., 2000; Nash et al., 2006).

*Relationships among expectancies*

Social Learning Theory postulates that expectancies influence migraine-related disability through influencing emotion concerning migraine and behaviors to prevent and manage migraines (Bandura, 1997). An internal control orientation is postulated to be a precondition for engaging in behaviors to manage migraine, and therefore is likely related to confidence to effectively engage in those behaviors. In two headache studies, self-efficacy has been positively related to internal and negatively related to chance locus of control (French et al., 2000; Nash et al., 2006). No significant relationship has been detected between health care professional locus of control and headache-related self-efficacy, suggesting that an individual’s confidence to perform the actions necessary to prevent and manage migraines is unrelated to reliance on health care professionals.
Optimal Expectancy Levels

In general, little discussion has been devoted to specifying optimal expectancy levels; the implicit assumption in the literature that ‘more is better’ may not be entirely accurate for migraine-related expectancies like self-efficacy and locus of control. In performance situations, very high self-efficacy is associated with overconfidence and errors (Vancouver, Thompson, Tischner, & Putka, 2002). Unrealistically high self-efficacy for self-management of migraine, a disorder influenced by physiological and environmental factors as well as behaviors (Nicholson, Houle, Rhudy, & Norton, 2007), is likely to lead to disappointment in self-management efforts. Similarly, unrealistically high internal locus of control may be associated with guilt or distress when one feels responsible for migraines, but incapable of engaging in behaviors to manage migraines (Bandura, 1997). Health care professional locus of control may also be most beneficial at moderate levels, that may indicate realistic reliance on one’s provider, rather than higher levels that likely reflect overdependence in the patient-provider relationship, or lower levels that may reflect distrust of the medical field. It could be postulated that effective management of migraine is most likely when an individual takes appropriate responsibility for factors the migraine sufferer influences, responds adaptively to migraine attacks and takes measures to prevent future migraines. Unrealistic positive expectancies are likely to conflict with real limitations, and are thus unlikely to facilitate effective long-term self-management. However, a positive halo, or some degree of overestimation of controllability, may well be adaptive, as has been observed in other
areas of attribution research, such as depression (Alloy, Albright, Abramson, & Dykman, 1990).

Current Study

The current study is a cross-sectional examination of expectancies in frequent migraine before and after receiving behavioral and/or drug therapy.

Hypotheses

Participants’ expectations about the controllability of the factors influencing their migraines, and expectations about their capability to take actions that will influence their migraines, will be related to migraine-related disability and quality of life. Specifically, higher levels of self-efficacy and internal locus of control will be associated with lower levels of headache-related disability, whereas higher levels chance locus of control will be associated with higher levels of headache-related disability. These relationships will account for variance in headache-related disability beyond that which is explained by migraine severity. Because health care professional locus of control bears no obvious relationship with headache-related disability, no significant correlation is predicted between health care professional locus of control and headache-related disability.

Methods

232 individuals with current migraine with or without aura were recruited and met inclusion criteria for the Treatment of Severe Migraine study. Described in detail elsewhere (Seng & Holroyd, unpublished) this is a 2 (drug therapy) X 2 (Behavioral Migraine Management; BMM) treatment study for individuals who were between 18 and 65 years and had an International Classification of Headache Disorders (ICHD) diagnosis.
of migraine (w or w/o aura) at 2 separate evaluations, with diary confirmed migraine severity criteria during an optimal acute therapy run-in of 3 or more migraines with disability in 30 days. All participants received optimal acute therapy consisting of abortive medication and brief education regarding migraine triggers. Participants in the drug therapy groups received a beta-blocker medication, whereas those not in the drug therapy groups received placebo. Participants in the BMM groups received 4 treatment sessions during which participants learned relaxation, identification and management of triggers, how to reduce the impact of a migraine on daily life, stress management, and thermal biofeedback (Lipchik et al., 2002). The current study examines data collected at baseline and at month 5 of the study, at which point all participants had received all BMM sessions and/or had completed the beta-blocker dose adjustment phase \((n \text{ at month } 5 = 176)\). All participants provided written informed consent according to procedures approved by the Ohio University Human Subjects Committee.

Measures

*Expectancies*

*Headache Management Self-Efficacy Scale (HMSE).* The HMSE (French et al., 2000) is a self-report, 25-item scale (7-points, ranging from 1= strongly disagree to 7=strongly agree), which measures an individual’s self-efficacy to manage headache pain and prevent headache episodes. Questions include, “I can reduce the intensity of a headache by relaxing,” and “Nothing I do will keep a mild headache from turning into a bad headache (reverse).” It has demonstrated excellent internal consistency, (Cronbach’s \(\alpha = .90\); French, et al., 2000). Support has been provided for the construct validity of the
HMSE (French et al., 2000). The HMSE demonstrated positive correlations with internal locus of control, and negative correlations with chance locus of control. Although significant, these correlations were appropriately low ($r=0.40$, and $r=-0.64$, respectively) indicating that the measures are discriminating between the constructs. Also, a high score on the HMSE was positively associated with positive psychological coping for the management and prevention of headaches. The HMSE was negatively related to measures of headache severity and disability.

*Headache Specific Locus of Control Scale (HSLC).* The HSLC (Martin et al., 1990) is a 33-item scale designed to assess the extent to which individuals with recurrent headache expect their headaches to be contingent upon factors influenced by themselves, chance, or their health care professionals. Items are coded on a 5-point Likert-type scale ranging from “strongly disagree” to “strongly agree.” Items include the following: “My actions influence whether or I have headaches,” (Internal); “My headaches are beyond all control,” (Chance); and “Following the doctors medication regimen is the best way for me not to be laid-up with a headache,” (Health Care Professionals). The internal subscale is scored so that low scores indicate high internality of control beliefs. This subscale will be reversed for the analyses. Each subscale demonstrates good internal consistency ($\alpha_s = .80-.89$) (Martin et al., 1990; VandeCreek & O'Donnell, 1992). All three subscales also demonstrated adequate three-week test-retest reliability ($rs = .72-.78$; Martin et al., 1990). Subscales demonstrated significant expected relationships with related measures. Chance LOC was related to catastrophizing ($r = .44$) while Internal LOC was related to a
preference for self-regulation treatments \((r = .21)\). Health Care Professionals was related to a preference for medical treatment rather than non-medical treatment \((r = .45)\).

*Migraine Severity*

*Headache Diary.* Participants entered daily reports of their headache activity into Palm III hand held computer (3 Com Corp.) throughout the course of the study. Patients were prompted daily by the hand-held computer to record an entry of their headache activity each day. Diary entries were made by tapping on the screen using pop-up lists and programmer-defined interface objects which appeared in sequence as each screen was completed. Information collected included whether or not the participant had a headache, the type, time of day and length of headache, severity of headache, sensitivity to light and sound, presence of nausea or vomiting, and medication use. Participants also reported how a headache affected their ability to work, sleep, and socialize. For women, the diary recorded menstrual flow onset. The data was uploaded at each clinic visit starting with the first treatment visit; therefore, 16 months of data was accumulated. 30 day averages were calculated and will be used in analyses.

*Disability*

*Migraine-Specific Quality of Life Questionnaire.* The Migraine-Specific Quality of Life Questionnaire (Jhingran, Osterhouse, Miller, Lee, & Kirchdoerfer, 1998) is a 16-item questionnaire designed to measure the quality of life of individuals with migraine. The questionnaire can be divided into three subscales: Role Function-Restrictive, Role Function-Preventative, and Emotional Function. Sample items include “In the past 4 weeks, how often have migraines interfered with how well you dealt with family, friends,
and others who are close to you?” (Role-Function-Restrictive), “In the past four weeks, how often have you had to cancel work or daily activities because you had a migraine?” (Role Function-Preventative), and “In the past four weeks how often have you felt fed up or frustrated because of your migraines?” (Emotional Function). The subtests demonstrated adequate reliability (.79-.85) and were highly correlated (.84-.89) (Jhingran et al., 1998).

*Headache Disability Inventory.* The Headache Disability Inventory (Jacobson, Ramadan, Aggarwal, & Newman, 1994) is a 25 item self-report inventory designed to assess everyday impairment in quality of life that is attributed to migraine. The measure can be divided into two subscales that measure the functional and emotional impairment. Sample items include, “Because of my headaches I feel handicapped,” (functional impairment) and “Sometimes I feel that I am going to lose control because of my headaches,” (emotional impairment). The Headache Disability Inventory has demonstrated high internal consistency (correlations between the subscales and the total score were both \( r = 0.89 \), correlations between the functional subscale and its items ranged from \( r = 0.48-0.69 \), and from \( r = 0.47-0.72 \) for the emotional subscale). The measure also demonstrated good short-term (1 week; \( r = 0.78 \)) and long-term (2-month; \( r = 0.83 \)) test-retest reliability (Jacobson et al., 1994; Jacobson, Ramadan, Norris, & Newman, 1995).

*Demographic Variables*

Demographic variables, including age, gender, socioeconomic status (SES) and ethnicity, were measured using a self-report questionnaire at baseline. The SES variable
was created using number of years of education completed and annual income. Ethnicity was a categorical variable including “White, non-Hispanic”, “Black, non-Hispanic”, “Asian or Pacific Islander”, “Hispanic”, “American Indian or Alaskan Native”, and “Other”.

**Statistical Analyses**

First-order correlations between demographic variables, expectancies and disability were examined at baseline and at month 5. Correlations at month 5 were examined in all groups jointly, and by BMM group status. Hierarchical regression analysis was used to examine the relationship between expectancies and headache-related functioning/quality of life at baseline. The Headache Disability Inventory and the Migraine-Specific Quality of Life Questionnaire served as the outcome variables in separate regression analyses with migraine severity (migraine days) entered in the first block, and expectancies entered in the second block. A forward stepwise procedure was used to enter variables into the model. In each analysis, migraine frequency (the number of migraine days per 30 days) was added in the first step because it is considered to be a good estimate of severity of migraine disorder in migraine literature. Baseline measurements the HMSE and the three subscales of the HSLC were entered in the second step. Variables were examined for non-linear relationships in the final step, in which second-order HMSE and HSLC variables (computed by squaring the variables’ baseline measurements) were added using a forward stepwise procedure.
Results

All variables were multinormally distributed. The mean age of participants was 38.16 (SD = 10.19). 194 individuals reported white, non-Hispanic ethnicity, 31 black, non-Hispanic, and 7 reported identifying with another ethnic group. Participants recorded an average of 8.47 (SD = 3.56) migraine days per 30 days during the five week Optimal Acute Therapy run-in period, an average HDI score of 45.73 (SD = 20.34), and an average MSQ score of 39.57 (SD = 2.68), both indicating severe impairment.

Baseline correlations among potential predictor variables, including demographic variables, migraine days and expectancies are reported in Table 2. Of note, higher SES was associated with lower chance HSLC, higher levels of HMSE and lower levels of disability. At baseline, higher levels of HMSE were strongly associated with lower levels of chance HSLC. Higher HMSE also demonstrated small but significant correlations with lower levels health care professional HSLC, and higher levels internal HSLC. Relationships between internal HSLC and chance and health care professional subscales of the HSLC were small but differed in direction: internal HSLC was associated with higher levels of health care professional HSLC, but lower levels of chance HSLC.
Table 2.

Baseline correlations among possible predictors, locus of control and expectancies

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*p < .05 *, p < .01**, p < .001***.
Higher levels of internal HSLC were associated with *higher* levels of disability, as measured by the Headache Disability Inventory. However, no significant relationship was observed between the Migraine-Specific Quality of Life questionnaire and internal HSLC. The Headache Disability Inventory contains a large number of emotion-related items (e.g., “I feel desperate because of my headaches”), whereas the Migraine-Specific Quality of Life Questionnaire includes subscales assessing Role Restriction and Role Prevention, in addition to Emotional Function. To clarify the discrepant correlations between internal HSLC and disability prior to treatment, correlations were run between the subscales of the Migraine-Specific Quality of Life Questionnaire and internal HSLC at baseline. If internal HSLC were related to the Emotional Function subscale, but neither Role Prevention nor Restriction, this would indicate that internal HSLC is associated with emotional, rather than functional aspects of disability. Upon examination of the subscales, only Emotional Function was significantly related to internal HSLC, \( r = .17, p < .05 \). It appears that, prior to treatment, individuals who believe that their migraines are contingent upon factors they can influence experience more emotional distress associated with their headaches.

Correlations among expectancies and disability after treatment were run to explore if receiving BMM and medication or medication alone influenced these relationships. It is possible that internal HSLC would be less associated with emotional distress after migraine suffers are taught migraine management techniques in the BMM groups, in which case the correlations between emotional distress and internal HSLC
would be expected to decrease after BMM treatment, but not drug therapy alone. After treatment, although most relationships did not differ, several changes in correlation patterns were observed that shed light onto the relationships among expectancies and disability. Most notably, in the drug therapy groups, higher internal HSLC continued to be moderately associated with higher levels of the Headache Disability Inventory, \( r = .28, \ p < .001 \), and was marginally associated with higher levels of disability in the Emotional Function subscale of the Migraine Specific Quality of Life Questionnaire, \( r = .20, \ p = .058 \); however, in the BMM groups, internal HSLC was no longer related to any measure of disability \( (p > .05) \). Additionally, health care professional HSLC was no longer associated with disability in either treatment condition \( (p > .05) \). This indicates that, after receiving drug therapy, regardless of BMM, the expectation that one’s health care professional influences migraines is no longer associated with higher levels of disability.

Hierarchical regression analysis at baseline revealed migraine days, health care professionals HSLC, internal HSLC, and HMSE made independent contributions to Headache Disability Inventory, with the contribution of HMSE being nonlinear (see Table 3). Controlling for migraine days, higher internal and health care professional HSLC was associated with greater disability, whereas greater HMSE was associated with less disability. The additive benefit of higher HMSE leveled off as HMSE increased. A second analysis demonstrated that health care professionals HSLC and HMSE each contributed independently to Migraine-Specific Quality of Life (see Table 4). Controlling for migraine days, higher health care professionals HSLC and lower HMSE were associated with greater impairment in quality of life. There was a trend for a nonlinear
relationship with HMSE, in which as HMSE increased, its relationship with the
Migraine-Specific Quality of Life Questionnaire became less negative, \( t(226) = 1.924, p = .056, \) partial \( r = .127. \)

Table 3.

Hierarchical regression for the Headache Disability Inventory

<table>
<thead>
<tr>
<th>Variable</th>
<th>( R^2 )</th>
<th>( \Delta R^2 )</th>
<th>partial ( r^2 )</th>
<th>( \beta )</th>
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<tbody>
<tr>
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<td></td>
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<tr>
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<td>.036</td>
<td>.036**</td>
<td>1.064</td>
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<td>.024*</td>
<td>.848</td>
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<td>Migraine Days</td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>Health Care Professionals HSLC</td>
<td></td>
<td></td>
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<td>.913</td>
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<tr>
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<td>.024*</td>
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<td>.810</td>
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<tr>
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<td>.023*</td>
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<td>.604</td>
</tr>
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<td>.727</td>
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<tr>
<td>HMSE(^2)</td>
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Note. \( P < .05 *, p < .01 **, p < .001 ***. \)
Table 4.

Hierarchical regression for the Migraine-Specific Quality of Life Questionnaire

<table>
<thead>
<tr>
<th>Step</th>
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<th>$\Delta R^2$</th>
<th>partial $r^2$</th>
<th>$\beta$</th>
</tr>
</thead>
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<td>.027</td>
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<td>.584</td>
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<td></td>
<td></td>
<td></td>
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<td>Step 2</td>
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<td>.017</td>
<td>.439</td>
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<tr>
<td>Health Care Professionals HSLC</td>
<td></td>
<td>.076***</td>
<td>.600</td>
<td></td>
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<tr>
<td>Step 3</td>
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<td>Migraine Days</td>
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<td></td>
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<td>Health Care Professionals HSLC</td>
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<td>.545</td>
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<tr>
<td>HMSE</td>
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<td>.037**</td>
<td>-.114</td>
<td></td>
</tr>
</tbody>
</table>

Note. P < .05*, p < .01**, p < .001***.

Discussion

This study demonstrated that greater confidence to self-manage migraine was associated with higher expectations that migraines are dependent on an individual’s actions, and lower expectations that chance influences migraine. Higher self-efficacy was also associated with lower headache-related disability, even when taking into account migraine days. The expectation that migraines are primarily influenced by chance or fate was positively associated with disability, although migraine days significantly diminished the relationship between chance locus of control and disability. The expectation that the actions of one’s health care professional influences migraines was associated differently with disability depending on treatment status: pre-treatment, higher health care professional locus of control was associated greater headache-related disability, but post-treatment, health care professional locus of control was no longer associated with disability in either treatment group. Internal locus of control demonstrated a negative
relationship with chance locus of control, but positive relationships with health care professional locus of control and headache-related disability, particularly emotional distress. However, after receiving BMM, internal locus of control was no longer associated with emotional distress.

*Expectancies predict disability beyond migraine severity*

At all levels of headache days, the belief that one could effectively manage and prevent migraines was associated with lower headache-related disability. This finding implies that, even when taking into account migraine frequency, self-efficacy is an important determinant of migraine-related disability and should be a focus of migraine treatment. This contrasts previous findings by Nash and colleagues (2006) where, in a sample of treatment seeking headache sufferers ($n = 96$) where, in a sample of treatment seeking headache sufferers ($n = 96$) in which the relationship between the HMSE and disability was not significant ($r = -.13, p > .05$) and was not useful in predicting disability in the presence of headache pain intensity, duration and frequency. However, this study used the Migraine Disability Assessment Scale (Stewart, Lipton, Dowson, & Sawyer, 2001) to assess headache-related disability, which focuses solely on functional impairment rather than including role and emotion-related disability and thus may be less sensitive to the full range of disability.

Before treatment, regardless of headache frequency, the expectation that one’s own actions influence migraine was associated with higher headache-related emotional distress, likely due to guilt associated with feeling responsible for one’s migraines. After treatment, the relationship between internal HSLC and headache disability related to
emotional distress was no longer significant in the BMM groups, suggesting that individuals who receive the skills necessary to self-manage migraine are no longer distressed by their expectation that they can influence factors that contribute to their migraines. These individuals received the tools necessary to influence their migraines, and were instructed in a realistic perception of the magnitude of migraine change their behaviors can effect, each of which likely contributed to lower levels of guilt and helplessness surrounding migraines. The positive relationship between internal HSLC and emotional distress maintained in individuals who received drug therapy only, providing further evidence that BMM, rather than treatment-related changes in disability, effected this change.

Prior to treatment, higher levels of both external measures of HSLC (chance and health care professionals) were associated with higher levels of headache-related disability. However, the influence of chance HSLC on disability appeared to be largely determined by headache frequency prior to treatment, such that an individual who experiences greater headache days also expects migraines to be primarily influenced by chance or fate. However, prior to treatment, regardless of headache frequency, the belief that the behaviors of a physician or other health care professional primarily influenced headaches contributed to greater disability. Pre-treatment participants with high health care professional HSLC were migraine sufferers who had expected their physicians to decrease their migraines, but were seeking more treatment and had likely been disappointed by their lack of headache relief with prior treatment. However, migraine treatment, regardless of treatment type, higher expectations that one’s migraines were
primarily influenced by the actions of one’s health care provider was no longer associated with higher levels disability.

*Optimal Expectancy Levels*

Several of the relationships between expectancies and disability seem to indicate “optimal” expectancy levels, points at which that expectancy is associated with the lowest level of headache-related disability. Optimal expectancy levels would be particularly salient in situations and disorders whose outcomes are influenced by factors outside of the control of the individual, in addition to being influenced by internal factors. Migraine, which is influenced by physiological, behavioral, and environmental factors (Nicholson et al., 2007), is a disorder in which expectations regarding control and efficacy may be associated with the lowest levels of disability at moderate, rather than extreme expectancy levels.

For example, the relationship between self-efficacy and the Headache Disability Inventory proved to be curvilinear; as self-efficacy increased, its negative relationship with disability lessened. This finding indicates the possibility of an optimal self-efficacy level, at which increasing levels of expectation that one is capable of managing migraine may not be realistic or beneficial in reducing headache-related disability. Unrealistic overconfidence in one’s ability to migraine, which is influenced by multiple factors, could lead to discouragement, disappointment, and ultimately less effective migraine self-management. In a performance situation, very high self-efficacy can lead to overconfidence and increased errors (Vancouver et al., 2002). In terms of reducing
disability, a highly efficacious attitude in a disorder which is only partially influenced by an individual’s actions may not be as useful as a realistically efficacious attitude.

A second piece of evidence that may indicate the presence of optimal expectancy levels is the positive relationship between internal HSLC and headache-related disability, particularly emotional distress, before treatment. There are several possible explanations for this finding. Potentially, the more a headache sufferer believes her behaviors influence her headaches, the greater headache-related disability she experiences. Although possible, this explanation does not take into account the relationship between HMSE and internal HSLC: one must have some belief that one’s behavior influences headache in order to feel efficacious to change those behaviors to manage headache. Considering the robust negative relationship between self-efficacy and pain-related disability demonstrated in this and other studies (Arnstein, 2000; Arnstein, Caudill, Mandle, Norris, & Beasley, 1999; French et al., 2000), this explanation seems unlikely. This explanation would also stand in direct contradiction with Social Learning Theory, which states that individuals who believe they have more control over their pain will more effectively use personal resources to cope with pain (Bandura, 1997).

On the other hand, this finding may be an indicator of an optimal level of an internal control orientation, particularly in migraine as it is influenced by multiple factors. In measuring the expectation of one’s own behaviors influencing headaches, we were likely also measuring feelings of responsibility. It is possible that an unrealistically high expectation that one was responsible for one’s own migraines, instead of encouraging proactive behavior to manage migraines, contributed to feelings of guilt and hopelessness.
surrounding migraine attacks. If a migraine sufferer felt responsible for headache frequency and severity, each headache could be interpreted as evidence for the migraine sufferer’s incompetence, and evidence that future efforts to influence migraines would be fruitless. This study provided evidence that very high internal HSCL may be tapping into guilt and helplessness related to a lack of knowledge of self-management techniques. Before treatment, and in the treatment groups in which self-management behaviors were not taught, higher internal HSCL was associated with greater emotional distress. But, after individuals were taught self-management techniques, internal HSCL was no longer associated with emotional distress. Feelings of guilt and hopelessness surrounding migraines should be assessed in future studies of locus of control in order to disentangle negative feelings associated with responsibility for migraines and positive characteristics associated with taking control of behaviors that influence migraine-related pain and disability.

Socioeconomic Status Plays a Role in Headache-Related Expectancies and Disability

In this study, individuals of higher SES were more likely to have higher self-efficacy, lower chance locus of control, and lower headache-related disability prior to treatment. This is not surprising, as SES is positively related to migraine prevalence (Stewart, Lipton, Celentano, & Reed, 1992) and pain-related disability (Fuentes, Hart-Johnson, & Green, 2007). However, it is interesting that SES is not only associated with disability, but is also associated with the expectations that one is capable of preventing and managing migraine, and that one’s migraines are contingent upon chance and fate. It is possible that these differing expectations about the etiology and treatment of migraine
contribute to the relationship between SES and disability. A recent headache treatment study demonstrated that individuals of low socioeconomic status are more likely to drop out of headache treatment (Heckman et al., 2008). Increasing self-efficacy and decreasing chance locus of control may need to be emphasized in the treatment of low SES migraine patients in an attempt to increase adherence to and benefit from behavioral and pharmacologic treatment of migraine.

Limitations

The data in this study were cross-sectional, precluding causal inferences. The measurement of health care professional locus of control confounded both the realistic reliance and overdependent aspects of the patient-provider relationship, which might have differential effects on headache-related SE and disability. Additionally, no measure of guilt was used to examine potential burden associated with a high internal control orientation.
REFERENCES


Implications for health education practice. *Health Promotion Practice, 6*(1), 37-43.


APPENDIX A: PREDICTION OF EARLY DROPOUT

BMM is built on the premise that an individual’s behaviors influence their migraines. If a migraine sufferer was prescribed BMM, but did not expect her behaviors to influence her migraines, this treatment choice may seem fruitless to the migraine sufferer, and she would therefore be more likely to discontinue the treatment. Similarly, if a migraine sufferer expected her migraines to be random (i.e., determined by chance), she may be less likely to follow through with a treatment option based on the premise that her migraines are patterned, and that she can influence that pattern.

Hypotheses

Dropouts (individuals who do not complete the four weeks of treatment) in the BMM group will have higher chance and lower internal locus of control scores at baseline than continuers (individuals who complete the four weeks of treatment).

Statistical Analyses

To determine if locus of control variables add information about whether or not an individual drops out of behavioral or pharmacologic treatment before completion of the behavioral program and/or dose adjustment, preliminary analyses were conducted. The two BMM groups were examined separately from the two medication groups, to determine which variables to control for using logistic regression for categorical variables, and t-tests for correlations for quantitative variables. Two hierarchical logistic regressions were used to examine the hypothesis that baseline LOC variables are able to assist in predicting dropout in BMM groups, and in the medication groups. Control variables identified in the previous analyses and group were entered in the first step, and
internal, chance, and health care professional subscales of the HSLC were entered in the second step. All variables were entered using a backward stepwise procedure.

Results

First, the BMM groups were examined. Four variables were identified as significantly associated with dropout before the first evaluation period, and were therefore added in the first step of the regression analysis, along with group, ethnicity, social status, migraine severity, and migraine-related disability. Ethnicity, Wald $X^2 (4, N = 124) = 9.964, p < .05$ was significantly related to dropout. Non-Hispanic black individuals were more likely to drop out than non-Hispanic white individuals, Wald $X^2 (1, N = 124) = 8.177, p < .01$, OR = 5.21. A social status variable was created using number of years of education completed and annual income. Social status, $r = .19, p < .05$, was also associated with dropout, indicating that individuals with higher social status were more likely to remain in the study. Baseline migraine severity, measured by migraine days recorded during the first month, $r = .25, p < .01$, and baseline migraine-related disability as measured by the HDI, $r = .20, p < .05$, were both significantly associated with dropout. Individuals with higher numbers of migraines, and individuals who experienced greater migraine-related disability were more likely to remain in the study.

The final model of the first step included social status, migraine severity and the HDI. The final model of the second step added chance HSLC to these variables, which explained a significant additional amount of the variance in drop out, $X^2 (1, N = 113) = 4.377, p < .05$. Jointly, these variables accounted for a significant amount of variance in
drop out, $X^2 (4, N = 113) = 22.533, p < .001$. Individuals with higher social status were more likely to remain in the study, Wald $X^2 (1, N = 113) = 3.977, p < .05, OR = 1.61$. Individuals who experienced more headache days, Wald $X^2 (1, N = 113) = 7.373, p < .01, OR = 1.25$, or greater disability at baseline, Wald $X^2 (1, N = 113) = 6.791, p < .01, OR = 1.03$, were more likely to remain in the study. Individuals with high scores on the HSLC chance subscale were more likely to drop out of BMM than individuals with lower chance HSLC scores, Wald $X^2 (1, N = 113) = 4.153, p < .05, OR = .93$.

The model’s sensitivity for dropout was 53.3%, and specificity was 77.6%. For our sample, in which 26.5% percent of patients in the behavioral groups dropped out before the end of the treatment period, the positive predictive value was 52.6% and the negative predictive value was 56.1%. Therefore, although the model is statistically significant, the baseline variables examined are insufficient to adequately predict individuals who are likely to drop out of a behavioral program for managing headaches.

The medication groups were then examined. Of the demographic variables, only age was identified as significantly related to drop out, and was therefore the only variable added in the first step of the logistic regression analyses. Only age was included in the final model, as none of the HSLC scales contributed significantly above age in predicting drop-out in the medication groups, and were therefore not entered in the model. As age increased, the likelihood of dropping out also increased, $X^2 (1, N = 108) = 4.795, p < .05$.

Conclusion

The expectation that migraines are random is related to dropping out of BMM before completion of treatment. However, demographic variables, migraine
characteristics, and expectancies combined did not adequately predict drop out of pharmacological or behavioral treatment. Anecdotally, many patients cited life stressors and lack of time as reasons for dropping out. Other variables should be examined to better predict drop out in behavioral and pharmacological treatment of migraine.
APPENDIX B: CORRELATIONS BETWEEN SELF-EFFICACY AND LOCUS OF
CONTROL CHANGES

Theoretically, locus of control and self-efficacy should be related to each other, but not so highly related that they are measuring essentially the same construct (Bandura, 1997). If these expectancies are related, they may also change together over the course of treatment postulated to influence expectancies. Although drug therapy is not postulated to influence expectancies, BMM is postulated to increase both internal locus of control and self-efficacy, and decrease chance locus of control.

Several studies using clinical headache samples have demonstrated a positive relationship between internal locus of control and self-efficacy, and a negative relationship between chance locus of control and self-efficacy. In a study of headache sufferers (50% migraine), the HMSE was positively related to internal HSLC ($r = .35$) and negatively related to chance HSLC ($r = -.53$), as measured by the Headache-Specific Locus of Control Scale (Nash, et al., 2006). In another study, using a clinical population of chronic tension-type headache sufferers (French, Holroyd, Pinell & Malinoski, 2000), the HMSE was again positively related with internal HSLC ($r = .40$) and negatively related with chance HSLC ($r = -.64$).

Neither study demonstrated a significant relationship between health care professionals HSLC and HMSE, suggesting that confidence in one’s ability to take the actions necessary to prevent and manage migraines may be unrelated to expectancies about the role health care professionals play in management of migraines. These data are cross-sectional and correlational, limiting the inferences one can draw from the studies.
One intervention study addressed the question of the relationship between self-efficacy and locus of control changes over behavioral treatment. Holroyd and colleagues (1984) conducted a study in which they attempted to manipulate self-efficacy by manipulating perceived success (a determinant of self-efficacy; Bandura, 1977) at a biofeedback task. 43 college student recurrent headache sufferers were randomized to receive either a high or moderate success feedback regarding EMG activity and, through experimental manipulation, either increased or decreased muscle tension (decreased muscle tension is the object of typical EMG biofeedback). This study found individuals in both of the high success feedback groups reported more internal control beliefs concerning their headaches at the completion of the four sessions than prior to treatment. This was not the case in either of the moderate success feedback groups, which suggests that self-efficacy increases through performance feedback may be related to locus of control changes during treatment. This study’s main purpose was not the examination of locus of control, and its examination of the relationship between locus of control and self-efficacy is limited by its correlational design. However, this study provides further evidence for a potential relationship among changes in self-efficacy and locus of control over the course of behavioral headache treatment.

**Hypothesis**

In the BMM groups, changes in internal locus of and self-efficacy will be positively correlated, whereas changes in chance locus of control and in self efficacy will be negatively correlated, although the strength of this relationship may differ during the
treatment phase and evaluation phases of the trial. These changes will not be correlated in the medication only groups.

**Statistical Analyses**

To examine correlations between changes in self-efficacy and the locus of control subscales, missing values first had to be imputed using the expectation-maximization method. This was necessary as individuals who dropped out of the study would simply be dropped from the analyses, creating potentially higher correlations between self-efficacy and locus of control in each group, and reducing the $n$ for each analysis. The expectation-maximization procedure is a two-step iterative process. During the first step, expected values are derived using observed data on specified variables. In this case, the observed data used was the variable in which missing values were being imputed, group, and time. In the second step, estimates of the parameters are created by maximizing the expected likelihood found in the first step. The process is then repeated using these parameters.

After missing variables were imputed, change scores were computed by subtracting the self-efficacy or locus of control subscale at each time point from the baseline level. Corresponding self-efficacy and locus of control subscale change scores were then correlated in separate analyses for each treatment group.

**Results**

Correlations between internal locus of control and self-efficacy changes at each time point were significant only in the combined β-Blocker and BMM group. In this group, changes in internal locus of control were positively related to changes in self-efficacy at every time point (Table 5, Figure 7). In the combined group, there were no
significant correlations between changes in chance locus of control and self-efficacy for month 1 or month 5, but all other time points demonstrated significant negative correlations between changes in chance locus of control and self-efficacy (Table 6, Figure 8). Again, no other groups showed a pattern of significant correlations in either direction. There were no significant correlations between changes in health care professional locus of control and self-efficacy in any treatment group.

Table 5.

<table>
<thead>
<tr>
<th>Month – Baseline</th>
<th>Month 1</th>
<th>Month 3</th>
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<th>Month 7</th>
<th>Month 10</th>
<th>Month 13</th>
<th>Month 16</th>
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<td>.064</td>
<td>.161</td>
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<td>.129</td>
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<td>.049</td>
<td>-.045</td>
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<td>-.065</td>
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<tr>
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<td>.372**</td>
<td>.297*</td>
<td>.336**</td>
<td>.304*</td>
<td>.267*</td>
<td>.367**</td>
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Note. $P < .05^*$, $p < .01^{**}$. 

Correlations between changes in internal headache-specific locus of control and headache self-efficacy.
Figure 7. Correlations between changes in internal headache specific locus of control and headache self efficacy over treatment.

Table 6.

<table>
<thead>
<tr>
<th>Month – Baseline</th>
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<th>Month 3</th>
<th>Month 5</th>
<th>Month 7</th>
<th>Month 10</th>
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<td>.105</td>
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<td>-.210</td>
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<td>.372**</td>
</tr>
</tbody>
</table>

Note $P < .05^*$, $p < .01^{**}$. 
In general, changes in chance and internal HSLC were correlated with HMSE in the expected directions in the combined behavioral and pharmacological treatment group. These relationships were not consistently demonstrated in any of the other treatment groups, including the BMM + PL group. It is notable that only when active medication and behavioral treatments were combined did the HSLC subscales correlate with HMSE. It appears that the increased knowledge and individual interventions taught during behavioral treatment in concert with the decreased headache frequency attributed to taking preventative medication are the conditions under which HMSE and HSLC are most closely related throughout the course of treatment.

Figure 8. Correlations between changes in chance headache specific locus of control and headache self efficacy over treatment.