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Nonmigrainous Pediatric Headache Management: Thermal Biofeedback and Parent Guidelines

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NONMIGRAINOUS PEDIATRIC HEADACHE MANAGEMENT: THERMAL BIOFEEDBACK AND PARENT GUIDELINES

by

Richard E. Arndorfer

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Submitted to the
Faculty of The Graduate College
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NONMIGRAINOUS PEDIATRIC HEADACHE MANAGEMENT: THERMAL BIOFEEDBACK AND PARENT GUIDELINES

Richard E. Arndorfer, Ph.D.
Western Michigan University, 1999

This study explored the utility of the combination of thermal biofeedback and parent-mediated pain behavior management guidelines as a treatment for children experiencing nonmigrainous headache. Five children, ages 8 to 14, were assigned to baselines of varying lengths prior to receiving treatment. Four of the five children demonstrated significant reductions in one or more headache parameters (frequency, duration, average peak intensity) following treatment. The utility of thermal biofeedback and parent-mediated guidelines are supported as a treatment for children suffering from nonmigrainous headache.
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INTRODUCTION

Recurrent headaches are a common health problem for children of all ages which may impact considerably on academic and social functioning. The most common headaches in children are tension-type headache (characterized by dull, diffuse, mild to moderate pain) and migraine headache without aura (characterized by sharp, throbbing, moderate to severe pain). Recent epidemiological studies indicated that the one-year prevalence of headache in children is 30-50% (e.g., Linet, Stewart, Celentano, Ziegler, & Sprecher, 1989; Mortimer, Kay, & Jaron, 1992; Sillanpaa & Anttila, 1996). Results from the National Health Interview Survey indicate that among 5 to 17-year-old children, headaches resulted in at least 153,501 days spent in bed, 360,848 days of restricted activity, and 2.75 million days of school missed during a two week period in the United States (Stang & Osterhaus, 1993). Studies of child headache sufferers indicated that 3-5% experience migrainous headache and 20-30% experience frequent nonmigrainous headaches (headaches not meeting criteria for a diagnosis of migraine with or without aura; e.g., Bille, 1981; Cady, Farmer, Griesemer, & Sable, 1996; Linet et al., 1989). Nonmigrainous headaches (NMHs) include episodic tension-type headache (ETTH), chronic tension-type headache (CTTH), migraine, not otherwise specified (NOS), and tension-type headache, NOS as defined by the Headache Classification Committee of the International Headache Society (1988; see Figure 1).
### Episodic Tension-type Headache

A. At least 10 previous headaches fulfilling criteria below

B. Number of days with such headache should be less than 15/month

C. Duration from 30 minutes to 7 days

D. At least two of the following pain characteristics:
   1. Bilateral location
   2. Pressing (non-pulsating) quality
   3. Mild or moderate intensity (may inhibit, but does not prohibit activities)
   4. No aggravation by walking stairs or similar routine physical activities

E. Both of the following:
   1. No nausea or vomiting (anorexia may occur)
   2. Photophobia and phonophobia are absent, or only one is present

### Chronic Tension-type Headache

A. Average headache frequency of more than 15 days per month for over 6 months

B. At least two of the following pain characteristics
   1. Pressing (non-pulsating) quality
   2. Mild or moderate intensity (may inhibit, but not prohibit activities)
   3. Bilateral location
   4. No aggravation by walking stairs or similar routine physical activity

C. Both of the following:
   1. No vomiting
   2. No more than one of the following: nausea, photophobia, phonophobia

D. Secondary headache types not suggested or confirmed

---

Figure 1. International Headache Society Diagnostic Criteria for Tension and Migraine Headaches.
Figure 1–continued

Migraine Without Aura (Common Migraine)
 A. At least 5 attacks fulfilling criteria below
 B. Headache attacks, lasting 2–48 hours (untreated or unsuccessfully treated)
 C. Headache has at least two of the following characteristics:
   1. Unilateral location
   2. Pulsating quality
   3. Moderate to severe intensity (inhibits or prohibits daily activities)
   4. Aggravation by climbing stairs or similar routine physical activities
 D. During headache, at least one of the following:
   1. Nausea and/or vomiting
   2. The combination of photophobia and phonophobia
 E. Secondary headache types not suggested or confirmed

Migraine With Aura (Classic Migraine)
 A. At least two attacks fulfilling criteria B
 B. At least three of the following four characteristics:
   1. One or more fully reversible aura symptoms indicating focal cerebral cortical and/or brain stem dysfunction
   2. At least one aura symptom develops gradually over more than 4 minutes or, two or more symptoms occur in succession
   3. No aura symptom lasts more than 60 minutes. If more than one aura symptom is present, accepted duration is proportionally increased
   4. Headache follows aura with a free interval of less than 60 minutes, but may begin before or simultaneously with the aura
 C. Secondary headache types not suggested or confirmed

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The IHS diagnostic criteria are difficult to apply to a pediatric population due to overlapping criteria (Gallai et al., 1995). Child sufferers whose headaches do not meet criteria for a specific diagnosis have often been overlooked by the research literature. Research documenting treatment efficacy for migraine, NOS and TTH, NOS is lacking in the published literature. The current study will investigate treatment outcome for all types of frequent NMH. The most common type of NMH is tension-type headache (TTH) including ETTH and CTTH, therefore the research literature regarding TTH will be utilized extensively in the discussion of NMH.

Pharmacological treatment of NMH can be an effective approach to treatment, however, clinical evidence suggests that many medications are effective for a limited time. Pharmacological treatments may also result in a variety of negative side effects including nausea, vomiting, and sleep problems. Data regarding the expense of pharmacological treatments in children is unavailable in the published literature, however, Blanchard, Jaccard, Andrasik, Guarnieri and Jurish (1985) report a two year average medical cost of $955 for an adult population of an adult population of chronic headache sufferers (i.e., TTH, migraine) including $225 in medication expenses.

A variety of nonpharmacological interventions have been developed for treating migrainous and nonmigrainous headaches. Relaxation and biofeedback, interventions designed to alter underlying physiology, are among the most extensively researched management strategies for headaches in a pediatric population (Blanchard, 1992; Holroyd & Penzien, 1994). On the other hand, interventions designed to alter the consequences of suffering and coping behaviors including pain behavior
management (PBM) guidelines have rarely been used in isolation to treat pain behaviors associated with recurrent headache. However, the importance of learning factors in understanding recurrent pain (e.g., lower back pain) has been well established (Fordyce, 1976; Fordyce & Steger, 1979; Rachlin, 1985). Based upon the literature concerning the management of recurrent pain in other areas, contingency management procedures appear to play an important role in promoting the use of adaptive coping strategies and reducing verbal reports of headache activity.

Biofeedback techniques (i.e., electromyographic (EMG) biofeedback, thermal biofeedback (TBF)) are among the most widely researched treatments of headache. From a learning theory perspective, biofeedback is viewed as operant conditioning of neuromuscular and autonomic activity (Olson, 1995). During biofeedback, the patient is allowed access to information from the targeted physiological system, which is otherwise unavailable, and subsequently uses the information to develop voluntary behaviors to reduce problematic physiological responses. Physiological responses such as muscle tension and vascular activity are conceptualized as operant behaviors that may be changed by their consequences or effects. The relevant consequences or effects in the case of biofeedback include the reinforcing effects of the feedback signals.

In the past, dominant conceptualizations of the pathophysiology of headaches have centered on the notion that migraines are primarily vascular in nature while TTH's arise secondary to sustained muscle contraction (Gascon, 1984; Silberstein, 1995). TBF is consistent with the proposed vascular component of migraines and
subsequently has been used extensively with pediatric migraine (e.g., Allen & McKeen, 1991; Hermann, Kim, & Blanchard, 1996). The efficacy of TBF has been attributed to either a specific reduction in sympathetic vascular activity or a general reduction in sympathetic arousal. One proposed mechanism for the efficacy of TBF is that by increasing peripheral temperature, patients learn to provoke a volitional decrease in sympathetic vascular activity. The decrease in sympathetic vascular activity is presumed to provoke a vascular dilation of the intracranial and extracranial arteries, which can abort or prevent the preheadache phase associated with excessive constriction of these arteries (Gauthier, Ivers, & Carrier, 1996). Routine vascular dilation would therefore prevent the excessive vasoconstriction presumed to be a prerequisite to the rapid vasodilation responsible for headache pain. EMG biofeedback is consistent with the proposed muscle contraction component of TTH and subsequently has been used extensively with TTH (Holroyd & Penzien, 1994). An alternative conceptualization proposed by Morrill and Blanchard (1989), indicates that TBF may produce a general decrease in sympathetic arousal and may result in a conditioned adaptation-relaxation reflex that affects many physiological systems including vascular dilation and muscle tension. The rationale for using EMG biofeedback with TTH is that reducing the intensity, frequency, and duration of excessive muscle tension of the pericranial (e.g., temporalis, frontalis) or the cervical paraspinal musculature may prevent or reduce the intensity of the headache. However, research has shown that the dominant conceptualization of the pathophysiology of TTH is inadequate (e.g., Andrasik, Blanchard, Arena, Saunders, & Barron, 1982; Hatch et al., 1992; Haynes,
Alternative conceptualizations of tension-type and migraine headaches have focused on the continuum model of headaches (see Table 1; e.g., Schade, 1997; Takeshima & Takahashi, 1988). Nelson (1993) argues that tension-type and migraine headaches can be seen as a disorder of central nervous system regulation, by hypothalamic or limbic centers. Serotonergic systems appear to be particularly sensitive to this dysregulation (Nelson, 1993). The dysregulation is presumed to result in

Table 1
Headache Continuum

<table>
<thead>
<tr>
<th>Headache Elements</th>
<th>Headache Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Muscle Tenderness</td>
<td>Mild-Severe</td>
</tr>
<tr>
<td>Throbbing Pain</td>
<td>Absent-Mild</td>
</tr>
<tr>
<td>Nausea / Vomiting</td>
<td>Absent-Mild</td>
</tr>
<tr>
<td>Unilaterality</td>
<td>Absent-Present</td>
</tr>
<tr>
<td>Neurological Aura</td>
<td>Absent</td>
</tr>
<tr>
<td>Current Headache Name</td>
<td>Tension</td>
</tr>
</tbody>
</table>

autonomic instability including instability of the vasomotor system (Nelson, 1993).

The muscle tension-vascular theory of TTH, a continuum model theory, proposes that the mechanism responsible for the pain of TTH includes central nervous system dysregulation in the form of an over-reactive vasomotor system (Gannon, Haynes, Cuevas, & Chavez, 1987). It is proposed that the vasomotor system is overly reactive to biochemical changes associated with normal muscle tension levels rather than abnormally elevated muscle tension levels (Haynes, Gannon, Bank, Shelton, & Goodwin, 1990). According to this model, the pathophysiology of TTH involves vascular as well as skeletal muscular components of central nervous system dysregulation (Gannon et al., 1987). Haynes et al. (1990) and Gannon et al. (1987) report significant modifications in cephalic blood flow patterns associated with TTH and suggest that clinical attention to cephalic blood flow may serve as an alternative to traditional methods (i.e., EMG biofeedback) of treating TTH.

Since the vascular component of TTH has received little attention, the usefulness of TBF with children experiencing TTH has not been fully explored. Preliminary investigations of the utility of TBF with adults have suggested that it may be an effective method of treating TTH (e.g., Billings, Thomas, Rapp, Reyes, & Leith, 1984; Daly, Donn, Galliher, & Zimmerman, 1983).

EMG and TBF have proven to be effective management strategies for headaches. Each procedure, however, has its limitations. EMG requires careful preparation of the skin and accurate electrode placements in order to yield useful data. Even with careful preparation, EMG is sensitive to a variety of environmental factors.
including movement artifacts, non-targeted muscle artifacts, and power line artifacts.
The limitations of TBF are somewhat more easily controlled than those of EMG.
When using TBF, several factors must be considered including maintaining a constant
room temperature, avoiding breezes or blanketing, and ensuring uninterrupted probe
contact with the skin. When compared to EMG, TBF is a more practical procedure in
the clinic that also has an inexpensive home practice version. The treatment of head­
aches using EMG biofeedback or TBF techniques involves training individuals to use
adaptive coping strategies; however therapeutic benefit may be limited if operant
processes maintain the use of current maladaptive coping strategies (e.g., lying down,
body posturing, staying home from school).

Over recent decades a variety of treatment strategies have been developed for
the management of chronic pain (e.g., lower back pain, recurrent headache). Many of
these strategies have focused on “cognitive” or verbal interventions for the manage­
ment of chronic pain (e.g., distraction, relabeling). Other pain management strategies
have focused on the alteration of consequences for various pain behaviors in an effort
to encourage coping behaviors and decrease behaviors associated with “suffering.”
These latter approaches, often referred to as PBM strategies, have proven effective as
part of a package intervention for a variety of chronic pain disorders (e.g., lower back
pain, migrainous headache) with adults and children. PBM strategies have rarely been
used in isolation to treat recurrent pediatric headache. One exception was Ramsden,
Friedman, and Williamson (1983), who used contingency management procedures to
reduce headache reports after a functional assessment indicated the headache reports
were maintained by parental attention.

Individuals can display a wide variety of maladaptive coping strategies or pain behaviors (e.g., laying down, body posturing, staying home from school) that are at least intermittently reinforced by temporary pain reduction, escape from responsibilities (e.g., chores, homework), or increased access to preferred objects/activities, or increased access to social attention. However, these maladaptive coping strategies have no known long-term therapeutic effects. Once children have learned alternative coping strategies (e.g., relaxation, biofeedback), the beneficial effects of biofeedback or relaxation may be limited by parent mediated consequences (e.g., allowing escape from responsibility or access to preferred objects/activities) that support behaviors that are associated with “suffering.” It is therefore worthwhile to incorporate guidelines designed to promote the use of adaptive coping strategies and to discourage the use of maladaptive coping strategies. Recently, Allen and Shriver (1997) reported that a group of pediatric migraine sufferers receiving PBM strategies in addition to TBF evidenced significantly greater reductions in headache activity and significantly greater improvements in adaptive functioning than a group of pediatric migraine sufferers receiving TBF only. The combination of PBM strategies and TBF have been shown to be an effective intervention for pediatric migraine sufferers.

The efficacy of TBF and PBM strategies, however, has not been demonstrated with pediatric headache sufferers suffering from NMHs. Consistent with the muscle tension-vascular model of TTH and TBF's mechanism of action, TBF appears to be a viable treatment worthy of further investigation with pediatric TTH sufferers. TBF
has several advantages: (a) TBF involves less technological sophistication than EMG biofeedback (Schwartz, 1995b); (b) TBF may be practiced in the home using inexpensive equipment which allows for greater generalization of management skills to situations outside of the clinical setting (Blanchard et al., 1991); and (c) hand-warming is easily acquired by most children with a minimum of training (Allen & Matthews, 1998). While Allen and Shriver (1997) have documented the benefits of parent implemented PBM strategies as an adjunct to TBF with pediatric migrainous headache sufferers, this study is the first to apply this package intervention to a population of pediatric nonmigrainous headache sufferers. Given the relative prevalence of NMH (compared to migrainous headache), it is important to: (a) verify that TBF is an efficacious treatment with this type of headache and (b) replicate the adjunctive effects of the parent implemented PBM strategies. The purpose of this research is to evaluate the efficacy of the combination of PBM strategies and TBF in the treatment of pediatric NMH.
METHOD

Participants

Participants (see Table 2) were five middle-class, Caucasian children (two male and three female) between the ages of 8 and 14 who were experiencing at least weekly headache and who met criteria for diagnoses of Migraine-NOS, ETTH, CTTH, or TTH-NOS (IHS, 1988). Participants had headache histories ranging from six months to three years. Participants had been evaluated medically to rule out organic pathology. Participants did not have a recent history of progressive symptoms and did not display evidence of medical impairment, developmental disability, chronic non-

Table 2

Participant Demographics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Headache Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>8</td>
<td>F</td>
<td>MIGRAINE, NOS</td>
</tr>
<tr>
<td>#2</td>
<td>8</td>
<td>M</td>
<td>MIGRAINE, NOS &amp; CTTH</td>
</tr>
<tr>
<td>#3</td>
<td>12</td>
<td>M</td>
<td>CTTH</td>
</tr>
<tr>
<td>#4</td>
<td>13</td>
<td>F</td>
<td>TTH, NOS</td>
</tr>
<tr>
<td>#5</td>
<td>14</td>
<td>F</td>
<td>ETTH</td>
</tr>
</tbody>
</table>
compliance, or psychopathology which contraindicated their participation per parental report. Participants continued to manage pain through prescription and over-the-counter medication as evidenced by medication information collected on the Weekly Headache Diary (Allen & Matthews, 1998). However, stability in headache parameters was established on the current medication regimen before a participant was included in the study. Participants did not introduce new medications or change dosages during the course of the study as evidenced by medication information collected on the Weekly Headache Diary.

Participant Recruitment

Participants were recruited through letters sent to pediatricians, pediatric neurologists, and pain clinics. Media presentations (i.e., radio, television, newspaper) were also utilized to recruit participants. Informed consent was obtained from the participant’s parent. Participants were informed that they could choose not to participate in the research project and receive treatment through a pediatric pain management clinic. Participants were also given twenty-five dollars at the conclusion of the study if they returned completed research forms throughout the study.

Dependent Measures

Headache Parameters

Headache data were recorded using a Weekly Headache Diary. Participants
were asked to record headache activity four times a day (i.e., meals and bedtime) on an intensity scale from 0-10 by marking a dot at the intersection of the time they were recording and the intensity of the pain. Participants also connected the marks by drawing a line that reflected the variability of their headache pain between scheduled recording times since a headache might peak or subside between scheduled recording times. Participants’ parents were informed of the recording procedures but were encouraged to allow their children to be as independent as possible. Participants were asked to record the type and quantity of medication taken and any school or activities missed each day. Studies have showed that this type of monitoring is a reliable and valid measure of perceptions of pain, above the age of 7, regardless of age, gender, and health status (Abu-Saad, 1984; Allen & Matthews, 1998; McGrath, 1987). Due to the covert nature of “headache pain,” it was not possible to obtain interobserver agreement data concerning headache parameters. The current recording procedure, despite being subject to limitations, is the “gold-standard” in headache research.

Weekly headache variables included: (a) frequency (discrete episodes), (b) duration (average length), and (c) intensity.

**Pain Behavior Impact Ratings**

Participants and their parents were asked to complete several questionnaires designed to assess functional status, palliative techniques, and psychosocial impact of NMHS on the participant's, parent's, and family's functioning. Participants completed the Waldron/Varni Pediatric Pain Coping Inventory (PPCI) and the Pain Relevant
Response Scale-Child Perception (PPRS-CP). Participant's parents completed the Parent Perception of Pain Interference (PPPI) and the Pain Relevant Response Scale (PRRS). In addition, participant's parents were asked to record school missed, classes missed, activities missed, and medication consumed during baseline (i.e., Pain Interference Monitoring Form (PIMF)) and treatment (i.e., Parent Guideline Monitoring Form). Discrepancies between data from the PIMF and the Weekly Headache Diary were discussed with participants and their parents in an effort to enhance the degree of correspondence.

The PPCI is a 41-item scale that asks children to rate (on a 3 point scale ranging from 0="not at all" to 2="often") the frequency with which they engage in common child responses to pain (Varni et al., 1996). These would include questions about seeking social support, distraction strategies, problem-solving strategies, helplessness, and self-instruction. Cronbach's alpha for the overall PPCI scale (0.85) and the five subscales (0.57-0.74) indicate that the scale has adequate internal consistency.

The PRRS-CP is a 17-item scale that asks children to rate (on a 7 point Likert-type scale ranging from 0="never" to 6="always") the frequency with which their parents engage in common parent behaviors in response to their pain (Kerns & Rosenberg, 1995). These would include questions about attending to pain (e.g., asking about intensity, frequency, duration of pain), assisting with treatment (e.g., offering a massage, offering medications, trying to distract, offering ice or heat packs), and/or suggesting or allowing a reduction of activity level (e.g., going to bed, dispensing...
with chores, skipping school). Cronbach's alpha for the three subscales (i.e., attending to pain, assisting with treatment, suggesting or allowing a reduction of activity level) indicate that the scale has adequate internal consistency (0.75-0.80).

Four items were added to the PRRS-CP that ask children to rate (on a 7 point Likert-type scale ranging from 0="never" to 6="always") the frequency with which their parents engage in behaviors thought to encourage them to independently manage their pain.

The PRRS, a parallel form of the PRRS-CP, is a 17-item scale that asks parents to rate (on a Likert-type scale ranging from 0="never", 6="always") the frequency with which they engage in common parent behaviors in response to their child's pain (Kerns & Rosenberg, 1995). These would include questions about attending to pain (e.g., asking about intensity, frequency, duration of pain), assisting with treatment (e.g., offering a massage, offering medications, trying to distract, offering ice or heat packs), and/or suggesting or allowing a reduction of activity level (e.g., going to bed, dispensed with chores, skipping school). Cronbach's alpha for the three subscales (0.75-0.80) indicate that the scale has adequate internal consistency.

Four items were added to the PRRS that ask parents to rate (on a 7 point Likert-type scale ranging from 0="never" to 6="always") the frequency with which they engage in behaviors thought to encourage their child to independently manage their pain.

The PPPI asks parents to indicate how much their child's pain typically interferes with family relationships and daily functioning such as doing chores, attending
school, doing school work, participating in and enjoying recreation (Kerns, Turk, & Rudy, 1985). The PPPI consists of 11-items that parents rate on a 7 point Likert-type scale ranging from daily functioning "not at all" affected to "very much" affected. The PPPI is a modified version of the West Haven-Yale Multidimensional Pain Inventory. Cronbach's alpha for the overall PPPI scale (0.90) indicates that the scale has adequate internal consistency.

**Consumer Satisfaction**

A social validation (treatment satisfaction) measure was administered at the conclusion of treatment. The Abbreviated Acceptability Rating Profile (AARP) was modified to specifically reflect the acceptability of headache treatment. Research has found that the instrument possesses acceptable internal consistency, reliability, and validity (Tarnowski & Simonian, 1992). Using a Likert-type scale (1 equals strongly disagree, 6 equals strongly agree), parents and children rated the acceptability of the headache treatment as well as their satisfaction with outcome, presence of side-effects, and willingness to refer others for this type of treatment. Prior to completing the AARP, participants and their parents were informed that their responses should be candid and that they were to place the completed survey in an envelope which was then sealed.

**Design**

Treatment was introduced in a multiple baseline across participants design in
which treatment across participants was introduced after varying amounts of time in baseline. Several of the baselines were contemporaneous in nature. Participant #3 (five week baseline) and Participant #4 (six week baseline) began recording simultaneously as did Participant #2 (four week baseline) and Participant #5 (seven week baseline). Baseline recording continued for 4-7 weeks to establish stable pre-treatment headache parameters before treatment was introduced. The sequential introduction of the treatment provides strong control over invalidating influences such as the passage of time and extraneous variables, highlights individual differences, and makes the power of the treatment immediately obvious (Kazdin 1982). A follow-up probe was completed at three months post-treatment.

Procedure

Setting

Treatment took place in a consultation room available in a pediatric outpatient clinic.

Initial Screening

Participants underwent an extensive structured interview for headache patients during an initial screening appointment. At the conclusion of the screening appointment potential participants were asked to begin headache monitoring using the Weekly Headache Diary. Twenty-five potential participants underwent the extensive
structured interview. Thirteen potential participants either did not meet frequency
criteria (at least one headache per week) or did not return headache monitoring data
(despite weekly reminder phone contacts). Seven participants were diagnosed with
migraine headache on the basis of the interview and were assigned to a concurrent
research project. Five participants who met the IHS criteria for a diagnosis of
Migraine-NOS, ETTH, CTTH, or TTH-NOS and who returned headache monitoring
data were invited to participate in the study.

**Apparatus/Materials**

Physiological responding was monitored and feedback was provided throughout
the study using a distal temperature thermistor and a portable Autogenic System -
AT42 temperature trainer (AT42). Temperature was monitored from the volar sur-
face of the most distal phalange of the nondominant index-finger. Home practice was
monitored by BMI Technologies inexpensive home temperature trainers (alcohol
thermometers).

**Baseline**

Participants were required to record baseline headache activity and functional
impairment information for several weeks (ranging from four to seven weeks) before
beginning treatment. Participants used the Weekly Headache Diary to record head-
ache activity and functional impairment information. Participant's parents used the
Pain Interference Monitoring Form (PIMF) to record functional impairment
information. Participants and their parents were asked to return the headache diary and PIMF to the investigator using self-addressed stamped envelopes on a weekly basis. Treatment was not introduced until headache activity was stable. Stability was considered to have been demonstrated when there was: (a) a constant range of variability; (b) a lack of trend; or (c) a trend in the opposite direction of the anticipated effect (Kazdin, 1982).

Treatment

Participants completed four sessions of TBF training and practice as well as two post-treatment assessment and problem solving sessions in the clinic. During clinic practices, participants were encouraged to increase the temperature of their hand. Hand-warming sessions were considered successful if the participant increased their hand temperature over the starting hand temperature by at least one degree. There is no clear support for an ideal temperature criterion, however, greater headache improvement is noted with participants who reach 96 degrees Fahrenheit (Schwartz, 1995b). During the sessions, participant’s parents were coached regarding the implementation of PBM strategies. In addition to in-clinic TBF training and practice, participants were encouraged to practice their TBF skills at home twice daily. Participants were asked to schedule two routine practices and to practice when they noticed the initial onset of headache pain or any common precursor to pain. When practicing TBF at headache onset, participants were encouraged to mark the line representing their headache state with an “X” to indicate that a TBF practice had
taken place. In theory, participants were thereby able to routinely or as needed attempt to provoke a volitional decrease in sympathetic vascular activity (or provoke a reduction in general physiological arousal) thereby avoiding or aborting headache pain.

The first treatment session (described below) was approximately two-hours in duration. All subsequent sessions (described below) were approximately one-hour in duration. Treatment sessions consisted of four phases. The first 10-minutes served as a habituation period, during which the child was asked to sit quietly. The second 10-minutes included an initial biofeedback practice. Third, a 5-minute rest period was used to discuss the results of the initial biofeedback practice. Finally, a 10 minute biofeedback practice with feedback from the AT42 or a 5-minute biofeedback practice without feedback from the AT42 was completed.

After participants obtained a stable baseline level of headache activity (over 4-7 weeks), they were contacted and scheduled for the initial treatment session. After the participant’s parents completed an informed consent form and the participant had completed an assent form, the participants and their parents independently completed several questionnaires (i.e., PPCI, PRRS-CP, PRRS, PPPI). Participants were also asked to complete two screening questionnaires. The Children's Depression Inventory (CDI) was utilized to screen for symptoms of depression (Kovacs, 1992). The Revised Children's Manifest Anxiety Scale (RCMAS) was utilized to screen for symptoms of anxiety (Reynolds & Richmond, 1987). Only one participant scored higher than a T-score of 65 (clinically significant) on either instrument and she was
subsequently interviewed to determine if a referral for additional services was warranted. During the follow-up interview, Participant #4 did not report substantial levels of anxious or depressive symptomatology, and she was subsequently included in the study without referral for additional services. Individuals who experience recurrent/chronic pain frequently show more psychological distress on self-report measures (Schwartz, 1995a).

Once the questionnaires were completed the participant's parent(s) was asked to return to the waiting room while the participant and the therapist completed the initial biofeedback training session. A checklist was utilized to ensure that all treatment components were administered and to prompt the recording of data. The Practitioner's Guidelines for Behavioral Treatment of Recurrent Pain was utilized to reassure and demystify their headache pain, to provide a rationale for skin temperature biofeedback, and to highlight and emphasize the benefits of biofeedback (Allen & Matthews, 1998).

Participants were able to observe a visual display of moment-to-moment changes in hand temperature via a digital readout and an electronic light bar. The AT42 was utilized to provide participants with feedback regarding their hand temperatures.

At the conclusion of the session, parents were instructed to begin using the Pain Behavior Management Guidelines and to record compliance with the Pain Behavior Management Guideline Monitoring Form. Parents were instructed to only eliminate "status checks" during the following week. Participants were encouraged to
practice their biofeedback skills twice per day for approximately 10-minutes each time. Daily practice of thermal biofeedback with home temperature trainers was recorded on the Biofeedback Practice Log. Starting and ending distal temperature were recorded for each daily practice. Use of the home temperature trainer was demonstrated and rehearsed.

At the second treatment session, participants and their parents were asked to complete the PRRS and PRRS-CP. A checklist was utilized to ensure that all treatment components were administered and to prompt the recording of data. The participant’s Weekly Headache Diary and Biofeedback Practice Log were reviewed during the session. The participants practiced warming their hands during the session with the AT42 providing feedback. At the conclusion of the session, the participants were given instructions for enhancing generalization of pain control skills (e.g., begin using hand-warming at the first onset of a headache, practice in more distracting environments) and were asked to record specific instances. During the second session, with the parent(s) and child present, the investigator also discussed the influence of parental responses on headache pain behavior. Parents were invited to begin using all of the Pain Behavior Management Guidelines, which specify how parents can encourage their children to cope independently with pain. The Guidelines include eliminating status checks, limiting their response to pain behavior to simple prompts to practice biofeedback, encouraging participation in normal activities regardless of pain, and providing praise and support for biofeedback practice and adaptive coping with headaches (Allen & Matthews, 1998).
At the third treatment session, participants and their parents were asked to complete the PRRS and PRRS-CP. A checklist was utilized to ensure that all treatment components were administered and to prompt the recording of data. During the third session, the Weekly Headache Diary, Biofeedback Practice Log, progress with generalization of coping behavior, and parental implementation of the Pain Behavior Management Guidelines was reviewed. The participant again practiced warming their hands during the session with the AT42 providing feedback. During this session, participants also began practicing biofeedback skills without the aid of immediate feedback from the AT42.

At the fourth treatment session, participants and their parents were asked to complete the PRRS and PRRS-CP. A checklist was utilized to ensure that all treatment components were administered and to prompt the recording of data. During the fourth session, the Weekly Headache Diary, Biofeedback Practice Log, progress with generalization of coping behavior, and parental implementation of the Pain Behavior Management Guidelines were reviewed. The participant again practiced warming their hands during the session with the AT42 providing feedback. Since all participants had acquired adequate handwarming skills, they were given recommendations for titrating home practice once a day along with additional recommendations for generalization.

Headache self-monitoring and practice recording continued for four weeks following the last treatment session. Participants returned at two weeks post-treatment for an assessment session during which time Weekly Headache Diaries and
Biofeedback Practice Logs were collected. The participant again practiced warming their hands during the session with the AT42 providing feedback. The participants then returned at four weeks post-treatment for an assessment session during which time Weekly Headache Diaries and Biofeedback Practice Logs were collected, and pain behavior assessment instruments and consumer satisfaction ratings were administered. The participant again practiced warming their hands during the session with the AT42 providing feedback. A self-control assessment was also conducted with the participant receiving no feedback from the AT42. At three months post-treatment, participants completed two weeks of headache activity and biofeedback practice monitoring using the Weekly Headache Diary and Biofeedback Practice Log.
RESULTS

Integrity of the Independent Variable

Biofeedback Clinic Practice

As depicted in Table 3, all participants increased their hand temperature over baseline on a consistent basis during biofeedback practices in the clinic. The average increase in temperature over baseline levels ranged from 1.59 degrees to 4.84 degrees. The average maximum temperature achieved during clinic biofeedback sessions ranged from 82.98 degrees to 94.38 degrees. The average temperature change during the final self-control practice (no feedback) ranged from 0.8 degrees to 5.3 degrees.

Biofeedback Home Practice

Participants demonstrated consistent increases in hand temperature of at least one degree with feedback both in the clinic and at home during the majority of their practices. As depicted in Table 4, all of the participants with the exception of Participant #1 reported biofeedback practice sessions that averaged at least once per day. Furthermore, participants reported success increasing hand temperature during home biofeedback practices. Participants #1 and #3 produced temperature increases of at least one degree during 69% and 71.75% of home practice sessions respectively. The three other participants reported temperature increases during at least 90% of home
Table 3

Biofeedback Clinic-Practices

<table>
<thead>
<tr>
<th>Participant</th>
<th>Mean Temperature Change in Degrees (Range)</th>
<th>Mean Maximum Temperature Achieved (Range)</th>
<th>Temperature Change During Final Self-Control Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>3.79 (1.12) (2.6-5.5)</td>
<td>94.38 (1.35) (92-95.8)</td>
<td>5.3</td>
</tr>
<tr>
<td>#2</td>
<td>4.84 (2.45) (1.9-9.5)</td>
<td>94.21 (1.47) (92.4-96.8)</td>
<td>2.3</td>
</tr>
<tr>
<td>#3</td>
<td>1.7 (0.81) (0.4-3.1)</td>
<td>87.92 (7.32) (73.0-94.8)</td>
<td>1.0</td>
</tr>
<tr>
<td>#4</td>
<td>1.86 (1.32) (0.4-5.2)</td>
<td>90.27 (6.74) (77.3-93.9)</td>
<td>0.8</td>
</tr>
<tr>
<td>#5</td>
<td>1.59 (1.43) (0.1-4.0)</td>
<td>82.98 (7.09) (76.5-93.0)</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are standard deviations.

Parent Guidelines

Data concerning average weekly parental compliance with the operant guidelines are presented in Table 5 and represent the average percentage of practice sessions.
Table 4

Biofeedback Home-Practice

<table>
<thead>
<tr>
<th>Participant</th>
<th>Frequency of Home-Practice Per Week</th>
<th>Percent of Practices With Temperature Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>2.667 (2.061) (Range: 0-6)</td>
<td>69% (42.89) (Range: 0-100)</td>
</tr>
<tr>
<td>#2</td>
<td>8.625 (2.77) (Range: 2-11)</td>
<td>93.25% (9.75) (Range: 77-100)</td>
</tr>
<tr>
<td>#3</td>
<td>11.875 (2.59) (Range: 7-14)</td>
<td>71.75% (9.56) (Range: 58-88)</td>
</tr>
<tr>
<td>#4</td>
<td>9.00 (2.71) (Range: 4-12)</td>
<td>98.29 (4.54) (Range: 88-100)</td>
</tr>
<tr>
<td>#5</td>
<td>9.60 (3.89) (Range: 3-13)</td>
<td>96% (6.82) (Range: 83-100)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are standard deviations.

recommendations endorsed. During the treatment phase, on days that participants reported no pain, parents were asked to eliminate “status checks” and to praise biofeedback practice sessions. Parents reported that they implemented at least two-thirds of these recommendations on average. Anecdotally, parents occasionally reported that the child practiced in private and they were subsequently unable to praise biofeedback practice sessions. If the participant reported pain during the treatment phase, parents were asked to comply with seven recommendations. The
### Table 5

Parent Guideline Compliance

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pain Reported</th>
<th>No Pain Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>100% (0.0)</td>
<td>66% (10.9)</td>
</tr>
<tr>
<td></td>
<td>(Range: 100-100)</td>
<td>(Range: 57-79)</td>
</tr>
<tr>
<td>#2</td>
<td>95% (7.1)</td>
<td>82.8% (6.6)</td>
</tr>
<tr>
<td></td>
<td>(Range: 90-100)</td>
<td>(Range: 79-93)</td>
</tr>
<tr>
<td>#3</td>
<td>83% (5.8)</td>
<td>85% (16.4)</td>
</tr>
<tr>
<td></td>
<td>(Range: 80-90)</td>
<td>(Range: 50-100)</td>
</tr>
<tr>
<td>#4</td>
<td>40% (0.0)</td>
<td>69.4% (17.0)</td>
</tr>
<tr>
<td></td>
<td>(Range: 40-40)</td>
<td>(Range: 43-86)</td>
</tr>
<tr>
<td>#5</td>
<td>0.0% (0.0)</td>
<td>66.3% (14.69)</td>
</tr>
<tr>
<td></td>
<td>(Range: 0-0)</td>
<td>(Range: 36-79)</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are standard deviations.

Parents of Participants #1, #2, and #3 complied with these recommendations more than 80% of the time. Participant #4 reported pain to her parents on only one occasion, and they complied with four of the ten recommendations. Participant #4’s parents could not implement the recommendations on any other occasion since she did not report pain to her parents again. Similarly, Participant #5’s parents could not implement the recommendations on even one occasion since she did not report pain to her parents.
Overall these data confirm that the participants learned the hand-warming skill, warmed their hands during most of their practices, practiced the skill on a regular basis, and warmed their hands without feedback at the conclusion of treatment. In addition, parents complied with PBM guidelines at a relatively high rate throughout treatment. Overall, the data suggest that the TBF skills and PBM guidelines were adhered to adequately.

Headache Activity

The participant’s weekly headache variables including: (a) frequency (discrete episodes), (b) duration (average length), and (c) intensity provide evidence of improvement in some if not all headache parameters for each participant. The baseline phase and treatment phase mean, range, and standard deviation for each parameter are presented in Table 6 for each participant. Frequency, duration, and intensity are also displayed graphically for each participant (see Figures 2-4). The data for Participants #1, #2, and #3 demonstrate a clear and sustained reduction in headache frequency, duration, and intensity following treatment. While the data for Participants #4 and #5 do not demonstrate clear reductions in headache frequency or intensity, they do indicate that headache duration marked reductions in one or more headache parameters.

Clinical Significance

In order to further evaluate the significance of the changes in headache activity, the clinical significance of the reductions was considered. Changes in headache
<table>
<thead>
<tr>
<th>Participant</th>
<th>Parameter</th>
<th>Baseline Mean, (STD), and Range</th>
<th>Treatment Mean, (STD), and Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ronnie</td>
<td>Frequency</td>
<td>3.60, (1.7), 1.0-5.0</td>
<td>0.88, (1.1), 0.0-3.0 *</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>5.31, (1.0), 3.75-6.0</td>
<td>1.69, (2.1), 0.0-5.0 *</td>
</tr>
<tr>
<td></td>
<td>Average Peak</td>
<td>8.60, (1.1), 7.0-10.0</td>
<td>3.13, (3.5), 0.0-7.0 *</td>
</tr>
<tr>
<td></td>
<td>Pain Index</td>
<td>1.59, (0.93), 0.6-3.0</td>
<td>0.23, (0.3), 0.0-0.7 *</td>
</tr>
<tr>
<td>Ellis</td>
<td>Frequency</td>
<td>9.14, (2.6), 6.0-14.0</td>
<td>0.14, (0.4), 0.0-1.0 *</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7.20, (4.6), 3.2-16.8</td>
<td>0.00, (0.0), 0.0-0.0 *</td>
</tr>
<tr>
<td></td>
<td>Average Peak</td>
<td>8.43, (2.1), 5.0-10.0</td>
<td>0.14, (0.4), 0.0-1.0 *</td>
</tr>
<tr>
<td></td>
<td>Pain Index</td>
<td>2.09, (0.8), 0.9-2.9</td>
<td>0.00, (0.0), 0.0-0.0 *</td>
</tr>
<tr>
<td>Austin</td>
<td>Frequency</td>
<td>5.50, (1.9), 4.0-8.0</td>
<td>2.22, (1.5), 0.0-5.0 *</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>4.53, (0.6), 3.8-5.0</td>
<td>1.51, (1.6), 0.0-4.0 *</td>
</tr>
<tr>
<td></td>
<td>Average Peak</td>
<td>5.00, (2.5), 2.0-7.0</td>
<td>3.11, (3.1), 0.0-9.0</td>
</tr>
<tr>
<td></td>
<td>Pain Index</td>
<td>0.85, (0.2), 0.7-1.1</td>
<td>0.30, (0.4), 0.0-1.1 *</td>
</tr>
<tr>
<td>Cloe</td>
<td>Frequency</td>
<td>6.17, (1.6), 3.0-7.0</td>
<td>4.29, (1.4), 3.0-7.0</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7.33, (2.8), 2.7-10.8</td>
<td>4.37, (2.9), 0.3-9.4</td>
</tr>
<tr>
<td></td>
<td>Average Peak</td>
<td>6.17, (1.2), 5.0-8.0</td>
<td>4.30, (1.5), 2.0-6.0</td>
</tr>
<tr>
<td></td>
<td>Pain Index</td>
<td>1.85, (0.7), 1.0-2.9</td>
<td>1.59, (1.0), 0.6-3.3</td>
</tr>
<tr>
<td>Josie</td>
<td>Frequency</td>
<td>4.29, (1.5), 2.0-7.0</td>
<td>3.63, (1.5), 1.0-6.0</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>2.78, (1.7), 1.2-6.0</td>
<td>0.77, (0.6), 0.0-1.7 *</td>
</tr>
<tr>
<td></td>
<td>Average Peak</td>
<td>6.29, (1.0), 5.0-8.0</td>
<td>4.38, (1.5), 2.0-7.0</td>
</tr>
<tr>
<td></td>
<td>Pain Index</td>
<td>0.84, (0.1), 0.7-1.0</td>
<td>0.32, (0.2), 0.06-0.6 *</td>
</tr>
</tbody>
</table>

* Clinically significant reduction

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Figure 2. Average Headache Frequency.
Average Headache Duration

Figure 3. Average Headache Duration.
Figure 4. Average Headache Intensity.
activity are generally considered clinically significant when they represent reductions greater than 50% (Blanchard, 1992). Four of the five participants experienced at least a 50% reduction in one or more of their headache parameters (see Table 6). Participants #1 and #2 experienced clinically significant reductions in headache frequency, duration, and was substantially reduced following treatment. Overall, participants experienced intensity. Participant #3 experienced a clinically significant reduction in headache frequency and duration. Participant #5 experienced a clinically significant reduction in headache duration. The data regarding Participant #4’s headache parameters indicate consistent reductions in headache activity, however, she did not obtain at least a fifty percent reduction in any headache parameter.

Three-Month Follow-up

The treatment gains achieved by Participants #1, #2, #3, and #5 were maintained at three months post-treatment. Several participants reported being headache free during the two week follow-up period including Participants #1, #2, and #3. At follow-up Participant #5 continued to experience several headaches per week with moderate intensity, however, she maintained the clinically significant reduction in headache duration. Participant #4 continued to experience nearly daily headaches with moderate intensity and several hour duration at follow-up.
Functional Impairment

**Participant Report**

Data regarding the number of days of school missed and activities missed during the study due to headaches are presented in Table 7. Participants did not miss school during the course of the study. Participants #1 and #2 each missed two activities during the baseline phase. Following treatment Participant #1 missed only one activity whereas Participant #2 missed no activities. Participants #3 and #4 did not miss activities during the baseline or treatment phases. Participant #5 missed one activity during the baseline phase and zero activities following treatment. In general, participants were missing few activities during the baseline phase but did consistently miss fewer activities during the treatment phase. The baseline level of functional impairment, as measured by school missed or activities missed, is not dramatically less than would be predicted based upon the results of Stang and Osterhaus (1993).

**Parent Report**

Parent reports were generally comparable with their child's reports regarding activities or school missed (see Table 8). However, Participant #3's parents reported that he missed two activities during the treatment phase which he did not report. Participant #5's parent also reported that she missed no activities during the baseline phase, whereas she reported missing one activity. Several parents anecdotally reported monitoring the missed school and activity information that their child reported...
<table>
<thead>
<tr>
<th>Participant</th>
<th>Medication (Days/Week)</th>
<th>School Missed (Days/Week)</th>
<th>Activities Missed (Days/Week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Prescription Medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.4</td>
</tr>
<tr>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.4</td>
</tr>
<tr>
<td></td>
<td>Non-Prescription Medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.3</td>
</tr>
<tr>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
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<tr>
<td>#2</td>
<td>Prescription Medication</td>
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<td>Baseline: 0.0</td>
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<tr>
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<td>Treatment: 0.0</td>
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<td>Treatment: 0.0</td>
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<td>Non-Prescription Medication</td>
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<td>Baseline: 2.7</td>
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</tr>
<tr>
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<td>Prescription Medication</td>
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<tr>
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<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
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<tr>
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<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
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<tr>
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<td>Non-Prescription Medication</td>
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<tr>
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<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
</tr>
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<td>Treatment: 0.4</td>
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<td>Prescription Medication</td>
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<tr>
<td></td>
<td>Treatment: 7.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
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<tr>
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<td>Non-Prescription Medication</td>
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</tr>
<tr>
<td></td>
<td>Baseline: 0.8</td>
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<tr>
<td></td>
<td>Treatment: 2.0</td>
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<tr>
<td>#5</td>
<td>Prescription Medication</td>
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<td>Baseline: 7.0</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
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<tr>
<td></td>
<td>Treatment: 7.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td></td>
<td>Non-Prescription Medication</td>
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<td></td>
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<tr>
<td></td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
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<tr>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
</tbody>
</table>
Table 8
Parent Report of Functional Impairment

<table>
<thead>
<tr>
<th>Participant</th>
<th>Medication (Days/Week)</th>
<th>School Missed (Days/Week)</th>
<th>Activities Missed (Days/Week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.4</td>
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<td>Non-Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Treatment: 0.0</td>
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<td>Treatment: 0.0</td>
</tr>
<tr>
<td>#2</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td></td>
<td>Non-Prescription Medication</td>
<td>Baseline: 2.7</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td>#3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Baseline: 0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.6</td>
</tr>
<tr>
<td></td>
<td>Non-Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Treatment: 0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td>#4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Prescription Medication</td>
<td>Baseline: 7.0</td>
<td>Baseline: 0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 6.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td></td>
<td>Non-Prescription Medication</td>
<td>Baseline: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
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<tr>
<td>#5</td>
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<td></td>
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<tr>
<td></td>
<td>Prescription Medication</td>
<td>Baseline: 7.0</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 5.4</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Treatment: 0.0</td>
<td>Treatment: 0.0</td>
</tr>
</tbody>
</table>

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on the Weekly Headache Diary and prompting corrections when necessary.

Medication Usage

Participant Report

Data regarding the consumption of prescription and non-prescription medication are presented in Table 7. Participant #1 reported that she used no medications during the baseline or treatment phases of the study. Participant #2 reported that he did not consume prescription medication during baseline, however he did receive non-prescription medication on 19 of 49 days (2.7 days/week). During treatment Participant #2 reported that he did not receive any medications. Participant #3 reported that he received no medications during the baseline phase or prescription medications during the treatment phase. Participant #3 did however indicate that he received non-prescription medication on four of 70 days (0.4 days/week) during treatment. Participants #4 and #5 received prescription medication every day throughout the course of the study. Participant #4 received non-prescription medication on five of 42 days (0.8 days/week) during baseline and 18 of 63 days (2 days/week) during treatment. Participant #5 did not receive non-prescription medication during the course of the study. The participants generally reported consuming very few prescription medications during the course of the study with the exception of Participants #4 and #5. Participants also reported using very little non-prescription medication during the course of the study.
Parent Report

Parent reports were comparable with their child’s reports regarding medication usage (see Table 8). Participants #4 and #5’s parents reported slightly less prescription medication usage (6 days/week and 5.4 days/week respectively) when compared to each participant’s reported use (7 days/week) during the treatment phase. In addition, Participant #4’s parents reported no use of nonprescription medication during the study while she reported 0.8 days/week during baseline and 2 days/week during treatment. Several parents reported monitoring the medication information that their child reported on the Weekly Headache Diary and prompting corrections when necessary.

Adaptive Functioning

Participants’ parents ratings on the PPPI indicate that their child’s pain interfered with family relationships and daily functioning such as doing chores, attending school, doing school work, participating in and enjoying recreation less during the treatment phase than during the baseline phase. The mean and standard deviation from pre-treatment and post-treatment are presented in Table 9. A repeated measures t-test indicated that parents reported significantly less pain impact on their child’s adaptive functioning following treatment, $t(4) = 4.519, p<.02$.

Coping Assistance

Participants ratings on the PPCI were analyzed using a repeated measures
Table 9
Screening and Pain Questionnaire Descriptive Statistics and T-Tests

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Pre-Treatment Mean (STD)</th>
<th>Post-Treatment Mean (STD)</th>
<th>T</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children's Depression Inventory</td>
<td>46.0 (12.47)</td>
<td>39.8 (1.643)</td>
<td>-1.149</td>
<td>0.315</td>
</tr>
<tr>
<td>Revised Children's Manifest Anxiety Scale</td>
<td>41.6 (9.529)</td>
<td>39.0 (3.391)</td>
<td>0.782</td>
<td>0.478</td>
</tr>
<tr>
<td>Pediatric Pain Coping Inventory</td>
<td>29.6 (11.014)</td>
<td>19.2 (8.526)</td>
<td>1.675</td>
<td>0.169</td>
</tr>
<tr>
<td>Parent Perception of Pain Interference</td>
<td>30.4 (9.503)</td>
<td>6.6 (6.95)</td>
<td>4.519</td>
<td>0.011</td>
</tr>
<tr>
<td>Pain Relevant Response Scale - Child Perception</td>
<td>46.0 (13.454)</td>
<td>11.8 (6.34)</td>
<td>4.372</td>
<td>0.009</td>
</tr>
<tr>
<td>Pain Relevant Response Scale - Parent Perception</td>
<td>57.8 (10.281)</td>
<td>16.2 (14.94)</td>
<td>4.045</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses are standard deviations.

t-test and do not suggest a significant change in the coping strategies that the participants used to manage their pain from pre-treatment to post-treatment, \( t(4) = 1.675, p = .169 \). The mean and standard deviation from pre-treatment and post-treatment are presented in Table 9. However, a repeated measures t-test on participant responses on the PRRS-CP indicated a significant change in the manner their parents were
responding to reports of pain, \( t(4) = 4.372, p < .01 \). Participants indicated that their parents were not attending to the pain, assisting with treatment, or allowing a reduction in activity following treatment and were instead encouraging them to independently manage their pain. The mean and standard deviation from pre-treatment and post-treatment are presented in Table 9. In addition, the parent responses on the PRRS suggest that they significantly altered the manner in which they were responding to their child’s reports of pain, \( t(4) = 4.045, p < .02 \). Parents indicated that they were not attending to the pain, assisting with treatment, or allowing a reduction in activity following treatment and were instead encouraging their child to independently manage the pain. The mean and standard deviation from pre-treatment and post-treatment are presented in Table 9. These self-report measures indicated that the participant’s parents were less involved with their child’s pain management.

Treatment Acceptability

Participants and their parents rated the treatment as acceptable on the AARP. An acceptability score greater than 30 indicates that the treatment was deemed acceptable. Ratings by the parents averaged 46 (standard deviation = 2.449) and ranged from 42 to 48. Ratings by the participants averaged 43.2 (standard deviation = 4.147) and ranged from 37 to 47. That is, participants agreed that the treatment was acceptable, that they liked it, that it had no negative side effects, and that it was effective.
DISCUSSION

The results indicate that after treatment the majority of participants were experiencing significantly less headache activity than they were prior to treatment. The majority of participants appear to have experienced clinically significant reductions in their headache activity regardless of diagnostic status. Interestingly, each child’s response to treatment varied depending upon the pain parameter measured. Consistent with prior research, TBF and PBM guidelines for parents appear to be an effective strategy for managing recurrent pediatric headache. The current study extends the literature by applying a proven intervention strategy to a novel population. TBF and PBM strategies have been shown to be an effective treatment for pediatric migraine sufferers, however, this study represents the first attempt to apply this technology to a population suffering from NMHs including CTTH, ETTH, TTH-NOS and Migraine-NOS. Overall, the results are consistent with the results obtained by Billings et al. (1984) and Daly et al. (1983) with adult tension headache sufferers. This study also represents the first effort to include pediatric headache sufferers that do not fit neatly into the IHS headache classification system. Research documenting effective intervention strategies for TTH-NOS and Migraine-NOS have been lacking from the literature.

The conclusions, however, that may be drawn on the basis of the data provided in this study must be preliminary due to the small number of participants. While
the data for each of the participants demonstrates benefits across the various headache parameters, it will be necessary to replicate these findings with larger numbers of participants suffering from recurrent NMHs. The current study includes only one participant diagnosed with each type of NMH. Future research should further evaluate the efficacy of this intervention with larger numbers of participants in each diagnostic category who are experiencing greater levels of functional impairment.

Participants #1 and #2's data indicated a reduction in headache activity to near zero levels across parameters (i.e., frequency, duration, peak intensity). Participant #1 was able to achieve clinically significant reductions in headache activity despite did not consistently practicing biofeedback skills at home. She did, however, successfully increase the temperature of her hand during the majority of clinic and home practices and sufficiently followed PBM strategies. In spite of her low frequency of home practices, she was able to acquire the hand warming skill as documented during her final self-control practice and effectively manage her headaches. Participant #3 also displayed clinically significant reductions in headache frequency and duration with a substantial reduction in peak intensity after the fifth week of treatment. Participant #5 achieved clinically significant reductions in headache duration and a substantial but nonsignificant reduction in peak intensity. Despite consistently practicing biofeedback skills at home, successfully increasing the temperature of her hand during clinic and home practices, and sufficiently following PBM strategies, Participant #4 did not achieve a clinically significant reduction in any headache parameter. However, she did display a substantial reduction in headache duration and peak intensity during
treatment. Participant #4 was the only participant who suffered from daily headaches that lasted nearly all day. Clinical evidence suggests that individuals who suffer from continual daily headache generally responded poorly to treatment (Silberstein, 1995).

Participants evidenced the ability to increase hand temperature over baseline levels throughout the course of clinic training and practice sessions, home practice sessions, and during self-control practices. Some participants increased the temperature of their hands more than others. The average temperature increase ranged from 1.59 degrees to 4.84 degrees. The actual amount of change does not appear to be the critical variable in determining the effectiveness of TBF. At present, the efforts to identify a dose-response relationship between hand-warming and headache relief have been disappointing (Schwartz, 1995b). Instead greater support has been found for a relationship between frequency of hand-warming practice and headache relief. In the current study, participants practiced on average at least once per day with the exception of Participant #1. In addition participants increased the temperature of their hands during 69% to 98% of their home practices on average. In general, the participants practiced the skill frequently and were successful in warming their hands during the majority of their practices.

Hand-warming appears to have a two pronged effect and therefore participants were encouraged to practice biofeedback skills on a routine basis each day and to practice as soon as they noticed the first symptoms of a headache. The routine practices of participants were presumed to promote vascular dilation and thereby prevent excessive vasoconstriction. Thus, participants prevented the onset of headache.
symptoms by preventing vasoconstriction. Participant's biofeedback practices at the onset of headache symptoms were presumed to produce a controlled reduction in vasoconstriction, which thereby aborted the headache or reduced the intensity or duration of the headache.

Functional impairment as defined by medication consumed (prescription and non-prescription), school missed, and activities missed was relatively unaffected by treatment. Despite improvements in headache activity, functional impairment measures remained relatively constant throughout the course of treatment. The participants did not regularly miss school due to headache activity during the baseline phase or treatment phase. During baseline, there was a tendency for participants to miss some activities. After treatment was implemented, participants did not miss any activities. This limited change does represent an improvement in functional status from baseline to treatment, however, participants were displaying minimal levels of functional impairment prior to treatment. It is hypothesized that this lack of effect was due to the fact that the variables measured were insufficiently sensitivity to the participants experience of functional impairment. Pediatric headache sufferers appear to participate in many of their scheduled academic and social activities regardless of their pain status. Medication consumption (prescription and non-prescription) also remained relatively constant throughout the course of the study perhaps due to recommendations to maintain their current medication regimen during the course of the study.

In contrast to the information collected on the PIMF during the baseline phase which reflects relatively little pain interference, parents reported substantial pain
interference as assessed by the PPPI at pre-treatment. This discrepancy would suggest that the two measures (PPPI and PIMF) were assessing different dimensions of pain interference. The PIMF would appear to be strictly assessing impact upon activities of daily living in terms of task completion. The PPPI, in contrast, may be assessing the quality of task completion and/or emotional distress associated with task completion. Parents appear to be indicating that their child’s pain interfered with but did not prevent task completion. Additional dimensions of pain interference may prove to be more sensitive to improvements in functional status (e.g., grimacing, crying, squinting, withdrawal, time spent lying down, frequency of verbal complaints of pain, irritability). This is among the first studies to report information regarding changes in functional impairment status, however it is clear that additional research in this area is necessary to identify parameters sensitive to therapeutic effects that also represent real-life improvements. Functional impairment status represents an important variable that has been poorly addressed in previous headache research.

Parents reported using the Pain Behavior Management Guidelines with a high level of adherence. Parents successfully complied with the guidelines requiring them to eliminate “status checks” and praise TBF practices 66% of the time. The percentage is somewhat lowered by the children’s tendency to practice away from their parents which therefore eliminated the opportunity for their parents to witness and praise the practice sessions. For those participants who did report pain to their parents on a regular basis (RR, EH, and AP), parents complied with the operant guidelines the majority of the time. The range of compliance with the operant
guidelines for these parents was from 83% to 100%. CC and JH rarely reported pain to their parents and therefore their parents were unable to implement these guidelines. Overall parents complied with the PBM strategies with a high degree of accuracy. The PBM strategies are hypothesized to have contributed to the intervention's efficacy by reinforcing adaptive coping strategies (i.e., TBF) and by eliminating the reinforcing effects of maladaptive coping strategies. The contribution of the PBM strategies to the overall efficacy of the intervention is unclear. However, a recent study by Allen and Shriver (1998), concluded that pediatric migraine sufferers who received TBF and operant guidelines improved to a greater extent than pediatric migraine sufferers who received TBF alone.

On self-report measures, parents reported significantly less pain impact on their child's adaptive functioning after treatment (PPPI) as well as a significantly greater tendency to allow their children to manage their pain independently (PRRS). Participants' self-report corroborates their parents' report of a significantly greater tendency for their parents to allow them to manage their pain independently (PRRS-CP). Data from the PGMF and Weekly Headache Diary indicate that participants independently managed their pain by engaging in TBF practice sessions. As recorded on the PGMF, parents routinely prompted participants to practice TBF when they reported pain. On the Weekly Headache Diary, participants also recorded TBF practices during headache activity by marking an "X" on the line representing their headache state. Interestingly, participants did not endorse an overall change in the strategies that they used to cope with their pain perhaps because the PPCI did not
specifically assess the use of adaptive coping strategies (i.e., TBF). Finally, participants and their parents found the intervention to be acceptable (AARP).

The main limitation of the study is that it was not designed to assess for the potential influence of placebo or expectancy effects, therefore it is not possible to draw any conclusion regarding the mechanism responsible for the efficacy of TBF. However, it was not the intention of the present study to examine underlying mechanisms, rather it was to document the efficacy of this intervention with a novel population. A secondary limitation is that no conclusions may be drawn regarding the relative contributions of TBF and PBM strategies. However, Allen and Shriver (1998) have documented the ancillary benefit of PBM strategies when used in conjunction with TBF.

TBF and operant guidelines represent an efficient and convenient treatment strategy for NMH. TBF training-in-clinic may be accomplished with less expensive equipment and with less extensive therapist training than EMG biofeedback. The ease of implementation and the inexpensive nature of the equipment allow for greater accessibility to clinicians and their clients. TBF is a skill that is easily acquired by children and adolescents and requires a minimum of training allowing for less therapist contact and lower cost of service (Schwartz, 1995b). In addition, home-TBF practice may be accomplished with inexpensive and practical equipment. Home practice of TBF allows for greater generalization of headache management skills. The typical regimen for TTH, the most common form of NMH, involves EMG biofeedback for which there is no convenient home practice version.
Future research should continue to explore the utility of TBF and PBM strategies in the management of NMH with larger numbers of participants. In addition, headache researchers should strive to develop additional measures of functional impairment that quantify observable behavioral correlates of headache pain (e.g., time spent lying down, frequency of pain complaints, irritability). Sufficiently sensitive measures of functional impairment for pediatric headache sufferers are lacking in the existing literature. Future studies may wish to differentiate the efficacy of TBF and PBM strategies with CTTH, ETTH, TTH-NOS, and Migraine-NOS. The evidence provided for the efficacy of TBF and PBM strategies for NMH in the current study is promising but is certainly preliminary in nature. Finally, the relative contributions of TBF and PBM strategies to the overall efficacy of this intervention is unknown and should be explored in future research.
Appendix A

Approval Letter From the Human Subjects
Institutional Review Board
Date: 20 October 1998

To: Wayne Fuqua, Principal Investigator
    Richard Arndorfer, Student Investigator for dissertation

From: Sylvia Culp, Chair

Re: HSIRB Project Number 98-03-04

This letter will serve as confirmation that your research project entitled “Thermal Biofeedback Treatment of Tension-Type Headache with a Pediatric Population” has been approved under the full category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: 18 June 1999
Appendix B

Assessing Children’s Perception of Pain:
Focus on Pediatric Headache
Assessing Children’s Perception of Pain:  
Focus on Pediatric Headache

Pain perception is a private event which has proven difficult to assess with an acceptable degree of reliability and validity. One of the most common forms of pain in a pediatric population and one of the most challenging to assess is recurrent headache. Recent epidemiological studies indicated that the one-year prevalence of headache in children is 30-50% (e.g., Linet, Stewart, Celentano, Ziegler, & Sprecher, 1989; Mortimer, Kay, & Jaron, 1992; Sillanpaa & Anttila, 1996). The most common headaches in children are tension-type headache (characterized by dull, mild to moderate diffuse pain) and migraine headache without aura (characterized by sharp, throbbing, moderate to severe pain). Studies of child headache sufferers indicate that 3-11% experienced frequent (1-2 times per week) migraine headache (MH) and 7-10% experienced frequent tension-type headache (TTH; e.g., Abu-Arefeh & Russell, 1994; Bille, 1981; Cady, Farmer, Griesemer, Sable, 1996). While the majority of the paper will address pain assessment as it applies to pediatric headache, many of the issues also pertain to other chronic pain syndromes that affect children (e.g., sickle cell, cancer).

The accurate assessment of pediatric pain constitutes a challenge for researchers and clinicians. The experience of pain in a pediatric population may be assessed via self-report, behavioral correlates, or impairment in functional status. Children’s limited verbal repertoires for describing pain as well as other developmental limitations (e.g., cognitive level) have complicated the assessment of the pain.
experience. The reliable and valid assessment of self-report (i.e., frequency, intensity, duration), behavioral correlates of pain (e.g., complaints of pain, postural guarding), and functional impairment (e.g., withdrawal from activity, impaired task performance) have been the focus of a considerable amount of research.

The reliability and validity of the assessment data collected in research and clinical practice is a source of concern since it impacts upon a variety of issues including accurate identification of the problem area, selection of an intervention, and evaluation of intervention efficacy (Bellack & Hersen, 1988). If assessment data lack reliability and validity, inaccurate diagnosis may be made, inappropriate interventions may be selected, and intervention efficacy may be misrepresented. Within the pediatric pain literature, several assessment techniques have been developed to assess the experience of pain in order to aid in the diagnosis of pain conditions, to aid in the selection of interventions, as well as to aid in the evaluation of intervention efficacy.

The reliable assessment of the experience of pain is, by definition, concerned with the consistency with which the pain experience may be assessed. Establishing the reliability of self-report measures of pain with a pediatric population can be difficult since changes in intensity ratings may be due to the variable nature of the pain experience or to a lack of rater consistency. Reliability information is more easily obtained with self-report measures of pain with an adult population since researchers have been able to deliver precisely measured noxious stimulation which allows for a careful evaluation of rating reliability. Reliability is also more easily achieved with the observable components of the pain experience (i.e., behavioral correlates, functional
impairment).

The valid assessment of pain perception is concerned with whether the assessment instrument actually measures the raters experience of pain. The validity of self-report pain measures can also be difficult to establish since their may be little in terms of established criteria to which the rating may be compared. Again, however, the validity of the observable components of the pain experience is somewhat more easily established.

One of the more problematic aspects of diagnosing and treating pediatric headache involves the reliable and valid assessment of pain parameters (i.e., headache frequency, intensity, and duration). The child's limited verbal repertoire, limited practice labeling pain, and cognitive level complicate the assessment of these parameters which are predominately private events unavailable to outside observers. Public aspects of the pain experience such as the behavioral correlates of pain and the functional impairment associated with pain are more easily monitored in a reliable and valid manner. However, behavioral correlates and functional impairment are not direct measures of pain. Each of the methods of assessing the experience of pain in a pediatric population described in this paper will be evaluated in terms of their contribution to reliable and valid problem identification (diagnosis), intervention selection (treatment utility), and intervention evaluation (sensitivity).

In the majority of research studies addressing pediatric pain management, the parameters of pain are assessed exclusively through the use of self-report data. The private nature of the child’s pain experience, however, makes it difficult to
independently verify the parameters of pain. Therefore, doubt regarding the reliability and validity of the self-report data provided are frequent issues in pediatric pain research. In an effort to address these issues for research and clinical purposes, authors have attempted to develop reliable and valid methods of assessing self-report of the experience of pain including interviews, rating techniques, and self-monitoring techniques.

Assessing Parameters of Pain via Self-Report

Interview Measures

The first diagnostic interview guidelines for use with a pediatric population were described by Diamond and Dalessio (1982). Schwartz (1995) has also provided guidance regarding the information to be solicited during diagnostic headache interviews. Structured headache interviews usually seek detailed descriptions of the characteristics of pain (e.g., location, frequency, duration, intensity), precipitating factors (e.g., food, stress, weather changes), relief factors (e.g., dark areas, quiet areas), previous treatment (i.e., medical, psychological), prodromal symptoms (i.e., auras), and any other associated symptoms (e.g., nausea, vomiting). Other important issues frequently addressed in headache interviews include the family history of headache as well as the child’s medical and surgical history.

Structured headache interviews also attempt to develop a functional assessment of the maintaining factors by identifying the antecedents and consequences of headaches. Common antecedents to headaches include changes in sleep habits, emotional factors, allergic reactions, visual disturbances, somatic stressors,
environmental stressors, and consummatory stimuli (Martin, Milech, & Nathan, 1993; Williamson, Baker, & Cubic, 1993). Common consequences of headaches include rest periods, consumption of medication, active coping, consumption of food or drink, rejection by significant others, reduction in school and household responsibilities, support by significant others, and increased attention (Martin et al., 1993; Ramsden, Friedman, & Williamson, 1983). Ramsden et al. (1983) recommend that the consequences of headache be evaluated as potential reinforcers maintaining the self-report of headache as well as maladaptive coping strategies.

A number of unpublished structured interviews have been developed for use with a pediatric population, however, the reliability and validity of these interviews has not been established. Structured interviews with adult headache sufferers provide some evidence that interview techniques may yield reliable and valid information (Williamson, Baker, & Cubic, 1993). In general, structured interviews are useful for making a headache diagnosis, selecting an intervention, and eliciting information relevant to intervention efficacy. However, the development of a structured interview for use with children with demonstrated reliability and validity is needed. In contrast to the relative lack of structured interviews for use with a pediatric population, there is a relative abundance of rating techniques.

**Rating Techniques**

A variety of rating techniques have been used in an attempt to quantify a child’s perception of pain intensity including various interval scales (e.g., faces varying in emotional expression, poker chips representing pieces of hurt, or pain thermometers}
graded in intensity), and visual analog scales. Many of these techniques, however, have not been applied to pediatric headache sufferers. All of the methods reviewed below have previously been applied to pediatric headache sufferers or hold promise for application with this population.

Perhaps the most widely researched instrument assessing children’s perception of pain intensity is the Oucher (Beyer, 1984). The Oucher consists of two vertical scales including a 0 to 100 numerical scale (for the older child) and a six-picture photographic scale (for the younger child) in sequence of increasing hurt/pain. The sequence of pictures indicating increasing levels of hurt/pain was established empirically (Beyer & Aradine, 1986). The photographic scale of the Oucher appears to have adequate content validity (it adequately samples pain perception) with children between the ages of four and seven (Beyer & Aradine, 1986). Research also indicates that the Oucher has adequate convergent validity (agreement with other pain assessment techniques) and discriminant validity (differentiates between groups of pain and non-pain sufferers) with children between the ages of three and twelve (Beyer & Aradine, 1988). Additional research supports the construct validity (it measures pain perception) of the Oucher (Aradine, Beyer, & Tompkins, 1988). Despite the methodological limitations (e.g., expectancy effects) of some of the studies cited, the Oucher is a widely used measure of pediatric pain. Unfortunately, the Oucher has been used primarily with children undergoing painful acute medical procedures. While the Oucher has not been used with a population of pediatric headache sufferers, it provides evidence that it is possible to obtain reliable and valid pain intensity ratings.
Another promising assessment instrument is the poker chip system developed by Hester (1979). While the poker chip system was designed to assess a child's perception of the pain evoked by immunizations, it provides further evidence that children can communicate their pain experience in a manner consistent with their observed behavioral reactions. In the poker chip system, children choose the number of chips (none to four) to indicate the "pieces of hurt" that they experience. Children ages four to seven were able to use the poker chips, in such a manner that their responses correlated positively with the behavioral distress that they demonstrated during the injections.

Pain thermometers usually take the form of vertical or horizontal scales graduated from 0-10 or from 0-100. Zero is usually designated as "no hurt" and the other end point is designated as "most hurt possible". Children are then asked to point to the level on the pain thermometer that matches the strength of their pain or to adjust the amount or red (mercury) to match the strength of their pain. Often there are numerical values indicated on the thermometer. While useful there is insufficient data available to determine the reliability and validity of this assessment tool (McGrath, 1990). Despite the lack of data regarding their reliability and validity, pain thermometers continue to be commonly used in clinical work. Additional research regarding the accuracy of pain thermometers is needed.

Visual analogue scales (VAS) involve adjusting the length of a line (without number values) to match the strength of a perception. VASs are commonly used with
children to enable them to rate pain intensity. Studies have found that the VAS is a
reliable and valid measure of pain perception in persons over the age of five regardless
of age, gender, and health status (McGrath, 1990; McGrath & Brigham, 1992).
Children from three to 16 years of age have used VASs to rate the intensity and
unpleasantness of several types of pain including acute pain evoked by medical
procedures, recurrent pain, post-surgical pain, and chronic pain. Generally, children
above five years of age were able to use VASs in a reliable and valid manner to
describe their perceptions (e.g., McGrath, 1987; McGrath & deVeber, 1986a, 1986b;
McGrath, deVeber, & Hearn, 1983).

Further corroboration of the correspondence between responses on a VAS and
behavioral correlates of pain is provided by Abu-Saad (1984). Using a form of VAS,
Abu-Saad (1984) assessed children’s self-assessment of their pain experience on a 10
cm scale with the ends marked “I have no pain” and “I have very severe pain”. The
participants were ten 9-15 year old children who were admitted to a hospital for
surgical procedures. In addition to the child’s response of the 10 cm scale, they were
also assessed using behavioral correlates and physiological parameters (i.e., pulse,
respiration, blood pressure). The behavioral correlates fell into three domains:
vocalizations (grunting, screaming, groaning, crying, gasping, sobbing), facial
expressions (clenched teeth, tightly shut lips, widely opened eyes, wrinkled forehead,
biting of lower lip), and body movement (immobile, purposeless, protective, rhythmic
or rubbing). No correlation was found between the physiological measures and the
children’s responses on the pain scale. It is likely that the physiological measures were
unable to differentiate the between pain and pain free episodes because elevated physiological measures may have been determined by the child's activity level, pain status, or other factors. However, the children's responses on the pain scale were significantly related to body, facial, and vocal indicators. The author concludes that 9-15 year old children can use the 10 cm scale to indicate their perceived pain, and that it is a valid indicator of the severity of the child's pain experience.

Clearly, further research into the utility of VASs with a population of pediatric headache sufferers is warranted. While direct manipulation of painful stimulation would yield data regarding the reliability and validity of the child's VAS ratings, ethical concerns limit the potential of this procedure. McGrath (1990) suggests using other perceptual experiences (e.g., size, brightness, heaviness) to establish the reliability and validity of a child's VAS ratings. However, the child's ability to apply this rating scale to the experience of pain would remain unaddressed. VASs have been used, as a direct measure of pain improvement, on a limited basis in the assessment of pediatric headache pain (Blanchard et al., 1981), however, initial research has been promising. Concurrent assessment of behavioral correlates and VAS ratings may help to provide further support of the utility of this assessment technique.

Rating techniques provide clinicians and researchers with data that reflect one aspect (intensity ratings) of the information necessary to diagnose recurrent headache. Self-report measures of this type provide little in terms of intervention selection, however, if they are used in a repeated manner they may yield useful data regarding intervention efficacy. Changes in self-report intensity ratings form the cornerstone of
headache assessment and intervention evaluation. Self-monitoring measures attempt to structure the method in which these self-reports are provided so that they may yield additional data regarding the frequency and duration of pain.

**Self-Monitoring**

VASs are often incorporated into the most common form of headache self-monitoring (i.e., headache diary). Two primary types of headache self-monitoring have been used in research. The first type, introduced by Budzynski, Stoyva, and Adler (1970) and later modified by Epstein and Abel (1977), constitutes the standard and consists of daily ratings of headache intensity at fixed intervals (i.e., headache diary). A second type of measure is the global rating by the patient (Solbach & Sargent, 1977). The global rating may be completed periodically or at the end of therapy. It may be verbal or on a printed rating scale. Global ratings, however, have been noted to produce overestimates of headache improvement following treatment when compared to headache diaries (Blanchard et al., 1981). The headache diary continues to be the most commonly used method of monitoring headache parameters.

When monitoring headache parameters, Collins and Thompson (1979) advocate the use of a simple descriptive scale to anchor pain intensity ratings, as well as the use of a momentary time sampling procedure (i.e., rating headache activity on four occasions each day). Momentary time sampling involves recording headache activity at specific points in time (e.g., breakfast, lunch, dinner, bedtime). Scheduling recordings to occur at specific daily breaks, increases the likelihood that individuals will not be engaged in other interfering activities and may therefore increase
compliance to self-monitoring demands. When monitoring headache parameters, it is important to avoid the excessive demands imposed by real-time (continuous) recording or high frequency momentary time sampling (hourly ratings) while still collecting sufficient information. Momentary time sampling avoids excessive recording demands as well as concurrent activities that may be associated with the provision of unreliable data. Collins and Thompson (1979) indicate that momentary time sampling, occurring at the pace of four ratings per day, loses little relevant information when compared to hourly ratings.

Budzynski, Stoyva, Adler, and Mullaney (1973) provide an example of the descriptive scale recommended by Collins and Thompson (1979). The six point scale (ranging from 0 to 5) used by Budzynski et al. (1973) provides operational definitions for each level of headache pain. For example, a rating of “1” is defined as “headache pain present, but can easily ignored”, a rating of “3” is defined as “headache pain present, cannot be ignored, interferes with concentration”, and a rating of “5” is defined as “headache pain present, cannot be ignored, bed rest required”. The operational definitions contained within the Budzynski Headache Pain Rating Scale attempt to provide behavioral correlates that allow for a degree of objectivity in the assessment of the private experience of pain.

Headache diaries are currently the most practical and widely accepted method of obtaining systematic information regarding headache frequency, intensity, and duration (Schwartz, 1995). The most common form is daily rating of headaches typically hourly or four to six times a day. These measures typically use a six or 10
point scale on the X axis to reflect the intensity of the pain and hourly intervals on the Y axis to reflect the time of day. Allen and Matthews (1998) provide an example of a headache diary that provides an intensity rating that is behaviorally anchored as recommended by Collins and Thompson (1979) and that uses an 11 point scale (ranging from 0 to 10; see Appendix A). For example, a rating of “2” is defined as “I only notice my pain when I focus attention on it”, a rating of “6” is defined as “It is painful, but I can continue what I am doing”, and a rating of “10” is defined as “I can’t do anything when I have such pain”. Once the child has rated the intensity of their pain they are commonly asked to record the intensity of their pain perception by making a mark (“X”) on a graph. It is then possible to calculate other parameters of the child’s pain experience including frequency and duration. The process of calculating frequency and duration is facilitated by having children connect the marks (i.e., X’s) made throughout the course of a day by drawing a line that reflects the variability of their headache pain between scheduled recording times since a headache may subside or peak between scheduled recording times. Frequency of headache pain is then obtained by counting the number of discrete pain episodes. A discrete pain episode is characterized by a pain rating of at least “1” that then subsides to zero (“no pain”) for at least one hour. Duration data may then be obtained by counting the number of hours that a discrete headache episode lasts.

Research supporting the reliability and validity of the headache diary continues to be somewhat preliminary. Additional studies are needed that delineate the factors influencing the accuracy of headache self-monitoring. At the present time, research
supports the convergent validity and social validity of headache diaries but questions whether recording procedures are adhered to adequately.

Metsahonkala, Sillanpaa, and Tuominen (1997) evaluated the usefulness of a headache diary in 145 children between the ages of 11 and 13. The authors reported that the majority of children in the study were able to adequately complete the headache diary. They noted that the most frequent inaccuracies seemed to occur in reporting the end point of a headache episode. The children frequently did not report an end point especially for headaches with an evening onset. The authors indicate a high degree of correspondence between interview and headache diary information regarding the frequency of headache episodes. However, headache duration was significantly underestimated during the interview when compared to the information reported on the headache diary.

The relationship between participants' ratings of improvement on headache diary ratings and global ratings of improvement by significant others was examined by Blanchard et al. (1981) in an effort to provide evidence regarding the social validity of headache diary data. Sixty-two participants were asked to record the intensity of headache pain they were experiencing four times per day using a six point scale. At the end of treatment, significant others were asked to rate participant improvement on a 100 mm VAS. The authors reported a modest but significant correlation ($r = .44, p<.002$) between participant ratings and significant other ratings. The authors conclude that the correlation "...is comparable to correlations between other concurrent measures of change used in behavior therapy research and does indicate a
significant degree of social validity for improvement detected from the diary” (p. 714).

Headache diaries are subject to limitations and may not be entirely accurate. In fact, Collins and Thompson (1979) found that research participants frequently depart considerably from the requested self-monitoring techniques. Collins and Thompson (1979) provided data cards that were to picked up on a periodic basis and that were coded according to the date they were picked up. The authors reported that participants would then record their headache levels over the past several days. As previously indicated, Metsahonkala et al. (1997) report concern regarding accurate recording of headache end-point despite supporting the overall usefulness of headache diaries with pediatric populations. Schwartz (1995) also indicates that research participants have been noted to make retrospective ratings when recording headache activity. The practice of recalling pain levels from memory raises concern regarding the accuracy of the headache activity information as well as the recording times.

Despite these limitations, headache diaries continue to be the most widely used assessment tool in headache research because they are practical and because they are the best available tool.

Researchers and clinicians may wish to address these issues since they have direct relevance to the reliability and validity of the information on which they are basing treatment decisions. Researchers in particular may wish to address the issue of retrospective recall in a manner similar to that employed by Collins and Thompson (1979). While, this practice would be rather inconvenient for most research participants and clinical clientele, it would address the problems associated with
retrospective recall. Additionally, perhaps the problems of retrospective recall can be avoided by placing minimal recording demands upon the participant. The method of rating headache activity four times per day appears to provide sufficient data for evaluating treatment outcome while placing a minimum of demand on the participant (Collins & Thompson, 1979). However, a balance between participant convenience and experimenter demands may be difficult to achieve.

Clearly, additional research regarding the reliability and validity of the information collected via headache diaries is needed. Headache diaries have been shown to be useful in the diagnostic process, selection of interventions, and evaluation of intervention efficacy. Perhaps additional information regarding the reliability and validity of headache diaries may be addressed through the concurrent assessment of behavioral correlates of pain by significant others since the perception of pain experience is a private event that is inaccessible to significant others.

Assessing Behavioral Correlates of Pain

Assessing children's pain by objectively recording the occurrence and frequency of their pain-related behaviors is similar to the practice of inferring children's emotions by observing their overt behavioral responses. However, McGrath (1990) indicates that children's behaviors are not simple and direct expressions of the quality or intensity of their pain. Behavioral responses to a painful stimulus may be influenced by learning history in addition to the actual pain experience. Furthermore, when discussing the issue of emotional expression (i.e., gasping, grunting, cries heard in extreme pain), Skinner (1957) indicates that while these "...are commonly observed
under extreme emotional conditions, they also occur when the inference of an emotional effect is misleading" (p.215). A child with considerable pain experience who has learned to cope with the pain may not exhibit the same overt distress behaviors as a child with less pain experience (McGrath, 1990). It is therefore necessary to be somewhat cautious regarding the assessment of pain via observations of the child’s pain-related behaviors.

Several aspects of the child’s learning history are likely to influence the expression of pain related behaviors. For example, the child’s pain behaviors are likely to vary according to the number of people present at the time of observation and whether they are peers, parents, or medical staff. The familial pattern of pain expression is perhaps among the most important aspects of the child’s learning history. Furthermore, the child’s learning history is also likely to be influenced by their age, gender, and cognitive level. Thus far, authors assessing pain related behaviors have attempted to identify indices that provide reliable, valid, and quantitative information about the child’s overt distress. A large number of behavioral indices have been identified, however, it is likely that pain expression will be somewhat idiosyncratic. In order to avoid overlooking important dimensions of behavior, it will be necessary to identify (via interview and/or observation) response patterns that are unique to the individual in addition to the behavioral indices included in existing observation scales or checklists.

Behavioral measures of pain in children consist primarily of observation scales or checklists in which a trained observer watches the child throughout a pain-inducing
situation and records the occurrence of certain pain-related behaviors. Several
behavioral rating scales have been developed to objectively evaluate children's overt
responses to acute pain produced by invasive medical procedures. However,
behavioral rating scales for use with recurrent pain disorders (e.g., headaches) are not
available at the present time. The existing behavioral rating scales assess the frequency
and duration of pain related behaviors that occur prior to and during a medical
procedure. The behavioral rating scales are then scored to produce a numerical value
that represents the child's overt distress.

Previous behavioral rating scales for invasive medical procedures have been
found to have adequate reliability and validity. The Procedural Behavior Rating Scale-
Revised (PBRS; Katz, Kellerman, & Siegel, 1980), the Observational Scale of
Behavioral Distress (OSBD; Jay, Ozolins, Elliot, & Caldwell, 1983), and the
Children's Hospital of Eastern Ohio Pain Scale (CHEOPS; McGrath et al., 1985)
provide examples of behavioral rating scales that may be modified to assess recurrent
pediatric headache. The PBRS and OSBD were developed for pediatric oncology
patients during lumbar punctures and bone marrow aspirations. Both scales rate 11
behaviors including cry, scream, physical restraint, verbal resistance, request for
emotional support, muscular rigidity, verbal pain, flail, nervous behavior, and
information seeking. The CHEOPS is a behavioral rating scale designed to assess
postoperative pain. Six behaviors (cry, facial expression, verbal expression, torso
position, touch behavior, and leg position) are rated every 30-seconds by a trained
observer. Behavior rating scales similar to these may be developed that are sensitive to
the unique characteristics of recurrent headache pain in children and thus allow for a
greater degree of objectivity in the assessment process.

Behavior rating scales for use with recurrent pain disorders may assess many
of the same dimensions of pain assessed by the behavioral rating scales for use with
invasive medical procedures. It is likely, however, that a degree of individualization
will be needed in order to accurately capture the more unpredictable pain experience
presented by recurrent headache.

Little research has addressed the utility of measures designed to assess the
behavioral correlates of recurrent or chronic pain. Although behavioral measures have
been shown to be reliable and valid indices of children’s overt distress, children’s
behaviors do not always constitute direct expressions of the intensity or quality of
their pain experiences. Clearly, the existing behavioral rating scales provide some
indication that it is possible to develop reliable methods of assessing the behavioral
correlates of pain. It, however, is an area of research that is desperately in need of
additional research.

Behavioral correlates of pain have not been shown to be of substantial use in
the diagnostic process, however, consistent with the HCCIHS diagnostic criteria,
certain behavioral correlates are a necessary part of the diagnosis (e.g., nausea,
vomiting, avoidance of light, avoidance of noise). Behavioral correlates may
contribute to intervention selection particularly in the development of guidelines
designed to encourage adaptive coping behaviors. In addition, their evaluation may
provide evidence regarding the efficacy of the intervention selected. Furthermore, the
behavioral correlates of pain often impact on the sufferers quality of life or are observable in the degree of associated functional impairment.

**Assessing Functional Impairment**

Observational measures of quality of life and functional impairment have not received a great deal of attention in the pediatric headache literature. However, a number of studies have investigated the utility of self-report measures of functional impairment. Unfortunately, neither observational nor self-report measures of quality of life and functional impairment have been used as primary outcome measures in headache research.

A number of functional impairment indices have been identified, however, it is likely that functional impairment will be somewhat idiosyncratic. In order to avoid overlooking important dimensions of impairment, it will be necessary to identify (via interview and/or observation) response patterns that are unique to the individual in addition to the functional impairment indices identified in previous studies.

**Self-Report Measures**

A variety of questionnaires have been developed to assess issues related to quality of life and functional impairment in pediatric (Kerns & Rosenberg, 1995; Varni & Thompson, 1985; Varni et al., 1996) and adult populations (e.g., Kerns, Turk, & Rudy, 1985; Melzack, 1975) of recurrent headache sufferers. Several of the questionnaires have been found to be reliable and valid measures of functional impairment, however they continue to be subject to the limitations of self-report data.

Several questionnaires commonly used in headache research have been...
developed to assess, from the child’s or significant-other’s (parent’s) perspective, issues related to functional status, palliative techniques, and psychosocial impact of recurrent headaches. The following listing represents only a portion of the resources available for assessing pediatric headache: the Significant-Other Version of the Pain-Relevant Response Scales (SOVPRRS; Kerns & Rosenberg, 1995), the Varni/Thompson Pediatric Pain Questionnaire - Form C (child), Form A (adolescent), and Form P (parent; Varni & Thompson (1985), and the Waldron/Varni Pediatric Pain Coping Inventory (PPCI; Varni et al., 1996). The majority of these questionnaires assess several aspects of the pain experience. Frequently, issues related to functional impairment are only a small part of the questionnaire.

The PPCI, for instance, is a 41-item scale that asks children to rate (on a 3 point scale ranging from 0="not at all" to 2="often") the frequency with which they engage in common child responses to pain (Varni et al., 1996). These would include questions about seeking social support, distraction strategies, problem-solving strategies, helplessness, and self-instruction. The subscale assessing problem solving strategies contains several items related to functional impairment including “go to bed”, “lie down”, and “ask for medicine”.

The SOVPRRS is a 17-item scale that asks significant others (parents) to rate (on a 7 point Likert-type scale ranging from 0="never" to 6="always") the frequency with which they engage in common parent behaviors in response to their child’s pain (Kerns & Rosenberg, 1995). These would include questions about attending to pain (e.g., asking about intensity, frequency, duration of pain), assisting with treatment.
(e.g., offering a massage, offering medications, trying to distract, offering ice or heat packs), and/or suggesting or allowing a reduction of activity level (e.g., going to bed, dispensing with chores, skipping school). The questions pertaining to a reduction in activity level are particularly relevant when assessing functional impairment.

Other self-report instruments take a more focused approach to the assessment of functional impairment with recurrent headache sufferers. Unfortunately, the majority of these instruments have been developed and used almost exclusively with adult populations of recurrent headache sufferers. The lone exception is the Parent Perception of Pain Interference (PPPI) questionnaire. Nevertheless, the measures used with adult populations hold a great deal of promise for application to pediatric headache sufferers (Osterhaus, Townsend, Gandek, & Ware, 1994; Philips & Jahanshahi, 1986; Santanello, Hartmaier, Epstein, & Silberstein, 1995). Despite their reliance on self-report, these instruments assess a variable that has been unduly neglected in the recurrent headache literature.

The PPPI asks parents to indicate how much their child's pain typically interferes with family relationships and daily functioning such as doing chores, attending school, doing school work, participating in and enjoying recreation. The PPPI consists of 11-items that parents rate on a 7 point Likert-type scale ranging from daily functioning "not at all" affected to "very much" affected. The PPPI is a modified version of the West Haven-Yale Multidimensional Pain Inventory. The PPPI appears to be sensitive to qualitative as well as quantitative impairment in functional status. The PPPI appears to detect changes in the continuum of functional impairment.
through the scores which are assigned to the various questions.

Santanello, Hartmaier, Epstein, and Silberstein (1995) assessed functional impairment in the 24-hour period following MH onset with a group of 107 adults. The 24-Hour Migraine Quality of Life Questionnaire (MQoLQ) consists of 15 items covering five domains of functioning: 1) work functioning, 2) social functioning, 3) energy/vitality, 4) migraine symptoms, 5) feelings/concerns. The items are rated on a seven point scale where “one” equals maximum impairment of quality of life and “seven” indicates no impairment. The authors indicated that the MQoLQ was sensitive to changes in quality of life.

Osterhaus, Townsend, Gandek, and Ware (1994) administered the Short Form-36 (SF-36) Health Survey Questionnaire to 845 adult MH sufferers as a measure of functional impairment. The SF-36 is a relatively brief instrument (36 items) that has been used extensively with individuals suffering from other chronic diseases. The SF-36 assesses eight domains of functioning including: 1) physical functioning, 2) role disability due to physical problems, 3) bodily pain, 4) general health, 5) vitality, 6) social functioning, 7) role disability due to emotional problems, 8) mental health. The authors indicate that the SF-36 was sensitive to the decrements in functional status and well being experienced by adult MH sufferers.

The Pain Behaviour Checklist developed by Philips and Jahanshahi (1986) provides an additional measure of functional impairment resulting from recurrent headache. The dimensions of pain behavior assessed include social avoidance, housework avoidance, mobility avoidance, exercise avoidance, stimulation avoidance,
non-verbal complaint (e.g., grimace), verbal complaint, self-help strategies A (e.g., have alcohol), self-help strategies B (e.g., have back massaged), medication, emotional distress, and distraction techniques. The PBC is reported to possess adequate reliability and validity properties. It is also noted to be of use in the evaluation of treatment outcome.

Questionnaires similar to those used with adult populations of recurrent headache sufferers may prove to be useful in the assessment of functional impairment associated with pediatric recurrent headache. Many of the domains of functioning assessed by these various questionnaires would presumably remain the same if the instrument were adapted for use with a pediatric population. As measures of the consequences of pain they also provide useful insight into the dimensions of behavior that are commonly affected by recurrent headache. This information, in turn, may be used to guide the development of observational instruments and self-monitoring techniques that are sensitive to the behavioral manifestations of functional impairment.

Self-Monitoring

Several authors have attempted to collect observational data regarding the impact that headaches have upon quality of life (e.g., Allen & Shriver, 1998). However, observational measures of functional impairment have rarely been reported as treatment outcome variables. Instead, they tend to occupy an ancillary role in headache outcome studies. Allen and Matthews (1998) recommend that pain monitoring include reports of the impact of the pain on activity and medication taken. Consistent with this recommendation, Allen and Shriver (1998) required child MH...
sufferers to self-monitor the type and quantity of medication taken as well as school or activities missed each day. However, Allen and Shriver (1998) placed little emphasis on this information when evaluating treatment outcome. Arndorfer (1999) also required child nonmigrainous headache sufferers to monitor the type and quantity of medication taken as well as school or activities missed each day. The author found that the variables changed minimally from pre- to post-treatment potentially due to low levels of medication consumption and activity interference during baseline recording. Arndorfer (1999) concluded that the manner in which the variables were monitored in the study may not have been sufficiently sensitive to therapeutic changes. Arndorfer (1999) suggests that it may be necessary to identify variables that are more sensitive to therapeutic changes including assessing qualitative impairment of functioning.

**Observational Measures / Significant-Other Monitoring**

Arndorfer (1999) required children and their parents to monitor the child’s medication consumption as well as school or activities missed. The author found a high degree of correspondence between child and parent report. The author also found that the variables evaluated changed minimally from pre- to post-treatment potentially due to low levels of medication consumption and activity interference during baseline recording... Arndorfer (1999) conclude that the manner in which the variables were monitored by significant others in the study may not have been sufficiently sensitive to therapeutic changes.

It is clear that objective measures of functional impairment have received little
attention in the pediatric and adult headache literature. However, it's promise as a dependent variable has been established in other pain research (e.g., Wright et al., 1996). It appears that additional variables that are sensitive to therapeutic changes need to be identified. Perhaps the simple frequency count method of assessing functional impairment as used by Allen and Shriver (1998) and Arndorfer (1999) lacks the sensitivity necessary to evaluate the impact of pain upon task completion. Observable qualitative impact on task completion may prove to be a viable alternative. Additional behavioral indices that may also prove useful include withdrawal from activities (i.e., physical or mental), sleep disturbances, emotional responses (e.g., grimaces, complaints, agitation), and eating difficulties.

Functional impairment has not been shown to be of substantial use in the diagnostic process, however, consistent with the HCCIHS diagnostic criteria, a degree of functional impairment is a necessary part of the diagnosis (e.g., inhibits or prohibits daily activities, aggravation by walking stairs or similar routine physical activity). Functional impairment may contribute to intervention selection particularly in the development of guidelines designed to encourage adaptive coping behaviors and to minimize maladaptive coping strategies (e.g., attention seeking, avoidance). In addition, their evaluation may provide evidence regarding the efficacy of the intervention selected.

Conclusions

Pain perception is a private event which has generally proven difficult to assess in a reliable and valid manner. The process of assessing the pain of recurrent headache
is further complicated in a pediatric population due to the limited nature of the child’s verbal repertoire as well as other developmental limitations (e.g., cognitive ability). This complexity continues to challenge researchers and clinicians who seek to assist children suffering from recurrent headache.

Several strategies exist for assessing the parameters of pain in a pediatric population including interviews, rating techniques, and self-monitoring techniques. Due to the private nature of the pain experience, it has proven difficult to obtain reliability and validity estimates concerning the information collected. However, reliability and validity information do exist for a number of strategies. These strategies have also been shown to contribute, to varying degrees, to the identification of the problem, selection of the intervention, and evaluation of the intervention. The most promising techniques for assessing headache pain parameters include the VAS and the headache diary. However, concurrent measures of behavioral indicators are needed in order to provide further support for the validity of the pain parameters that are produced by VAS ratings and headache diary ratings.

The behavioral correlates of pain have received little attention in the headache literature despite their frequent use with pain produced by invasive medical procedures. Perhaps due to the somewhat unpredictable and non-discrete nature of headache pain, there are no behavior rating scales for use with pediatric headache sufferers. Overt distress is not perfectly correlated with the child’s pain experience, however, it does allow for a degree of objective assessment that is otherwise impossible to obtain due to the subjective nature of pain. The assessment of behavioral
correlates of pain have also been shown to contribute, to varying degrees, to the identification of the problem, selection of the intervention, and evaluation of the intervention.

Perhaps functional impairment represents the area of greatest opportunity for pediatric headache researchers. A variety of self-report questionnaires exist that may be used to assess functional impairment. The assessment of functional impairment has also been shown to contribute, to varying degrees, to the identification of the problem, selection of the intervention, and evaluation of the intervention. Self-monitoring data has been used to track functional impairment as has monitoring by significant others (parents). Preliminary investigations indicate that a global approach (i.e., task/activity completion) to assessing functional impairment may lack the necessary sensitivity. Pediatric headache sufferers appear to continue their participation in school and other activities despite the pain of headache. An analysis of the dimensions of behavior impacted by chronic pain may hold promise for identifying variables that are more sensitive to therapeutic change. Rather than targeting general aspects of functional impairment (e.g., school missed, activities missed), it may be necessary to identify specific behaviors (e.g., avoiding walking, avoiding bright light, avoiding loud noise) and specific qualitative changes in functioning (e.g., ability to focus on tasks). Many of these specific behaviors and qualitative changes are likely to be somewhat idiosyncratic. Additionally, existing self-report measures of functional impairment and behavioral correlates of pain may provide clues regarding variables that may be sensitive to changes in functional status (e.g., holding the site of pain, avoid bending,
postural guarding, grimacing).

Pediatric pain assessment continues to be a challenging area for researchers and clinicians seeking to understand the parameters of the child’s headache experience. Substantial progress has been made in recent decades in the development of self-report instruments. However, observational measures have not developed as rapidly and should be the focus of future assessment research.
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