**INTERACTIVE COMPUTER ANIMATION PAIN ASSESSMENT:
APPLICATION WITH OLDER PATIENTS IN A CHRONIC CARE
AND REHABILITATION HOSPITAL**

by

Patricia A. O'Hara M.A.

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the Faculty of Graduate Studies and Research
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Abstract

Traditionally, pain assessment has relied on two broad approaches to measurement: behavioural techniques and self-report methods. There are many patient populations for whom these approaches are problematic, particularly geriatric patients. An experimental pain assessment device known as Interactive Computer Animation (IA) has been developed as an alternative to self-report procedures that rely on verbal communication and, therefore, are subject to certain biases of language (Swanston, Abraham, Macrae, Walker, Rushmer, Elder & Methven, 1993). IA is comprised of four animated modules (representing Throbbing, Burning, Piercing and Pressure) as well as a Visual Analogue Scale, which can be manipulated through the use of arrow keys in order to reflect the quality and quantity of the subjects' pain experience. Preliminary work comparing the results of the IA to the definitive self-report assessment tool used by clinicians today - the McGill Pain Questionnaire (Melzack, 1987) - has shown good concurrent validity. The sample employed in the Swanston et al. (1993) study ($n=50$) represented a broad age range (26 to 86 years) of subjects who visited a pain clinic. There was no attempt to examine the usefulness of IA with older adults (as a separate subsample), nor were subjects retested at a second point in time.

The purpose of the present study was to investigate the usefulness of IA as a measure of pain in a population of subjects who have received relatively little attention in the field of clinical pain measurement, and who present certain challenges to

traditional methods of assessment, that is, older adult patients in a long-term care, rehabilitation setting. Fifty-one subjects who were identified as having pain of least one month's duration, and who consented to take part in the study, underwent a pain assessment battery that included a modified version of the Short-Form McGill Pain Questionnaire which is considered one of the "Gold Standards" of pain measurement (Forrest, 1995; Roy, 1995) and IA. The high correlations found between analogous items of the two measures is indicative of the concurrent validity of the new technique. Correlations obtained in the present study (with older adults) were comparable to data from younger subjects in the Swanston et al. (1993) study, suggesting that age does not have a major effect on the way in which IA is used. A subset of the entire sample ($n=20$) underwent a second pain assessment battery and, once again, the Modified SF-MPQ and IA were highly and significantly correlated.

Age and cognitive function (as assessed by the Standardized Mini-Mental State Examination) did not predict preference for one measure over another, the number of IA items chosen, or the difference in z-transformed Modified SF-MPQ scores from IA scores. Not only is IA a valid measure of pain in an older population, it is preferred to the paper-and-pencil assessment technique, and it holds promise for populations with even greater physical and cognitive deficits than the one studied here. This study opens the door for research into the usefulness of IA with older, institutionalized patients who may not be able to report their pain with traditional techniques like the SF-MPQ.

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**INTERACTIVE COMPUTER ANIMATION PAIN ASSESSMENT:
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There are only two things that can be said about pain with any degree of certainty: It is, virtually, a universal experience, and it is extremely hard to define and, therefore, measure.

Aristotle suggested that pain is the opposite of pleasure (Price, 1988). As simplistic as this definition sounds, it is difficult to be more precise about a phenomenon that can be manifested in so many different ways in any given individual. The first subcommittee on Taxonomy of the International Association for the Study of Pain (IASP) defines pain as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain is always subjective" (Merskey, 1986, p. S217). This definition implies several important things: First of all, the sensation of pain should be thought of as something apart from the stimulus; that is, the degree of tissue damage is not an accurate predictor of how much "hurt" will be felt. The best evidence for this statement is a woman in labour. Childbirth is a perfectly natural process that can be accompanied by excruciating levels

of pain that do not signify any organic problem. On the other hand, there are some forms of cancer that can go undetected for so long that treatment is no longer possible. If pain were always a signal of danger, these inequities would not exist.

The IASP definition of pain also highlights the emotional or affective aspect of the experience. Although a patient may feel pain in her leg, for example, that sensation is interpreted in the brain and it is, therefore, subject to modulation by all the cognitive and emotional processes of which human beings are capable. The pain that the patient feels may alter her mood or it may itself be altered by her emotional state. It is also important to examine the meaning of the pain within the context of this particular patient's life: If the leg pain follows a 10 kilometre run, the patient may be content to live with it, knowing that it will soon be gone. If the pain does not appear to be the result of any particular activity, the stress of wondering whether or not this sensation might indicate the existence of a tumour could magnify the intensity of the experience.

As with depression or anxiety, the experience of pain is subjective and, therefore, is best assessed through means which produce subjective data. Although depression, anxiety and pain are all associated with the concept of "suffering," only pain is identified by specific sensory characteristics (Chapman, 1989). It is this set of characteristics which often overwhelms the definition of pain, leading clinicians to doubt the accessibility of such a "personal experience." However, like any psychological variable (such as depression) or sensory state (such as nausea), it is at least theoretically possible

to apply meaningful principles of measurement that will yield data that are reliable, valid, consistent and useful. It is imperative that those concerned with the clinical aspects of pain learn to measure all aspects associated with the experience of pain.

Without a precise way to describe and measure the type of pain that a patient is experiencing, it is very difficult to design an appropriate treatment. It is also essential to have assessment techniques that will evaluate the efficacy of such pain-controlling treatments. In 1987, Liebeskind and Melzack indicated that there are two groups for whom pain is poorly managed, and who are most defenceless in terms of demanding pain-alleviating treatments: the very young and the very old. Since that time, interest in pediatric and adolescent pain assessment and management has flourished (e.g. McGrath, 1990; McGrath, Unruh, Finley, 1995; Tyler & Krane, 1990), while the field of geriatric pain measurement and treatment has been slower to develop. Few articles specifically target older adults as an important population in pain research, and only one book is particularly concerned with chronic pain in old age (Roy, 1995). The application of pain measurement techniques to a geriatric population will be highlighted in the present review.

Pain assessment has traditionally relied on two broad approaches to measurement: behavioural techniques (including, for example, the monitoring of facial expressions and physiological reactions to medications), and self-report methods (such as paper and pencil

questionnaires). These approaches, and specific examples of pain measurement techniques, will be discussed in subsequent sections.

Behavioural Measures of Pain

Clinicians are inherently behaviourists, that is, they make inferences about the physical and psychological condition of patients by observing them. Behavioural observation can mean, for example, asking a patient with chronic back pain to walk down a hallway as a physiotherapist looks for difficulties in gait. It can also mean examining the facial expressions of a post-surgical patient to look for creasing of the forehead or tightening of the lips. While these methods can yield useful information, it should be remembered that, strictly speaking, they do not assess *pain*, but rather *behaviour which may be associated with pain*. According to the IASP definition (Merskey, 1986), pain is what the patient tells us it is: Caution is, necessarily, required when inferring another person's "state of being" from their behaviours (Melzack, 1983).

A. Problems With Behavioural Methods of Pain Assessment.

In general, behavioural methods of pain assessment are prone to several difficulties:

1. It is difficult to quantify actions or expressions. The relative sensitivity of behavioural observation scales, as defined by number of response categories, is limited (Turk & Melzack, 1992).
2. It is difficult to assess different qualities of a pain experience; for example, throbbing or burning.
3. The subjective interpretation of the person doing the observation may account for more of the within-subject variance than the between-group variance (when evaluating, for example, the effect of a therapeutic intervention). Degree of tissue injury is poorly correlated with amount of suffering (Turk, 1989); therefore, observers may be unfairly influenced by what they expect the level of pain to be, based on the presenting symptoms or diagnosis.
4. It may be essential, but perhaps impossible, to know the patient's pre-pain behaviours, since it is really only the *change* in actions or expressions that indicate that some new discomfort is being experienced. Complicating the assessment process further, changes in pain behaviour can occur for a variety of reasons (some related more to the context of the situation than to level of pain) (Chapman, Casey, Dubner, Foley, Gracely & Reading, 1985; Keefe, 1989).
5. Chronic pain behaviours may differ markedly from acute pain behaviours, making their detection problematic. For example, an Alzheimer patient with long-term pain may simply become more withdrawn (which could be mistaken for dementia) rather than displaying the facial grimaces and verbal complaints that are normally associated with suffering (Forrest, 1995).

6. Finally, the problem of disentangling other sources of distress (such as depression) from the pain experience is extremely difficult when restricted to behavioural means.

One recent innovation in behavioural pain measurement deserves closer attention because it attempts to quantify (facial) movements in a precise and scientific manner. It may also permit separate coding of the sensory and affective components of the pain experience (Chapman et al., 1985) as suggested by the IASP definition of pain (see page 1). The Facial Action Coding System (Ekman and Friesen, 1985) is one of the most promising techniques to emerge in the last decade, and will serve here to illustrate the behavioral approach to measurement.

B. Facial Action Coding System.

While many behavioural methods of assessing of pain rely on movements of the entire body (typically, while the subject is performing a given task or movement; Keefe, 1989), their applicability is limited when dealing with a population that is more sedentary. In an attempt to analyze facial expressions as a reflection of pain behaviour (independent of all other body movements), Prachin and Mercer (1989) studied 24 patients at a sports physiotherapy clinic, and 12 pain-free controls. All subjects were videotaped while performing a series of movements that could, potentially, produce pain in someone who has complained of shoulder discomfort. A modified version of the

Facial Action Coding System (FACS) developed by Ekman and Friesen (1985), was used to categorize 14 distinct facial expressions thought to be associated with pain, such as nose wrinkling and mouth stretching. Each action was rated on a standardized scale that ranges from A (trace) to E (maximum).

Prachin and Mercer (1989) concluded that certain facial expressions, such as lowering the brow and narrowing the eye, were most useful in discriminating between pain patients and pain-free controls. The degree to which other actions were observed, such as horizontal mouth stretching, were associated with pain intensity. It is also interesting to note that it was not enough to dichotomize these expressions as simply present or absent; it was only when actions were scored in terms of intensity and duration that they were related to subjective reports of pain.

While the encoding of facial expressions shows potential for the assessment of pain in clinical populations, particularly for those patients who are unable to express their discomfort in any other way, there are several reasons to be cautious about using this type of assessment in a clinical setting. Prachin and Mercer (1989) suggested that there were certain combinations of expressions that were more indicative of the experience of shoulder pain in their sample, than others. It is possible that for every type of pain there exists a particular constellation of behaviours, putting a heavy burden on the clinician to be able to interpret this complicated "language" of pain. In an experimental setting it is

possible to videotape behaviours in order to analyze them, in detail, at a future date - this is not, currently, a viable option for the clinician.

The sample used in this study (Prachin and Mercer, 1989) was, on average, 36 years old (age range: 21 to 55). It is possible that the truncated range of expressions of an older face would be more difficult to score than the plastic and changeable facial appearance of a younger person. As well, many years of experience with a particular pain-producing condition can train an individual to assume a "mask" that reflects a consistent, low or high, degree of discomfort. It is also a consequence of many conditions, such as stroke, that the ability of the facial muscles is compromised, and the expression seen on the face is no longer an accurate reflection of what the patient is feeling. These factors further limit the usefulness of this otherwise promising technique.

Self-Report Methods of Pain Assessment

Self-report methods can give direct insight into the way a patient is feeling and what the feeling means to them. These methods include: (a) having patients keep a pain diary; in this way it is possible to see what daily activities, time of day, or time of medication, are associated with fluctuations in pain (e.g. McGrath, 1990), (b) the use of body drawings (supplied by the clinician or generated by the patient) to provide the patient with a way to indicate exactly where the pain is, how it feels and, perhaps, the

direction from which it emanates, or the different levels of intensity which exist in different areas (e.g. Margoless, 1983). (c) analogue measures, such as a vertical line with the words "No Pain" at the bottom, and "Worst Possible Pain" at the top; patients are asked to treat this line like a "pain thermometer" which can be used to register intensity by putting a mark through the line at the degree of pain that they are experiencing (e.g. Huskisson, 1983; McCormack, Horne, & Sheather, 1988), and (d) verbal and numerical scales found in pain questionnaires: patients can be prompted with a list of words to describe pain - these words can reflect all dimensions of the pain experience, including intensity and affect (e.g. McDowell & Newell, 1987; Melzack, 1975; Melzack, 1987).

A. Problems With Self-Report Methods of Pain Assessment.

In general, self-report methods of pain assessment can be subject to several difficulties:

1. Since they rely on the patients' input, these methods assume that the people being assessed are physically and (especially) cognitively able to describe their pain.
2. Pain can be very difficult to describe: sometimes language just does not convey what we are feeling because it is such a personal experience.
3. When patients are prompted with words to describe their pain, there may be subtle differences in the way these words are defined and understood, leading to discrepancies in the results.

4. There are a limited number of categories that one can assign to a word; for example, if patients describe their pain as "aching," they may only be able to say that it feels like it aches "a bit," "a moderate amount," or "a lot."

Despite these potential problems, there is evidence to indicate that self-report measures of pain are preferable to behavioural methods, when assessing clinical pain (particularly when the patients are older adults). An audit of papers published in the journal Pain over a three-year period, reveals that 90% of the studies used self-report methods of pain assessment (Craig, 1990). Several forms of subjective pain assessment will be discussed in subsequent sections, because of the importance of this approach: the Pain Chart (a form of body drawing), spontaneous pain drawings, the Visual Analogue Scale, the McGill Pain Questionnaire, and the Short-Form McGill Pain Questionnaire.

B. The Pain Chart.

In an attempt to provide a "visual" description of pain, some clinicians have used body drawings to find out what patients are feeling, and where they are feeling it. Margoles (1983) describes one such "Pain Chart" that provides patients with a number of sketches of the human form, from different angles. Different qualities of sensation (e.g. burning and numbness) can be illustrated with different colours of markers, areas

of pain can be indicated by drawing or shading the affected areas, and descriptive words can be added to the chart for more detailed explanation.

Although this type of approach may be helpful to the therapist who is evaluating the spatial characteristics of a particular patient's pain over time (especially when the pain being assessed has different regional components), it is unclear how useful this information is when determining treatment efficacy, particularly the detection of small changes in the quality and quantity of pain. There are no explicit rules about the way in which patients are expected to use such scales (e.g. does the use of shading indicate "more" pain in a given area, than its identification by a single dot?), and so body charts have been recommended as adjunctive diagnostic tools to aid in the evaluation of pain, and the design of appropriate treatment plans (Margoies, 1983).

C. Spontaneous Pain Drawings.

In the attempt to uncover the way in which children conceptualize pain, several investigators have given young subjects the opportunity to draw pictures that show pain (reviewed by McGrath, 1990). The drawings do not provide a source of quantitative data concerning the level of pain experienced by these children, but they do offer a vivid portrayal of the quality of suffering experienced by the very young.

Jeans (1983) reported that children aged 5 to 13 years tended to draw a body, or body part, when depicting pain. Red and black were the colours most frequently chosen to represent the sensation of pain. Unruh, McGrath, Cunningham and Humphreys (1983) found that the details provided in the drawings of paediatric migraine patients were of clinical importance in understanding the nature of the childrens' headache experiences. Unfortunately, there are no data to confirm the reliability and validity of spontaneously generated pain drawings, compared to results from self-report scales or structured interviews.

D. The Visual Analogue Scale.

The Visual Analogue Scale (VAS) is a more abstract graphic approach to the representation of pain than the body drawing. The VAS is a line which represents a continuum of pain intensity, with one end defined as "No Pain," and the other end defined as a maximum state of pain (e.g. "Worst Possible Pain"; Melzack, 1987). It has been used with a variety of experimentally induced pains and pains of clinical origin, as well as with subjects of many ages, from young children (minimum 5 years) to senior adults (Huskisson, 1983; McCormack, Home, & Sheather, 1988). The VAS can also be used to measure the affective component of pain by changing the anchors to reflect, for example, "unpleasantness" (Price, 1988).

The VAS has consistently demonstrated good reliability over successive measurements of pain severity (Scott & Huskisson, 1979), and validity to the extent that it is highly correlated with other measures of pain intensity (Scott & Huskisson, 1976). Like any self-report method of pain assessment, it cannot be verified that all subjects will use the VAS in the same way but it has still proven useful when making comparisons among groups of patients (reviewed by McCormack, Horne, & Sheather, 1988).

The weaknesses of the VAS lie in its abstract nature (for some, this presents a difficulty in understanding how to use the scale), and the more serious suggestion that it does not accurately reflect the condition it purports to measure. Huskisson (1983) has suggested that it is not necessarily surprising that there is some evidence that an easily quantifiable phenomenon (such as grip strength) is poorly related to VAS ratings. It is the way in which subjects appraise their overall condition (e.g. weakness) that matters most to the clinician; affirming, once again, the axiom that pain is what the patient tells us it is.

The strengths of the VAS technique lie in its ability to detect the effects of treatment (sensitivity), the simplicity of its presentation, its independence from language (other than the explanation of its use), and its ability to generate ratio scaled data (Price, McGrath, Raffi & Buckingham, 1983). All these characteristics make it a useful tool for clinical settings. Interestingly, VAS ratings have been used to demonstrate that "younger" chronic pain patients (mean age=35.6 years) and "older" chronic pain patients

(mean age=71.3 years), do not differ in their appraisal of the sensory and affective aspects of their pain experience (Harkins, Laguna, Price & Small, 1995).

E. The McGill Pain Questionnaire.

The McGill Pain Questionnaire (MPQ) was developed by Melzack and Torgerson (Melzack, 1975) in order to measure and describe pain in a way that would capture some of its many qualities and dimensions. Although pain is an almost universal experience (e.g. between 15% and 20% of the Canadian population claims to suffer from chronic pain; Millar, 1996), and language affords many descriptive words that could vividly portray the experience of pain, it is often difficult for patients to generate spontaneously a list of appropriate descriptors. It may be that such words (e.g. searing and rasping) are unfamiliar or, at least, not usually associated with explaining a painful sensation (Melzack & Katz, 1992). It is also true that patients and health-care professionals alike, are not used to examining the complex network of sensations and feelings that make up pain and, therefore, simply quantify it along a unitary dimension of intensity.

Building on the work of Dallenbach (1939) who assembled a list of 44 pain descriptors, Melzack and Torgerson (Melzack, 1975) developed an extensive inventory of 78 words, grouped in 20 subclasses, to describe the experience of pain. These words can be divided into three classes: (a) words that describe pain in terms of its sensory

qualities (e.g. stabbing or burning), (b) words that describe pain in terms of its affective qualities (e.g. tiring or wretched), and (c) words that describe the way in which the person evaluates the intensity of the overall pain experience (e.g. annoying or discomforting). These three categories of words represent Melzack's *a priori* theoretical framework for understanding the multidimensional nature of the pain experience, and they have since received some confirmation by several studies using factor-analytic procedures to investigate the number and types of dimensions underlying the pain words chosen by different patient populations (Lowe, Walker & McCallum, 1991; Turk, Rudy & Salovey, 1985). Some researchers (reviewed by Reading, 1989) have suggested that this three-dimensional conceptualization of pain may be flawed to the extent that there is a potential overlap between the two latter dimensions (i.e. affective and evaluative). These dimensions may not be totally distinct, for example, when measuring brief experimental pain induced in a laboratory (Melzack & Katz, 1992). The major contribution of the MPQ to the area of pain assessment has been to separate physical sensations from emotional/psychological ones, and to acknowledge the range of qualities that comprises each dimension.

Administration of the MPQ requires a high degree of cognitive competence from patients. They are required to indicate whether or not each of the 78 words in the descriptor list applies to their pain; therefore, it is assumed that words such as lancinating, drawing and jumping are part of the vocabulary of the people being assessed. Every descriptor has a particular rank value within its subclass (e.g. for the "spatial"

subclass, jumping=1, flashing=2, and shooting=3). The rank values of words chosen by patients are summed within each broad category in order to give scores for the sensory, affective, and evaluative dimensions of pain (as well as a miscellaneous dimension). All dimensions can be summed to yield a total pain score. Melzack, Katz and Jeans (1985) have also suggested the use of weighted rank values in order to maximize the sensitivity of the tool when subjected to certain statistical procedures.

The MPQ also provides a Present Pain Index which allows patients to gauge their discomfort with a number-word combination scale that ranges from "0=None" to "5=Excruciating." A VAS is also included as an overall register of pain intensity. The 10 centimetre line is anchored by the words "No Pain" at one end and "Worst Possible Pain" at the other end. The Present Pain Index has been used on occasion as the sole indicator of pain intensity among the institutionalized elderly (e.g. Parmalee, Katz, & Powell Lawton, 1990).

Of course, there are restrictions on the types of populations that can use the MPQ. When Shannon, Ryan, D'Agostino and Brescia (1995) attempted to gauge the feasibility of using standardized pain assessment techniques in a population of patients with advanced cancer, they found that almost one-half (44.8%) of the patients were unable to use the MPQ. Both cognitive impairment and severe physical illness limited the patients' ability to use these tools. Without the capacity to express how they are feeling, patients -

who suffer in vastly different ways and to greatly differing degrees, even with the same disease progression - cannot be sure of adequate pain control.

The internal consistency, test-retest reliability, concurrent validity and discriminative validity of the MPQ has been demonstrated many times (Chapman et al., 1985; Melzack, 1983; Melzack, Terrence, Fromm & Amsel, 1986; Reading, 1989; Wilke, Savedra, Holzemer, Tesler, & Paul, 1990), making it the "Gold Standard" of pain measurement (McDowell & Newell, 1987). It has been translated into more than a dozen languages, and has been used successfully in over 100 studies to measure acute, chronic, and experimentally induced pain. The most recent studies have included populations with neuropathic cancer pain (Eisenach, DuPen, Dubois, Miguel, & Allin, 1995), central post-stroke pain (Vestergaard, Nielsen, Andersen, Ingeman-Nielsen, Arendt, Nielsen, & Jensen, 1995), chronic back and leg pain (Burchiel, Anderson, Wilson, Denison, Olson, & Shatin, 1995), postoperative coronary artery bypass grafts (Pozehl, Barnason, Zimmerman, Nieveen, & Crutchfield, 1995), chronic pain (Geisser, Robinson, Keefe, & Weiner, 1994), fibromyalgia (Nichols & Glenn, 1994), and in a comparison of nurses' and patients' perceptions of postsurgical pain (Stephenson, 1994). The MPQ has also proven useful with older patients with chronic pain (Farrell, Gerontol, Gibson, & Helme, 1995; Keefe & Williams, 1990), and degenerative osteoarthritis (Stelian, Gil, Habot, Rosenthal, Abramovici, Kutok, & Khahil, 1992; Wessel, 1995).

F. The Short-Form McGill Pain Questionnaire.

Although the MPQ is widely used by pain researchers, its length and level of complexity do not make it appropriate for all patient groups. This is particularly true when the administration of a questionnaire may be compromised by a short attention span (perhaps as the result of physical frailty), language difficulties (due to lack of education, or linguistic incompatibility), or cognitive problems. The Short-Form MPQ (SF-MPQ) was developed to address some of these problems and, although it still requires a fairly high degree of comprehension, it is easier and shorter to use than the longer form from which it is derived.

A short list of 15 pain descriptors was culled from the original inventory of 78 words in the MPQ. The decision was made to choose the most popular descriptors (i.e. selected by at least 33% of the subjects) within various types of pain populations (Melzack, 1987). The words used in the SF-MPQ represent the sensory and affective dimensions of the pain experience (leaving out the more controversial evaluative dimension), without the built in redundancy of the MPQ (where similar qualities of pain are presented with two to five descriptors that may differ, only slightly, in degree of implied intensity). Each SF-MPQ descriptor is rated on an intensity scale by the patient, as "None," "Mild," "Moderate," or "Severe."

Within different types of pain populations (i.e. postsurgical, labour, and musculoskeletal), the long and short forms of the MPQ have been found to be significantly correlated on the sensory dimension ($r=.65$ to $r=.68$, $p=0.001$), affective dimension ($r=.69$ to $r=.82$, $p=0.001$), and total pain score ($r=.77$ to $r=.93$, $p=0.001$; Melzack, 1987). Among these same populations, the long and short forms of the MPQ have also been found to be significantly correlated following a therapeutic intervention to reduce pain, on the sensory dimension ($r=.70$ to $r=.83$, $p=0.001$), affective dimension ($r=.79$ to $r=.94$, $p=0.001$), and total pain score ($r=.70$ to $r=.92$, $p=0.001$; Melzack, 1987). In a sample of patients with chronic pain due to cancer, three administrations of the long and short forms of the MPQ (over, approximately, two months), yielded significant correlations on the sensory dimension (mean $r=.87$, $p=0.001$), affective dimension (mean $r=.88$, $p=0.001$), and total pain score (mean $r=.90$, $p=0.001$; Dudgeon, Raubertas & Rosenthal, 1993).

The SF-MPQ has proven to be a useful alternative to the standard MPQ within special needs populations, for example, geriatric patients. Stelian, Gil, Habot, Rosenthal, Abramovici, Kutok, and Khahil (1992) used the SF-MPQ to evaluate the effects of low-power light therapy on pain and disability in elderly patients (age range: 55 to 86 years) with degenerative osteoarthritis of the knee. The SF-MPQ was also the assessment tool of choice when Gagliese and Melzack (1995) compared age differences in the experience of chronic pain (subjects were divided into "young," "middle-aged,"

and "elderly" groups). Helme, Katz, Gibson and Corran (1989) investigated the usefulness of standard psychometric tools with a population of older adults (age range: 42 to 94 years) who were diagnosed with a variety of chronic pain conditions, including degenerative musculoskeletal problems and post-herpetic neuralgia. The authors (Helme et al., 1989) concluded that, not only can the SF-MPQ be used with this age group, but that "older patients may be considered more reliable in their reports than younger subjects" (p. 115).

The SF-MPQ provides a method to assess the multidimensional aspects of pain in a way that takes less time, and is less complicated to understand than its longer counterpart. It also contains the Present Pain Index and the VAS found in the long form, in order to provide information about level of pain intensity. The short and long forms of the MPQ are significantly correlated, and the SF-MPQ, like its longer counterpart, is sensitive to changes in pain as a result of some type of intervention; for example: analgesic drugs, transcutaneous electrical nerve stimulation (TENS), and epidural blocks (Dudgeon, Raubertas & Rosenthal, 1993; Melzack, 1987). Like the standard MPQ, the SF-MPQ may even be able to discriminate among different pain syndromes (such as phantom limb pain, degenerative disc disease, toothache, etc.) by identifying different clusters of descriptors associated with each condition (Melzack & Katz, 1992). The potential for the discriminative capacity of the SF-MPQ has exciting implications for difficult diagnoses such as fibromyalgia, but much work needs to be done before its usefulness in this area can be established.

G. Interactive Computer Animation Pain Measurement.

An experimental pain assessment device using interactive computer animation (IA) has been developed as an alternative to self-report procedures that rely on verbal communication and which are subject to certain biases related to the use or understanding of language (Swanston, Abraham, Macrae, Walker, Rushmer, Elder & Methven, 1993). IA is also an attempt to go beyond the unidimensional nature of the VAS - since the experience of pain is a multidimensional phenomenon - and yet preserve the continuous scaling ability of the VAS.

Swanston et al. (1993) combined the notion of static images to depict pain such as the body drawings used by Margoies (1986) and the spontaneous drawings provided by children to investigators in paediatric pain assessment (Jeans, 1983; Unruh et al., 1983), with the developing technology associated with the design of interactive animations for the computer, which are based on graphical displays. The use of graphics in computer displays, most notably the evolution of icons, has revolutionized human-computer interaction (Shneiderman, 1992). The popularity of icons can be explained by the idea that "graphic images are often considered a potentially universal means of communication and are assumed, therefore, to be able to overcome some of the problems associated with verbal language" (Rodgers, 1986).

Swanston et al. (1993) chose to animate four qualities of pain - Pressure, Burning, Throbbing and Piercing - (plus a VAS), based on two criteria: (1) their inclusion in the MPQ, and (2) their concreteness. By choosing qualities that matched descriptors from the MPQ, an immediate source of data concerning concurrent validity was available. Reliance on items that could be translated into concrete concepts is not only a practical choice but the one recommended by investigators who have found that, in general, subjects prefer concrete rather than abstract representations (Jones, 1983).

Construction of the actual images used in IA was based on the way in which adults spontaneously draw their pain (Walker, Abraham, Swanston, Rushmer & Methven, 1992). Comments and suggestions were also solicited from students with clinical experience. Certain restrictions had to be imposed on the choice of images; for example, although a picture of a flame might be more easily recognizable as representing "Burning" than a depiction of a red ball within a black sphere (the image chosen for IA), fire is also characterized by "Flickering," thus complicating the identification of the quality of pain being presented. Each IA image represents a "compromise between realism and usability as a scale" (Swanston et al., 1993). The animation modules are described more fully in the Methods section.

Preliminary work comparing the results of the IA to the "Gold Standard" of self-report assessment tools used by clinicians today, the McGill Pain Questionnaire (in this case, the short form was used: Melzack, 1987), has shown good concurrent validity

($r = .30$, $p < 0.05$ to $r = .88$, $p < 0.01$; Swanston et al., 1993). The sample employed in this study ($N = 50$) represented a broad age range (26 to 86 years) of subjects who visited a pain clinic. There was no attempt to examine the usefulness of LA with older adults (as a separate subsample), nor were subjects retested at a second point in time.

Pain Assessment in the Elderly

There is increasing evidence to suggest that pain is a significant problem for a large proportion of the geriatric population (Crook, Rideout & Browne, 1984; Millar, 1996; Roy & Thomas, 1986). Estimates of the prevalence of pain among community dwelling seniors range from 25% to 50%, and among institutionalized elderly the figures rise from 45% to 80% (Lau-Ting & Phoon, 1988; Roy & Thomas, 1986). People over the age of 60 are affected by a number of physical problems that produce pain in a way that is disproportionately high when compared to people under the age of 60. These conditions include osteoarthritis, cancer, herpes zoster and neuromuscular disorders (Gordon, 1979; O'Brien, 1992).

Despite the prevalence of pain in this aged population, there has been surprisingly little attention paid to the necessity of assessing, documenting, and treating pain among the elderly (Ferrell, 1991). There are many factors which may contribute to difficulty in using standard measures to assess pain in this population, including frailty (and,

therefore, a lower tolerance for extensive procedures), physical restrictions that might prevent the completion of a questionnaire, communication difficulties arising, for example, from cerebrovascular accident, and a general reluctance to cooperate as the result of an unwillingness to "complain," or fear of negative consequences, such as the loss of autonomy (Herr & Mobily, 1991; Sengstaken & King, 1993). As Roy (1995) points out, very few pain measurement tools have been validated for use within elderly populations, so their generalizability to this group - with its attendant physical problems, cohort characteristics, and stereotypical attitudes held by them, and about them - is unknown. Herr and Mobily (1991) conclude that "research regarding assessment tools for the elderly is clearly needed" (p. 14.).

The other major reason for pain in the elderly going undetected is that physicians often fail to ask their older patients, directly, about their levels of pain (Sengstaken & King, 1993). This may be the result of the mistaken notion that pain perception decreases over a lifetime, or it may simply reflect the belief (on the part of the patient and/or the clinician) that pain is an inevitable part of life (Herr & Mobily, 1991). Melding (1991) even asks, "could the lack of attention to the problem [of geriatric pain] be a covert form of ageism?" (p. 120). These are unfortunate attitudes with potentially detrimental consequences for the elderly patient. Most researchers in the area of geriatrics believe that pain is not a "normal" part of aging (Ferrell & Ferrell, 1990; Forrest, 1995; Harkins, Kwentus & Price, 1990). There is no reason to believe that pain perception is altered by the aging process (Bonica, 1990). As Giuffre, Asci, Arnstein

and Wilkinson (1991) point out, "it is clearly documented in the literature that the elderly consistently receive less postoperative pain medication although there exists no conclusive evidence that they in fact perceive less pain" (p. 241). In a study of older institution residents (age range: 61 to 99 years), there was no relationship between age and pain intensity, or number of localized pain complaints (Parmalee, Katz, & Powell Lawton, 1991).

One of the most compelling studies illustrating the lack of pain control offered to patients who are unable to use traditional pain assessment tools to express their level of discomfort, took place in a nursing home. Sengstaken and King (1993) reported that 43% of the patients who were able to communicate with their physicians, self-identified themselves as having pain. In contrast, only 17% of the patients who were non-verbal (due to communication or cognitive difficulties) were identified by staff as being in pain. This difference in recognition of pain between the two groups persisted in their treatment regimes. Five times as many communicative patients received analgesics on a regular basis (21%), as compared to non-communicative patients (4%). Forrest (1995) suggests that inadequate pain control can restrict patients' physical activity (leaving individuals open to many other problems, such as pneumonia), and lead to depression and cognitive impairment.

The presence of pain in the last years of life has the potential to greatly diminish the quality of that life. There is every indication that treatment of the older patient can

be just as effective as treatment of the younger patient, in controlling pain (Harkins, Price, Bush, & Small, 1994). Many health care professionals in the area of geriatric care are calling for more research into the assessment and treatment of pain in the elderly, as well as education that would promote the objective of "comfort" as well as pain control (Ferrell, 1991; O'Brien, 1992; Harkins & Warner, 1986; Melding, 1991; Roy & Thomas, 1986; Sorkin, Rudy, Hanlon, Turk, & Stieg, 1990; Zimmer, Calkins, Hadley, Ostfeld, Kaye, & Kaye, 1985). It is only by investigating the usefulness of standard pain assessment tools with older adult subjects, and developing new measurement procedures that deviate from the customary reliance on verbal and numerical scales, that we will be able to gauge the nature of the pain conditions experienced by seniors, and design treatment programs to meet their specific needs. It is particularly important to extend this essential service to patients who heretofore had no adequate way to communicate the intensity and quality of their pain.

Rationale for the Present Study

There are many patient populations for whom traditional pain assessment techniques are problematic. As new measurement tools are developed, it is imperative to test their usefulness within different groups of pain patients, as well as assessing each tool's sensitivity in describing the pain experience as it changes under varying conditions. It is also essential to capture as much information about the multidimensional pain experience as possible in a way that is parsimonious, makes sense to the patient, and can be understood in quantitative terms by clinicians and researchers. One conclusion from the previous review of approaches to pain measurement is that the assessment of new techniques to measure pain in special populations - particularly the elderly - is essential.

The purpose of this study was to investigate the usefulness of a new method of pain assessment - Interactive Animation - that holds special promise for a population of subjects who have received relatively little attention in the field of clinical pain measurement and who present certain challenges to traditional methods of assessment. Specifically, the usefulness and concurrent validity of IA was assessed with older adult patients in a (chiefly geriatric) chronic care, rehabilitation setting, and geriatric day hospital setting. For the purposes of this investigation, "older adult" will be defined as 60 years of age, and over.

Guiding Questions for the Present Study

This study attempted to address several questions:

1. **Can IA be used with a sample of older adults?** As a first step in examining the usefulness of images, as opposed to words, in the description of the pain experience, seniors with moderate to high cognitive function were assessed. It is hoped, in time, that IA will be a useful assessment device with seniors who are more verbally compromised since, theoretically, it is possible that the ability to process pictures may outlast the ability to process words.
2. **Is the pattern of results from a sample of older patients using IA, similar to the results obtained from a younger sample of subjects attending an out-patient clinic?** The only published results of IA, thus far, is with a group of 50 patients attending a clinic in Scotland (Swanston et al., 1993). By comparing the correlations obtained in the Swanston et al. (1993) study with correlations obtained in the present study, it will be possible to examine the similarities or differences in the way the younger and older subjects responded to both the SF-MPQ and IA.

3. **Is IA as likely to detect changes in the level or quality of pain (either increased or decreased) that senior patients in a chronic care/rehabilitation setting or day hospital experience, as compared to the "Gold Standard" of pain measurement: the Short-Form McGill Pain Questionnaire (SF-MPQ)?** Typically, and regardless of its etiology, pain fluctuates over time (Jensen & McFarland, 1993). Patients who undergo physiotherapy, for example, often report a change in their pain as a result of therapy; this change can be in either direction. By assessing patients twice and using both types of pain measures, it is possible to assess the ability of IA to detect different pain "states."
3. **Are the number of IA items chosen related to the correlations between the SF-MPQ and IA?** Swanson et al. (1993) found that there were different response patterns between subjects who chose only one animation, versus those who chose multiple animations to describe their pain. The way in which IA is used by older patients in a chronic care/rehabilitation or day hospital setting, will be examined in this study.
4. **What items predict the overall pain intensity score reflected in the visual analogue scale contained in the IA as well as the SF-MPQ?** Since pain is often assessed in a unidimensional way (e.g. "Are you in pain?" or even "How much pain are you in?") it is interesting to know what, if any, descriptors are related to the patients' notion of overall pain.

Method

Subjects

Subjects were recruited from Saint Vincent Pavilion, part of the Sisters of Charity of Ottawa Health Services, a chronic care and rehabilitation hospital (with a day hospital facility) in Ottawa. Physicians, nurse managers, and physiotherapists were asked to identify patients whom they believed were suitable for the study, that is: patients who were in pain for at least one month (the pain could be of any etiology), and willing to give consent (see Appendix A). Subjects had to be judged to be cognitively able to participate. This was particularly important because patients who are older have often experienced a stroke, or have been diagnosed with varying forms of dementia. Hospital/clinic staff were asked to use their clinical judgement to screen potential subjects for cognitive suitability, and all subjects were administered the Standardized Mini-Mental State Examination (Molloy, Alemayehu, & Roberts, 1991; see Appendix B) to measure cognitive impairment, for the purpose of describing the patient cohort. Demographic information and diagnostic profiles were obtained from medical records (see Appendices C and D).

Of the 54 subjects referred to the pain study, one refused to participate, one dropped out after the initial interview (self-discharged from the hospital), and one was unable to comprehend the pain measures, leaving a sample size of 51. A subsample of

this group ($n=20$) participated in a second testing outlined in Procedure (pp. 34-37). Although subjects were not randomly selected for retesting (availability of patients played a major role in being able to identify potential candidates), it was established *post hoc* that there were no significant differences between subjects who were tested once ($n=31$) and those who were tested twice ($n=20$) on any of the major demographic or pain variables (see Appendix E).

A power analysis to determine sample size was computed prior to conducting the research (see Appendix F). The number of subjects eventually recruited (for the overall sample [$N=51$] as well as the subsample [$n=20$]) exceeds the numbers suggested by the power analysis ($N=37$ and $n=15$, respectively).

Apparatus

A. The Standardized Mini-Mental State Examination (SMMSE).

The Standardized Mini-Mental State Examination (Molloy, Alemayehu, & Roberts, 1991) is a valid and reliable method of measuring cognitive impairment (Folstein, Folstein, & McHugh, 1975; Helme et al., 1989). This scale measures orientation to time and place, immediate recall, short-term memory, calculation, language, and constructive ability (Molloy, et al., 1991) in a way that is easy to administer and score (see Appendix B). Herr and Mobily (1991) suggest the use of this

scale, specifically, when assessing the ability of an older patient to effectively process the information required in a pain assessment. The SMMSE is used here to characterize the sample, rather than to screen for cognitive suitability.

B. The Modified Version of the Short-Form McGill Pain Questionnaire
(Modified SF-MPQ).

The short-form of the McGill Pain Questionnaire (SF-MPQ; Melzack, 1987) consists of 15 descriptors (11 sensory and 4 affective) that are rated on a four-point scale of intensity (0=none, 1=mild, 2=moderate, 3=severe). Three types of pain scores can be derived from this scale: sensory, affective, and total pain. For the purposes of this study, two additional words from the long form of the MPQ were added to the questionnaire (Piercing and Pressure) in order to make it comparable to the other pain measurement device used in this study - Interactive Animation (IA), thus it becomes the Modified SF-MPQ (see Appendix G). These additional words, however, are not included in the sensory, affective, and total pain scores.

The SF-MPQ also contains a visual analogue scale and a Present Pain Index (PPI) designed to measure overall pain intensity (see Appendix H). The PPI is a list of 6 descriptors (scored 0 to 5) that reflect varying degrees of pain (from no pain, to excruciating pain) - see Appendix H.

C. Interactive Animation for Pain Measurement.

Interactive Animation consists of five animation modules presented on a colour computer screen: four represent different dimensions of pain, and the fifth is a visual analogue scale that uses the same verbal anchors as the MPQ (Melzack, 1987). The four dimensions of pain are: Pressure, Burning, Throbbing and Piercing (see Appendix I). Each of the animations can be manipulated by subjects to reflect the degree to which the different "qualities" of pain are reflected in their experience (data are captured on a 100-point scale).

Pressure - A red ball caught in the jaws of a vise is used to portray "Pressure." This image is common among pain drawings (Swanston et al., 1993), and can be easily animated to show "no pressure" (the circular shape of the ball is intact), and "extreme pressure" (the jaws of the vise tighten on the ball until it is squeezed into an ellipse). As the vise closes, the screw thread appears to turn.

Burning - A small red dot within a large black circle can be expanded to a large red circle that eclipses its background, symbolizing maximum "Burning." As discussed earlier, it is difficult to find a representation for this pain quality that is orthogonal to other aspects of the pain experience. Early testing with images that expanded in only one direction (horizontal or vertical)

were found to be inadequate in their portrayal of "Burning," thus leading to the idea of an image that grows in all directions at once (Swanston et al., 1993).

- Throbbing - Since the notion of "Throbbing" implies fluctuation in pain, a hammer (or piston) hitting the base of a box was chosen as the appropriate image. The hammer is also a popular image used by patients when depicting throbbing (Swanston et al., 1993). Only the *intensity* of the throbbing can be controlled by the patient (the greater the distance between the head of the hammer and the base of the box, the greater the degree of throbbing), and not the *rate* (or frequency) of fluctuation. Whenever the hammer contacts the box, the white background flashes red - indicating pain.
- Piercing - As with "Pressure" and "Throbbing," the idea to use a needle to depict "Piercing" comes from patient feedback (Swanston et al., 1993). As a needle penetrates a box, in this animation, the needle turns red. The degree of penetration into the box is analogous to the degree of "Piercing" felt by the subject.

The IA program, which is central to this study, was developed by a team of researchers in Scotland (Swanston et al., 1993), for use on an AMIGA 3000 personal computer. Working in conjunction with Swanston, I have been supplied with a new

version of IA which operates through Windows (there are no published studies with this version of IA, and only one published study to date with the original version; Swanston et al., 1993). The present study, which is strictly limited to the use of IA in an applied clinical setting, will contribute to the development of the instrument as a tool for the assessment of pain. Interactive Animation, although highly promising in many respects, is limited in others (for example, the number of dimensions of pain that have been translated into images).

D. Computer and Interface Device.

The IA program was installed on a Eurocom Notebook computer. It was possible to bring this lightweight, portable computer to the subject, rather than having the subject come to the investigator, for low-invasive assessment at the convenience of the patient and the hospital staff. An oversized keypad with arrows (Intellikeys) was attached to the computer for facilitated image manipulation (see Figure 1). This hardware was described as a "screen" or "picture presentation device" to measure pain, rather than a computer which might have intimidated some of the patients in, what is chiefly, a geriatric, chronic care setting.

Figure 1 Notebook computer and Intellikeys interface device.

Procedure

The same investigator met with each subject on two to three occasions. During the first meeting the investigator provided the subjects with a detailed explanation of the study, obtained informed consent, interviewed the subjects with respect to their pain, and administered the SMMSE. At this time the investigator identified the "major" pain complaint of the subject (when the subject described more than one pain problem). The "major" complaint was the pain problem considered to be of greatest significance to the patient. All pain assessments were restricted to the one "major" complaint of each subject.

During the second and third sessions, subjects were asked to characterize their pain using the two methods described above: IA and the SF-MPQ. The procedure for IA was closely modelled on that of Swanston et al., (1993), and was presented to the subjects as a way to express their pain using pictures. The images were presented to each subject in the same order (as dictated by the software). As each picture was presented to the subject, the particular quality of pain that it represented was explained and the method for manipulating the animation was demonstrated. If, after an image was demonstrated, the subject felt that it did not represent the pain they were experiencing, that image was considered "not chosen" and the investigator proceeded to the next image. Subjects were asked to manipulate each image until the pictures on the screen reflected

an appropriate representation of their pain. The final image that subjects manipulated was always the computerized version of a visual analogue scale.

The Modified SF-MPQ was presented to subjects as a way to express their pain using words. After the Likert-type response scale was explained (0=none, 1=mild, 2=moderate, 3=severe), subjects were asked to respond to each of 17 words on the Modified SF-MPQ, with an appropriate rating. The words were presented in the same order for each subject. If a subject had difficulty responding to a word, the investigator moved on and came back to the word after the list was exhausted. Following the presentation of pain words, subjects were asked to rate their overall pain with the Present Pain Index and a paper and pencil version of a visual analogue scale.

The order of presentation of the two methods was counterbalanced so that approximately half of the subjects completed the Modified SF-MPQ first ($n=27$, 52.9%) and the rest of the subjects completed the IA first ($n=24$, 47.1%). This was done in order to control for possible order effects. A script was used to achieve standardization during the explanations of IA (see Appendix J). Subjects were also questioned about their preferences concerning the two methods of assessing pain.

The second and third pain assessment sessions were scheduled to coincide with potential "high" and "low" pain times, as dictated by the individual patient profile (obtained during the initial interview). For example, a patient undergoing pain

alleviating treatment at the day hospital was tested at admission and again at discharge. The nature of the pain alleviating or inducing activity/treatment was noted, but since this study is not concerned with what *causes* the fluctuation in pain (only that changes in pain can be measured), it was not necessary to standardize the pain alleviating/inducing activity/treatment across subjects.

Depending on the physical stamina of the patient, it was sometimes possible to combine Session 1 (the explanation of the study and the initial pain interview) with Session 2 (the first administration of the Modified SF-MPQ and the IA.). The length of the assessment was of particular concern with older patients who may be physically frail and who may not have a long attention span. This pain measurement battery was designed with that special population in mind, and it reflects the practical limitations of a chronic care/rehabilitation setting.

Subjects were asked if they would like the information gathered from the study to become part of their medical record. Patients had to sign a Release of Information form (see Appendix K) to declare their intent. Subjects were debriefed following the final visit (see Appendix L), and encouraged to contact the investigator with any further questions or suggestions about the assessment.

Analytical Strategy

Statistical analyses were designed to answer the questions posed in the section entitled: **Guiding Questions for the Present Study** (pp. 28-29).

In order to describe the sample and so establish the parameters of ecological validity (generalizability), the frequency distributions of all major demographic and diagnostic variables are presented, for example: age, gender, length of stay at hospital (where applicable), SMMSE, primary diagnoses, diagnosis related to pain, and number and type of analgesics. Means and standard deviations are presented, where relevant.

In order to determine the concurrent validity of IA, Pearson product-moment correlations are computed for all Modified SF-MPQ pain words and corresponding IA pain qualities. Swanston et al. (1993) were not able to compare all IA pain qualities with their matching SF-MPQ counterparts, because their scale did not include two of the necessary words (i.e. pressure and piercing). The Modified SF-MPQ includes the missing words (which are, in fact, part of the original MPQ). Swanston et al. (1993) *did* report a significant and substantial correlation between the paper and computer versions of the VAS ($r=.88$), but they did not describe the relationships between their other matching pain qualities (i.e. burning and throbbing).

In order to determine the similarity between the assessment of pain with IA in a younger population compared to the assessment of pain with IA in an older population, comparisons between the Swanston et al. (1993) study (mean age=55) and the present study (mean age=75) are made.

In order to determine the relative "sensitivity" of IA to detect different levels of pain over time, compared to the SF-MPQ, correlations are computed on the absolute difference scores (i.e. between Time 1 and Time 2) of each pain quality.

Pearson product-moment correlations are also computed for all Modified SF-MPQ pain words and corresponding IA pain qualities at pre-defined "low" and "high" expected pain times (for those subjects where such a designation of "low" and "high" expected pain is possible), in order to assess the degree of correspondence between the two measures' ability to detect change

In order to further explore the relationship between the two measures as indicators of change in pain over time, a repeated measures analysis of variance (ANOVA) is computed on each pain quality (as assessed by Modified SF-MPQ and IA) separately. That is, for each pain quality there is an ANOVA with two within-subject factors: Time (two levels: "lower" and "higher" presumed pain intensity), and Measure (Modified SF-MPQ and IA).

In order to investigate the relationship between the sensory and affective scales of the Modified SF-MPQ, and the IA, correlations are computed. A mean IA score is obtained by averaging the four IA qualities of pain (i.e. Pressure, Burning, Throbbing, and Piercing) chosen by each patient (as suggested by Swanston et al., 1993). A "Sensory" dimension score is obtained by summing the scores from the first 11 items on the Modified SF-MPQ for each patient, and an "Affective" dimension score is obtained by summing the scores of the last four items on the Modified SF-MPQ (Melzack, 1987).

In order to investigate the potential impact of number of IA items chosen, separate analyses are conducted to look at the differences between patients choosing multiple pain qualities as assessed by IA, versus only one. Swanston et al. (1993) suggest that this could be an important factor in the relationship between IA scores and the Sensory and Affective dimensions of pain, as reflected by the Modified SF-MPQ. Preliminary work done by Swanston et al. (1993) suggests that subjects choosing only one pain quality have a different pattern of results than subjects choosing multiple pain qualities. Specifically, they found that the Sensory scale of the SF-MPQ was not correlated with the Affective scale, the VAS, the PPI, or mean IA scores, for single-choice subjects (while the opposite was true for multiple-choice subjects; Swanston et al., 1993).

In order to investigate whether there are particular qualities of pain or combinations of qualities, that predict overall pain, linear regression analyses are conducted with both versions of the VAS (Modified SF-MPQ and IA) as dependent variables. Separate analyses are conducted for pain "systems" (i.e. musculoskeletal versus nervous system).

Results

The Demographic and Diagnostic Composition of the Sample

Demographic characteristics are presented in Table M-1, and diagnostic data are presented in Table M-2 (see Appendix M). Subjects ranged in age from 60 to 92 years ($M=75.09$, $SD=8.40$). Due to the importance of age as the defining characteristic of this sample, a graphical breakdown of subjects by five-year age groups is presented (see Figure 2).

Figure 2. Distribution of subjects by five-year age groups ($n=51$).

Diagnostic data specifically related to the major pain complaint (i.e. the pain problem identified for measurement in this study) are presented in Table M-3 (see Appendix M). On average, patients had 2.26 pain complaints ($SD=1.04$); see Figure 3. The areas of the body identified by the major pain complaint are described in Table M-4 (see Appendix M). All medications taken by subjects are listed by category in Appendix N. Most important to note is that 87% ($n=47$) of the sample is prescribed some type of analgesic. Specifically, 78.4% ($n=40$) are prescribed topical analgesics, 78.4% are prescribed non-narcotic analgesics, 31.4% ($n=16$) are prescribed narcotic analgesics, and only 3.9% ($n=2$) are prescribed non-steroidal non-narcotic (NSAID) medications.

Figure 3. Number of pain complaints per subject ($n=51$)

Session 1: Modified SF-MPQ and IA Pain Data

Frequency of responses to pain items. The frequency of responses to the Modified SF-MPQ and to IA on analogous descriptors (i.e. Throbbing, Burning, Piercing and Pressure) as well as VAS ratings are presented in Figures 4 to 8. Since IA provides continuously scaled data *without* demarcations that suggest "Mild," "Moderate" and "Severe" pain, an innovative method of combining responses based on the methods of Cleeland (1996) was adapted and utilized. Cleeland (1996) and Serlin, Mendoza, Nakamura, Edwards and Cleeland (1995) have found a consistent trend among cancer patients from four different countries using a ten-point pain scale, which suggests that ratings of 1 to 4 can be considered "Mild," ratings of 5 to 6 can be considered "Moderate," and ratings of 7 to 10 can be considered "Severe" pain. Extrapolating this approach to a 100-point scale allows a categorical distribution of responses to IA items (as well as both versions of the VAS) to be presented.

Pain descriptors chosen. Chi-square analyses revealed no significant differences in the proportions of subjects choosing analogous items from the Modified SF-MPQ and IA. See Tables 1 and 2 for a presentation of numbers of subjects choosing each descriptor. The kappa statistic (Fleiss, 1981) is a useful way to judge interrater agreement or, in this case, to determine if the *same* subjects chose (or did not choose) analogous pain measures (complete agreement is indicated by $\kappa=1$; if observed

Figure 4. Session 1: Distribution of Modified SF-MPQ and IA Throbbing scores.

Figure 5. Session 1: Distribution of Modified SF-MPQ and IA Burning scores.

Figure 6. Session 1: Distribution of Modified SF-MPQ and IA Piercing scores.

Figure 7. Session 1: Distribution of Modified SF-MPQ and IA Pressure scores.

Figure 8. Session 1: Distribution of Modified SF-MPQ and IA VAS scores.

TABLE 1 Session 1: Modified Short-Form McGill pain data for all subjects (n=51).*

Modified Short-Form McGill Item		M	SD	N Choosing Item (%)
1.	Throbbing	.71	1.01	19 (37.3%)
2.	Shooting	.71	1.19	15 (29.4%)
3.	Stabbing	.67	1.03	17 (33.3%)
4.	Sharp	1.20	1.23	28 (54.9%)
5.	Cramping	.55	.92	15 (29.4%)
6.	Gnawing	.60	.99	15 (29.4%)
7.	Hot-Burning	.76	.99	21 (41.2%)
8.	Aching	1.58	1.11	39 (76.5%)
9.	Heavy	.84	1.23	17 (33.3%)
10.	Tender	1.29	1.12	35 (68.6%)
11.	Splitting	.38	.86	9 (17.6%)
12.	Tiring-Exhausting	1.46	1.03	38 (74.5%)
13.	Sickening	.76	1.13	18 (35.3%)
14.	Fearful	.68	1.13	15 (29.4%)
15.	Punishing-Cruel	1.04	1.26	22 (43.1%)
16.	Piercing	.98	1.22	23 (45.1%)
17.	Pressure	1.46	1.07	38 (74.5%)
Sensory Score (Based on items 1 to 11)		1.93	.58	51 (100 %)
Affective Score (Based on items 12-15)		1.73	.89	44 (86.3%)
Total Score (Based on items 1 to 15)		1.92	.52	51 (100 %)
VAS (Scored 0 to 100)		55.64	25.73	51 (100 %)
Present Pain Index (Scored 0 to 5)		1.57	1.38	35 (68.6%)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

TABLE 2 Session 1: Interactive Animation pain data for all subjects (n=51).*

Interactive Animation Item		M	SD	N Choosing Item (%)
1.	Throbbing	17.59	27.01	17 (33.3%)
2.	Hot-Burning	17.86	24.26	21 (41.2%)
3.	Piercing	22.20	31.79	18 (35.3%)
4.	Pressure	39.08	32.91	36 (70.6%)
Total Score (Based on items 1 to 4)		45.38	26.54	51 (100 %)
VAS (Scored 1 to 100)		50.63	24.33	51 (100 %)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

agreement is greater than or equal to chance agreement, $k \geq 0$). Kappa was computed for each pair of analogous measures: (a) Throbbing: $k = .57$, 80.39% agreement, (b) Burning: $k = .67$, 84.31% agreement, (c) Piercing: $k = .63$, 80.39% agreement, and (d) Pressure: $k = .61$, 84% agreement. According to Fleiss (1981), when the value of kappa is between .40 and .75 (as the obtained values are), it indicates "fair to good agreement beyond chance" (p. 218).

Pain data. Mean scores for the Modified SF-MPQ (including sensory, affective and total pain scores, as well as the Present Pain Index) and IA (including total score) are presented in Tables 1 and 2. Figures 9 and 10 give a graphical presentation of analogous Modified SF-MPQ and IA items.

Session 2: Modified SF-MPQ and IA Pain Data

Frequency of responses to pain items. The frequency of responses to the Modified SF-MPQ and IA on analogous descriptors (i.e. Throbbing, Burning, Piercing and Pressure) as well as VAS ratings are presented in Figures 11 to 15. Again, the continuously scaled IA data is divided into categories that are labelled "Mild," "Moderate" and "Severe" pain, based on the method suggested by Cleeland (1996) and Serlin, Mendoza, Nakamura, Edwards and Cleeland (1995).

Figure 9(a). Session 1: Analogous Modified SF-MPQ and IA mean pain scores for all subjects (including those who did *not* choose items thus scoring "zero").

Figure 9(b). Session 1: Analogous Modified SF-MPQ and IA mean pain scores for subjects actually *choosing* those items.

Figure 10. Session 1: Modified SF-MPQ and IA VAS mean scores for overall pain.

Figure 11. Session 2: Distribution of Modified SF-MPQ and IA Throbbing scores.

Figure 12. Session 2: Distribution of Modified SF-MPQ and IA Burning scores.

Figure 12. Session 2: Distribution of Modified SF-MPQ and IA Piercing scores.

Figure 14. Session 2: Distribution of Modified SF-MPQ and IA Pressure scores.

Figure 15. Session 2: Distribution of Modified SF-MPQ and IA VAS scores.

Pain descriptors chosen. Chi-square analyses revealed no significant differences in the proportions of individual subjects choosing analogous items from the Modified SF-MPQ and IA. See Tables 3 and 4 for a presentation of numbers of subjects choosing each descriptor. Once again kappa was computed for each pair of analogous measures: (a) Throbbing: $\kappa = .68$, 85% agreement, (b) Burning: $\kappa = .80$, 90% agreement, (c) Piercing: $\kappa = .57$, 85% agreement, and (d) Pressure: $\kappa = 1.0$, 100% agreement. According to Fleiss (1981), these values indicate "good" to "excellent" agreement beyond chance.

Pain data. Mean scores for the Modified SF-MPQ (including sensory, affective and total pain scores, as well as the Present Pain Index) and IA (including total score) are presented in Tables 3 and 4. Figures 16 and 17 give a graphical presentation of analogous Modified SF-MPQ and IA items.

Concordance Between the Modified SF-MPQ and IA During Session 1

Pearson product-moment correlations were computed on all Modified SF-MPQ pain words and analogous IA pain qualities, in order to assess the correspondence between the two measures during Session 1 (see Table 5). All analogous items were significantly correlated.

TABLE 3 Session 2: Modified Short-Form McGill pain data for retested subjects (n=20).*

Modified Short-Form McGill Item		M	SD	N Choosing Item (%)
1.	Throbbing	.55	.83	8 (40.0%)
2.	Shooting	.85	1.27	7 (35.0%)
3.	Stabbing	.15	.49	2 (10.0%)
4.	Sharp	1.35	1.23	13 (65.0%)
5.	Cramping	.40	.82	4 (20.0%)
6.	Gnawing	.40	.75	5 (25.0%)
7.	Hot-Burning	1.10	1.17	11 (55.0%)
8.	Aching	1.55	1.05	15 (75.0%)
9.	Heavy	1.05	1.15	10 (50.0%)
10.	Tender	1.70	1.08	16 (80.0%)
11.	Splitting	.55	1.05	5 (25.0%)
12.	Tiring-Exhausting	1.75	1.16	15 (75.0%)
13.	Sickening	.70	1.08	7 (35.0%)
14.	Fearful	1.05	1.28	9 (45.0%)
15.	Punishing-Cruel	1.30	1.26	12 (60.0%)
16.	Piercing	.50	1.00	5 (25.0%)
17.	Pressure	1.65	1.14	15 (75.0%)
Sensory Score (Based on items 1 to 11)		1.95	.63	20 (100 %)
Affective Score (Based on items 12-15)		1.80	.97	17 (85.0%)
Total Score (Based on items 1 to 15)		1.96	.61	20 (100 %)
VAS (Scored 0 to 100)		60.80	25.41	20 (100 %)
Present Pain Index (Scored 0 to 5)		2.05	1.64	15 (75.0%)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

TABLE 4 Session 2: Interactive Animation pain data for retested subjects (n=20).*

Interactive Animation Item	M	SD	N Choosing Item (%)
1. Throbbing	21.45	30.67	7 (35%)
2. Hot-Burning	22.15	29.54	9 (45%)
3. Piercing	8.50	19.10	4 (20%)
4. Pressure	47.20	34.50	15 (75%)
Total Score (Based on items 1 to 4)	46.97	28.38	20 (100%)
VAS (Scored 1 to 100)	54.65	28.43	20 (100%)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

TABLE 5 Session 1: Correlation coefficients between analogous Modified SF-MPQ and IA items for all subjects (n=51).

Item/Pain Quality	r	p
1. Throbbing	.54	< .001
2. Hot-Burning	.72	< .001
3. Piercing	.74	< .001
4. Pressure	.36	< .010
VAS	.84	< .001

Figure 16(a). Session 2: Analogous Modified SF-MPQ and IA mean pain scores for all subjects (including those who did *not* choose items thus scoring "zero").

Figure 16(b). Session 2: Analogous Modified SF-MPQ and IA mean pain scores for subjects actually *choosing* those items.

Figure 17. Session 2: Modified SF-MPQ and IA VAS scores.

**Prediction of the Difference Between Modified SF-MPQ Scores
and IA Scores During Session 1**

Although the analogous pain items from the Modified SF-MPQ and IA are significantly correlated (see section entitled **Concordance Between the Modified SF-MPQ and IA During Session 1**, p. 57), and a visual examination of the response distributions of the two measures reveal that they appear very similar (see Figures 11 to 14), it is still interesting to investigate whether or not any subject characteristics are capable of predicting the difference between the two measures. In order to analyze the difference between the Modified SF-MPQ and IA during Session 1, the data were transformed into z-scores. It was necessary to standardize the distribution of the two measures because the Modified SF-MPQ and IA use different scales to quantify responses. A z-transformation gives both measures a mean of zero and a standard deviation of one (z-score), thus allowing for direct comparison (Vogt, 1993).

Separate stepwise linear regression analyses were conducted with the z-transformed difference scores for Throbbing, Burning, Piercing and Pressure as the dependent variables. The predictor variables were: age, SMMSE total score, presence or absence of a cerebrovascular accident, and preference for one measure over another (see section entitled **Preference for Type of Pain Measure**, pp. 77-78) for a complete description of preference data). None of these variables predicted the difference between the Modified SF-MPQ and IA versions of Throbbing, Burning and Piercing or Pressure.

Comparison to Swanston et al. (1993) Data

Swanston et al. (1993) were not able to compare all IA pain qualities with their matching SF-MPQ counterparts, because their scale did not include two of the necessary descriptors (i.e. pressure and piercing). The Modified SF-MPQ includes the missing words (which are, in fact, part of the original MPQ). Swanston et al. (1993) *did* report a significant and substantial correlation between the paper and computer versions of the VAS ($r=.88$), but they did not describe the relationships between their other matching pain qualities (i.e. burning and throbbing). Correlations from the Swanston et al. (1993) study are reproduced in Table 6.

A mean IA Total score was computed by averaging the four IA qualities of pain (i.e. Pressure, Burning, Throbbing, and Piercing) chosen by each patient (as suggested by Swanston et al., 1993). A "Sensory" dimension score was obtained by summing the scores from the first 11 items on the Modified SF-MPQ for each patient, and an "Affective" dimension score was obtained by summing the scores of the last four items on the Modified SF-MPQ (as suggested by Melzack, 1987).

Correlations from the present study that are based on the same pain dimensions those presented by Swanston et al. (1993) appear in Table 7. Cohen and Cohen (1981) suggest that Fisher's z transformation should be used to produce data for testing the difference between correlation coefficients (see Appendix O for the formula to compute

TABLE 6 Swanston et al. (1993) study: Correlation coefficients between measures obtained with all patients on the SF-MPQ and IA (n=50). Table includes SF-MPQ Sensory Dimension (SF-MPQ items 1 to 11) and SF-MPQ Affective Dimension (SF-MPQ items 12-15).

	SF-MPQ Sensory	Affect	VAS	PPI	IA Tot
SF-MPQ Affective	.56**				
SF-MPQ VAS	.39**	.43**			
SF-MPQ Present Pain Index	.35**	.47**	.64**		
IA Total	.30*	.39**	.57**	.48**	
IA VAS	.43**	.41**	.88**	.60**	.66**

Note. From "Pain assessment with interactive computer animation" by Swanston et al., 1993, *Pain*, 53, p.350. Reprinted with permission.

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

TABLE 7 Session 1: Correlation coefficients between measures obtained with all patients on the SF-MPQ and IA in the present study (n=51). Table includes SF-MPQ Sensory Dimension (SF-MPQ items 1 to 11) and SF-MPQ Affective Dimension (SF-MPQ items 12-15).

	SF-MPQ Sensory	Affect	VAS	PPI	IA Tot
SF-MPQ Affective	.49***				
SF-MPQ VAS	.63***	.37**			
SF-MPQ Present Pain Index	.32*	.22	.20		
IA Total	.46***	.33*	.47***	.33*	
IA VAS	.65***	.44**	.84***	.20	.45*

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

the normal curve deviate, and Table P-1 for the values of z obtained for this comparison). Any resulting value that does not meet the two-tailed alpha criterion of .05 (i.e. $z < 1.96$) is considered non-significant. No significant differences were found between the correlations reported by Swanston et al. (1993) and the correlations from the present study, with two exceptions: correlations between the Modified SF-MPQ Present Pain Index (PPI) and both versions of the VAS were more highly correlated in the data of Swanston et al. (1993) than the data from the present sample of older patients. Swanston et al. (1993) did not report mean PPI scores, therefore, it is impossible to compare the two samples on their level of "current" pain. It is probable, however, that since Swanston et al. (1993) only assessed subjects for pain that they were experiencing at that particular moment in time (rather than the procedure utilized in this study which allowed for the measurement of "usual" pain), that differences in the PPI scores of the two groups could explain the differences in correlations with the VAS.

Concordance Between the Modified SF-MPQ and IA During Session 2

Pearson product-moment correlations were computed on all Modified SF-MPQ pain words and analogous IA pain qualities, in order to assess the correspondence between scores on the two measures during Session 2 (see Table 8). All analogous items were highly and significantly correlated (in the range of .64 to .93).

TABLE 8 Session 2: Correlation coefficients between analogous Modified SF-MPQ and IA items for retested subjects (n=20).

Item/Pain Quality	r	p
1. Throbbing	.64	< .010
2. Hot-Burning	.86	< .001
3. Piercing	.80	< .001
4. Pressure	.93	< .001
Visual Analogue Scale for Overall Pain	.85	< .001

Correlations from the present study that use the same pain dimensions as those used by Swanson et al. (1993) are presented in Table 9. All pairs of items are significantly correlated with the exception of the Present Pain Index and the Modified SF-MPQ version of the VAS (as in Session 1), and the Present Pain Index and the Total IA score (which had a low but significant correlation during Session 1).

Agreement Between Session 1 and Session 2 Pain Measures

Fisher's z transformation was used, once again, in order to produce the data to test the difference between correlation coefficients obtained during Session 1 (between the Modified SF-MPQ and IA) and correlation coefficients obtained during Session 2 (see Appendix O for the formula to compute the normal curve deviate, and Table O-2 for the values of z obtained for this comparison). Two correlations were significantly greater

TABLE 9 Session 2: Correlation coefficients between measures obtained with all patients on the SF-MPQ and IA (n=20). Table includes SF-MPQ Sensory Dimension (SF-MPQ items 1 to 11) and SF-MPQ Affective Dimension (SF-MPQ items 12-15).

	SF-MPQ Sensory	Affect	VAS	PPI	IA Tot
SF-MPQ Affective	.80***				
SF-MPQ VAS	.74***	.67**			
SF-MPQ Present Pain Index	.53**	.48*	.32		
IA Total	.49*	.38*	.38*	.12	
IA VAS	.81***	.68***	.85***	.58**	.44*

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

during Session 2 than Session 1: the Modified SF-MPQ and IA versions of Pressure, and the Sensory and Affective dimensions of the Modified SF-MPQ. All other possible pairs of correlations were not significantly different between the two assessment sessions.

Absolute difference scores between Session 1 and Session 2 were computed for both the Modified SF-MPQ and IA versions of Throbbing, Burning, Piercing and Pressure. Separate stepwise linear regression analyses were conducted with these difference scores as the dependent variables, and age, SMMSE total, and time elapsed between the two assessments ($M=76.60$ days, $SD=127.98$) as the predictor variables. The SMMSE total score was the only predictor of the Modified SF-MPQ version of Burning ($r=.53$, $F=7.15$, $p<0.05$) and the IA version of Burning ($r=.70$, $F=17.02$, $p<.001$). In both cases the higher the SMMSE, the lower the difference between

Session 1 and Session 2 correlations. No other differences between Session 1 and Session 2 pain qualities could be predicted.

How Well Do the Modified SF-MPQ and IA Detect Changes in Pain over Time?

In order to investigate the ability of the new pain measure (i.e. IA) to detect changes in pain over time in a manner similar to the traditional pain measure (i.e. the Modified SF-MPQ) with older adult patients, correlations were computed on the absolute difference scores (i.e. between Session 1 and Session 2) of each pain quality, as well as the VAS (see Table 10). Difference scores for the Modified SF-MPQ were significantly correlated with IA difference scores for every pain quality except Pressure.

In order to further explore the relationship between the two measures as indicators of change in pain over time, an *a priori* designation was made concerning the expected "Low" and "High" pain sessions of each subject. It is known that pain fluctuates over time, and this fluctuation may be associated with, for example: time of day, type of therapy, and length of time in treatment (Jensen & McFarland, 1993). Sessions 1 and 2 were not consistently associated with times of "Lower" and "Higher" presumed pain intensity, therefore, retested subjects' assessment sessions were categorized as "Low" or "High" on a case-by-case basis. Only 15 of the 20 retested subjects fit the *a priori* designation for times of "lower" and "higher" presumed pain intensity times (the other

TABLE 10 Correlation coefficients of difference scores (Session 1 versus Session 2) between analogous Modified SF-MPQ and IA items for retested subjects (n=20).

Item/Pain Quality	r	p
1. Throbbing	.42	< .050
2. Hot-Burning	.66	< .010
3. Piercing	.47	< .050
4. Pressure	.02	NS
Visual Analogue Scale for Overall Pain	.49	< .050

five subjects experienced pain fluctuations that were too unstable to categorize). Most of these "designated" subjects (n=8, 53.3%) were identified through self-report and medical staff opinion as having fluctuations due to time of day. Five subjects (33.3%) had a change in medical condition, and the remaining 2 subjects (13.3%) generally felt less pain immediately after a physiotherapy session.

A repeated measures analysis of variance (ANOVA) was computed on each pair of analogous pain items (as assessed by Modified SF-MPQ and IA), as well as both versions of the VAS, separately. That is, each pain quality was examined by means of an ANOVA with two within-subject factors: Time (two levels: "lower" and "higher" presumed pain intensity), and Measure (Modified SF-MPQ and IA). The means (and SDs) for each pain quality (as measured by the Modified SF-MPQ and IA) at each designated Time (i.e. "lower" and "higher" presumed pain intensity) are presented in Table 11.

TABLE 11 Mean pain scores at "Lower Presumed Pain" and "Higher Presumed Pain" times, as measured by the Modified SF-MPQ and IA (n=15).

Item/Pain Quality	Lower Presumed Pain		Higher Presumed Pain	
	SF-MPQ M (SD)	IA M (SD)	SF-MPQ M (SD)	IA M (SD)
1. Throbbing	.47 (.64)	16.93 (23.63)	.80 (1.08)	21.60 (32.62)
2. Hot-Burning	.73 (.88)	13.40 (19.90)	.87 (1.06)	22.27 (32.81)
3. Piercing	.67 (.98)	7.67 (17.60)	.93 (1.03)	14.73 (21.32)
4. Pressure	1.53 (.92)	38.13 (25.24)*	1.87 (0.99)	61.07 (29.55)*
VAS	46.80 (15.16)	45.00 (22.96)	71.53 (20.68)	65.07 (21.34)

* Different at $p < 0.01$

The pain qualities Throbbing, Burning, and Piercing showed similar results, that is, no significant main effect for Time, and no significant Time by Measure interaction. In other words, neither measure detected a significant change in pain over time.

The ANOVA for Pressure revealed a significant main effect for Time (i.e. taken together, the pain measures were able to detect a change in reported pain in the expected direction: $F=11.35$, $df=1,14$, $p<0.001$), as well as a significant Time by Measure interaction ($F=11.91$, $df=1,14$, $p<0.01$). *Post hoc* tests reveal that only IA (and not the Modified SF-MPQ) was significantly different over time, that is, only IA was able to detect a change in pressure pain over time ($t=3.41$, $df=14$, $p<0.01$).

The ANOVA on VAS scores produced a significant main effect for Time (i.e. taken together, the two versions of the VAS were able to detect a change in reported pain in the expected direction: $F=33.89$, $df=1,14$, $p<0.001$), but there was no significant effect for Measure, nor was there a significant Time by Measure interaction. In other words, both versions of the VAS showed a significant change in overall pain over time; however, the paper-and-pencil version of the test did not yield significantly different results from its animated counterpart.

Single Versus Multiple Choices of Interactive Animation Items

Separate analyses were conducted to look at the differences between subjects choosing multiple pain qualities as assessed by IA, versus only one (see Table 12 for a presentation of the number of IA items chosen by subjects). Swanston et al. (1993) suggested that this could be an important factor in the relationship between IA scores and the Sensory and Affective dimensions of pain, as reflected by the Modified SF-MPQ. Preliminary work done by Swanston et al. (1993) suggested that subjects choosing only one pain quality have a different pattern of results than subjects choosing multiple pain qualities. Specifically, they found that the Sensory scale of the SF-MPQ was not correlated with the Affective scale, the VAS, the PPI, or mean IA scores, for single-choice subjects, while such a correlation was shown for multiple-choice subjects; Swanston et al., 1993).

TABLE 12 Session 1: Number of Interactive Animation items chosen by subjects.

Number of IA Items Chosen	Number (%) of Subjects
None	7 (13.7%)
One	14 (27.5%)
Two	15 (29.4%)
Three	12 (23.5%)
Four	3 (5.9%)

Pearson product-moment correlations were computed on all Modified SF-MPQ pain words and analogous IA pain qualities for both the "Single IA Choice" group, and the "Multiple IA Choice Group" (see Table 13). In the "Single IA Choice" group Throbbing was not chosen by any subject, the analogous items for Burning and Piercing were significantly correlated, and the analogous measures for Pressure were not significantly correlated. In the "Multiple IA Choice" group the analogous items for Throbbing, Burning and Piercing were significantly correlated, and (similar to the "Single IA Choice" group) the analogous measures for Pressure were not significantly correlated.

Correlations from the "Single IA Choice" group and the "Multiple IA Choice" group from the present study that are based on the same pain dimensions as Swanson et al. (1993) are presented in Tables 14 and 15.

TABLE 13 Session 1: Correlation coefficients between analogous Modified SF-MPQ and IA items for subjects choosing only one IA item (Single IA Choice Group: $n=14$), as well as subjects choosing more than one IA item (Multiple IA Choice Group: $n=30$).

Item/Pain Quality		Single IA Choice Group		Multiple IA Choice Group	
		r	p	r	p
1.	Throbbing	---	---	.36	$p < .050$
2.	Hot-Burning	.88	$p < .001$	.60	$p < .001$
3.	Piercing	.62	$p < .010$	.72	$p < .001$
4.	Pressure	.17	NS	.15	NS

TABLE 14 Session 1: Correlation coefficients between measures obtained with "Single IA Choice" subjects on the SF-MPQ and IA (n=14). Table includes SF-MPQ Sensory Dimension (SF-MPQ items 1 to 11) and SF-MPQ Affective Dimension (SF-MPQ items 12-15).

	SF-MPQ Sensory	Affect	VAS	PPI	IA Tot
SF-MPQ Affective	.18				
SF-MPQ VAS	.65**	.65**			
SF-MPQ Present Pain Index	.36	.28	.51*		
IA Total	.77**	.21	.70**	.73**	
IA VAS	.64**	.72**	.94***	.44	.56*

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

TABLE 15 Session 1: Correlation coefficients between measures obtained with "Multiple IA Choice" subjects on the SF-MPQ and IA (n=30). Table includes SF-MPQ Sensory Dimension (SF-MPQ items 1 to 11) and SF-MPQ Affective Dimension (SF-MPQ items 12-15).

	SF-MPQ Sensory	Affect	VAS	PPI	IA Tot
SF-MPQ Affective	.40				
SF-MPQ VAS	.51**	.15			
SF-MPQ Present Pain Index	.27	.15	.03		
IA Total	.56**	.29	.53**	.07	
IA VAS	.60***	.22	.78***	.02	.44**

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Fisher's z transformation was used in order to produce the data to test the difference between correlation coefficients obtained from the two "Choice" groups (see Appendix O for the formula to compute the normal curve deviate, and Table O-3 for the values of z obtained for this comparison). Of the analogous pain items from the two measures, only one correlation (i.e. Burning) was significantly different between the two groups, that is, the correlation of the Modified SF-MPQ and IA versions of Burning was significantly higher for the "Single IA Choice" group than for the "Multiple IA Choice" group. When using the same pain dimensions utilized by Swanson et al. (1993) only two correlations were significantly different between the two groups: the Modified SF-MPQ Affective dimension and the IA VAS, as well as the Modified SF-MPQ Present Pain Index and the IA Total score. In both cases, the correlations were higher for the "Single IA Choice" group than the "Multiple IA Choice" group. All other possible pairs of correlations were not significantly different between the two "Choice" groups.

A logistic regression analysis with "Single IA Choice" versus "Multiple IA Choice" as the dichotomous dependent variable, revealed no significant predictors when age, cognitive function (as measured by the SMMSE), and overall pain (as measured by the IA version of the VAS) were used as independent variables ($p > 0.05$).

Predictors of Overall Pain

Stepwise linear regression analyses employing the various pain items as predictors were conducted in order to examine the predictors of overall pain as assessed by both versions of the VAS (Modified SF-MPQ and IA) during Session 1. When all Modified SF-MPQ Items were used as predictors of overall pain as assessed by the paper-and-pencil version of the VAS, two items accounted for approximately 51% of the variance (Sharp and Heavy: $r=.71$, $F=22.78$, $p<0.001$). Sharp was the first, and most important predictor of overall pain: Heavy only added about 1% to the total variance accounted for. When the list of variables was restricted to those items that are analogous to IA items, only Piercing emerged as a predictor of overall pain ($r=.55$, $F=20.63$, $p<0.001$). Similarly, when IA items were used to predict overall pain as measured by the computerized version of the VAS, Piercing was the only variable to enter the equation ($r=.40$, $F=8.96$, $p<0.01$). All items were correlated positively with overall pain.

Categorization of pain by "system" (as opposed to, for example, "area of body," and "duration") is a notion adapted from the taxonomy of chronic pain developed by the International Association for the Study of Pain (Merskey, 1986). Separate analyses were conducted for the two major "systems" of pain reported in this sample, that is: (a) musculoskeletal pain involving disease or injury to bones, joints and tendons ($n=30$), and (b) pain arising from the nervous system, for example, deafferentation pain following

a cerebrovascular accident, and Peripheral Neuropathy ($n=14$). The pattern of results for the prediction of overall pain using Modified SF-MPQ items and IA items within each pain "system" group is very similar. In every case where a predictor emerged, Piercing was associated with overall pain (see Table 16).

TABLE 16 Session 1: Results of stepwise linear regression analyses for prediction of overall pain by Modified SF-MPQ VAS and IA VAS, within two pain groups (Musculoskeletal and Nervous System).

	MUSCULOSKELETAL PAIN ($n=30$)	NERVOUS SYSTEM PAIN ($n=14$)
Predict SF-MPQ VAS from Analogous SF-MPQ Items	PIERCING $r=0.51$ $F=9.89$ $p<.010$	PIERCING $r=.70$ $F=13.11$ $p<.010$
Predict IA VAS from IA Items	NO PREDICTORS	PIERCING $r=.55$ $F=6.09$ $p<.050$

Preference for Type of Pain Measure

Subjects were asked whether or not they liked each of the five IA images (that is, did they seem to represent the qualities of pain that they were supposed to), and whether

or not each of those images was easy to use (in terms of understanding how it could be manipulated to represent the quality of their own pain experience). Their opinions are presented in Table 17. Subjects were also asked whether or not they preferred the Modified SF-MPQ or IA as a pain assessment tool. Almost half of the sample ($n=24$, 47.1%) had a clear preference for IA as a method of reporting pain. Only 8 subjects (15.7%) preferred to use the Modified SF-MPQ, and the remaining 19 subjects (37.3%) had no preference for one measure over another. Of the 32 subjects with a preference, therefore, 75% chose IA over the Modified SF-MPQ.

Univariate analyses (t-tests for continuous variables and chi-square tests for categorical variables) were conducted to see if preference for the Modified SF-MPQ or IA was associated with age, SMMSE, diagnosis related to pain, number of IA pain qualities chosen, and overall pain as measured by both versions of the VAS (see Table 18). Had there been any indication of a relationship between preference for measure and any of the variables described, it would then have been interesting to look at all the variables together in a multivariate way (through logistic regression) in order to ascertain the contribution of each factor to overall preference. However, none of these variables were individually associated with preference for one pain measure over another.

TABLE 17 Session 1: Frequency of opinions concerning "Likeability" and "Ease of Use" of Interactive Animation items.

	"Like" Image n (%)	"Easy" to Use n (%)
THROBBING	YES n=36 (70.6%) NO n=5 (9.8%) NO OPINION n=10 (19.6%)	YES n=12 (23.5%) NO n=1 (2%) DID NOT USE n=30 (58.8%) NO OPINION n=8 (15.7%)
BURNING	YES n=39 (76.5%) NO n=3 (5.9%) NO OPINION n=9 (17.6%)	YES n=15 (29.4%) NO n=0 DID NOT USE n=26 (51%) NO OPINION n=10 (19.6%)
PIERCING	YES n=36 (70.6%) NO n=5 (9.8%) NO OPINION n=10 (19.6%)	YES n=12 (23.5%) NO n=2 (3.9%) DID NOT USE n=28 (54.9%) NO OPINION n=9 (17.6%)
PRESSURE	YES n=37 (72.6%) NO n=7 (13.7%) NO OPINION n=7 (13.7%)	YES n=21 (41.2%) NO n=1 (2%) DID NOT USE n=20 (39.2%) NO OPINION n=9 (17.6%)
VAS	YES n=38 (74.5%) NO n=1 (2%) NO OPINION n=12 (23.5%)	YES n=33 (64.7%) NO n=2 (3.9%) DID NOT USE n=0 NO OPINION n=16 (31.4%)

TABLE 18 Session 1: Comparison of subjects who preferred the Modified SF-MPQ (n=8) to subjects who preferred IA (n=24). All differences are non-significant ($p > 0.05$).

	Preferred SF-MPQ (n=8)	Preferred IA (n=24)
	M (SD)	M (SD)
Age	77.14 (SD = 8.97)	76.57 (SD = 7.72)
SMMSE	26.25 (SD = 3.11)	25.92 (SD = 3.84)
Number of IA Items Chosen	1.13 (SD = 0.84)	1.88 (SD = 1.23)
SF-MPQ VAS	56.50 (SD=22.91)	53.88 (SD=26.89)
IA VAS	48.43 (SD=24.87)	50.78 (SD=24.41)
	n (%)	n (%)
Pain System:		
Musculoskeletal	5 (62.5%)	15 (62.5%)
Nervous System	3 (37.5%)	9 (37.5%)

Discussion

The results of this study clearly indicate that older subjects are able to use Interactive Computer Animation as a self-report method of pain measurement, in a way that is valid when compared to a current "Gold Standard" of pain assessment: the Short-Form McGill Pain Questionnaire. It is also evident that older subjects respond in ways similar to younger subjects, when using IA to assess pain. As well, IA was preferred by a majority of subjects over the SF-MPQ. These findings clear the way for the evaluation of IA in patient populations where such a technique may be of the most use; that is, where other types of self-report pain measures are not suitable.

Description of Pain Intensity in this Sample

The pain levels reported by this sample indicate that subjects were experiencing clinically significant levels of pain and that the "quality" of the pain being experienced varied across patients. While Figure 8(a) presents the mean analogous pain scores for the Modified SF-MPQ and IA, it indicates deceptively low levels of average pain related to each "quality" assessed: Throbbing, Burning, Piercing and Pressure. Figure 8(b) is a more accurate portrayal of the pain levels actually experienced by these subjects because it is limited to only those patients who chose any given "quality." It would not be reasonable to expect to describe any given pain experience with all four qualities

presented (in other words, if one has pain from neuralgia it may be scored "zero" on all qualities except burning which may require an extremely high score).

When assessing the accuracy of a measure it is as important to detect "no pain" as it is to detect any other level of pain. However, for the purposes of quantifying the pain of an individual or a sample with a multidimensional technique, it is important to make sure that pain levels are not diluted by low scores from inappropriate items. If the "worst" (i.e. highest, pain score were selected from the 17 items of the Modified SF-MPQ and the 4 items of the IA, the average levels of pain intensity would be 2.37 ($SD=0.72$) and 52.69 ($SD=30.40$) respectively, both in the high moderate range.

Currently IA is limited to the extent that it only portrays four "qualities" of pain, compared to the 15 items normally contained in the SF-MPQ (increased to 17 items for the purposes of this study), and the 78 items of the Long-Form MPQ. Interestingly, the four "qualities" depicted by IA are among the most popular Modified SF-MPQ items chosen by subjects in this sample (see Table 1). Pressure (chosen by 74.5% of the current sample) was second only to Aching (chosen by 76.5% of the sample) as the most popular single pain descriptor. Although Aching would undoubtedly be a valuable addition to IA, it is unclear how such a concept could be translated into a graphic image. Piercing was the fifth most popular sensory item (chosen by 45.1% of the sample), followed by the sixth (Burning) and seventh (Throbbing) most popular items (chosen by 41.2% and 37.3% of the sample, respectively).

Fernandez and Towery (1996) have suggested that approximately 40% of the descriptors currently employed in the Long Form of the MPQ could be eliminated on the basis of ambiguity of meaning or infrequency of use. The four qualities of pain portrayed by IA are included in this streamlined version of the MPQ, and they are among the most frequently chosen items: Throbbing (80%), Burning (96%), Piercing (50%), and Pressure (90%) (Fernandez and Towery, 1996).

Concordance Between the Modified SF-MPQ and IA

The basic tenet of this thesis is that by demonstrating the concurrent validity of IA with a measure that has well established reliability and validity (such as the Short Form McGill Pain Questionnaire), then IA will also be able to claim validity as a measure of self-reported pain. In other words, it will be assumed that IA is tapping into the same constructs as the SF-MPQ. Concordance between IA and the Modified SF-MPQ was demonstrated in three ways: (1) comparison of the frequency of items chosen (and their severity) from both measures, (2) correlation between analogous items on both measures, and (3) attempted prediction of the difference between the two measures.

In comparing the frequency of items chosen on each of the two measures, tests of proportions (chi-square analysis) and interrater agreement (kappa) revealed that subjects' choice of descriptors was consistent across the Modified SF-MPQ and IA. Although the two measures are scaled differently (the categorical scale of the Modified

SF-MPQ ranges from 0 to 3, while the continuous scale of IA ranges from 1 to 100) it was possible to impose categories on IA scores (as suggested by Cleeland, 1996 and Serlin, Mendoza, Nakamura, Edwards and Cleeland, 1995). A visual inspection of Figures 3 to 7 suggests that, even though IA was not designed to produce data that could be classified as "Mild," "Moderate" and "Severe," when such a classification is imposed there is a clear correspondence between the severity levels of the analogous items of the two measures.

Correlation coefficients between analogous items on the measures ranged from $r = .36$ (for Pressure) to $r = .84$ (for the Visual Analogue Scales). All five correlations indicated moderate to strong agreement between the Modified SF-MPQ and IA. The fact that the VAS demonstrates the highest obtained correlation is not surprising because of the nature of that particular item. Both versions of the VAS present a line with the anchors "No Pain" and "Worst Possible Pain" at opposite ends. Both versions are scored on a 100-point scale and are presented to the subject as a way to gauge "overall" pain. The only differences between the two versions of the VAS are the medium of the presentation (paper versus screen), and the mode of interaction (pencil versus keyboard). The high correlation between these versions of the VAS is strong evidence for the "transferability" of pain measures from traditional formats to the more unorthodox display of the computer. This is a particularly important "feasibility" finding in this study, where the subjects are representative of an older age group which has had much less exposure to computers and related technology (Shneiderman, 1992).

All correlations between analogous items are *highly* significant, with the exception of Pressure ($r=.36$) which is still significant but considered in the more "Moderate" range (Cohen, 1988). It is possible to speculate that the particular image of pressure used in IA (i.e. a ball in the jaws of a vise) is so concrete that it may evoke a slightly different response from subjects, than simply the word "Pressure." If one is distracted by the image of a *ball* being squeezed (which could easily be taken to be a head), rather than the general concept of pressure which could apply to any area of the body, then it is possible that subjects would respond to the two measures in somewhat disparate ways.

On the other hand, the word "Pressure" may evoke other tangential notions (e.g. pressure as psychological strain) that are not strictly intended by the questionnaire. In fact *any* SF-MPQ pain descriptor may generate alternate ideas in the mind of a subject; it is only because there is a slightly lower correlation of the Pressure items that such an explanation is explored. It is impossible to judge which measure is best at getting at the subjects' "real" experience of pain as pressure; however, it can be speculated that it may be easier to judge responses to a picture rather than a word (with all of the inherent difficulties in interpretation and understanding that go along with language). It should also be remembered that when subjects respond to the list of descriptors in the Modified SF-MPQ, they are not given any definitions to elucidate the meanings of these words. With IA, subjects hear the word "Pressure" (as in, "sometimes pain feels like pressure") and then they are confronted by an image of pressure. IA attempts to provide constant visual input as subjects make their judgements, in a way, levelling the linguistic playing

field that the Modified SF-MPQ provides. Until investigators can find a way to separate the verbal descriptor from its visual counterpart, it will be difficult to determine the proportion of variance that is unique to each form of measurement and the proportion of variance that is common to both measures.

Three variables were chosen as potential predictors of the difference between z-transformed Modified SF-MPQ scores and IA scores: age, SMMSE Total score, the presence or absence of a cerebrovascular accident, and preference for one measure over another. All four potential predictors were selected for theoretical reasons that have to do with hypothesized influences on ability to process IA images. Both age and cognitive ability (as assessed by the SMMSE and possibly complicated by the negative affects of a stroke) have been implicated in the diminished ability of (some) older persons to give accurate self-reports (Ross & Crook, 1995). Preference may also influence the way in which pain measures are used. A strong preference for one technique over another may indicate the inability or unwillingness of a subject to use one of the assessment devices in a valid way (similarly, the successful use of a map-like learning aid in older subjects is related to how much maps were used successfully in the past and, therefore "liked," by subjects: Caplan and Lipman, 1995).

In the end, none of these variables (i.e. age, SMMSE Total score, the presence or absence of a cerebrovascular accident, and preference for one measure over another) predicted the difference between The Modified SF-MPQ and IA versions of Throbbing,

Burning, Piercing or Pressure. Although the subjects in this sample were screened for severe cognitive impairments, they did represent a significant range of cognitive abilities. Six subjects had SMMSE Total scores that were less than or equal to 21 (the lowest score being 17) which is considered "poor" cognitive functioning (Launer, Dinkgreve, Jonker, Hooijer and Lindeboom, 1993). Twelve subjects were considered "borderline" in terms of cognitive function, and the remaining 33 subjects were "adequate."

Three times as many subjects preferred IA ($n=24$) as preferred the Modified SF-MPQ ($n=8$). Age and cognitive function failed to predict who would prefer one pain measure over another, as did overall pain ratings (as assessed by both versions of the VAS), pain "system" (musculoskeletal versus nervous system), and the number of IA items chosen (a potential indicator of how much subjects identified with the computerized pain measure and, therefore, preference). In any case, preference for the Modified SF-MPQ or IA was not related to the difference between the two measures. Also, preference for one type of measure was not related to the order in which the SF-MPQ and IA were presented to the subject ($X^2=1.52$, $df=1$, $p>0.05$).

Taken together, the data indicate that IA demonstrates good concurrent validity with the Modified SF-MPQ as a measure of various pain qualities in a sample of older subjects who were patients at a chronic care and rehabilitation hospital. Another question, then, concerns whether or not the concordance between the two measures demonstrated in this study and with this particular sample of subjects, is comparable to

the concordance between the two measures exhibited by a sample of younger subjects from a general pain clinic (Swanston et al., 1993).

Comparison of the Present Study to the Swanston et al. (1993) Study

As mentioned earlier, there is only one published study (to date) which uses a version of IA as a measure of pain (Swanston et al., 1993). The results from the present study were compared to the Swanston et al. (1993) study, by using Fisher's z transformation to provide the data to test the difference between correlation coefficients (Cohen and Cohen, 1981). The size of sample used in the Swanston et al. (1993) study ($N=50$) is comparable to the size of sample used in the present study ($N=51$). Only two significant differences were found between the Swanston et al. (1993) study and the present study, and they both pertained to the Present Pain Index (which did not correlate with either version of the VAS). The fact that the failure of the Present Pain Index to correlate significantly with "overall pain" is consistent across the two measures suggests that the difference between the two studies may lie with the intensity of "present pain" reported by subjects, rather than with the measures themselves.

Swanston et al. (1993) used subjects who were patients at a pain clinic, as opposed to the sample used in this study which is composed of "regular" geriatric in and out-patients attending various programs at a chronic care and rehabilitation hospital who

"happen" to have pain as part of their [usually] complex patient profiles. It is reasonable to assume that the subjects used by Swanston et al. (1993) were probably experiencing more "acute" or immediate pain than subjects used in the present study. The Swanston et al. (1993) subjects were seeking treatment to specifically alleviate their pain. The subjects in the present study may have been receiving therapy to reduce pain as a part of their overall treatment, but it was not the sole reason for their being patients at the hospital. It is difficult to draw further conclusions about the patient sample used by Swanston et al. (1993) because data were not provided concerning the Present Pain Index other than the correlations already discussed.

The other difference between the results of the two studies is evident when one inspects the actual significance levels of the correlation coefficients (see Tables 6 and 7). All of the correlations between the SF-MPQ variables (i.e. Sensory and Affective dimensions, VAS and Present Pain Index) and the IA variables (i.e. Total score and VAS) reported by Swanston et al. (1993) are significant (at least $p < 0.05$). Three of the correlations from the present study fail to reach significance, and they all contain the Present Pain Index (with the Modified SF-MPQ Affective Dimension, and both versions of the VAS). Once again, the hypothesized difference between the levels of "present pain" reported by the two samples, could explain these variations in attained significance.

It is unfortunate that Swanston et al. (1993) did not modify the SF-MPQ (as was done in the present study) in order to include the two missing descriptors from the Long

Form MPO which would be analogous to IA, that is, Piercing and Pressure. However, a direct comparison of the present study to the pain dimensions used by Swanston et al. (1993) suggests strong evidence for the comparability of results between a younger pain clinic population (average age = 55.33 years) and an older population of chronic care and rehabilitation patients (average age = 75.09). This is dramatic testimony to the ability of adults of *any* age to use IA as a valid self-report measure of pain, even when cognitive functioning is less than perfect. It remains to be seen how robust these results will be when IA is tested within a population where the cognitive deficits are more severe.

The Ability of IA to Detect Changes in Pain Over Time

In addition to establishing the validity of IA as a measure of pain with older subjects, it is also critical to examine its reliability over time and, presumably, under varying levels of pain intensity, as well as its usefulness in detecting changes in degree of pain experienced. This question is somewhat problematic in the absence of a clearly defined pain-alleviating treatment (or pain-inducing activity) that could be held constant across subjects. The subjects who made up the particular sample in this study, unlike many clinical studies, were not specifically identified as "pain" patients in their medical charts, nor were they necessarily undergoing therapy to alleviate painful conditions. This is an important qualification because it limits the ability of any measurement technique to detect changes (often in the form of expected decreases) in pain levels over time.

Given the heterogeneous nature of the pain complaints and therapeutic regimes across this sample, an attempt was made to designate times of expected "Lower" and "Higher" pain intensity in an *a priori* way. Fifteen subjects of the 20 who were retested were categorized in this way. This classification was based on information about factors that precipitated fluctuations in patients' pain, gleaned from the patients themselves as well as from medical staff.

Only small differences in pain levels were reported by subjects: therefore, mean scores for Throbbing, Burning and Piercing were not significantly different across expected "High" and "Low" pain times as assessed by both measures. Interestingly, the IA version of Pressure (and not the Modified SF-MPQ variant) *did* demonstrate a significant difference across times. The fact that IA produces continuously scaled data would automatically suggest that this measure has potential advantages over the categorical scale of the SF-MPQ in detecting changes in levels of self-reported pain intensity (McDowell & Newell, 1987). IA also has the potential to avoid another problem seen with the SF-MPQ (particularly in older subjects), and that is the reluctance of subjects to use the end-points of the scale (L. Gagliese, personal communication, August 22, 1996). It seems that there is a tendency among older subjects to use the "Moderate" rating category (perhaps, more correctly put, to avoid the use of "Mild" or "Severe") which limits the sensitivity of the SF-MPQ to reflect subtle changes in pain states. Only by measuring pain in subjects where there are expected and substantial

changes in pain over time, can the question of IA's sensitivity to different levels of pain be adequately answered (e.g. pre-post analgesic administration).

One other indication of the advantage of the IA version of Pressure to detect changes in pain over time (relative to the Modified SF-MPQ version of Pressure) is evidenced by the absence of a significant correlation between the Modified SF-MPQ difference score ("Low" presumed pain versus "High" presumed pain) and the IA difference score. Unlike Throbbing, Burning and Piercing (whose difference scores *were* correlated), the degree of separation between presumed "High" and "Low" IA scores was not related to the degree of separation between presumed "High" and "Low" Modified SF-MPQ scores. This is consistent with the hypothesis that the IA version of Pressure is more likely to detect subtle changes in pain intensity than the Modified SF-MPQ version of Pressure.

"Single IA Choice" Subjects Versus "Multiple IA Choice" Subjects

Swanston et al. (1993) noticed that the correlation between the Sensory dimension of the SF-MPQ and the IA Total score was low though significant ($r=.30$, $p<0.05$). This prompted them to divide their sample (*post hoc*) into two subgroups: subjects who chose only one IA animation and subjects who chose more than one animation. The correlation between the SF-MPQ Sensory dimension (which is based on 11 descriptors, only 2 of which are found in IA) and the IA Total score, was *not* significant for "Single

IA Choice" subjects, and was significant for "Multiple IA Choice" subjects. Swanston et al. (1993) suggested that this difference between the two subgroups might be due to the different requirements connected to verbal and visual means of self-reporting pain but they were reluctant to draw any definite conclusions based on this observation.

When the sample used in the present study was divided into subgroups based on "Single" or "Multiple" IA choice, the differences in correlations were less pronounced than the differences found by Swanston et al. (1993). In fact, the only pairs of correlations that were significantly different were the Modified SF-MPQ Affective dimension and the IA VAS, as well as the Modified SF-MPQ Present Pain Index and the IA Total score.

Swanston et al. (1993) collected no data concerning the cognitive abilities of their subjects; however, subjects in the present study were assessed for cognitive functioning using the SMMSE. There were no significant differences between the mean SMMSE scores of the "Single IA Choice" group ($M=26.14$, $SD=3.21$) and the mean SMMSE scores of the "Multiple IA Choice" group ($M=25.33$, $SD=3.66$); therefore, it would seem unlikely that level of cognitive function has an impact on the number of IA items chosen. Age and overall pain (as measured by the IA version of the VAS) also failed to predict "Single" or "Multiple" IA choice.

Unlike Swanston et al. (1993), there was a significant difference in the present study between the number of Modified SF-MPQ items chosen by the "Single IA Choice" group ($M=6.00$, $SD=2.91$), and the number of Modified SF-MPQ items chosen by the "Multiple IA Choice" group ($M=9.20$, $SD=3.16$; $t=3.21$, $df=42$, $p<0.01$). In other words, the group of subjects that chose more than one IA item also tended to choose more Modified SF-MPQ items than their "Single IA Choice" counterparts. Until more is known about the particular verbal or visual "abilities" that inform the use of *any* self-report instrument, it seems most parsimonious to conclude that some people and, perhaps, some pains, simply require more descriptors than others.

Prediction of "Overall" Pain

Pain is typically reduced to a single, unidimensional construct by both researchers and clinicians (Melzack, 1983). It is instructive, then, to investigate the number and type of qualities that predict "overall pain" as assessed by both versions of the VAS.

When all Modified SF-MPQ items were used as potential predictors in a regression analysis, two items emerged to account for more than half the variance: Sharp and Heavy. When this list was restricted to only those items which are analogous to IA, and again when only IA items themselves were used, Piercing was the only predictor of overall pain. Even breaking the sample into two subgroups based on pain "system" (i.e. musculoskeletal versus nervous system) did not change the emergence of Piercing as the

only predictor of overall pain. This is an interesting result because the nature of pains arising from injury or disease of bone and muscle could be expected to differ from pain emanating from the nervous system (Merskey, 1986), and yet there is no indication from these data that different pain systems produce different results. Even the mean scores for the IA versions of Throbbing, Burning, Piercing and Pressure do not differ significantly between pain "system" groups.

Rather than conclude that it is only necessary to include descriptors like Sharp and Piercing in a pain assessment it seems more reasonable to look with caution at what the VAS, or any measure of "overall" pain, is really tapping into. The notion of "what pain is" must certainly be influenced by stereotypical ideas held by subjects. Perhaps one would not normally label the extreme pressure experienced by patients with severe edema as "pain" unless prompted to do so. As Herr and Mobily (1991) point out, the elderly may "deny pain, but respond affirmatively to terms such as discomfort, ache, soreness or hurt" (p. 17).

The problem with asking one general question such as, "Are you in pain?" is that patients may ignore a lot of uncomfortable sensations that researchers in this area now include in the "domain" of pain. Answering "No" to a simple question about overall pain may result in the under-diagnosis of this facet of the health profile of the hospitalized elderly.

Conclusion

In conclusion, by establishing the concurrent validity of IA with a psychometrically and clinically established self-report measure of pain in older subjects (i.e. the SF-MPQ), it is clear that the new computerized assessment technique is an appropriate tool for use in this population. In fact, there is very little to differentiate the way in which a younger population used IA (as reported by Swanston et al., 1993) from the way in which a sample of older subjects used IA in the present study. The comparability of the two modes of eliciting pain data (i.e. paper versus computer screen) was demonstrated by the extremely high correlation between almost identical versions of the VAS. This suggests that the computer is not a significant source of "noise" when evaluating the impact of IA on the way in which subjects respond to questions about their pain. Any (minor) discrepancies between data yielded by the SF-MPQ and IA may be interpreted not as a weakness of either measure but as evidence of two types of assessments which disclose slightly different aspects of the pain experience. As Sternbach (1989) has pointed out, the use of different pain assessment tools (e.g. observational and self-report) may not simply describe pain in distinct ways but may actually allow the investigator or clinician to access different events that make up the constellation of sensations and emotions called the "experience of pain." It is conceivable that IA is actually superior to paper-and-pencil measures such as the SF-MPQ, because IA avoids the variety of definitions and interpretations elicited by verbal descriptors, and prompts subjects to respond to simple, easily understood images.

Certainly, the positive reaction of older subjects to IA is indicative of the usefulness of this tool in populations which are prone to measurement difficulties.

The complete contribution of IA may ultimately be realized with patients who are *not* able to use measures such as the SF-MPQ (because of physical and/or cognitive deficits) and who may yet be able to respond to computerized images of pain. At the 8th World Congress on Pain, one presenter with extensive research experience with pain and the elderly challenged clinicians to believe, and take seriously, the pain reports/behaviours of even the most cognitively impaired patients (Ferrell, 1996, August). What was missing from this directive were specific suggestions about the tools necessary to elicit self-reports of pain in such compromised populations. Perhaps patients will be able to identify with the pain images provided by Interactive Computer Animation and use them to describe their internal sensations of discomfort, even if they have lost the ability to understand and process the verbal descriptors provided by traditional pain measures.

Future Research

The validity of IA as a measure of pain in an older population established in the present study, leads to several potential areas of investigation:

1. Exploring the possibilities of using IA with a sample of older subjects who are not cognitively intact would open the door to a means of pain assessment with a segment of the population which is under-diagnosed and under-treated for pain. Knowing that IA is a valid means of measuring pain in subjects who are similar in age and pain-producing condition would allow the investigation of this technique with cognitively compromised patients if they could be assessed prior to, and following, a known pain-producing or pain-relieving activity/therapy/treatment.
2. Research is needed to establish the amount of verbal explanation necessary when administering IA. Since the most promising aspect of this measurement device is its lack of reliance on verbal skills, it would seem obvious to attempt administration of the IA (first with adults, then with other more specialized populations e.g. non-English speakers and seniors) with varying degrees of explanation. The relationship between IA and other pain measures would give information about the amount of verbal explanation necessary to make adequate

use of the tool. This could, potentially, extend the usefulness of IA as a measure of pain when other pain assessment techniques are not possible.

3. IA is limited by the restricted number of pain qualities that it portrays. The SF-MPQ presents a total of 15 pain descriptors (a subset of the 78 words contained in the MPQ), while IA has only four images of pain (and a VAS). More research and development is required to create and test new images to represent pain qualities.
4. It is unclear what the effect of manipulating the degree of realism associated with the images in IA would have on the way the measurement device is used. For example, are simple line drawings sufficient or would three-dimensional pictures increase the face validity of the measure? Are there groups (e.g. stroke patients) for whom extra detail would detract from the image or make it more confusing?
5. Just as the MPQ and, to a certain extent, the SF-MPQ have been validated as useful diagnostic tools in identifying certain constellations of descriptors associated with particular pain conditions, could IA differentiate diagnoses as well (discriminative validity)? In order to determine its usefulness in this respect, it would be necessary to test groups of clinically diagnosed patients (e.g. fibromyalgia and arthritis) and explore the possible differences in choices of pain qualities and mean scores on those pain qualities. This could be a particularly

useful tool in helping to identify conditions like fibromyalgia, which are hard to disentangle from other maladies that present with similar symptoms but require different treatments.

6. IA has not yet been tested in a purely experimental setting. In an attempt to use cross-modality matching, experimental subjects could be exposed to different pain-producing stimuli (e.g. pressure and heat), in a way that could be scientifically monitored. Subjects could be tested at intervals with the appropriate IA modality to see if the amount of pressure, for example, being exerted by the stimulus was related to the amount of pressure being recorded by the subject with IA. Conversely, IA could be used to document changes expected from analgesics. The pain qualities that are most affected by a given analgesic, or in a specific patient population, are other intriguing areas that could be addressed by IA.

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APPENDIX A**PAIN ASSESSMENT STUDY:
CONSENT FORM**

The investigators wish to insure that you understand the purpose of this study and the nature of your involvement. The following information will help you to decide whether you wish to participate in our investigation.

The Research Department at Saint-Vincent Hospital is conducting a study examining various ways of assessing pain. Participation in this study will entail two half-hour sessions with the investigator.

During the first session you will be asked about your pain experience (how long you have had it, what makes it better or worse etc.), and then you will have the opportunity to try several different methods of gauging your present level of pain (one method involves words that describe pain, while another method uses pictures). Each type of assessment will be thoroughly explained, and you will have the opportunity to ask questions at any time. During the second session, your pain will be assessed again with the same methods used during the first session. Sessions can be scheduled at your convenience.

This assessment procedure will **NOT CAUSE ANY PAIN** whatsoever. It is simply meant to provide a clearer picture of the pain that you may be feeling at the time of the assessment. All results will be kept confidential, unless you wish them to become part of your medical record. You can stop the assessment at any time, without affecting any aspect of your treatment.

If you decide not to participate in this study, this will in **NO WAY** have an impact on your treatment.

By signing below, you are indicating that you understand the nature of this research and that you agree to participate. Thank you for your time, and for your consideration of this worthwhile project.

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE: _____

RESEARCHER'S NAME: _____

RESEARCHER'S SIGNATURE: _____

DATE: _____

APPENDIX B**PAIN ASSESSMENT STUDY:
STANDARDIZED MINI-MENTAL STATE EXAMINATION**

NAME: _____
UNIT: _____
ROOM: _____
DATE: _____

I am going to ask you some questions and give you some problems to solve. Please try to answer as best you can.

(Allow 10 seconds for each reply)

SCORES

1(a) WHAT YEAR IS THIS? (Accept exact answer only)

(b) WHAT SEASON IS THIS?

(During last week of the old season or first week of a new season, accept either season)

(c) WHAT MONTH OF THE YEAR IS THIS?

(On the first day of new month, or last day of the previous month, accept either)

(d) WHAT IS TODAY'S DATE?

(Accept previous or next date, e.g., on the 7th, accept 6th or 8th)

(e) WHAT DAY OF THE WEEK IS THIS? (Accept exact answer only)

(Allow 10 seconds for each reply)

2(a) WHAT COUNTRY ARE WE IN? (Accept exact answer only)

(b) WHAT PROVINCE ARE WE IN? (Accept exact answer only)

- (c) WHAT CITY ARE WE IN? (Accept exact answer only) _____
- (d) WHAT IS THE NAME OF THIS HOSPITAL?
(Accept exact name of the hospital only) _____
- (e) WHAT FLOOR OF THE BUILDING ARE WE ON?
(Accept exact answer only) _____

3. I AM GOING TO NAME 3 OBJECTS. AFTER I HAVE SAID ALL 3 OBJECTS. I WANT YOU TO REPEAT THEM. REMEMBER WHAT THEY ARE BECAUSE I AM GOING TO ASK YOU TO NAME THEM AGAIN IN A FEW MINUTES

(Say them slowly at approximately 1 second intervals)

BALL CAR MAN

PLEASE REPEAT THE THREE ITEMS FOR ME.

(Score 1 point for each correct reply on the first attempt.)

(Allow 20 seconds for reply. If subject did not repeat all three, repeat until they are learned, or up to a maximum of five times).

4. SPELL THE WORD WORLD
(You may help the person spell world correctly) _____

NOW SPELL IT BACKWARDS PLEASE

(Allow 30 seconds to spell backwards. If the subject cannot spell "world", even with assistance, score 0)

5. NOW WHAT WERE THE THREE OBJECTS THAT I ASKED YOU TO REMEMBER?

BALL CAR MAN _____

(Score 1 point for each correct response regardless of order. Allow 10 seconds).

6. Show wristwatch.

WHAT IS THIS CALLED?

(Score 1 point for correct response.

Accept "wristwatch", or "watch".

Do not accept "clock", "time", etc.

Allow 10 seconds)

7. Show pencil.

WHAT IS THIS CALLED?

(Score 1 point for correct response.

Accept "pencil" only. Score 0 for "pen".)

8. I'D LIKE YOU TO REPEAT A PHRASE AFTER ME.

"NO IF'S, AND'S, OR BUT'S".

(Allow 10 seconds for response. Score 1 point
for a correct repetition. Must be exact.)

9. READ THE WORDS ON THIS PAGE AND THEN
DO WHAT IT SAYS.

Hand subject the sheet with **CLOSE YOUR EYES** on it.
If the subject just reads and does not close their
eyes, you may repeat the instructions up to 3 times.

10. Ask if the subject is right of left handed.

TAKE THIS PAPER IN YOUR RIGHT/LEFT HAND.
FOLD THE PAPER IN HALF, AND PUT THE
PAPER DOWN ON THE FLOOR.

Takes paper in correct hand

Folds it in half

Puts it on the floor

11. Hand subject a pencil and paper.

WRITE ANY COMPLETE SENTENCE ON
THAT PIECE OF PAPER.

(Allow 30 seconds. Score 1 point.
The sentence should make sense.
Ignore spelling errors.)

12. Place design, pencil, eraser and
paper in front of subject.

COPY THIS DESIGN PLEASE [See Figure 1 - actual design shown to patient
is full-page size] (Allow multiple tries until the patient is finished
and hands it back. Score 1 point for correctly copied diagram.
Maximum time 1 minute)

Figure 1

APPENDIX C**PAIN ASSESSMENT STUDY - DEMOGRAPHIC INFORMATION**

DATE (Year-Month-Day) _____ CHART NUMBER _____ UNIT _____

DATE OF BIRTH (Year-Month-Day) _____ GENDER M ___ F ___

NO. OF YEARS OF EDUCATION _____ USUAL OCCUPATION _____

MARITAL STATUS: _____ 1. SINGLE _____ 2. MARRIED/COMMON LAW
_____ 3. SEPARATED/DIVORCED _____ 4. WIDOWED

INITIALLY ADMITTED TO HOSPITAL (Year-Month-Day) _____

ON UNIT SINCE (Year-Month-Day) _____

ADMITTED FROM: _____ 1. HOME _____ 2. NURSING HOME
_____ 3. HOSPITAL _____ 4. RESIDENCE
_____ 5. OTHER (Please specify) _____PRIMARY DIAGNOSIS:

_____SECONDARY DIAGNOSES:

_____NATURE OF PAIN COMPLAINT (INCLUDING DURATION AND FREQUENCY
OF PAIN, AREAS OF BODY INVOLVED ETC.)

_____MEDICATIONS (INCLUDING FREQUENCY AND DURATION)

APPENDIX D**PAIN ASSESSMENT STUDY - SPECIFIC PAIN INFORMATION**

WHERE IS THE PAIN LOCATED?

WHAT DOES THE PAIN FEEL LIKE?

HOW OFTEN DO YOU FEEL THIS PAIN?

DOES IT HURT EVERYDAY?

DOES IT HURT MORE AT CERTAIN TIMES DURING THE DAY OR NIGHT?

DOES THE PAIN EVER PREVENT YOU FROM SLEEPING, OR WAKE YOU UP?

WHAT HELPS YOU RELIEVE THE PAIN?

DO YOU TAKE ANY MEDICATION FOR THE PAIN?

APPENDIX E

TABLE E-1 Demographic characteristics of single-tested subjects (n=31) and retested subjects (n=20). Groups did not differ significantly on any comparison (t-tests for continuous variables, chi-square tests for categorical variables: $p > 0.05$).

Characteristic		Single Tested Ss N=31 n (%)	Retested Ss N=20 n (%)
Patient	In-Hospital	23 (74.2%)	12 (60.0%)
	Day-Hospital	8 (25.8%)	8 (40.0%)
Gender	Male	12 (38.7%)	6 (30.0%)
	Female	19 (61.3%)	14 (70.0%)
Education	Grade School	4 (12.9%)	4 (20.0%)
	High School	15 (48.4%)	8 (40.0%)
	Post High School	6 (19.4%)	3 (15.0%)
	University	6 (19.4%)	5 (25.0%)
Marital Status	Single	3 (9.7%)	2 (10.0%)
	Married/Common Law	19 (61.3%)	6 (30.0%)
	Separated/Divorced	1 (3.2%)	3 (15.0%)
	Widowed	8 (25.8%)	9 (45.0%)
		Single Tested Ss M (SD)	Retested Ss M (SD)
Age		74.03 (SD=8.47)	76.72 (SD=8.24)
Length of Hospital Stay for In-Hospital Patients		1.52 Years (SD=2.47)	0.82 Years (SD=1.31)
Length of Hospital Stay for Day Hospital Patients		1.18 Months (SD=1.70)	0.65 Months (SD=1.10)
SMMSE - All Subjects		26.29 (SD=3.33)	24.90 (SD=3.35)
SMMSE - Only Subjects With Complete Scores (Single n=25, Retested n=13)		26.92 (SD=2.87)	26.23 (SD=2.86)
SMMSE - Subjects With Incomplete Scores (Single n=6, Retested n=7)		23.67 (SD=4.08)	22.43 (SD=2.88)

TABLE E-2 Session 1: Modified SF-MPQ scores of single-tested subjects (n=31) and retested subjects (n=20). Groups did not differ significantly on any comparison (t-tests: $p > 0.05$).

Modified Short-Form McGill Item		Single Tested Ss N=31 n (%)	Retested Ss N=20 n (%)
1.	Throbbing	.71 (SD=1.07)	.70 (SD=0.92)
2.	Shooting	.71 (SD=1.22)	.70 (SD=1.17)
3.	Stabbing	.71 (SD=1.10)	.60 (SD=0.94)
4.	Sharp	1.23 (SD=1.26)	1.15 (SD=1.23)
5.	Cramping	.55 (SD=0.93)	.55 (SD=0.95)
6.	Gnawing	.63 (SD=0.99)	.55 (SD=0.99)
7.	Hot-Burning	.65 (SD=0.95)	.95 (SD=1.05)
8.	Aching	1.68 (SD=1.11)	1.42 (SD=1.12)
9.	Heavy	.97 (SD=1.32)	.65 (SD=1.09)
10.	Tender	1.45 (SD=1.09)	1.05 (SD=1.15)
11.	Splitting	.47 (SD=0.97)	.25 (SD=0.64)
12.	Tiring-Exhausting	1.33 (SD=1.12)	1.65 (SD=0.88)
13.	Sickening	.97 (SD=1.19)	.45 (SD=0.99)
14.	Fearful	.63 (SD=1.19)	.75 (SD=1.07)
15.	Punishing-Cruel	.97 (SD=1.25)	1.16 (SD=1.30)
16.	Piercing	1.00 (SD=1.34)	.95 (SD=1.05)
17.	Pressure	1.37 (SD=1.22)	1.60 (SD=0.82)
VAS		54.63 (SD=30.73)	57.15 (SD=16.20)
Present Pain Index (Scored 0 to 5)		1.35 (SD=1.50)	1.90 (SD=1.17)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

TABLE E-3 Session 1: Interactive Animation scores of single-tested subjects (n=31) and retested subjects (n=20). Groups did not differ significantly on any comparison (t-tests: $p > 0.05$).

Interactive Animation Item	Single Tested Ss	Retested Ss
	N=31 M (SD)	N=20 M (SD)
1. Throbbing	20.84 (SD=30.22)	12.55 (SD=20.83)
2. Hot-Burning	16.16 (SD=22.25)	20.50 (SD=27.48)
3. Piercing	25.42 (SD=33.80)	17.20 (SD=28.52)
4. Pressure	38.71 (SD=36.81)	39.65 (SD=26.65)
VAS (Scored 1 to 100)	47.66 (SD=28.06)	54.95 (SD=17.39)

* Means are based on the scores of *all* subjects (those subjects who did not choose an item are scored as "zero").

APPENDIX F**Power Analysis Calculation for Sample Size**

The critical analyses in this study are Pearson product-moment correlations (r) between the various dimensions associated with two pain measures: the Modified SF-MPQ and the IA (see "Analyses"). This statistic is an index of the linear relationship between two variables, and it is an ideal choice when comparing measures that are based on different scales, because each variable is standardized to the same variability. The only correlation between matching pain qualities reported by Swanston et al. (1993) is very high ($r=.88$). Other correlations between sum scores are in the moderately high ($r=.30$) to very high ($r=.66$) range (Swanston et al., 1993). This suggests that one can conservatively postulate an effect size somewhere between what Cohen (1988) terms a "medium" ($r=.30$) and "large" ($r=.50$) effect. With alpha set at 0.05 and power set at 0.80, the sample size necessary to detect an effect size of .40 is 37 subjects.

Within this sample, it is hypothesized that there will be a high correlation (.60 or higher) between the difference scores of the two measures (collected at two different points in time). With alpha set at 0.05 and power set at 0.80, the subsample size necessary to detect an effect size of .60 is 15 subjects (therefore, a minimum number of 15 subjects is necessary for retest).

APPENDIX G**MODIFIED SHORT-FORM MCGILL PAIN QUESTIONNAIRE**

NAME: _____

DATE: _____

	NONE	MILD	MODERATE	SEVERE
THROBBING	0) _____	1) _____	2) _____	3) _____
SHOOTING	0) _____	1) _____	2) _____	3) _____
STABBING	0) _____	1) _____	2) _____	3) _____
SHARP	0) _____	1) _____	2) _____	3) _____
CRAMPING	0) _____	1) _____	2) _____	3) _____
GNAWING	0) _____	1) _____	2) _____	3) _____
HOT-BURNING	0) _____	1) _____	2) _____	3) _____
ACHING	0) _____	1) _____	2) _____	3) _____
HEAVY	0) _____	1) _____	2) _____	3) _____
TENDER	0) _____	1) _____	2) _____	3) _____
SPLITTING	0) _____	1) _____	2) _____	3) _____
TIRING-EXHAUSTING	0) _____	1) _____	2) _____	3) _____
SICKENING	0) _____	1) _____	2) _____	3) _____
FEARFUL	0) _____	1) _____	2) _____	3) _____
PUNISHING-CRUEL	0) _____	1) _____	2) _____	3) _____
PIERCING	0) _____	1) _____	2) _____	3) _____
PRESSURE	0) _____	1) _____	2) _____	3) _____

APPENDIX H**MODIFIED SHORT-FORM MCGILL PAIN QUESTIONNAIRE: VAS & PPI**

VISUAL ANALOGUE SCALE FOR OVERALL PAIN RATING

NO PAIN |-----| WORST POSSIBLE PAIN

PRESENT PAIN INDEX (PPI)

0	NO PAIN	_____
1	MILD	_____
2	DISCOMFORTING	_____
3	DISTRESSING	_____
4	HORRIBLE	_____
5	EXCRUCIATING	_____

APPENDIX IINTERACTIVE COMPUTER ANIMATION (IA)

These are schematic illustrations of graphics used for Interactive Animation (IA). Each animation is shown in its "low" pain intensity state, and "high" pain intensity state: (1) Pressure, (2) Burning, (3) Throbbing, (4) Piercing, and (5) Visual Analogue Scale.

APPENDIX J**PAIN ASSESSMENT STUDY: SCRIPT FOR IA ASSESSMENT**

I want to find out more about what your pain feels like by showing you some pictures. Each picture is like a different aspect of your pain. You may find that some of the pictures apply to what you are feeling more than others. That is OK. I will explain each picture as I show it to you, and I will demonstrate how you can change the appearance of the picture to reflect what you are feeling/usually feel. Ask as many questions as you like.

Pressure:

This is a picture of a ball in the jaws of a vise. Sometimes pain can feel like pressure. Right now the ball is perfectly round, and this represents no pressure. As I press or tap the left arrow key, the vise-grip tightens, and the ball is squeezed. (Show maximum pressure). This is what it looks like when the pressure is the highest it can be. If I press or tap the right arrow key the vise-grip loosens, pressure decreases, and the ball becomes round again. (Show minimum pressure). This is what it looks like when there is no pressure. Does your pain feel like pressure? Press or tap the right and left arrow keys until you think the pressure on the ball is like the pressure you feel.

Burning:

This is a picture of a red ball within a black ball. The red ball represents a burning feeling. Sometimes pain can feel like burning. The bigger the red ball, the

bigger the feeling of burning. As I press or tap the up arrow, the red ball increases. (Show maximum burning.) This is what it looks like when burning is the highest it can be. If I press the down arrow, the red ball gets smaller, until it is the smallest it can be. (Show minimum burning.) This is what it looks like when there is no burning. Does your pain feel like burning? Keep pressing or tapping the up and down arrow keys until you think the size of the ball represents your burning.

Throbbing:

This is a picture of a hammer hitting the bottom of a box. The pounding action represents throbbing. The greater the distance between the hammer and the bottom of the box, the greater the throbbing. If I press the up arrow, the hammer moves up the box. (Show maximum throbbing.) This represents the most throbbing you can feel. If I press the down arrow key, the hammer moves down the box. (Show minimum throbbing.) This represents no throbbing. Once the hammer is at the right distance from the bottom of the box, I can turn it "on" to demonstrate the "throbbing" action. The speed of the hammer doesn't change, just the distance it falls. The colour is not important - it flashes red to indicate the "throbbing" nature of pain. Does your pain feel like throbbing? Once you think have adjusted the hammer to the right position (by using the up and down arrows), I will turn the hammer back on, so that you can decide if it looks right to you.

Piercing:

This is a picture of a needle piercing a box. Sometimes pain can feel like piercing. If I press or tap the up arrow, the needle moves into the box. As the needle enters the box, it changes colour from black to red. (Show maximum piercing.) This represents the most piercing you can feel. If I press or tap the down arrow, the needle moves back out of the box. (Show minimum piercing.) This represents no piercing. Does your pain feel like piercing? Use the up and down arrows until you feel that the picture represents the amount of piercing you feel.

Visual Analogue Scale:

This black line represents the range of pain you can feel. At one end the line is marked NO PAIN, and at the other end the line is marked THE WORST POSSIBLE PAIN. I want you to show me how much pain you are in by moving the small red vertical mark so that it sits at the place on the black line that represents the amount of overall pain you are in. The closer the red mark is to the left side (show minimum pain), the less pain you are in. The closer the red mark is to the right side (show maximum pain), the more pain you are in. Use the right and left arrows until you feel that the red mark is sitting on the black line, in the place that best represents the overall amount of pain you feel.

APPENDIX K**PAIN ASSESSMENT STUDY: INFORMATION RELEASE CONSENT FORM**

I authorize any information gathered during this study
to become part of my medical record.

PARTICIPANT'S NAME: _____

PARTICIPANT'S SIGNATURE: _____

INVESTIGATOR'S NAME: _____

INVESTIGATOR'S SIGNATURE: _____

DATE: _____

APPENDIX L

PAIN ASSESSMENT STUDY - DEBRIEFING

Accurate measurement of pain has important implications in the medical treatment and overall quality of life for patients of all ages. Methods developed for the assessment of pain have included questionnaires, interviews, chart reviews, observation, body drawings, visual analogue scales, and verbal rating scales. Perhaps the most widely accepted measure of pain is the McGill Pain Questionnaire.

The pain assessment technique used in this study utilizes interactive computer animation (IA), and has been used with Scottish pain patients, as well as with in-patients and out-patients at Saint-Vincent Hospital in Ottawa. In both cases, it has been found that IA correlates well with the McGill Pain Questionnaire. The purpose of this on-going study is to determine whether IA is useful with patients in different settings.

We would like to thank you very much for participating in this research. Your time and efforts are greatly appreciated!

If you have any further questions about this study, or if you have any comments about the pain assessment procedure that you have participated in, please do not hesitate to call one of the investigators.

PRINCIPAL INVESTIGATOR: Paddi O'Hara

CO-INVESTIGATOR: Stephen Johnston

SAINT-VINCENT HOSPITAL RESEARCH DEPARTMENT:
233-4041 Ext. 2159

Other inquiries can be directed to:

Dr. Dan W. Harper **Director of SVP Research and Faculty Advisor**
233-4041 Ext. 2159

APPENDIX M

TABLE M-1 Demographic characteristics of all subjects (n=51) at first assessment.

Characteristic		N	%
Patient	In-Hospital	35	68.6%
	Day-Hospital	16	31.4%
Gender	Male	18	35.3%
	Female	33	64.7%
Education	Grade School	8	15.7%
	High School	23	45.1%
	Post High School	9	17.6%
	University	11	21.6%
Marital Status	Single	5	9.8%
	Married/Common Law	25	49.0%
	Separated/Divorced	4	7.9%
	Widowed	17	33.3%
		M	SD
Age		75.09 years Range: 60.90 to 92.38 years	8.40
Length of Hospital Stay for In-Hospital Patients (n=35)		1.23 Years Range: 0.02 to 8.82 years	2.15
Length of Hospital Stay for Day Hospital Patients (n=16)		0.91 months Range: 0.07 to 4.44 months	1.14
SMMSE - All Subjects		25.75 Range: 17 to 30	3.38
SMMSE - Only Subjects With Complete Scores (n=38)		26.68 Range: 17 to 30	2.85
SMMSE - Subjects With Incomplete Scores (n=13)		23.0 Range: 17 to 28	3.39

TABLE M-2 Medical diagnoses of all subjects (n=51). Subjects usually have multiple diagnoses, therefore, percentages exceed 100.

Medical Diagnosis	N	%
Cancer	2	3.9%
Cerebrovascular Accident	29	56.9%
Decubitus Ulcers	3	5.9%
Deep Vein Thrombosis (DVT)	4	7.8%
Degenerative Disk Disorder	2	3.9%
Diabetes	8	15.7%
Gastrointestinal Disease	2	3.9%
General Deconditioning	2	3.9%
Heart Disease	7	13.7%
Hypertension	14	27.5%
Lung Disease	4	7.8%
Multiple Sclerosis	2	3.9%
Musculoskeletal Injury / Fracture	10	19.6%
Optic Atrophy	3	5.9%
Osteoarthritis	10	19.6%
Osteoporosis	4	7.8%
Peripheral Vascular Disease (PVD)	3	5.9%
Rheumatoid Arthritis	5	9.8%
Seizure Disorder	2	3.9%
Subluxed Shoulder	2	3.9%
Transient Ischemic Attacks (TIAs)	3	5.9%

TABLE M-3 Pain-related diagnoses of all subjects (n=51).

Pain-Related Diagnosis	N	%
Acute Angina	1	1.9%
Cerebrovascular Accident - Deafferentation	10	19.6%
Cerebrovascular Accident - Subluxation	5	9.8%
Degenerative Disk Disorder	2	3.9%
Gout	1	1.9%
Migraine	1	1.9%
Musculoskeletal Injury / Fracture	10	19.6%
Osteoarthritis	9	17.6%
Polyneuropathy	2	3.9%
Rheumatoid Arthritis	5	9.8%
Spinal Tumour	1	1.9%
Tendonitis	3	5.9%
Varus Deformity (i.e. knock-kneed)	1	1.9%

TABLE M-4 Areas of the body identified by major pain complaints for all subjects (n=51).

Painful Area of Body	N	%
Head	1	1.9%
Shoulder	13	25.5%
Arm	3	5.9%
Hand	1	1.9%
Spine (Back and Neck)	1	1.9%
Back	3	5.9%
Lower Back Only	3	5.9%
Side	3	5.9%
Ribs	1	1.9%
Hip	5	9.8%
Groin	3	5.9%
Leg	2	3.9%
Upper Leg Only	3	5.9%
Knee	6	11.8%
Foot	2	3.9%
All Joints	1	1.9%

APPENDIX N**CATEGORIES OF MEDICATIONS**

Each medication category is accompanied by the number of subjects having prescriptions in that category. The oral analgesic categories give the actual number of subjects with prescriptions for each drug listed (some patients have multiple analgesic prescriptions, therefore, category totals may not match individual drug list totals).

ANY ANALGESIC (TOPICAL, NON-NARCOTIC OR NARCOTIC) n=47**ANALGESICS: NARCOTIC n=16**

DEMEROL (MEPERIDINE)	n=1
MORPHINE	n=1
NOVO-GESIC (ACET & CODEINE)	n=1
TYLENOL 2 (ACET & CODEINE)	n=10
TYLENOL 3 (ACET & CODEINE)	n=5

ANALGESICS: NON-NARCOTIC n=40

ACETAMINOPHEN/TYLENOL	n=29
ASA/ASPIRIN/ACETYL. ACID	n=3
ENTROPHEN (ASA)	n=3
IBUPROFIN	n=1
NOVASEN (ASA)	n=8

ANALGESICS: TOPICAL n=11

A535
AURALGAN
FLEXALL CREAM
PREMARIN VAG CREAM
ZOSTRIX CREAM (CAPSAICIN)

ALCOHOL n=2

BEER/WINE
SCOTCH

ANTACIDS n=10

ALPRAZ (ALPRAZOLAM)
DIOVOL SUSPENSION
OVOL (SIMETHICONE)

AMPHOJEL (ALUM. HYDROXIDE)
GAVISCON

ANTI-ANGINA n=15

ADALAT/NIFEDIPINE
CARDIZEM/DILTIAZEM
NITRO-DUR (NITROGLYCERIN)
NITROSTAT (NITROGLYCERIN)
NOVO-VERAMIL

AMLODIPINE
ISORDIL
NITROL OINTMENT
NORVASC

ANTI-ANXIETY/MUSCLE RELAXANT/SEDATIVE n=21

ATIVAN/LORAZEPAM
BUSPAR/BUSIPRONE
FLEXERIL
NOVOCHLORHYDRATE

BACLOFEN/LIORESAL
DIAZAPAM
IMOVANE/ZOPICLONE
OXAZEPAM/SERAX

ANTI-DEPRESSANTS n=16

ANAFRANIL
DESIPRAMINE
DOXEPIN (TRIADAPIN)
LUVOX
NOVO-TRIPTYN/AMITRIPTYLINE
TRAZODONE (DESYREL)

AVENTYL
DESYREL DIVIDOSE
IMIPRAMINE
NORDRYPTILINE
PROZAC
ZOLOFT

ANTI-HYPERTENSION/VASODILATOR n=20

CAFTOPRIL
ENALAPRIL/VASOTEC
METHYLDOPA/ALDOMET
MONOPRIL
NOVO-TRIAMZIDE

DYAZIDE
LOZIDE
METOPROLOL
NOVO-CAPTOPRIL
PRINIVIL

ANTI-NAUSEA n=7

DIMENHYDRINATE
GRAVOL

ANTI-OSTEOPOROSIS n=7

CALCIUM
CALSAN
OSTOFORTE (VITAMIN D)

CALCIUM CARBONATE
DIDRONEL
ROCALTROL (VITAMIN D)

ANTI-RHEUMATIC/ARTHRITIS n=3

METHOTREXATE
MYOCHRSINE (GOLD)

ANTI-ULCER n=16

CYTOTEC
NOVO-RANIDINE
RANITIDINE/ZANTAC

LOSEC (OMEPRAZOLE)
PEPCID
SUCRALFATE (SULCRATE)

CORTICOSTEROID: TOPICAL n=9

ECTOSONE LOTION
HYDROCORTISONE (CREAM)

HYDERM CREAM
PROCTOSONE OINTMENT

CORTICOSTEROID: ORAL n=5

HCTZ (HYDROCORTISONE)
MEDROL (METHYLPREDNIS.)

HYDROCORTISONE (TABS)
PREDNISONE

LAXATIVES/ENEMAS/BULK-FORMING AGENTS n=38

AGAROL	BISACODYL
COLACE	DOCUSATE SODIUM
FLEET ENEMA	GLYCERINE SUPPOSITORY
LACTULOSE LIQUID	MAALOX
METAMUCIL	MICROLAX ENEMA
MILK OF MAGNESIA	NOVO-MUCILAX
PREPULSID (CISAPRIDE MONO.)	REGULEX
SENNOSIDES	SENOKOT

NON-STEROIDAL ANTI-INFLAMMATORIES (NSAIDS) n=2

FELDENE	n=1
NAPROXEN (ANAPROX)	n=1

PSYCHIATRIC DRUGS n=2

HALDOL (HALOPERIDOL)	LITHIUM
PROCHLOPERAZINE (STEMETIL)	

VITAMINS/MINERALS/SUPPLEMENTS n=18

B12	COD LIVER OIL
FERROUS FUMARATE	FERROUS GLUCONATE
FERROUS SULFATE	K/SLOW K
LETHICIN	MULTIVITAMIN
NIACIN (NICOTINIC ACID)	THIAMINE
VITAMIN B	VITAMIN C

MISCELLANEOUS n=46

ALLOPURINOL	ATROVENT INHALER
BACTROBAN (MUIPIROCIN)	BALMINIL DM
BECLOFORTE	BENADRYL
BETAGAN (LEVOBUNOLOL)	CANESTEN (CLOTRIMAZOLE)
CARBAMAZEPINE (TEGRETOL)	CIPRO (CIPROFLOXACIN)
CLONAZEPAM	CLOTRIMADERM
COUMADIN (WARFARIN)	DERMABASE
DIGOXIN (DIGITALUS)	DILANTIN (PHENYTOIN)
DITROPAN	ELTROXIN

MISCELLANEOUS (CONTINUED)

EPIVAL (DIVALPROEX)	ESTROGEN
EURAX CREAM	FOLIC ACID
FUDICIN	FUROSEMIDE
GLYBERIDE	HEMACORTH C
HYDROCHLOROTHIAZIDE	HYDROXYUREA
HYGEOL SOLUTION	IMODIUM
INSULIN	ISOPTO TEARS
HIBITANE MOUTH RINSE	KAOPECTATE LIQUID
KOFFEX ELIXIR	LACTO BACILLUS (BACID)
LANOXIN (DIGOXIN)	LASIX
LEVOTHROXINE (ELTROXIN)	LOPID
L-THYROXINE	METFORMIN
MEVACOR (MSD)	MOI-STIR SOLUTION
MURO 128 OPHTHALMIC DROPS	NOROXIN
NOVAMOXIN	NOVO-METFORMIN
NOVO-QUININE SULFATE	NOVOLIN NPH INSULIN
NOVO-TRIMEL	NYSTATIN
OCULUX	ORABASE
POLYTAR SHAMPOO	POLYTOPIC
PREMARIN TABS	PULMICORT TURBOHALER
PYRIBENZAMINE	ROBITUSSIN (GUAIFENESIN)
SEBULEX SHAMPOO	SEPTRA
TEGRETOL (CARBAMAZEPINE)	TETRACYCLINE (TETRACYN)
THYROXINE	TICLID
TIMOPTIC OPHTHALMIC SOL.	TUCK'S MEDICATED PADS
TYLENOL DM SYRUP	VENTOLIN (SALBUTAMOL)
ZOLADEx (SUBCUTANEOUS)	

APPENDIX O**Fisher's z Transformation for Comparison of Correlation Coefficients**

According to Cohen and Cohen (1981), if one wishes to test the significance of the difference between two correlation coefficients it is necessary to compute the normal curve deviate:

$$z = \frac{z_1' - z_2'}{\sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}}$$

Where $z' = 1/2 [\ln (1 + r) - \ln (1 - r)]$
and $\ln$ is the natural (base e) logarithm

TABLE O-1 Z scores for comparison of Swanston et al. (1993) correlations and Session 1 correlations.

VARIABLE PAIR	SWANSTON ET AL. r (z')	SESSION 1 r (z')	Z SCORE
Se & Af	.56 (0.633)	.49 (0.536)	0.47
Se & VAS	.39 (0.412)	.63 (0.741)	1.60
Se & PPI	.35 (0.365)	.32 (0.332)	0.16
Se & IA Total	.30 (0.310)	.46 (0.497)	0.91
Se & IA VAS	.43 (0.460)	.65 (0.775)	1.54
Af & MPQ VAS	.43 (0.460)	.37 (0.388)	0.35
Af & PPI	.47 (0.510)	.22 (0.224)	1.39
Af & IA Total	.39 (0.412)	.33 (0.343)	0.34
Af & IA VAS	.41 (0.436)	.44 (0.472)	0.18
MPQ VAS & PPI	.64 (0.758)	.20 (0.203)	2.70 *
MPQVAS & IA Tot	.57 (0.648)	.47 (0.510)	0.67
MPQVAS & IAVAS	.88 (1.376)	.84 (1.221)	0.76
PPI & IA Total	.48 (0.523)	.33 (0.343)	0.88
PPI & IA VAS	.60 (0.693)	.20 (0.203)	2.39 *
IA Tot & IA VAS	.64 (0.758)	.45 (0.485)	1.33

* $p < .05$

TABLE O-2 Z scores for comparison of Session 1 correlations and Session 2 correlations.

VARIABLE PAIR	SESSION 1 r (z')	SESSION 2 r (z')	Z SCORE
Throbbing	.54 (0.604)	.64 (0.758)	0.55
Burning	.72 (0.908)	.86 (1.293)	1.36
Piercing	.74 (0.950)	.80 (1.099)	0.53
Pressure	.36 (0.377)	.93 (1.658)	4.54 *
Se & Af	.49 (0.536)	.80 (1.099)	1.99 *
Se & VAS	.63 (0.741)	.74 (0.950)	0.74
Se & PPI	.32 (0.332)	.53 (0.590)	0.41
Se & IA Total	.46 (0.497)	.49 (0.536)	0.14
Se & IA VAS	.65 (0.775)	.81 (1.127)	1.25
Af & MPQ VAS	.37 (0.388)	.67 (0.811)	1.50
Af & PPI	.22 (0.224)	.48 (0.523)	1.06
Af & IA Total	.33 (0.343)	.38 (0.400)	0.20
Af & IA VAS	.44 (0.472)	.68 (0.829)	1.26
MPQ VAS & PPI	.20 (0.203)	.32 (0.332)	0.46
MPQVAS & IA Tot	.47 (0.510)	.38 (0.400)	0.39
MPQVAS & IAVAS	.84 (1.221)	.85 (1.256)	0.12
PPI & IA Total	.33 (0.343)	.12 (0.121)	0.79
PPI & IA VAS	.20 (0.203)	.58 (0.662)	1.62
IA Tot & IA VAS	.45 (0.485)	.44 (0.472)	0.05

* $p < .05$

TABLE O-3 Z scores for comparison of "Single IA Choice" subjects and "Multiple IA Choice" subjects at Session 1.

VARIABLE PAIR	SINGLE CHOICE r (z')	MULTIPLE CHOICE r (z')	Z SCORE
Throbbing	-----	.36 (0.377)	----
Burning	.88 (1.376)	.60 (0.693)	2.11 *
Piercing	.62 (0.725)	.72 (0.908)	0.56
Pressure	.17 (0.172)	.15 (0.151)	0.06
Se & Af	.18 (0.182)	.40 (0.424)	0.75
Se & VAS	.65 (0.775)	.51 (0.563)	0.65
Se & PPI	.36 (0.377)	.27 (0.277)	0.31
Se & IA Total	.77 (1.020)	.56 (0.633)	1.20
Se & IA VAS	.64 (0.758)	.60 (0.693)	0.20
Af & MPQ VAS	.65 (0.775)	.15 (0.151)	1.93
Af & PPI	.28 (0.288)	.15 (0.151)	0.42
Af & IA Total	.21 (0.213)	.29 (0.299)	0.27
Af & IA VAS	.72 (0.908)	.22 (0.224)	2.11 *
MPQ VAS & PPI	.51 (0.563)	.03 (0.030)	1.65
MPQVAS & IA Tot	.70 (0.867)	.53 (0.590)	0.86
MPQVAS & IAVAS	.94 (1.738)	.78 (1.045)	2.14
PPI & IA Total	.73 (0.929)	.07 (0.070)	2.65 *
PPI & IA VAS	.44 (0.472)	.02 (0.020)	1.40
IA Tot & IA VAS	.56 (0.633)	.44 (0.472)	0.50

* $p < .05$