Published in final edited form as:

J Pain. 2009 January ; 10(1): 53–59. doi:10.1016/j.jpain.2008.07.007.

A Comparison of Laboratory Measures of Escape and Avoidance Behavior

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Abstract

Escape and avoidance of the onset of pain and exacerbations of pain can be difficult to distinguish in certain circumstances. This investigation compared measures of participants' ($N = 61$, 50.8% women) escape and avoidance behavior during an ischemic pain task. Instructions for the ischemic task were manipulated so that one group stopped the task whenever they wanted (e.g., before the onset of pain) and another group endured the ischemic pain to tolerance. Delay time before beginning the task and willingness to complete the task were not related to self-reported escape/avoidance ($r = -.21$, $p = .10$; $r = -.14$, $p = .30$). Also they were not predicted by fear, anxiety, or catastrophizing. Task duration with the unrestricted stop rule was not related to self-reported escape/avoidance ($r = -.13$, $p = .50$) and was not predicted by fear, anxiety, or catastrophizing. However, task duration with the tolerance stop rule was associated with self-reported escape/avoidance ($r = -.40$, $p = .02$) and was predicted by catastrophizing ($t_{29} = -2.92$, $p < .01$). Thus, evidence for the validity of task duration with a tolerance stop rule as a measure of escape from pain or avoidance of pain exacerbation was found.

Perspective—Measures of avoidance of pain onset were not supported. However, task duration was a valid measure of escape from pain or avoidance of pain exacerbation with tolerance stop rules. Other measures of escape/avoidance behavior and participants' perceptions of stable or increasing pain level throughout a pain task should be examined.

Keywords

measurement; Fear Avoidance Model; ischemic; tolerance

Measures of escape and avoidance behavior from laboratory pain date back to the development of controlled pain stimuli. Escape and avoidance behaviors (e.g., pain tolerance) are important due to evidence of relations with clinical pain ratings ^{5,11,14,22}. In addition, avoidance is related to chronic pain disability within the Fear-Avoidance Model, which postulates that fear, anxiety, and catastrophizing lead to activity avoidance and disability ^{20,21}. Furthermore, use of an avoidant coping strategy is positively related to escape/avoidance behavior ¹².

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Cipher and Fernandez⁴ have argued that there is an obvious distinction between staying away from a sensation that is expected to be painful (i.e., avoidance) and escaping from the continuation of a sensation that already is painful. However, escape and avoidance behaviors can be difficult to distinguish – even within human laboratory models. For example, numerous researchers have labeled escape (i.e., withdrawal) from a cold-pressor task as an indicator of pain avoidance^{15-17,23,24} or as “escape/avoidance”³².

Examinations of escape and avoidance behaviors necessitate clarification of whether the behaviors occur in relation to threat or onset of pain or exacerbations of pain. For example, it is theoretically possible for pain-free participants to escape and avoid the onset of pain. Also it is possible for pain-free participants and clinical pain patients to escape and avoid exacerbations of pain. However, it may be difficult to distinguish between escape from pain and avoidance of exacerbations of pain. In addition, it has been advocated that it is not possible to avoid the threat of pain¹.

Some may argue that distinguishing between escape and avoidance behaviors is unnecessary; it is sufficient to label these behaviors as “escape/avoidance.” However, these behaviors may indicate different cerebral processes. For example, fear of pain may instigate escape while pain-related anxiety may induce avoidance^{1,20}. Thus, consideration of escape and avoidance behaviors and related psychological processes is warranted.

The objective of this investigation was to compare laboratory measures of escape and avoidance behavior in pain free participants. Stop rules for termination of a pain task were provided so that escape and avoidance of both the onset of pain and exacerbations of pain could potentially occur³⁶. The following measures of escape and avoidance behavior were examined: delay time before beginning a painful task; self-reported willingness to complete a painful task; and task duration (i.e., stop time for completing a painful task). Delay time before beginning the ischemic task and self-reported willingness to complete the ischemic task could measure avoidance of the onset of pain while task duration could measure escape and avoidance of the onset of pain and exacerbation of pain depending upon the stop rule.

We hypothesized that task duration should be smaller when participants were given a stop rule to terminate the pain task whenever they wanted in contrast to when participants were given a stop rule to tolerate the pain of the task as long as possible. We also hypothesized that the percentage of participants stopping the task before the onset of clinically important levels of pain (i.e., avoidance of the onset of pain) should be higher within the group that was instructed to stop the pain task whenever they wanted in comparison to the percentage within the group that was instructed to tolerate the pain of the task as long as possible. In addition, we hypothesized that all valid measures of escape and avoidance behavior would (1) negatively correlate to the escape/avoidance subscale of the Pain Anxiety Symptoms Scale⁷ and (2) be predicted by fear, anxiety, and catastrophizing²⁰.

Methods

Participants

Participants ($N = 61$; 50.8% women) were recruited from a university participant pool and their average age was about 20 years ($SD = 2.39$). The exclusion criteria were that participants could not have a chronic pain condition or previous experience with the ischemic task. Also participants were required to refrain from smoking or consuming caffeine within the 3 hours prior to the session or consuming an analgesic within 12 hours prior to the session. Each participant consented to participate in a manner that was approved by the University of Missouri Health Sciences Institutional Review Board.

Procedures

During a single experimental session, participants completed previously validated questionnaire measures of fear, anxiety, catastrophizing, and escape/avoidance. Then participants were randomly assigned to receive one of two instructional sets for an ischemic pain task. One group ($n = 29$) was told to stop the ischemic task whenever they wanted to (i.e., unrestricted instructional set), which permitted avoidance of the onset of pain. The other group ($n = 32$) was told to stop the ischemic task when they could no longer tolerate the ischemic pain (i.e., tolerance instructional set). (See Table 1 for the exact instructions.)

A standard blood pressure cuff and a handgrip dynamometer (Lafayette, Inc.) were used to induce ischemic pain. Initially, the pressure cuff was applied above the elbow of the participant's dominant arm and the arm was elevated and supported in a vertical position for 30 s. Then the cuff was inflated to 240-260 mmHg before the arm was lowered to a horizontal position and 20 2-s handgrip contractions were completed at 50% of the participants' predetermined maximum handgrip strength at 2-4 s intervals. The ischemic task duration and pain ratings at the time of ischemic task termination were measured. (The maximum time period that the participant was allowed to endure the ischemic stimulus was 15 min.)

Next, both groups were led to believe that a second trial of the ischemic task would be completed to pain tolerance. The participants' were given their instructions. Their willingness to complete a second trial of the ischemic task to pain tolerance and their confidence that a second trial of the ischemic task would be completed were measured. Then the delay time before participants indicated readiness to begin the second ischemic task was recorded. Once the participants' dominant arm was elevated, the participants were told that the investigator had just realized that the data collection packet indicates the participants were assigned to group that did not actually require completion a second trial of the ischemic task. Therefore, the study was actually complete. See Figure 1 for the research design.

Each participant completed the experimental session individually. All the measures were collected by an investigator who was blinded to the participants' instructional set (i.e., stop rules) for the first ischemic task. The experimental session required approximately 1 hr.

Fear of pain—The Fear of Pain Questionnaire (FPQ-III)²⁶ was administered to assess pain-related fear. The FPQ-III is a 30-item questionnaire that measures fear about typically painful situations. Support for its validity has been reported in non-clinical samples²⁹.

State Anxiety—The State-Trait Anxiety Inventory (STAI) was administered to measure anxiety. The STAI assesses anxiety with 20 items and a Likert scale that ranges from “not at all” to “very much so.” The reliability and validity of the STAI has been established³.

Catastrophizing—The Pain Catastrophizing Scale (PCS) was administered to quantify catastrophizing. The PCS contains 13 questions about cognitions and emotions that may occur during the perception of pain. The questions are answered with a Likert scale that ranges from “not at all” to “all the time.” The reliability and validity of the PCS have been established^{27, 33}.

Self-reported escape/avoidance—The Pain Anxiety Symptoms Scale (PASS-20) asks 20 items about typical responses to pain⁷ and is based on a 40-item version²⁸. Higher scores represent greater anxiety. Support for the reliability and validity of the 20-item version has been reported⁷. Our interest was in the escape/avoidance subscale of the PASS, which evaluates participants' general avoidance of pain⁷. The entire PASS-20 was administered, but only the escape/avoidance subscale was analyzed because we were interested in escape and avoidance.

Expected and actual ischemic pain intensity and pain unpleasantness—The expected and actual ischemic pain at termination of the ischemic task were assessed with visual analog scales. Expected pain was measured to clarify participants' expectations for the novel first ischemic task and actual pain was measured to clarify pain levels at stop time of the first ischemic task. Participants were instructed to rate the ischemic pain in their forearms below the blood pressure cuff.

The scale for pain intensity (VAS-I) consisted of a 10 cm line with anchors of “no pain” and “most intense pain sensation imaginable”. The scale for pain unpleasantness (VAS-U) consisted of a 10 cm line with anchors of “not at all unpleasant” and “most unpleasant imaginable”. The intensity scales measure the sensory-discriminative dimension of pain and the unpleasantness scales measure the affective-cognitive dimension of pain³¹. Clinically important levels of pain intensity were defined as 1.2 cm according to data on the minimum clinically important difference in visual analog pain intensity ratings^{13,19,34}.

Willingness to experience more pain—A 10 cm visual analog scale was also used to appraise participants' willingness to complete a second trial of the ischemic stimulus to pain tolerance. The minimum and maximum anchors of the scale were “not at all willing” and “completely willing,” respectively.

Manipulation check—The participants' level of confidence that another trial of the ischemic task would actually occur was measured with a 10 cm visual analog scale. The minimum and maximum anchors of the scale were “not at all confident” and “completely confident,” respectively.

Data Analyses—Group differences in the dependent variables were examined using independent t-tests, but group differences in pain ratings were analyzed with analyses of covariance with task duration controlled. Fisher's Exact Tests were run to compare the percentage of participants with pain intensity less than minimum clinically important levels for the unrestricted and tolerance groups. Also bivariate correlations were calculated to examine the relationships among the measures of escape and avoidance behaviors and the escape/avoidance subscale of PASS-20. Finally, forced-entry regression analyses were performed to examine the relationships among the measures of escape and avoidance behaviors and fear, anxiety, and catastrophizing. (All analyses of task duration were conducted within the unrestricted and tolerance groups.) Cohen's d values of .20, .50, and .80 corresponded to small, medium, and large effect sizes, respectively⁶. Analyses were conducted using SPSS 13.0 (SPSS, Inc.).

Results

There were no statistically significant group differences in the age and sex of the participants in the unrestricted and tolerance groups. Also the baseline ratings of arm pain, fear, anxiety, and catastrophizing were similar between the two groups. Furthermore, there were no group differences in the manipulation check for participants' level of confidence that a second trial of the task to pain tolerance would be completed. (See Table 2.) Thus, our randomization of participants to balanced groups appeared to be successful.

The participants within the unrestricted group expected lower pain intensity ($t_{59} = -2.99$, $p < .01$, $d = .77$) and pain unpleasantness ($t_{59} = -2.18$, $p = .03$, $d = .56$) from the ischemic task. However, the mean levels of expected pain intensity and pain unpleasantness exceeded minimum clinically important levels for both groups. The participants within the unrestricted group stopped the ischemic task earlier than the participants within the tolerance group ($t_{59} = -4.15$, $p < .01$, $d = 1.06$). When task duration was controlled, the unrestricted group reported

lower pain intensity at task termination ($F_{2,58} = 4.34$, $p = .04$, $\eta^2 = .07$) than the tolerance group, but there was no significant group difference in pain unpleasantness ($F_{2,58} = 2.67$, $p = .11$, $\eta^2 = .04$). However, the adjusted mean levels of actual pain intensity exceeded minimum clinically important levels for both groups. There was no difference in the percentage of participants reporting less pain intensity than the minimum clinically important levels within the unrestricted and tolerance groups. (See Table 3.)

Within the entire sample, neither the participants' delay time before choosing to begin the second ischemic task nor the willingness to complete a second trial of the ischemic task to pain tolerance was significantly associated with the escape/avoidance subscale of Pain Anxiety Symptoms Scale ($r = -.21$, $p = .10$ and $r = -.14$, $p = .30$, respectively). In addition, within the unrestricted group, task duration was not associated with the escape/avoidance subscale of Pain Anxiety Symptoms Scale ($r = -.13$, $p = .50$). However, within the tolerance group, task duration was associated with the escape/avoidance subscale of Pain Anxiety Symptoms Scale ($r = -.40$, $p = .02$). The correlations between fear, anxiety, and catastrophizing were small, but significant ($r_s = .26 - .34$, $p < .05$).

Within the entire sample, neither the participants' delay time before choosing to begin the second ischemic task nor the willingness to complete a second trial of the ischemic task to pain tolerance was predicted by fear, anxiety, or catastrophizing. In addition, within the unrestricted group, task duration was not predicted by fear, anxiety, or catastrophizing. However, within the tolerance group, task duration was predicted by catastrophizing ($t_{29} = -2.92$, $p < .01$). (See Tables 4 and 5.)

Discussion

The objective of this investigation was to compare laboratory measures of escape and avoidance behavior in pain free participants. Evidence for the validity of delay time before beginning a painful task or willingness to complete a painful task as measures of avoidance of the onset of pain was not obtained. The measures were not correlated to the escape/avoidance subscale of the Pain Anxiety Symptoms Scale. Also they were not predicted by fear, anxiety, or catastrophizing.

Similarly, evidence for the validity of task duration with an unrestricted stop rule as a measure of avoidance of the onset of pain was not found. Task duration with the unrestricted stop rule was not correlated to the escape/avoidance subscale of the Pain Anxiety Symptoms Scale. Also task duration with the unrestricted stop rule was not predicted by fear, anxiety, or catastrophizing. However, some aspect of the methodology impaired the unrestricted stop rule (i.e., stop the ischemic task whenever they wanted) from eliciting avoidance of the onset of ischemic pain because a similar percentage of participants reported minimum clinically important levels of pain intensity at task termination in the unrestricted and tolerance groups.

The task duration within the unrestricted group was shorter, but the difference in task duration between the groups may have simply reflected that the participants in the unrestricted group did not feel obligated to endure pain from the ischemic task to tolerance. Perhaps the enrolled participants were willing to experience pain (i.e., selection bias)⁸ and/or were curious about the ischemic task. Regardless, uncertainty about the reasons for task termination within the unrestricted group was a limitation of this study. Avoidance of the onset of induced pain may be easier to elicit in chronic pain patients because most laboratory studies with healthy participants will be limited by the meaning of pain from brief, controlled, and non-damaging stimuli¹⁰.

In contrast, evidence for the validity of task duration with the tolerance stop rule as a measure of escape from pain or avoidance of exacerbations of pain was acquired. Task duration within

the tolerance condition was correlated to the escape/avoidance subscale of the Pain Anxiety Symptoms Scale. Also task duration within the tolerance condition was correlated to catastrophizing. Future investigations of task duration with a tolerance stop rule could assess participants' perceptions of stable or increasing pain level throughout a pain task in order to refine whether escape from pain or avoidance of pain exacerbation is being assessed. Attention to avoidance of pain exacerbation, in particular, is needed due to increasing recognition of the importance of pain exacerbations (i.e., breakthrough pain) within chronic noncancer pain patients^{2,30}.

It is noteworthy, that we did not locate any other investigations comparing the escape/avoidance subscale of Pain Anxiety Symptoms Scale to other indicators of pain avoidance (e.g., activity avoidance due to pain, self-care behaviors for pain, etc.) so the subscale should not be considered as the "gold standard" for measuring general tendencies to avoid pain. Certainly the subscale does not distinguish between escape and avoidance of the onset of pain and exacerbation of pain. In addition, the interpretation of our results may have been improved if pain threshold had also been measured in order to determine how long the participants persisted beyond pain onset. Furthermore, it is possible that the measure of delay time before beginning the ischemic task was influenced by the question regarding participants' confidence that a second task would actually occur. Some data should have been collected without the confidence measure for comparison. Finally, our conclusions about relations between avoidance measures and the Fear-Avoidance Model may have been enhanced by the inclusion of anxiety sensitivity and/or self-efficacy within a larger sample because these constructs have been advocated for inclusion in the Fear-Avoidance Model^{9,35}.

In summary, no behavioral measure of avoidance of the onset of laboratory pain in humans was supported by comparison to previously validated questionnaire measures of escape/avoidance, fear, anxiety, and catastrophizing. However, evidence for the validity of task duration with a tolerance stop rule as a measure of escape from pain or avoidance of exacerbation of pain was obtained. Future investigations of other measures of escape and avoidance behaviors such as physical performance are needed³⁵. In addition, it would be informative to integrate assessment of task persistence in future investigation of escape and avoidance behavior as it may be related to delayed escape. It has been advocated that continued activity (i.e., task persistence) can also be harmful when rest, protection, and/or guarding are recommended^{18,25}. Furthermore, these associations should be examined when using an induced pain model that resulted in longer duration pain (e.g., delayed-onset muscle pain) or in participants with concurrent clinical pain.

Acknowledgements

Support was provided from grants (1KO1 AR050146-01A1) from the National Institute of Arthritis and Musculoskeletal and Skin Diseases and University of Missouri School of Health Professions to Dr. Erin A Dannecker. The authors would like to thank all the participants who volunteered for this investigation.

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Figure 1.
Research design.

Table 1

Instructional sets for the unrestricted and tolerance groups.

	Instructional Set
First Ischemic Task – Unrestricted Group	After you have finished the hand exercise, you can stop the task whenever you want to. It is up to you to stop the task. Just say the word “STOP” loudly and clearly to the investigator when you want to stop.
First Ischemic Task – Tolerance Group	Please continue the task for as long as possible. When you cannot tolerate the pain below the blood pressure cuff any longer, say the word “STOP” loudly and clearly to the investigator.
Second Ischemic Task – Unrestricted and Tolerance Groups	Please continue the task for as long as possible. When you cannot tolerate the pain below the blood pressure cuff any longer, say the word “STOP” loudly and clearly to the investigator.

Table 2

Descriptive statistics for the baseline characteristics of the unrestricted and tolerance groups.

	Unrestricted Group		Tolerance Group	
	15 females	14 males	16 females	16 males
Sex				
Age (years)	19.17 (1.70)		20.28 (2.80)	
Fear (FPQ)	74.04 (18.94)		79.25 (14.71)	
Anxiety (STAI)	30.90 (8.87)		30.06 (6.54)	
Catastrophizing (PCS)	18.03 (8.89)		15.41 (10.20)	
Escape/Avoid Subscale (PASS)	8.76 (4.82)		8.19 (4.99)	
Expected pain intensity for ischemic task	1.83 (1.30) [*]		3.23 (2.20) [*]	
Expected pain unpleasantness for ischemic task	2.78 (1.93) [*]		4.01 (2.41) [*]	

Note. Means and standard deviations are presented.^{*} The groups were significantly different ($p < .05$).

Table 3

Descriptive statistics for the unrestricted and tolerance groups.

	Unrestricted Group	Tolerance Group
Delay time before second ischemic task (seconds)	1.48 (0.65)	1.67 (0.89)
Willingness to complete second trial	8.70 (1.99)	8.07 (2.12)
Pain intensity at first ischemic task termination	2.60 (1.91) *	3.67 (1.90) *
Pain unpleasantness at first ischemic task termination	4.01 (2.57)	5.15 (2.55)
Percentage of participants reporting less pain intensity than minimum clinically important levels at ischemic task termination	13.79%	9.38%
Confidence in future performance of a second ischemic trial to tolerance	9.05 (1.82)	9.13 (1.19)

Note. In general, means and standard deviations are presented except that adjusted means and standard deviations when task duration is controlled are presented for the actual pain ratings.

* The groups were significantly different ($p < .05$).

Table 4
Summary of the regression of Fear Avoidance Model predictors onto three different criterion measures of pain avoidance for the unrestricted group.

	R ²	B	SEB	Beta	t	p
Task duration	.08					
Catastrophizing (PCS)		.34	6.44	.02	0.05	.96
Anxiety (STAI)		-3.44	6.56	-.11	-0.52	.60
Fear (FPO)		-3.23	2.94	-.22	-1.10	.28
Delay time before beginning second ischemic task	.17					
Catastrophizing (PCS)		.01	.02	.12	0.63	.53
Anxiety (STAI)		-.01	.02	-.12	-0.63	.53
Fear (FPO)		.02	.01	.39	1.99	.06
Willingness to complete second ischemic task	.14					
Catastrophizing (PCS)		-.07	.04	-.30	-1.52	.14
Anxiety (STAI)		.05	.04	.21	1.05	.30
Fear (FPO)		-.02	.02	-.17	-0.87	.39

Table 5

Summary of the regression of Fear Avoidance Model predictors onto three different criterion measures of pain avoidance for the tolerance group.

	R ²	B	SEB	Beta	t	p
Task duration	.34*					
Catastrophizing (PCS)		-14.75	5.06	-.50	-2.92	<.01
Anxiety (STAI)		-5.63	8.17	-.12	-0.69	.50
Fear (FPQ)		-1.16	3.52	-.06	-0.33	.75
Delay time before beginning second ischemic task	.03					
Catastrophizing (PCS)		-.01	.02	-.14	-0.66	.51
Anxiety (STAI)		.02	.03	.12	0.58	.57
Fear (FPQ)		-.01	.01	-.14	-0.66	.51
Willingness to complete second Ischemic task	.13					
Catastrophizing (PCS)		-.01	.04	-.06	-0.33	.75
Anxiety (STAI)		-.12	.06	-.36	-1.86	.07
Fear (FPQ)		.02	.03	.14	0.71	.48

* A significant ($p < .05$) linear association was detected.