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Enduring Pain for Money: Decisions Based on the Perception and Memory of Pain

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ABSTRACT

We examine the relationship between memory for, and decisions about, pain. We test whether people's willingness to accept pain (WTAP) in exchange for money depends on whether they experienced a sample of a similar pain either moments earlier, or one week earlier. Inspired by Leventhal *et al.*'s two-factor theory of pain, we also manipulated whether subjects focused on, or were distracted from, their pain sensations. As predicted, although the distraction group displayed less WTAP than the sensation-focus group immediately after the initial experience, one week later they displayed *greater* WTAP. We also elicited WTAP and ratings of estimated pain intensity from a group of subjects who were given a description of the pain-induction procedure but did not actually experience it. These subjects exhibited greater WTAP, but similar ratings of pain intensity, compared with subjects who had experienced the pain either one week or moments earlier.

KEY WORDS pain; experienced utility; predicted utility; remembered utility

Utility is often treated as a unitary concept: we choose A over B because the utility of A exceeds that of B. At any one time, however, there are many ways of describing the utilities involved in any particular decision. These modes of description have been mapped out in a recent series of papers by Kahneman and his coworkers (Kahneman and Snell, 1990, 1992; Kahneman, Wakker and Sarin, 1997). Kahneman *et al.* (1997) suggest that we distinguish between four different variants of utility:

(1) *Experienced utility*. The utility actually experienced by decision makers when they consume or experience what they have chosen. Since choices are always made for the future, the magnitude of experienced utility cannot be known with certainty before the experience (e.g. March, 1978).
(2) *Remembered utility*. The utility of an experience, as recalled by the decision maker after it has occurred.

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(3) *Predicted utility*. The decision maker's prediction of their experienced utility.
(4) *Decision utility*. The utility as inferred from decisions. That is, if A is chosen over B then it has greater decision utility.

These four types of utility have complex interrelationships. To illustrate, experienced utility, after undergoing changes due to time and retrospective interpretation, becomes remembered utility. And predicted utility is a primary determinant of decision utility. Kahneman *et al.* (1997) propose an ambitious research program into each kind of utility and their relationships, and Kahneman himself has made a good start on this research. One line of work has been into the accuracy of predicted utility (i.e. the degree to which it is like experienced utility). This research has revealed a number of systematic biases in predictions of utility (for a recent review, see Loewenstein and Schkade, forthcoming). For example, people seem to exaggerate the importance of any particular factor to which their attention is directed (Schkade and Kahneman; forthcoming) and to underestimate their own powers of adaptation (Loewenstein and Frederick, 1997; Gilbert, Gill and Wilson, 1998).

Kahneman has also begun exploring the issue with which this paper is directly concerned: the relationship between remembered and predicted utility. When choosing for future consumption, if the alternatives between which we choose are similar to those which we have experienced before, it is natural to choose to repeat those experiences that we recall as pleasurable (i.e. those with higher remembered utility), and to avoid those which we remember as aversive. A bias in memory, therefore, can distort future-oriented decisions. If we remember an experience as having been better than it was, we are likely to invest too much effort into seeking, or too little effort into avoiding, similar experiences in the future. Likewise, if we remember an experience as having been worse than it was, we will be insufficiently motivated to repeat, or excessively motivated to avoid, similar experiences in the future. Kahneman *et al.* (1993) have shown that memories of pain are, in fact, often inaccurate, in that they are based on evaluations of some features of the pain stimulus (its peak magnitude, and its magnitude when it ends) but not on others which intuitively seem at least as important (notably, its duration). One consequence of this is that if people use their memories as a guide to decision making, they may end up choosing to experience a pain sequence that is dominated by its alternatives. For instance, an individual who conforms to the peak-end rule might prefer three minutes of pain — two minutes of intense pain plus one minute of moderate pain — over two minutes of intense pain (the same sequence minus the moderate pain) because the pain at the end of the longer sequence is lower than that at the end of the shorter sequence.

Although our study also examines memory for pain and its implications for decision making, our focus is different from that of Kahneman and his co-authors. Instead of studying how sequence properties influence pain memories, we examine how memory for pain, and decisions based on those memories, depend on the length of time that has passed since the pain was experienced as well as the individual's focus of attention when the pain is experienced. The decision which our subjects made was whether to accept, in exchange for monetary payments, an additional dose of the painful experience — a measure which we refer to as the willingness to accept pain (WTAP). The manipulation of attention focus was motivated by Leventhal's two-factor theory of pain, which holds that pain has two cognitive components, which we characterize as a *hot* component (the distress or emotional response to the experience) and a *cold* component (the perception of the sensory effects). In the next section, we elaborate on this theory and discuss its implications for pain memory and decisions made based on those memories.

THE TWO COMPONENTS OF PAIN

The cognitive orientation of someone experiencing pain has a strong influence on the perceived intensity of that pain, and the degree of distress that it causes (Melzack and Wall, 1982). One illustration of this is found in a series of experiments by Leventhal and his colleagues (H. Leventhal *et al*., 1979; Ahles, Blanchard and Leventhal, 1983), who found that people who attend to the sensation of pain typically judge it be less unpleasant than do those who try to distract themselves from it. In Leventhal *et al*.'s experiments, subjects immersed their fingers in ice-cold water and then judged the degree of distress that they experienced, while their attention was focused on either the pain or on something else. Focusing on the sensation led to less distress than did distraction. This surprising effect has been replicated many times and in a variety of contexts (e.g. E. A. Leventhal *et al*., 1989). To explain these findings, Leventhal *et al*. (1979) proposed that the experience of pain has two components: an informational (cold) and affective (hot) component. The informational component is composed of the objective features of the sensation, and the emotional component is the subjective stress or fear that it causes. Leventhal argued that sensation-focus and distraction have their effect on pain perception through their influence on the weight given to each component. When people attempt to distract themselves from pain they distract themselves from the informational component, and so their experience is primarily due to the distressing emotional component. Paradoxically, therefore, distraction increases distress. On the other hand, sensation-focus reduces distress by using up cognitive resources that might otherwise be applied to worrying about the pain.

Although Leventhal *et al*. emphasized the effects of distraction and sensation-focus on perception, focus of attention might also affect *memory* for pain. One of Leventhal *et al*.'s claims is that by focusing on pain we create and elaborate a schematic representation of that pain. A schema is formed, in part, by creating links between related concepts in memory (e.g. Anderson, 1983). When information is so integrated with other knowledge it becomes resistant to forgetting, and is also readily accessed. This occurs because, by linking new incoming information (such as the sensation of pain) to other information (previous pain experiences, information about the context in which we are experiencing the pain), we establish multiple pathways or 'routes' to the new information. Whenever these pathways are activated, they also activate the newly stored information. Likewise, activating this new information will also activate associated information. Consequently, if we recall an event that has been well integrated with other knowledge, we will also call to mind that other knowledge. Recently, Dar and Leventhal (1993) showed that focusing on pain apparently does lead to increased integration of memories of the pain experience with related information. They asked subjects whose hands were immersed in cold water to study a list of words related to the sensory or emotional features of coldness (e.g. 'ice,' 'frozen') along with unrelated words. Sensation-focus subjects later recognized more of the cold-related target words, and also incorrectly recognized more cold-related distractors, than did distraction subjects. The increase in incorrect recognition of cold-related words suggests that the original experience of cold became integrated with related knowledge. One implication of this finding is that sensation-focus will give rise to a durable and long-lasting memory of a painful experience.

Distraction, on the other hand, does not lead to construction of a schema that is closely integrated with semantic knowledge but rather to the activation of emotions. Indirect evidence that emotions may be less memorable than other types of information comes from recent research by Loewenstein and his colleagues. They argue that it is extraordinarily difficult to imagine what it would be like to be in a different emotional state than the one you are currently in. Loewenstein (1996) calls this an *intra-personal hot/cold empathy gap*. Evidence for these empathy gaps come from studies of *prediction* rather than memory. In one study, male college students who were not sexually aroused gave a lower estimate of the probability that they would behave aggressively on a date than did students who were aroused (Loewenstein, Nagin and Paternoster, 1997). Loewenstein *et al*. (1997) argued that the non-aroused students could not imagine how they would feel if they were aroused. Similarly, subjects who were not yet made curious (by attempting general knowledge questions without learning the correcting answers) underestimated the strength of their future curiosity (Loewenstein, Prelec and Shatto, 1998). This empathy gap apparently applies to memory for, as well as predictions of, behavior. This is illustrated by the self-recriminations that often occur 'the morning after' giving in to the urge to drink or eat excessively, to fight, or to have unprotected sex — recriminations which often take the form of 'how could I have ...' It is difficult for a decision maker, no longer subject to a strong emotional drive, to remember the strength that the drive once had. Applied to memory for pain, this implies that when a pain experience is coded for its emotional content, as occurs under conditions of distraction, the magnitude of its effect on preference will be forgotten (that is, not empathized with) when the individual is no longer in the emotional state under which it was encoded.

The preceding arguments give rise to seemingly paradoxical predictions concerning the relationship between the willingness to experience future pain and the manner in which earlier pain was encoded. Under conditions of distraction, remembered pain (i.e. *dis*utility) should be great for subjects who have just experienced the pain because they are still in the negative emotional state caused by the pain. However, this remembered pain is based on a short-lived emotional component which, after a delay, should be all-but-forgotten. Hence, under conditions of distraction, remembered pain should be high initially but decline rapidly as time passes. With sensation-focus, on the other hand, remembered pain should be relatively lower than with distraction immediately after the pain experience, due to suppression of the emotional component. However, under sensation-focus, memory for pain should be relatively stable over time because the memory is based on information that has been encoded for meaning.

Since predicted utility is based on remembered utility, sensation-focus and distraction should have an equivalent impact on decisions to experience future pain. Under conditions of distraction we should therefore expect willingness to accept pain to be initially low, but rise with the passage of time. Under conditions of sensation-focus, on the other hand, willingness to accept pain should be greater initially but should be relatively stable over time.

We tested these predictions in an experiment. Our dependent measure, willingness to accept pain (WTAP), was the choice of how much of a painful experience to endure in exchange for a specific amount of money. In the terms of Kahneman *et al.* (1997), WTAP is an index of decision utility. We compared immediate and one-week delayed WTAP of subjects who first experienced cold pain while distracted (the *distraction* group), or while focusing on it (*sensation-focus*). This yielded four experimental conditions: DIS/IMM (distraction coding, immediate WTAP), SENS/IMM, DIS/DEL and SENS/DEL. We predicted that, immediately after the experience, decision makers who focused on the sensations of pain would experience less distress and pain than would those who were distracted: DIS/IMM > SENS/IMM, where the symbol ' > ' indicates greater perceived or remembered pain. After a period of delay, however, we predicted that WTAP would be relatively unchanged for sensation-focus subjects SENS/IMM = SENS/DEL, but that WTAP would increase over time for distracted subjects: DIS/IMM > DIS/DEL. We combine the three predictions to yield the following composite hypothesis:

$$\text{DIS/IMM} > \text{SENS/IMM} = \text{SENS/DEL} > \text{DIS/DEL}.$$

Before describing our experiment, we discuss some methodological considerations in the study of pain memory.

METHODOLOGICAL ISSUES

Our study differs in many details from most prior studies of pain memory. As we discuss in this section, we believe that these changes reduce or even eliminate what we consider to be potential limitations of these earlier studies.

The willingness to accept pain plays a double role in our study. It is both a decision based on remembered pain and an index of that memory. As a measure of pain perception and memory, WTAP is different from the verbal measures and graphical scales used in most prior studies, and has several advantages over such methods. First, subjects are motivated to provide accurate responses to WTAP questions because their responses have real consequences. WTAP is thus designed to motivate truthful revelation of preferences and to reduce potential biases such as self-presentation effects. By the same token, subjects may be more likely to think carefully about their responses, thereby reducing errors due to careless responding. We are aware of only two other studies that have made use of decision-based indices of pain estimation. One is the study by Kahneman *et al*. (1993), already mentioned, in which subjects were first exposed to two separate pain experiences, and afterwards asked which experience they would prefer to repeat. In another, Christensen-Szalanski (1984) asked pregnant women who had previously given birth to indicate whether they would want to receive anesthetic when giving birth to their next child. Consistent with the hot/cold empathy gap, a large number of women stated that they did not want anesthetic, but subsequently changed their mind.

An additional advantage of WTAP is that it involves multiple measures — decisions involving different intervals of pain and different money amounts — which can increase reliability. Use of different money amounts and time intervals also allows for testing of pain sensation and memory over a wide range of pain intensities using the same instrument. For less painful stimuli, we would expect to see more of the useful variance occurring at low money amounts and long intervals of pain, with little variation between conditions or subjects at high money amounts or short intervals, which most subjects should be willing to accept. For very painful stimuli, on the other hand, most of the relevant variation should occur at high money amounts and short intervals. Few subjects will be willing to endure high levels of pain either for a long time or for little money.

Our study also differs from previous ones in that it is an experiment, rather than a clinical field study (see the review in Erskine, Morley and Pearce, 1995). In most other studies of pain memory, patients first report the pain they are experiencing and then, after a delay, report the pain that they *were* experiencing at the time of the initial report (e.g. Beese and Morley, 1993; Cogan, Perkowski and Anderson, 1988; Eich *et al*., 1985; Jamison, Sbrocco and Paris, 1989; Linton, 1991; Linton and Götestam, 1983; Linton and Melin, 1982; Norvell, Gaston-Johansson and Fridh, 1987; Porzelius, 1995; Rachman and Eyrl, 1989; Rofe and Algom, 1995). Most of these studies find that people usually give the same, or quite similar reports on both occasions. To cite a particular and much-discussed case, apart from Christensen-Szalanski's (1984) study, there is little evidence for the prevalent belief that labor pain is rapidly forgotten.[1] Overall, although there is occasional under-remembering (e.g. Norvell *et al*., 1987; Rachman and Eyrl, 1989) and over-remembering (Kent, 1985), looking across studies there is no definite trend in either direction. Pain intensity is judged to be approximately the same at the time of experience and after quite lengthy delays (Beese and Morley, 1993; Hunter, Philips and Rachman, 1979). On the face of it, this strongly supports the view that memory for pain is quite accurate.

The fact that almost all of these studies are conducted in the field, however, makes them vulnerable to two major methodological shortcomings. First, because there is usually no objective correlate for the magnitude of pain, the index to which delayed reports are compared is usually another report. Consequently, memory for pain is confounded with memory for this report. One solution to this problem, exemplified by Algom and Lubel's (1994) work, is to compare an objective correlate of pain with pain reports — in their case, the magnitude of uterine contractions experienced during childbirth with pain reports made either during or after labor. Another solution is to experimentally manipulate

[1] In what may be the best controlled study of the memory of labor pain, women actually remembered their labor pains as being worse than they actually were (Algom and Lubel, 1995). This study, discussed below, did not use the concurrent test/post test procedure.

the degree of pain which subjects are asked to recall. For example, Kahneman *et al.* (1993) had subjects experience two sets of cold water pain stimuli, one with their left hand and the other with their right hand. Yet a third solution, which we adopt in the study below, is to have one randomly chosen group provide pain ratings immediately after the experience, and have a different group recall the pain after a long delay. This design also allows us to test for the presence of anchoring effects, in which later reports are influenced by earlier ones.

An additional methodological problem with many studies is that pain memory reports, even when they are apparently accurate, may not reflect memory at all, but only prior beliefs and expectations about pain. Consistent with this view, Niven and Brodie (1995) found that women who had never given birth reported the same level of labor pain intensity as those who had. Presumably, those who had given birth could have given their reports without making any mnemonic reference to their experience, and there is evidence that in many similar situations this is exactly what people do. Autobiographical memory, especially of phenomena having a subjective component, such as bodily states and attitudes, is often strongly influenced, perhaps even completely determined, by intuitive theories of these phenomena (Ross, 1989). In a particularly pertinent example, McFarland, Ross and DeCourville (1989) compared women's daily reports of distress (including water retention and negative affect as well as pain) before and during menstruation, with their memory for that distress. Both women and men have strongly held, and largely erroneous, beliefs about the negative effects of menstruation (e.g. Tavris, 1992). McFarland *et al.* obtained strong support for the view that these beliefs actually drive memory reports. Although the daily reports revealed little or no increase in distress due to menstruation, in retrospect subjects remembered less distress before menstruation and more distress during menstruation. Indeed, their memories of menstrual symptoms corresponded more closely to their theories than to their daily reports. Another possible example of this phenomenon is the tendency for chronic pain patients to over-remember past pain after they have undergone treatment (Linton and Melin, 1982). Although the hypothesis has not been tested, we suggest that because these patients believe that their relatively ineffective therapies are more effective than they are, they remember past pain as being greater than it was in order to bring their memories in line with their theories about their treatment.

To ensure that intuitive theories cannot account for pain memory reports, it is necessary to obtain simulated reports from a control group who know about, but have not actually experienced, a pain source. It is only when the control group differs systematically from the experimental group that we can be certain that the experimental group's responses are actually influenced by the pain experience. In the experiment reported below, our subjects underwent an experience (submersion of their hand in ice water) that is usually experienced as unexpectedly painful. We predicted that a control group would underestimate the level of pain undergone by experimental subjects. As a consequence, the remembered pain on which experimental subjects based their WTAP should be greater than the predicted pain on which control subjects based theirs.

THE EXPERIMENT

Summary of method

We employed a five-cell design consisting of a 2×2 factorial design plus a control condition. Depending on the condition, subjects participated for either two or three sessions, with each session separated by one week. During the first session, subjects in the experimental conditions underwent 'pain induction' by immersing their hands in ice-cold water for 30 seconds. The two experimental factors were attentional focus and delay. Subjects either attended to the sensations of cold (*sensation-focus* condition) or were led to believe that the experiment was about manual dexterity (*distraction*). In addition, the dependent measures were taken either *immediately* after pain induction or following a delay of one week. Thus, as already observed, there were four experimental conditions: *SENS/IMM*, *DIS/IMM*, *SENS/DEL*, *DIS/DEL*.

We used five dependent measures. The first was willingness to accept pain (WTAP), which was the amount of time subjects were willing to keep their hands submerged in the ice water for $1, $3 and $5. In addition, subjects rated both the intensity of the pain, and how distressing it was, on a 7-point scale. Finally, subjects estimated their 'typical' tolerance and memory for pain on 7-point scales. These latter estimates were included as potential indirect measures of memory — that is, subjects who perceived the cold water as more painful might rate themselves as being less tolerant of pain and having a better memory for it.

Attentional focus was manipulated either by informing subjects that we were studying the 'perception and memory of cold', (sensation-focus), or by telling them that they were participants in a study of manual dexterity (distraction) under conditions of cold. In part to maintain circulation of the water (and thus a constant cold temperature), as well as to increase the plausibility of the cover story told to the distraction group, during pain induction all subjects held a nut and bolt in their submerged hand and screwed and unscrewed the nut with their thumb and forefinger. Distraction subjects were told that their performance on this task was the dependent variable of interest.

Because immersing one's entire hand in ice water is unexpectedly painful, we anticipated that control subjects would underestimate the pain. If this is the case, then the observed differences between control and experimental subjects on different dependent measures can be viewed as one test of the validity of these measures. That is, a valid measure of pain sensation and memory will distinguish between those who have experienced the pain and those who have not.

Method

Subjects

Eighty-two students and staff at the University of Illinois, Urbana-Champaign completed the experiment in exchange for a payment of $10 plus the possibility of up to $5 more. Nine subjects (not included in the 82) dropped out at some stage. Forty-eight percent of the subjects were male (39/82) and the mean age was 26 (range: 19 to 57). The subjects were recruited on the understanding that they would participate in three sessions spaced one week apart, although some were only required to come for two sessions.

Design and materials

Exhibit 1 depicts the sequence of events in the experiment. In week 1, all subjects except those in the control group underwent pain induction. They grasped a large metal nut and bolt in their right hand, and then immersed this hand into an insulated 2-liter bucket filled with very cold ice water (35°F, 2°C) for 30 seconds. While their hand was immersed they undid the nut from the bolt and then tightened it back on using their thumb and forefinger, repeating the task until the experimenter instructed them to stop.

Before immersing their hands, distraction subjects were given a cover story. We told them that we were studying hand coordination under conditions of cold, and then asked whether their current job, or any hobbies that they pursued, required fine motor coordination. If they responded in the affirmative they were asked to elaborate. Subjects then spent 30 seconds doing the bolt-tightening task without immersing their hands in water. The experimenter obtrusively recorded subjects' responses to these questions as well as the number of times they tightened and untightened the nut from the bolt.

Exhibit 1. Time sequence of experiment by delay conditions

	Session		
Condition	One	Two	Three
Immediate (*IMM*)	• Distraction or sensation-focus instructions • 30 second experience of ice water • All dependent measures — including WTAP1	• WTAP2 • Draw poker chip to determine which WTAP choice counts • Endure cold if poker chip drawn corresponds to 'yes' judgment	
Delay (*DEL*)	• Distraction or sensation-focus instructions • 30-second experience of ice water	• All dependent measures — including WTAP1	• WTAP2 • Draw second poker chip • Endure cold if poker chip drawn corresponds to 'yes' judgment
Control	• Pseudo distraction or sensation-focus instructions • All dependent measures — including WTAP1	• WTAP2 • Draw poker chip to determine which WTAP choice counts • Endure cold if poker chip drawn corresponds to 'yes' judgment	

Sensation-focus subjects were told that we were studying 'how people perceive and remember the experience of cold.' Just like the distraction subjects, they too practiced the nut-and-bolt task for 30 seconds, but they were informed that the purpose of the task was to ensure that the water temperature was constant.

Control subjects received the same initial instructions as the sensation-focus group. We then showed them the ice-filled bucket and explained the nut-and-bolt task to them. At this point, however, we informed them that although other subjects in the experiment actually performed the task for 30 seconds with their hand in the ice water, they would not be required to do so.

Following pain induction, the delay groups were scheduled to return in a week and then dismissed. At this point (in the first week for the immediate and control groups, but in the second week for the delay groups) all subjects stated their WTAP for the first time (WTAP1). They were presented with three money amounts ($1, $3, and $5) and five time intervals for each (1, 3, 5, 7 and 9 minutes). Each of the 15 money and time combinations was written on a separate line, and subjects ticked off a box corresponding to 'yes' (meaning they were. willing to immerse their hand in ice-cold water for that time in exchange for money) or 'no.' They were told that when they returned one week later one of the money and time combinations would be chosen randomly, and that their decision for that combination would 'count'. This meant that if they checked 'yes' for a combination, and that combination was randomly chosen in the draw, they would be asked to immerse their hand in the ice water for the specified period, and would be paid the agreed upon amount for doing so. They were also informed, however, that if they failed to hold their hand in the water long enough, they would not receive the extra money. If they checked 'no' on the chosen line, they would neither be asked to submerge their hand nor would they receive any extra payment. Although they were later given a chance to change their minds (WTAP2), at the moment when they made their first choices subjects were led to believe that these choices would count.

After providing WTAP1, subjects gave two additional measures of pain memory (the control group questions are in brackets):

> How intense was the pain? [How intense do you expect the pain to be?] (1 = Very mild; to 7 = Extremely intense)
> How distressing was the pain? [How distressing do you expect the pain to be?] (1 = Hardly at all; to 7 = Extremely unpleasant and distressing).

In addition, all subjects gave their opinion concerning their usual pain tolerance and memory for pain:

> Would you say you have a high or low tolerance for pain? (1 = Very low tolerance; to 7 = Very high tolerance)
> Would you say that you have a good or poor memory for pain? (1 = Poor memory; to 7 = Good memory)

After answering these questions subjects were asked to return one week later. Upon returning, subjects first stated their WTAP a second time (WTAP2). They then drew a poker chip from a bag containing chips numbered 1 through 15. If they picked a number corresponding to a WTAP2 decision of 'no' (that is, they did not want to submerge their hand for that period of time), they were paid $10 and dismissed. If they picked a number corresponding to a 'yes' decision, they immersed their hand in cold water and, if they did not withdraw their hand before the designated time was up, they received the additional payment (of $1, $3 or $5) as well as $10. Subjects who withdraw their hands before the agreed-upon time received only $10.[2]

RESULTS AND DISCUSSION

Tests of sensation/distraction hypotheses

As already discussed, there were five measures of the intensity of remembered pain: WTAP, a direct rating of pain *intensity*, the degree of *distress* that it caused, and the indirect measures of *self-rated memory* of and *tolerance* for pain.

We operationalized WTAP as the number of money/time combinations agreed to by each subject (ranging from 0 to 15). Exhibit 2 depicts the mean values for WTAP1. We tested the prediction introduced above, that WTAP estimates would be ordered in the following way:

$$\text{WTAP1}: \ \text{DIS/IMM} < \text{SENS/IMM} = \text{SENS/DEL} < \text{DIS/DEL}$$

(Note that for WTAP, smaller numbers mean that pain is judged to be greater). Inspection of these means shows that WTAP1 does follow this ordering. In order to test this composite hypothesis we conducted a contrast analysis testing for the presence of a linear trend (Keppel, 1982; Rosenthal and Rosnow, 1985). We assigned all WTAP1 judgments in *DIS/IMM* to Group 1, those in *SENS/IMM* and *SENS/DEL* (because they were predicted to have the same mean) to Group 2, and those in *DIS/DEL* to Group 3. We then tested for the presence of a significant linear trend in which group 1 < group 2 < group 3. The analysis was highly significant, $F = 5.1$, $p < 0.01$. For WTAP1, at least, our results are as predicted from our interpretation of Leventhal *et al.*'s (1979) theory.

We also conducted separate *t*-tests to determine if the individual pairs of means differed significantly. Based on the hypothesized cold–hot empathy gap we had predicted that there would be a shift in pain

[2] Few subjects in any condition, except for the control group, actually drew a number corresponding to a 'yes' decision. In the experimental groups, all but one successfully held their hand in for the appointed time.

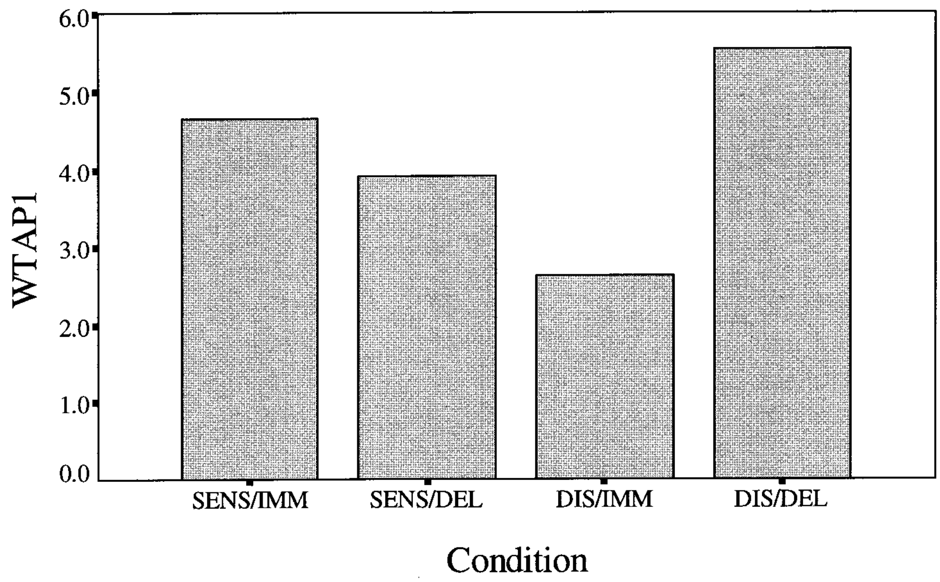

Exhibit 2. Willingness to accept pain as a function of experimental condition

memory in the distraction group, such that *DIS/IMM* < *DIS/DEL* and this prediction was supported, $t(35) = 2.31$, $p < 0.03$. An additional important test is of the prediction that *SENS/IMM* = *SENS/DEL*. It is clear from inspection of the means that there is little difference between them, and this was confirmed by the formal analysis ($t < 1$).

Exhibit 3 shows the mean values of the remaining dependent variables. Only one of these variables, distress, shows the predicted ordering of results:

$$\text{Distress}: \ \text{DIS/IMM} > \text{SENS/IMM} = \text{SENS/DEL} > \text{DIS/DEL}$$

(Note that for distress, as well as for the secondary measures of intensity and memory for pain, higher numbers mean that pain is judged greater.) A linear trend analysis revealed a significant trend for distress, $F = 7.5$, $p < 0.01$, although, as expected, there was no suggestion of a trend for the remaining measures (all *F*s < 1). A separate *t*-test of the prediction *DIS/IMM* > *DIS/DEL* was also significant for distress ($t(35) = 2.87$, $p < 0.01$), while a comparison between *SENS/IMM* and *SENS/DEL* was non-significant ($t < 1$).

Exhibit 3. Secondary measures of pain perception and memory as a function of experimental condition

	Sensation		Distraction	
Measure	Immediate	Delayed	Immediate	Distraction
Distress ratings[a]	2.8 (2.1)	2.7 (1.8)	2.1 (1.2)	3.7 (2.0)
Intensity ratings[a]	2.7 (1.7)	2.5 (1.3)	2.7 (1.5)	3.1 (1.7)
Memory for pain[a]	2.9 (1.4)	2.7 (1.4)	2.2 (1.6)	2.1 (1.6)
Tolerance of pain[b]	4.0 (1.4)	4.0 (1.4)	4.1 (1.2)	4.5 (1.7)

[a]Lower numbers mean pain is greater.
[b]Higher number means pain is less.

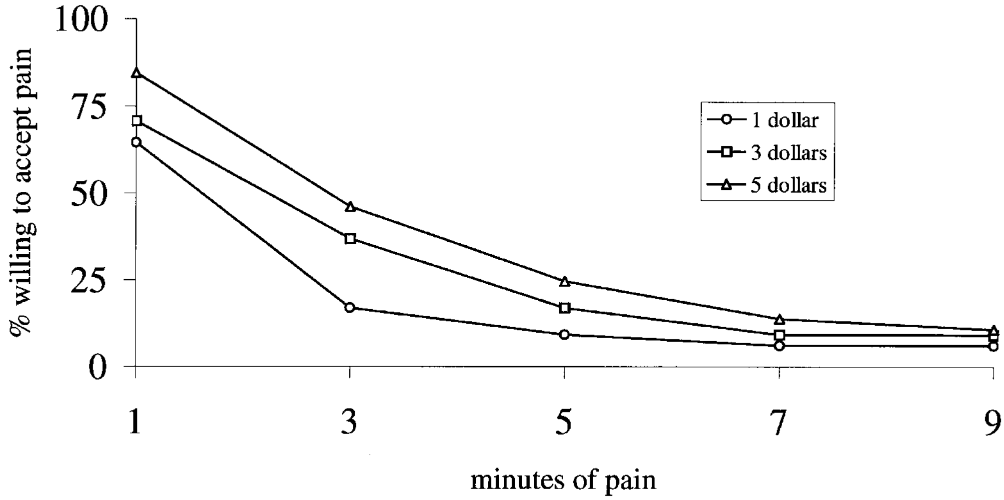

Exhibit 4. Percent of subjects willing to accept each duration of cold water pain for each amount of money

Inspection of the mean ratings for general pain memory gave rise to the (admittedly *post-hoc*) speculation that those in the distraction groups judged themselves to have better memories for pain than those in the sensation focus groups. A *t*-test did not confirm this speculation ($t(66) = 1.66$, $p = 0.1$), although the trend was sufficiently strong to warrant further investigation.

One of our primary concerns was with whether WTAP is superior to other measures for distinguishing between experimental conditions. There is no basis for concluding that, in this regard, it is superior to distress ratings which were at least as sensitive as WTAP to the differences between the experimental conditions. Both distress and WTAP1, however, were superior to the remaining secondary measures.

Exhibit 4 shows the percent of subjects willing to accept pain as a function of monetary consumption and duration of pain. Not surprisingly, subjects' willingness to accept a given pain increases as a function of the amount of money they will be paid for accepting it. Also, WTAP declines as a function of the duration of the pain. This shows that duration neglect, as document by Kahneman and his colleagues (1993; Fredrickson and Kahneman, 1993; Redelmeier and Kahneman, 1996), is an inherently retrospective phenomenon. In recall, people may not encode the duration of pains they have experienced in the past. But duration is very important to people when they make decisions about future pains of specified duration.

Comparisons between control and experimental groups

Niven and Brodie (1985) found that the pain 'memories' of a control group who had never experienced labor pain did not differ from those of a group who had. Although we replicated this finding for conventional measures of memory, WTAP clearly distinguished between experimental and control groups. Exhibit 5 presents the means for all dependent variables, contrasting the control condition with the pooled results from all experimental conditions. Control and experimental groups gave virtually identical ratings of pain intensity and distress, as well as the implicit measures of memory for, and tolerance of, pain. In contrast there were sizable difference between the two groups for both WTAP1 ($t(80) = 5.01$, $p < 0.001$) and WTAP2 ($t(80) = 4.19$, $p < 0.001$).

Exhibit 5. Comparisons between control and pooled, experimental groups

	Group	
	Experiment	Control
WTAP1[a,b]	4.2 (4.0)	9.9 (4.5)
WTAP2[a,b]	3.9 (3.7)	8.1 (3.8)
Intensity ratings	2.8 (1.6)	3.1 (1.3)
Distress ratings	2.9 (1.9)	3.2 (1.4)
Memory for pain	2.8 (1.5)	2.5 (1.3)
Tolerance of pain	4.5 (1.5)	4.7 (1.5)

[a]Higher numbers mean less judged pain.
[b]Control and experimental group differ significantly at $p < 0.01$.

Exhibit 6. Correlations between WTAP1 and WTAP2, for all conditions

Condition	*r*
SENS/IMM	0.90
SENS/DEL	0.93
DIS/IMM	0.96
DIS/DEL	0.94
CONTROL	0.75

All *p*s < 0.001.

Comparisons between WTAP1 and WTAP2

One of the methodological concerns raised above was whether memory reports might be based on, or at least influenced by, recollections of earlier reports rather than recollection of earlier pain. We measured WTAP on two occasions, and this permitted us to determine the extent to which they are related. We conducted two relevant analyses. First, we looked at the correlation between WTAP1 and WTAP2. A low correlation between the two measures would eliminate the hypothesis that WTAP2 is based on WTAP1, while a very high correlation between the two would be consistent with (but would not prove) this hypothesis. Exhibit 6 presents the correlation coefficients for each condition. As can be seen, for all conditions the correlation coefficient is significantly greater than 0, and is extremely high in absolute terms. Even more telling is the percentage of subjects who made identical WTAP judgments on both occasions. For 51% of subjects WTAP1 and WTAP2 were identical, while for an additional 26% they differed by only 1.

A second comparison is between memory reports that differ only in whether they have been preceded by another report. In our case, we have two such conditions: WTAP2 in both of the *IMM* conditions is comparable to WTAP1 in the corresponding *DEL* condition. Exhibit 7 depicts the mean WTAP1 and

Exhibit 7. Mean WTAP1 and WTAP2 for all conditions

	Sensation		Distraction		
Measure	Immediate	Delayed	Immediate	Delayed	Control
WTAP1	4.7 (4.4)	3.9 (3.9)	2.6 (2.8)	5.6 (4.8)	9.9 (4.5)
WTAP2	4.1 (4.0)	3.3 (3.1)	3.1 (3.2)	4.8 (4.1)	8.1 (3.8)
Difference	0.6	0.6	−0.5	0.8	1.8

WTAP2 for all conditions. Of particular interest for the present purpose is the comparison between WTAP2(*DIS*/*IMM*) and WTAP1(*DIS*/*DEL*). If WTAP2 is based wholly on the earlier experience, then these two values should be equal. In fact, they differ significantly, $t(35) = -1.86$, $p < 0.05$. It is clear that WTAP2(*DIS*/*IMM*) is closer to its antecedent, WTAP1 (*DIS*/*IMM*), than to the theoretically identical WTAP1(*DIS*/*DEL*). As with the correlational analysis, this again suggests that WTAP2 is based in large part on WTAP1.

Although WTAP2 is partially anchored on WTAP1, subjects did change their minds. As can be seen in Exhibit 7, most groups reduced their WTAP from time 1 to time 2. Combining all groups together, the average drop from WTAP1 to WTAP2 was 0.63, $t(81) = 2.9$, $p < 0.005$, with every group showing a drop except *DIS*/*IMM*. We attribute subjects' tendency to reduce their WTAP to an 'immediacy effect' (Prelec and Loewenstein, 1991) — subjects are no longer how much pain they are willing to experience next week, but *right now*.

It is clear from Exhibit 6 that the overall decrease in WTAP conceals an important between-group difference. The *DIS*/*IMM* group *increased* their WTAP, an increase which was marginally significant ($t(16) = 2.1$, $p < 0.06$). But the difference is not marginal when seen in the context of the decrease in the remaining conditions. This suggests that those in the *DIS*/*IMM* group did forget the magnitude of the original pain experience, and that this forgetting was sufficient to offset the decrease in WTAP2 attributable to the immediacy effect. Thus, WTAP2 is probably influenced by the (fading) memory for the pain experience as well as by the earlier reported WTAP1.

DISCUSSION

We conclude by briefly examining several issues raised by our work. First, we ask what it means to remember the utility of experiences. Then we consider some more applied questions: whether WTAP is superior to other measures of pain memory (we argue that it is, and should be used more), and whether sensation-focus is always the best way to deal with pain.

What does it mean to 'remember' utility?

As we observed above, a growing body of research into remembered utility shows that it does not always correspond to experience utility. One reason for this is that the cognitive processes that occur during an experience can lead us to store different features of it, and these stored features are the basis for subsequent recall. For instance, Kahneman's studies showing duration neglect suggest that we create a memory trace of the peak of the experience and its end, but that there is little or no trace of its duration. Consequently, when we 'remember' the utility, we are actually recalling representations of two incomplete determinants of that utility, from which we then construct our memories.

A related argument been made in the mainstream literature on pain memory. Morley (1993), for instance, has distinguished between the *reexperiencing*, or actual reliving of pain, and remembering *that* a pain had occurred. Morley argues that sensory experiencing either does not exist or is extremely rare, and that pain memory is usually of the second variant. In one of his studies in which subjects recalled a painful experience and then gave reports on the form of that memory, not a single subject reported actually reexperiencing the pain. In line with this, Fienberg, Loftus and Tanur (1985) ended their review of pain memory by asking: 'Is it pain that people recall or is it really the events such as injuries and severe illnesses?' (p. 592). The implication is that it is from memories of events that people construct their representations of past pain. Just as we could remember a pain as being extremely bad because we remember that it was very bad at its worse, so we might remember a pain as being bad because it was caused by a fall from a great height.

We believe that this inability to reexperience pain is at the heart of the distinction between the sensory-focus and distraction conditions of our experiment. When people focus on the sensations of pain, they encode some of those sensations in a language which can later be recalled, and then transformed into a memory or a decision. When they are distracted, however, they end up learning mainly the emotional component of the pain. This emotional component may be central to the experience of pain, but it cannot be reexperienced. We might remember that we were in pain, but that recollection is not the pain itself. The cold-to-hot empathy gap is attributable to this universal failure of imagination, which occurs not only in memory, but also in intrapersonal and interpersonal prediction, and which applies not only to pain but to a wide range of other 'visceral factors' (Loewenstein, 1996).

The usefulness of WTAP as an index of memory

We assessed WTAP in three closely related ways. First, we compared the WTAP of experimental groups who had experienced pain induction to a control group who had not. Second, we examined the sensitivity of WTAP to the effects of attentional focus. Finally, we compared the performance of WTAP to that of judgment-based indices of pain memory. We conclude that WTAP should be the measure of choice whenever it can be used to measure pain memory. First, it was the only measure that distinguished between control and experimental subjects. This is an important finding because of recent suggestions that memory reports, and perhaps especially reports of pain, are highly influenced by personal theories of what pain is. In addition, WTAP was sensitive to our experimental manipulations. Finally, of our judgment measures, only distress was comparable to WTAP in its ability to distinguish between conditions. Even distress judgments, however, did not distinguish between control and experimental subjects.

WTAP is not, of course, always a practical measure of pain memory and perception. For example, it would be unethical and impractical to ask people how much they would need to be paid in order to experience a medical procedure that they needed (or worse, that they did not need). However, in some circumstances it might be possible to formulate a hypothetical choice question that would incorporate an element of decision making, such as 'how much would you pay to obtain an effective pain-killing drug?' Whether such questions would yield valid information depends on how critical it is that WTAP responses actually count. Perhaps simply using a decision-based format, whether hypothetical or real, is sufficient to obtain the advantages of WTAP that are evident in our experiment.

The usefulness of sensation-focus and distraction as moderators of pain experience and memory

Most discussions of the practical use of distraction and sensation-focus have been restricted to their effects on the immediate experience of pain. Sensation-focus is sometimes prescribed as a technique for mitigating pain (e.g. E. A. Leventhal *et al.*, 1989). The effects of sensation-focus and distraction on memory, however, suggest that the story is more complex. Sensation-focus reduces the unpleasantness of experienced pain, which is almost always desirable. But, at least in the conditions sampled in our study, distraction apparently reduces the unpleasantness of *remembered* pain. Whether sensation focus or distraction is the best pain-management procedure, therefore, may depend not only on whether it is better to suffer more or less from the pain stimulus itself, but also on whether it is better to remember or forget pain.

In many situations accurate pain memory is a good thing because it gives decision makers an accurate view of negative consequences. In such situations, focusing on the experience of pain is doubly beneficial because it not only mitigates pain severity but also enhances the accuracy of memory for that pain. Consider, for example, the treatment of drug addiction. Drug craving, like other pains, has both an affective and sensory (or 'somatic,' as Markou and Koob, 1997, call it) component. The ideal situation, insofar as drug treatment is concerned, is for addicts not to be overwhelmed by intense cravings (so they don't relapse), but also to remember how intense and unpleasant their cravings are (so they don't risk exposing themselves to situations that could induce craving). Our research suggests that by focusing on the craving experience addicts may be able to reduce its intensity (relative to attempts at distraction) while simultaneously consolidating the memory for that craving.

In other cases, there is no apparent benefit from recalling pain, and it is probably better to just forget the pain altogether. Someone who has undergone a painful medical procedure, for instance, might not be able to improve their future decision making by remembering the pain, and they may well be unnecessarily burdened by its memory and even delay further treatment. For these people, the costs of the increased pain that comes from distraction might well be outweighed by the benefits of forgetting.

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