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The role of values with personal examples in altering the functions of pain: Comparison between acceptance-based and cognitive-control-based protocols

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Abstract

The purpose of the present study was twofold. First, to compare the effect of establishing a motivational context of values on pain tolerance, believability, and reported pain, with three experimental conditions: pain acceptance (ACT condition), pain control (CONT condition), or no values (untrained condition). Second, the study aimed to isolate the impact of adding the corresponding coping strategies to both the ACT and the CONT conditions. Thirty adults were randomly assigned to one of the three experimental conditions. The participants went through the pain task in two occasions (Test I and Test II). In Test I, the effects of the ACT-values protocol (which established pain as part of valued action), the CONT-values protocol (which established high pain as opposed to valued action), and the no-values protocol, were compared. In Test II, the effect of adding the corresponding coping strategy to each condition (defusion for ACT vs. suppression for CONT) was examined. Test I showed a clear superiority of the ACT-values protocol in increasing tolerance and lowering pain believability. In Test II, the superiority of the ACT protocol was replicated, while the CONT protocol proved useful to reduce reported pain, in accordance with previous studies.

Keywords: ACT; Acceptance; Pain; Values; Suppression

Introduction

Recent controlled studies have shown the superiority of acceptance-based (ACT) protocols in comparison with cognitive-control-based (CONT) protocols to cope with laboratory-induced pain (Gutiérrez, Luciano,

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Rodríguez, & Fink, 2004; Hayes, Bissett et al., 1999 Hayes et al., 1999; Masedo & Esteve, 2007; Páez-Blarrina et al., in press). These studies differ in the methodological controls employed to better isolate the components of both the ACT and the CONT protocols; however, the results of all of them highlight the importance of values. Values are defined as verbally constructed, global, desired and chosen life directions (Hayes, Strosahl, & Wilson, 1999).

In the first of these pain studies (Hayes, Bissett et al., 1999), two multi-component protocols (ACT-based protocol vs. CONT-based protocol) were compared for their effectiveness to cope with the pain induced through a cold pressor procedure. Values were addressed in a general non-explicit way in the ACT protocol, and values involved in the CONT protocol were not considered at all. The results suggested that the ACT protocol produced a larger increase of pain tolerance and reduction of the believability of thoughts and sensations as reasons for actions than either the CONT protocol or a placebo condition. No differences were found in the subjective experience of pain across conditions. Masedo and Esteve (2007) used similar protocols (ACT vs. supression vs. spontaneous coping) and they replicated the superiority of the ACT protocol in increasing pain tolerance. However, contrary to Hayes, Bissett, et al.'s findings, participants in the ACT condition reported less pain and distress in the immersion and recovery periods than did the participants in the other conditions. In a study with a different pain induction procedure, Gutiérrez et al. (2004) incorporated specific methodological controls aimed at better isolating the differences among protocols. First, the two protocols in this study (ACT vs. CONT), were equalized in regard to both the formal (e.g., number of rhetoric elements) and the functional components (presentation of a value or purpose to the task). Second, the utilization of increasingly aversive discrete electric stimulation (instead of the cold-pressor task) allowed for a more systematic manipulation and analysis of the results. Third, an explicit motivational context was given to make sense of the pain task (e.g., connecting the participants' performance during the pain task with the value of helping the researchers learn more about how people cope with chronic pain). Results showed that, for the CONT protocol (which attempted to modify private contents), only the subjects reporting lower levels of perceived pain increased their pain tolerance. Conversely, subjects in the ACT condition (which was intended to disconnect private contents from literal actions), increased pain tolerance even when they perceived high levels of pain. Although the employed methodology proved successful, it did not allow the isolation of the effect of the motivational context by itself, and it could be argued that the establishment of an overall value-oriented context at the very beginning of the experiment might have altered the functions of pain right during the pre-test, and then contaminated the pre–post comparison for both conditions.

This aspect was addressed by Páez-Blarrina et al. (in press) in a study with an identical pain-induction procedure to that in Gutiérrez et al. (2004). Here, the participants went through the first pain task (pre-test) after the sole presentation of the informed consent and basic information regarding the shocker calibration and voltage-level selection. All the participants in either condition showed a very low pain tolerance. After the pre-test, the values-oriented protocol was introduced for the first time, which also included either an ACT or a CONT-based strategy for coping with the pain. Specifically, in the ACT condition, pain was integrated as part of a valued direction by utilizing examples of varied circumstances where people persist and keep doing activities in spite of very severe discomfort. In the CONT condition, pain and valued action were established as somehow incompatible, by utilizing examples of varied circumstances where people give up important things because of the pain they feel. The specific pain-coping strategies, each coherent with the respective orientation given, were presented by means of a metaphor and an exercise in a similar manner to Gutiérrez et al. (2004). During post-test, pain tolerance increased and self-reported pain decreased in both conditions. However, pain believability (measured as giving up the task upon reporting "very much pain") was significantly different between conditions, getting considerably reduced in the ACT condition as compared to the CONT condition. Recently, McMullen et al. (in press) have replicated these findings employing the same experimental task as in Gutiérrez et al. (2004) and Páez-Blarrina et al. (in press). In addition, the McMullen et al.'s study has shown that when acceptance and distraction strategies are directly instructed, a very low pain tolerance is found in both conditions.

To date, however, no study has isolated the personal values component of acceptance vs. cognitive control without training any coping strategy. This is the main purpose of the present study. Briefly, participants went through the pain task in two occasions (Test I and Test II). Before going through Test I, values-focused protocols were applied across three experimental conditions. The ACT values-focused protocol involved the

integration of pain in a valued direction; the CONT values-focused protocol involved establishing pain as incompatible with valued actions; in the untrained condition, no value was given to the pain. Before Test II, participants received an additional protocol including the corresponding pain-coping strategy (defusion for ACT vs. suppression for CONT). Pain tolerance, self-reports of pain and pain believability were measured during Test I and Test II.

Method

Participants

Thirty-five undergraduate students volunteered to participate in the study. One student was excluded because of inappropriate medical conditions, three students refused to participate when experimental conditions were explained to them, and one student discontinued participation before the completion of the study. The final sample consisted of 30 participants (21 women, 9 men) aged 18–31 years (mean 22.67 years, SD = 2.77).

Experimental setting and apparatus

Sessions were conducted in two rooms in the human operant behavior laboratory at the University of Almería. One room contained the apparatus for the pain task and the other room was used to implement the experimental protocols.

The pain task, controlled by software programmed in Visual Basic (6.0), required an electric shock stimulator and a personal computer. A Lafayette 824151S isolated square-wave stimulator was used to generate the electric shocks. The aversive stimulation consisted of a train of pulses delivered to the volar surface of the left forearm via two round electrodes (10 mm in diameter and 2 cm apart). A laptop computer (Pentium 4—Compaq nx 9010H.P.) served to control the presentation of visual stimuli (nonsense syllables and a red asterisk) on the screen, the presentation of visual analogue scale (VAS), the synchronized administration of electric shocks, and the delivery of points.

Experimental design

The participants were randomly assigned to one of the three experimental conditions: ACT, CONT, and untrained. The ACT and the CONT conditions involved two protocols each, respectively administered before Test I and Test II. The first part of each condition consisted of a values-focused protocol, and the second one consisted of a coping strategy. Participants in the untrained condition did not receive any specific protocol, but just the informed consent and information regarding voltage-level selection procedures, apparatus calibration, and task description. Participants were run individually according to the following sequence: First, the participants received either the ACT values-focused protocol, the CONT values-focused protocol, or the untrained condition. Then, all of them went through the first pain task (Test I). Participants who reached the top criterion of 15 shocks in Test I were dropped at this point. The remaining participants received the corresponding coping protocol, either ACT defusion or CONT suppression. Participants in the untrained condition again received instructions concerning the apparatus and the task. Subsequently, they all went through the second pain task (Test II). A brief description of the pain task and the experimental protocols follows.

Pain task

A matching to sample (MTS) task identical to that in Gutiérrez et al. (2004) and Páez-Blarrina et al. (in press) was used. For each trial, four stimuli (nonsense syllables) were presented simultaneously on the computer screen. The sample appeared at the top center of the screen and the three comparison stimuli appeared at the bottom of the screen. Participants were instructed to "look at the nonsense syllable at the top and then choose the identical nonsense syllable from the bottom." If participants performed correctly across trials they received points (according to a variable-ratio 9 schedule) that could be exchanged for a reward at

the end of the session (a coupon exchangeable for a snack at the student canteen). At different times throughout the task a red asterisk appeared on the screen, which signaled the opportunity to choose whether to continue or finish with the task. That is, the participants could avoid being shocked and stop performing the task by choosing the "FINISH" option on the computer screen, or they could choose the "CONTINUE" option, which meant being willing to be shocked and earn more points. The task was, thus, designed to be an analogue of pain experiences that involve a conflict situation. After receiving the shocks, subjects rated how painful the shock had been on a VAS. Then, they could continue with the task. The red asterisk was presented after a variable number of MTS trials (an average of eleven). In each subsequent shock presentation, the shock duration and the frequency (number of pulses per second) were increased linearly so that pain magnitude increased throughout the scheduled range of stimulation (see Table 1). The maximum number of shocks to be delivered was 15, but participants had no knowledge of this limit.

Two measures were collected during the pain task procedure: (1) pain tolerance, defined as the maximum number of shocks that a participant chose to receive during the task; (2) self-report of experienced pain after each shock, measured with a VAS which consisted of a 100 mm line displayed in the computer screen with "no pain" at one end and "very much pain" at the other end.

Experimental protocols

Values-focused protocols: The ACT values-focused protocol was aimed at establishing a motivational context where pain-related thoughts and sensations were disconnected from literal actions. The CONT values-focused protocol was aimed at setting up a motivational context where pain-related thoughts and sensations were connected to literal actions. Both protocols specified, (i) the aims of the study and its clinical implications, (ii) the relation between pain and valued actions through general and specific personal examples; (iii) the functional equivalence between those general and personal examples and the pain task (see Procedure for details).

Coping protocols: They consisted of a coping strategy (acceptance/defusion vs. control/suppression) for coping with pain, which was coherent with the value context previously established with the first protocol. The ACT-defusion protocol was aimed at promoting that the best way to continue with the task and get important outcomes when pain was present, was just to notice and observe the pain-related thoughts and sensations; that is, being willing to experience these private events while acting in valued directions. On the contrary, the CONT-suppression protocol was aimed at promoting that the best way to continue with the task and get important outcomes was to move all the pain thoughts and sensations away from mind. Both protocols included three elements: (i) examples to enhance the specific relation between pain and valued actions, (ii) and the Swamp metaphor, along with (iii) an experiential exercise, all these elements adapted so as to be coherent with the strategies being established (defusion vs. suppression) (see Procedure for more details).

Precautions were taken to isolate the effects of the ACT vs. CONT experimental conditions. The ACT and CONT values-focused protocols were equal in: (a) formal components, (b) duration (approximately 20 min), (c) number of connections between pain and values, and (d) number of instructions given to encourage continuation in the pain task for as long as possible. In regard to the coping protocols (defusion vs. suppression), they were also equal in: (a) rhetoric components (both involved the thoughts and sensations experienced during the pain task, one metaphor and one experiential exercise), (b) duration (25 min), (c) number of instructions concerning the implementation of acceptance or control-based strategies, (d) number of opportunities to practice the strategies, (e) number of connections between the participant's pain-related thoughts and sensations during the first pain task and the elements of the protocol, and

Table 1
Frequency (pulses/s) and duration (s) through successive electric shocks in the pain task

	Successive shocks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Frequency (pulses/s)	1	2	3	2	3	4	3	4	5	4	5	6	5	6	7
Duration (s)	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5

(f) number of instructions given to encourage continuation in the second pain task for as long as possible. Two different experimenters participated in order to avoid inadvertent experimenter contamination. Experimenter 1 conducted both phases of the pain task and Experimenter 2 implemented the experimental protocols. Experimenter 1 was blind to the protocol assigned to each participant and Experimenter 2 was blind to the subject's level of achievement in the pain task. The protocols were scripted word-by-word and the intervention with each participant was video-taped during the protocol application. Two observers rated experimenter adherence by means of a 0–10 scale. Inter-observer agreement was appropriate for the protocols in all the experimental conditions (kappa $(w) > .80$).

Procedure

Pre-screening

Participants were recruited through in-class announcements for participation in research concerning health psychology. An individual appointment was made and Experimenter 2 briefly interviewed each participant about his or her medical history in order to exclude persons who might be placed at risk by participating. Each participant completed a Statement of Informed Consent that contained the appropriate information for participation in a pain investigation (Casarett, Karlawish, Sankar, Hirschman, & Asch, 2001). Upon the participant's consent to participate, Experimenter 2 invited the participant to go into the other room, where Experimenter 1 was waiting.

Voltage-level selection and task description

Experimenter 1 invited the participant to take a seat and placed the electrodes on the participant's forearm. He informed that the participant would be receiving a series of shocks of increasing intensity in order to determine the voltage level of the shocks that would be delivered during the pain task. After each shock, the participant was asked to rate on the VAS how painful it had been. The voltage was initially set at zero and increased gradually for each shock until the participant first marked beyond three quarters of the scale. The voltage corresponding to this rating was set as the stimulation voltage level that would be kept constant for that participant during the pain task.

The experimenter then removed the electrodes and gave the participant the specific written instructions about the pain task that included information about: (i) what s/he had to do in the matching-to-sample trials; (ii) the choices that s/he could make (either to continue or to quit) while the red asterisk was displayed on the screen; (iii) the gradual increase of the duration and frequency of electric shocks, and (iv) the points that the participant would gain by continuing with the task, which would be exchanged by minor rewards (breakfast or snack coupon/s) at the end of the experiment.[1] Once the experimenter had checked that the participant had understood the instructions properly (through a short questionnaire), he asked the participant to go into the other room, where Experimenter 2 was waiting.

Values-focused protocols

Experimenter 2 implemented the corresponding protocol (ACT values-focused, CONT values-focused, or untrained condition) (see footnote 1).

ACT values-focused protocol. The values protocol consisted of three elements. They will be described in the same order they were presented:

1. The aims of the study and its clinical implications. Experimenter 2 explained to the participants that the main goal of the study was to help people who really suffer from pain. The experimenter said: "*As you know, many people have a really hard time with their pain, but they persist and keep working even with very severe discomfort. They do it, perhaps, because it is the way to feed their family or to go on with their life. This experiment is about that. We know that your participation may be uncomfortable and that the shocks may be painful but we need to do this kind of work in order to understand how people do keep their life even when feeling pain. We thank you for your collaboration*."

[1] A complete transcript of either the instructions or the experimental protocols can be obtained upon request from the first author.

2. The relation between private events and valued actions. Then, the experimenter said: "*Have you known or heard of someone who has been treated with chemotherapy? You know that sometimes this treatment is very aversive, people refer that they feel dizzy and sick, they lose their hair and feel a lot of unpleasant symptoms, but even so, only a few of them refuse the treatment. Why do you think most of them do not quit?*" The participant responded something like "*Because they need the treatment to recover their health*", the experimenter continued saying: "*Exactly, because feeling bad during a short period could be related to recovering from cancer in the long run, or at least to an improvement in the quality of life. Have you ever been, not exactly in such a situation, but in a somehow similar one where you have felt bad for a while in order to achieve something important, something you value?*" Then the experimenter asked the participant to give one or two personal examples that would correspond with such experiences. If the participant did not respond, the experimenter prompted one example: "*For example, when you spend time studying, or when you visit the dentist, in the short run it is painful but you do it because getting a degree, or your tooth health are important*." Immediately after that, she asked for another example. Then, the experimenter continued with the third element.
3. Functional equivalence between the general and personal examples and the pain task. The experimenter continued saying: "*So, the aim of the study is to help you to perform the pain task for the longest you can, overcoming the pain and the discomfort produced by the electric shocks. Imagine a person who suffers from back-pain and then gets a job which is boring and requires a considerable physical effort. This is painful for him/her, but s/he keeps doing the job because it is the only way to feed his/her family. It is also similar to the examples you have just given*" (the experimenter presented again the personal examples). She continued: "*Thus, when doing the task, keep in mind that the more time you spend performing the task, the more points you will get and the better will be the reward you will obtain at the end (it is like the salary for our worker and his/her family). So when you get into the experimental room think about the worker example, and specially, think that by keeping performing the task you are contributing to the understanding of those cases in which people have to go through discomfort and pain in their daily life in order to get the things they really value.*"

CONT values-focused protocol. The three elements of the values protocol were formally equivalent to the ACT protocol. They are summarized in the same order they were presented.

1. The aims of the study and its clinical implications. In this condition, the pain was framed as a barrier to act in valued directions. Experimenter 2 said: "*As you know, many people have a really hard time with their pain, and even when they want to do things, sometimes they cannot because of the severe discomfort they suffer. The pain is like a barrier for doing what they would like to do. This experiment is about that. We know that your participation may be uncomfortable and that the shocks may be painful but we need to do this kind of work in order to understand why people have to give up doing some activities when they feel pain. We thank you for your collaboration.*"
2. The relation between private events and valued actions. The experimenter said: "*Do you know any athlete? Imagine an athlete who wants to run 1000 meters every day. He starts running, and when he has run 150 m. he feels some pain in the ankle, but he keeps running. When he has run 300 m. he starts feeling that he cannot lean the foot on the ground correctly because of the pain. After a while he starts having a cramp and quits. And why do you think he has to quit?*" The participant responded something like "*Because he could not stand the pain and sometimes you have to quit*". The experimenter continued saying: "*Exactly, he will have to quit pursuing his goal because he cannot continue with such pain. Actually, when he stops running, the pain stops for a short while. Have you ever been, not exactly in such a situation, but in a somehow similar one where you had to quit doing something because you were having a terrible time?*" Then the experimenter asked the participant to give one or two personal examples that would correspond with such an experience. If the participant did not respond, the experimenter prompted one example: "*For example, when you are studying so hard and you have to stop because of an unbearable headache. You want to continue reading, but sometimes you simply cannot because of the severe discomfort you feel, because pain sometimes becomes a barrier for doing what you would like to do.*" Immediately after that, she asked for another example. Then, the experimenter continued with the third element.

3. Functional equivalence between the general and personal examples and the pain task. The experimenter continued saying: "*So, the aim of the study is to help you to perform the pain task for the longest the pain and discomfort produced by the electric shocks let you. Imagine a person who suffers from back-pain and gets a job which is boring and requires a considerable physical effort. So, after a while, this person stops doing the job task. It is similar to the examples you have just given*" (the experimenter presented again the personal examples). She continued: "*Thus, keep in mind that the more time you spend performing the task, the more points you will get, and the better will be the reward you will obtain at the end (it is like the salary for our worker and his/her family). It will be uncomfortable and the shocks will be painful, but we need to do this type of work in order to understand why people have to give up some activities when they have pain. So when you get into the experimental room think about the worker example, and specially, think that by keeping performing the task you are contributing to the understanding of those cases in which the people who suffers from pain have to quit important activities because of the discomfort and pain*".

Untrained condition. Experimenter 2 explained to the participant that there was an initial test to calibrate the apparatus and that the experimenter in the other experimental room would explain it in detail. It was emphasized that although the participant could decide when to discontinue the task, the more time s/he spent performing the task, the better for the calibration of the apparatus.

First pain task (Test I)

When the implementation of the first protocol was completed, the participant was escorted to the experimental room where Experimenter 1 was waiting. The experimenter placed the electrodes on the participant's forearm and asked him/her to enter his/her personal password in the computer in order to start the pain task. Then, the pain task commenced (Test I), and the experimenter left the room. When the participant chose to terminate his/her participation or achieved the top criterion of 15 shocks, Experimenter 1 went into the room, removed the electrodes and invited the participant to go to the other room, where Experimenter 2 was waiting. If the participant reached the top criterion of 15 shocks, s/he was invited to exchange the points gained during the task and his/her participation terminated at this point.

Coping protocols

Experimenter 2 presented individually the corresponding protocol (ACT defusion, CONT suppression or untrained condition). The protocols are summarized below.

ACT-defusion protocol. This protocol had three elements:

1. Examples to enhance the specific relation between pain and valued actions. Experimenter 2 asked the participant about the unpleasant thoughts and sensations that s/he was having when s/he decided to finish the first pain task. After the participant responded with one or two thoughts or sensations, the experimenter told him/her (using the specific reactions given by the participant): *So when you have noticed… and when you have thought…*(listing the participants' thoughts and sensations that came during the pain task, for example *"too much pain", "heat in your arm," "this has no sense," etc.*); *you have decided to terminate the task, haven't you?* Then, she said: *Let me ask you something: "Have you ever really wanted to do something and you finally have not done it? Have you ever thought that you would do something and finally never did it?"* The experimenter continued: *"So it seems that we can act as we choose even when our thoughts and sensations say the opposite…The point is that this is possible and perhaps it might be possible that you could keep doing the pain task and win more points just noticing the thoughts and sensations that show up …"*
2. *The Swamp metaphor* (Hayes, Strosahl et al., 1999, pp. 247–248). Then, the experimenter asked the participant to describe some important goal that s/he wanted to achieve during his/her life. The participant was asked to imagine that the only way to reach such an important goal was by crossing a muddy swamp. Several examples of distressing thoughts regarding crossing the swamp were asked or presented by the experimenter ("*It is all smelly, it is too hard, I cannot do it, something dangerous might*

happen…''). The participant was then told that *''the best way of crossing the swamp and working toward the goals that are important for you, is just to notice the occurrence of the distressing thoughts and sensations…to make room for them…and to hold them very close to you''*. The participant was then told that *''this might be similar to the experimental task where keeping matching the syllables might have the meaning of helping people who suffer from pain and persist in the adversity because they are doing what is important for them.''*

3. *Experiential exercise*. Finally, the experimenter invited the participant to practice the ability of ''*watching the thoughts and noticing the sensations*''. She asked the participant to close his/her eyes and think of the moment s/he was sitting in the chair in the experimental room, in front of the computer. Then, she asked the participant to see him/herself in four different moments of the pain task (the moment the red asterisk appeared on the screen signaling an opportunity to choose whether or not to receive a painful electric shock; the moment s/he decided to continue with the task; the moment s/he received a shock; the moment s/he decided to terminate the task) and to notice the thoughts and sensations that were showing up *now* in relation to those moments during the pain task. In each of the different moments of the tasks (indicated above), the participant was invited to put the thoughts and sensations *in front of* him, to look at them and let them go without any resistance.

CONT-suppression protocol. This protocol had also three components, formally equivalent to the ACT-defusion protocol:

1. Examples to enhance the specific relation between pain and valued actions. Experimenter 2 proceeded in the same way as in the ACT condition, asking the participant about the unpleasant thoughts and sensations that s/he was having when s/he decided to finish the first pain task. When the participant responded with one or two examples, the experimenter said (using those examples): *So, when you have noticed… and when you have thought…* (listing the participant's thoughts, sensations and emotions that came during the pain task, for example *''too much pain,'' ''heat in your arm,'' ''this has no sense,'' etc.); ''you have decided to terminate the task, haven't you?''* Then, she said: *''Let me ask you something: When you noticed these negative sensations in your arm, you decided to terminate the task, didn't you? So it seems that not having such thoughts and sensations would have enabled you to keep going with the task…What if you suppressed the painful thoughts and sensations so that you could keep performing the task and hence win more points?*''
2. *The Swamp metaphor.* The metaphor was introduced as described in the ACT protocol, except that there was an emphasis in the usefulness of suppressing pain-related thoughts and sensations. The participant was told that: *''the best way of crossing the swamp is not to have those unpleasant thoughts and sensations.''* The participant was then told: *''This might be similar to the experimental task, where suppressing discomforting thoughts and sensations is important to continue matching syllables. It might also be equivalent to the cases where people feel pain and need to suppress the pain in order to do the things that are important for them''*.
3. *Experiential exercise*. Finally, the experimenter invited the participants to do an exercise to practice how to suppress such thoughts and sensations. She asked the participant to close his/her eyes and to think of him/herself while seated in the chair in the experimental room, in front of the computer. She asked the participant to see him/herself in four different moments of the pain task (the same as in the experiential exercise in the ACT-defusion protocol). Then, she asked her/him to suppress right there the thoughts and sensations that showed up about those moments.

Untrained condition. For this condition, the second part of the experiment was equivalent to the first one. Experimenter 2 explained the participant that the goal of the study was to help people suffering from pain, for which it was necessary to have him/her performing the task again once the apparatus was calibrated. The experimenter said: *''As you know, many people have a really hard time with their pain. We want to know what happens in those cases, thus this experiment deals with that. We know that your participation may be uncomfortable and that the shocks may be painful, but we need to do this kind of work in order to understand*

those problems. We thank you for your collaboration." After that, the experimenter repeated again the instructions for performing the pain task, including that the participant could decide either to continue or to terminate the task at any time.

Second pain task (Test II) and debriefing of the experiment

After completing the protocol, the participant was escorted to the experimental room to perform the pain task again in identical procedural conditions to those in Test I. After this test, the participant was invited to exchange the points accumulated for the available rewards (breakfast or snacks coupons). Finally, the experimenter thanked the participants for their cooperation and the experiment finished.

Results

Firstly, pre-test differences across a number of variables are analyzed. Then, we present the data for pain tolerance, self-reported pain, and pain believability during both tests for the three experimental conditions.

Pre-test differences

ANOVAs revealed that the groups formed did not differ significantly in age of participants, $F(2, 27) = .69$, $p = .51$ and selected shock voltage, $F(2, 27) = .54$, $p = .59$. The ratio of female to male participants was 7:3 for the three groups. All of the variables on which the ANOVA was conducted met the assumption of homoscedasticity (equality of variances), as revealed by the Levene test.

Pain tolerance

Fig. 1 (left) shows that 7 participants out of 10 (70%) in the ACT condition tolerated the maximum number of shocks (15) during Test I, while only 1 participant out of 10 (10%) in the CONT condition and 2 participants out of 10 (20%) in the untrained condition reached this maximum level of tolerance. A Kruskal–Wallis test showed this difference to be statistically significant, $\chi^2\ (2) = 8.9$, $p < .05$. These participants who reached the maximum number of shocks were excluded from further participation, and consequently, just 3, 9 and 8 participants, respectively for the ACT, CONT and untrained conditions, went through Test II. Fig. 1 (right) shows that 2 participants out of 3 (66.67%) in the ACT condition tolerated the maximum number of shocks during Test II, while only 2 participants out of 9 (22.22%) in the CONT condition and none in the untrained condition reached this highest level of tolerance. Between-condition differences on maximal tolerance level on Test II were also significant, $\chi^2\ (2) = 5.80$, $p < .05$.

Table 2 shows mean tolerance levels at the two occasions of testing (Test I and Test II) for the three conditions. During Test I, the tolerance level of the participants in the ACT condition (13.30 shocks) was

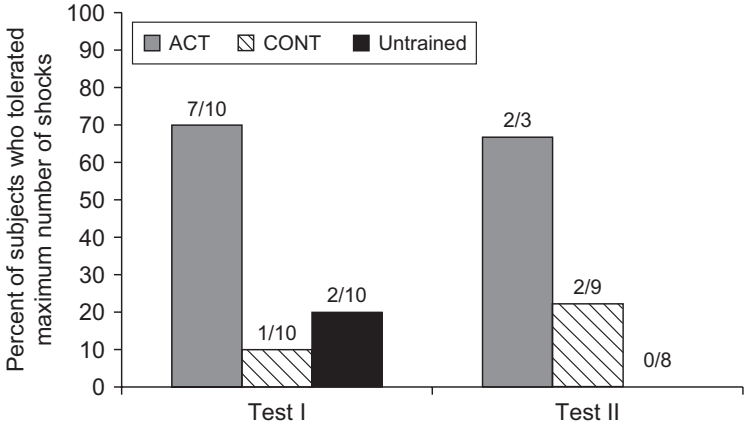

Fig. 1. Percent of subjects in the ACT, CONT and untrained conditions who tolerated the maximum number of shocks in Test I and Test II.

Table 2
Means (and standard deviations) of received shocks for ACT, CONT, and untrained conditions during Test I and Test II

	Test I	Test II
ACT	13.30[a] (3.53)	13.67 (2.31)
CONT	8.6[a] (3.50)	9.9[1] (4.46)
Untrained	6.5[a] (4.86)	5.00[1] (3.25)

Means sharing superscripts differ significantly at $p<.05$.

clearly higher than those of participants in the other two conditions (8.6 and 6.5 shocks respectively). These differences between-conditions reached statistical significance, F (2, 27) = 7.53, $p<.005$. These results show that the impact of the ACT values-focused protocol was significantly greater than the CONT values-focused protocol and the untrained condition.

During Test II a similar trend was found, as shown in Table 2. Since only 3 participants in the ACT condition went through Test II, these data will not be considered in the subsequent ANOVAs in order to accomplish the assumptions of parametric analyses. Analyses showed that the CONT participants got significantly higher levels of tolerance (9.9 shocks) during Test II than untrained participants (5.0 shocks), F (1, 15) = 6.52, $p<.05$.

Within-condition comparisons in tolerance data from Test I to Test II show tolerance increases in ACT and CONT conditions but not in the experimental-control condition. Specifically, in the ACT, CONT and untrained conditions, respectively, 2 out of 3 (66.67%), 6 out of 9 (66.67%), and 3 out of 8 (37.5%) participants increased pain tolerance.

Mean tolerance levels at the two occasions of testing (Test I and Test II) were compared for each participant in the CONT and the untrained conditions, using dependent t-tests (as said, ACT participants were excluded from these statistical analysis due to the small number of participants in Test II). The changes in pain tolerance from Test I to Test II did not reach statistical significance under any experimental condition (in CONT group, t (8) = −1.77, p = .12, in untrained group, t (7) = −.54, p = .60).

Self-reported pain

All participants in the three conditions rated the experienced pain (as measured with the VAS) in accordance with the increasing duration and frequency of shocks, in both occasions of testing (Test I and Test II). A high positive correlation between the magnitude of the electric shocks and the magnitude of reported pain was found (In Test I, for ACT condition, r = .97, $p<.01$; for CONT condition, r = .91, $p<.01$; for untrained condition, r = .67, $p<.01$; In Test II, for ACT condition, r = .91, $p<.01$; for CONT condition, r = .84, $p<.01$; for untrained condition, r = .94, $p<.01$).

Given the clearly significant differences between the experimental conditions on tolerance, participants on the ACT condition received shocks of higher magnitude than participants in either the CONT or the untrained conditions. Accordingly, only the VAS ratings of the first seven shocks received during Test I and Test II were compared among experimental conditions (Gutiérrez et al., 2004).

Table 3 shows the means and the standard deviations of the seven first VAS ratings at the two occasions of testing (Test I and Test II) for the ACT, CONT and untrained conditions. During Test I, VAS ratings by participants in the untrained condition were significantly higher than those by participants in the ACT and the CONT conditions, F (2, 27) = 3.1, $p<.05$. A similar pattern of results was obtained during Test II. Participants in the untrained condition reported higher levels of pain than participants in the CONT condition, F (1, 14) = 7.36, $p<.01$.

Pre-post within-condition comparisons in self-reported pain (from Test I to Test II) show that the 3 participants (100%) in the ACT condition reported less pain during Test II. In the CONT and untrained conditions, respectively, 6 out of 9 (66.67%) and 2 out 7 (28.57%) participants reported less pain.

Mean self-reported pain at the two occasions of testing (Test I and Test II) was compared for each participant in the CONT and the untrained conditions, using dependent t-tests. Self-reported pain decreased

Table 3
Means (and standard deviations) of seven first VAS ratings for ACT, CONT, and untrained conditions during Test I and Test II

	Test I	Test II
ACT	68.59[a] (15.41)	53.76 (23.95)
CONT	70.26[b] (13.81)	52.94[1] (18.52)
Untrained	82.74[a,b] (12.25)	77.74[1] (17.63)

Means sharing superscripts differ significantly at $p<.05$.

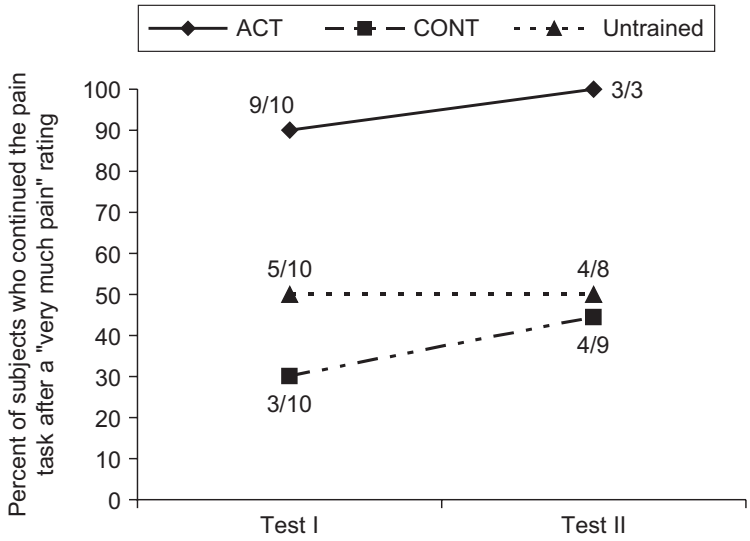

Fig. 2. Percent of subjects in the ACT, CONT and untrained conditions who continued performing the pain task when they reached a maximal rating of "very much pain" on the VAS scale during Test I and Test II.

significantly in the CONT condition, t (8) = 2.52, $p<.05$. However, no significant changes were observed in the untrained condition, t (6) = 1.04, $p = .34$.

Pain believability

Pain believability was measured as in Gutiérrez et al. (2004). That is, it was considered that believability was low when the participant continued performing the task after rating "very much pain" on the VAS scale (ratings beyond 95-mm on the 100-mm VAS scale).

Fig. 2 shows that during Test I, 9 out 10 (90%) participants in the ACT condition continued performing the task after reaching "very much pain." However, only 3 out 10 (30%) participants in the CONT condition and 5 out of 10 (50%) participants in the untrained condition did. These differences were statistically significant, χ^2 (2) = 7.35, $p<.05$. A similar pattern of results was found during Test II. Three out of three (100%) participants in the ACT condition continued performing the task even experiencing "very much pain" in contrast to 4 out of 9 (44.4%) participants in the CONT condition and 4 out of 8 (50%) in the untrained condition. However, these differences in pain believability did not reach statistical significance during Test II, probably due to the few participants considered into analysis. Within-subject analyses comparing pain believability during both tests showed the same trend than between-subjects analyses (they are available upon request).

Discussion

The present experiment shows a clear superiority of the ACT values-focused protocol compared to the CONT values-focused protocol and the untrained condition in the number of shocks the participants chose to

receive during the pain tolerance task. Regarding self-reported pain, the impact of ACT vs. CONT values-focused protocols was equivalent, while participants in the untrained condition reported significantly higher pain. The most remarkable result was the low believability of high pain in the ACT condition (most subjects continued performing the pain task upon reporting "very much pain") compared to the other two conditions. The present preparation adds clear evidence on the superiority of the protocols directed to disconnecting private events from literal actions by enhancing valued directions and promoting the acceptance of the private events that show up while valued acting. Same as in previous controlled trials and experimental analogues (Gutiérrez et al., 2004; Hayes, Bissett et al., 1999; Masedo & Esteve, 2007; Masuda, Hayes, Sackett, & Twohig, 2004; Páez-Blarrina et al., in press), believability appears as a key process in the present study.

This is the first study comparing acceptance vs. control-based behavioral regulation without incorporating any coping method, and by using personal examples as analogues of the experimental task. Although additional replication is needed, the results in Test I show that accepting the pain in the context of values (as in the ACT condition) was sufficient to keep most of the participants in the painful task even when feeling high pain and without any explicit coping strategy being instructed. On the contrary, when pain and continuing in the task were established as opposed to each other through personal examples (as in the CONT condition), most participants discontinued their participation upon reporting "very much pain," even when the task was given the same general value as in the ACT condition (i.e., helping people who really suffer from pain). It seems that the analogue between personal examples of control and the pain task in the CONT condition promoted the believability of pain as a barrier for action. The data obtained with the untrained condition replicate those obtained by Páez-Blarrina et al. (in press), where most participants showed high discomfort and very low tolerance during pre-test, when no value was given to the experimental task.

We address now the characteristics of the ACT values-focused protocol that, in our opinion, are responsible for such a high impact in this study. Previous ACT experimental protocols were more general with regard to the values component (Gutiérrez et al., 2004; Hayes, Bissett et al., 1999) or they were introduced along with the coping strategies (Páez-Blarrina et al., in press), or they implemented the isolated acceptance component (McMullen et al., in press) in an instructed format (i.e., basically, the participants were requested to accept the pain during the tasks), instead of establishing the context for continuing in the task as a chosen action through personal examples. The singularity of the protocols employed in the present study is that, in addition to providing a general meaning to the experimental tasks (Gutiérrez et al., 2004; Páez-Blarrina et al., in press), general and personal examples of acceptance vs. avoidance were established as analogies of the choice situations the participants would be confronted with during the tasks.

The contextual cues embedded in those examples might be the basis for the different transformations of the functions of the pain experienced during the tasks across experimental conditions. In the ACT values-focused protocol, the pain was encapsulated as part of a valued direction. That is, the valued actions were given verbal discriminative (for task continuation) and reinforcing functions, incorporating the pain as part of such valued actions. This seemed to transform (via deictic, comparative, and hierarchical contextual cues: see Hayes, Barnes-Holmes, & Roche, 2001) the aversive functions of the pain. In other words, by contextualizing the pain in a frame of hierarchy between the person's values and his private events, pain might become *less important than values*. On the contrary, the CONT values-focused protocol contextualized the pain as the first thing to get rid of in order to pursue valued actions. The incorporation of contextual cues in such a direction (for instance, the causal framing "if high pain, no valued action"), might transform the functions of the pain so that pain was now *more important than valued actions*. Further research is necessary so as to isolate the contextual cues that facilitate the transformation of avoidance functions of pain in any given protocol, especially in ACT-based protocols, where it has been just shown that such transformation is possible by appealing to personal experiences.

Test II incorporated a specific coping strategy coherent with the functional roles given to pain and valued action in the preceding protocols. Results show that all participants who were exposed to the ACT-defusion protocol continued in the task even when rating "very much pain" and most of them achieved the maximal criterion of shocks. Alternatively, participants in the CONT-suppression protocol and those in the untrained condition maintained the high levels of pain believability, although participants in the CONT condition reported less pain and, consequently, increased tolerance slightly but not significantly, as seen in previous studies (Gutiérrez et al., 2004; Hayes, Bissett et al., 1999; Masedo & Esteve, 2007). This result contrasts,

however, with that obtained by Páez-Blarrina et al. (in press), where the increase during the post-test was in fact significant. This inconsistency may be due to the fact that in Páez-Blarrina et al.'s study the tolerance in the first test was very low. It is common across studies, however, that the cognitive-control-based protocols only increase tolerance to the point of not having too much discomfort, and that the ACT protocols (with or without an explicit coping strategy) allow participants to continue in the pain task even while feeling high discomfort.

The defusion protocol included a metaphor and an experiential exercise, same as in Páez-Blarrina et al. (in press) and similarly to Gutiérrez et al. (2004). The metaphor emphasized the value of accepting the discomfort when it is in a valued trajectory. The exercise provided practice with several thoughts and sensations (a sort of multiple-exemplar training: see Hayes et al., 2001) for noticing such private events from the perspective of the person as the context of all the thoughts and sensations as mere cognitive content. These clinical methods facilitate the verbal discrimination of one's own sensations and thoughts and they seem to alter the function of the discomfort that occurs while the person behaves in a valued trajectory. It is still unclear the type of transformation of functions that defines these clinical methods, although conceptual and empirical studies point to hierarchical and deictic framing. This means framing the *self* in the here-and-now context and *one's own thoughts/sensations,* as part of oneself, in the there-and-then context (Barnes-Holmes, Hayes, & Dymond, 2001; Luciano, Rodríguez, & Gutiérrez, 2004).

The suppression protocol was effective when low discomfort was present, but did not work better than the untrained condition when discomfort was too high. These data replicate those of previous studies, however further research might analyze the differential effects of distraction vs. suppression methods of discomfort. For instance, when a suppression strategy is promoted as in the present study (and as in Páez-Blarrina et al., in press), discomfort seems to be higher than when distraction is promoted (Gutiérrez et al., 2004; McMullen et al., in press). This might be due to the exposure component to painful thoughts and sensations that occur with distraction methods.

In summary, the obtained high impact of the ACT values-focused protocol is consistent with the results of correlational research, clinical interventions, and analogue studies showing that some clients change quickly upon clarifying their valued goals, the barriers to them, and the cost of non-acceptance, although other clients need additional defusion practice (Dahl, Wilson, Luciano, & Hayes, 2005; Gutiérrez et al., 2004; Hayes, Bissett et al., 1999; Luciano et al., 2003; Luciano, Visdómine, Gutiérrez, & Montesinos, 2001; McCracken, Vowles, & Eccleston, 2005; McCracken & Yang, 2006; Wilson & Luciano, 2002). In this sense, this piece of research has advanced to show the benefits of framing pain in the context of valued actions through personal examples, which may be enhanced—when necessary—by adding specific defusion practice. This is in line with the proposal of the third wave of behavioral therapies (Hayes, 2004; Hayes, Luoma, Bond, Masuda, & Lillis, 2006).

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