Journal of Experimental Psychology: General
2010, Vol. 139, No. 3, 520–534

0096-3445/10/$12.00 DOI: 10.1037/a0020008

# Feelings Don't Come Easy: Studies on the Effortful Nature of Feelings

Assaf Kron, Yaacov Schul, Asher Cohen, and Ran R. Hassin
The Hebrew University of Jerusalem

We propose that experience of emotion is a mental phenomenon, which requires resources. This hypothesis implies that a concurrent cognitive load diminishes the intensity of feeling since the 2 activities are competing for the same resources. Two sets of experiments tested this hypothesis. The first line of experiments (Experiments 1–4) examined the intensity of participants' feelings as they performed a secondary (backward counting) task. The results showed that the intensity of both negative and positive feelings diminished under a cognitive load and that this attenuation of feeling was not mediated by either distraction from external stimuli or demand characteristics. In the second set of experiments (Experiments 5–6), load was created by asking the participants to focus on the feelings. Even in these circumstances, the participants who were under load reported a lower intensity of feeling than those who were not under load. We explain these findings in terms of a resource-dependent model of emotional experience. Possible implications of our findings for a broader class of phenomenological experiences are succinctly discussed.

*Keywords:* feelings, emotions, resources, cognitive load, effort

The everyday view of feelings holds that they are, to a large extent, unintentional, uncontrollable, and effortless. People do not usually think of feelings as requiring conscious intention to be initiated ("The movie has such a tragic end, I intend to be sad") nor can they be intentionally stopped ("Oh, but I don't wish to feel sad, so I'll stop it now"), and, most relevant to the present study, people do not think that they exert mental resources to continue feeling the way they do. People simply and effortlessly feel, until they do not. In this article, we challenge this view and suggest that at least as far as the last feature is concerned, intuition is mistaken: Merely feeling requires mental resources. We present a series of experiments demonstrating that a concurrent cognitive load reduces the subjective experience of feelings. On the basis of our findings, we conclude that the mere subjective experience of emotions requires mental resources or that, put differently, any additional demand for resources (e.g., a concurrent load) reduces conscious feelings. For reasons that become clearer later, we refer to this hypothesis as the *mere resource hypothesis*. Although our experiments exclusively examined feelings that accompany emotions, the mere resource hypothesis may apply to other phenomenological experiences (e.g., tastes, smells) as well. This possibility is addressed in the General Discussion.

Assaf Kron, Yaacov Schul, Asher Cohen, and Ran R. Hassin, Department of Psychology, The Hebrew University of Jerusalem, Jerusalem, Israel.

This research was funded by grants from the Israel Science Foundations to Asher Cohen, Ran R. Hassin, and Yaacov Schul, as well as Doctoral Grant 28 from the Israel Foundation Trustees to Assaf Kron. We thank Dina Danovich for her help in this research.

Correspondence concerning this article should be addressed to Assaf Kron, Department of Psychology, The Hebrew University, Jerusalem 91905, Israel. E-mail: assaf.kron@mail.huji.ac.il

## Working Definitions

We begin by briefly presenting working definitions of the terms that are central to the current article: emotion, feelings, mood, and mental resources.

### Emotion

Emotion can be thought of as a multicomponent state that indexes the occurrence of an event as pleasant or unpleasant (Dolan, 2002). The emotional state is a profile composed of different levels of activation of various components (Russell, 2003), such as nonverbal signals (e.g., facial expressions, voice), action tendencies, autonomic patterns, core affect, affective quality, attribution, appraisal, and feelings that are the focus of our investigation.

### Feelings

Feelings are not easy to define (see Feldman Barrett, Mesquita, Ochsner, & Gross, 2007; Frijda, 2005; Lambie & Marcel, 2002, for reviews). To a first approximation, we refer to feelings as the conscious experience of X, where X in our case is an emotion. Because some definitions of feelings include unconscious aspects as well (Damasio, 1999; Winkielman & Berridge, 2004), it is important to emphasize that here we restrict the use of the term feelings to the conscious experiences of emotion. By doing so, we do not mean to suggest that there are no unconscious equivalents of feelings. We have simply devoted the work reported in this article to conscious feelings.

### Mood

The concept of mood is closely related to that of emotion. Mood is frequently distinguished from emotion on the basis of two features—duration and object relatedness (see Beedie, Terry, &

Lane, 2005, for a review). The first feature is somewhat vague. However, it is often maintained that emotions are brief, lasting for seconds or for several minutes, whereas moods last for minutes, hours, or even several days (Damasio, 1999; Ekman,1994; Lang, 1988; Nowlis & Nowlis, 1956). The second feature that distinguishes emotion from mood–object relatedness has to do with their causes. Emotion is usually referred to as object related, that is, it is a reaction to a specific object or event (e.g., Damasio, 1999; Lazarus, 1994; Levenson, 1994). Mood, on the other hand, does not necessarily spring from a specific object or event (Beedie et al., 2005).

### Mental Resources

We adopt a broad definition of mental resources, which encompasses any limited capacity, entity, or asset that helps to execute mental processing (Navon, 1984; Wickens, 1984), without discerning between energy (Kahneman, 1973) or storage units (Norman & Bobrow, 1975) models.

## The Mere Resource Hypothesis

Simply put, the mere resource hypothesis states that feelings—or the conscious experiences of emotion—require mental resources. The degree to which an emotional response in general relies on mental resources has been a major theme in the scientific study of emotion and cognition (for recent reviews, see Barrett, Ochsner, & Gross, 2007; Robinson, 1998). Yet, while several theoretical perspectives are consistent with the mere resource hypothesis (Erber & Tesser, 1992; Lambie & Marcel, 2002; LeDoux, 1996; Pessoa, 2009; Robinson, 1998; Van Dillen & Koole, 2007), none of them explicitly links effort or resources with feelings. Perhaps the most elaborate description on this topic is that given by LeDoux (1996), who claimed that "you can't have a conscious emotional feeling of being afraid without aspects of the emotional experience being represented in working memory" (p. 296). To the extent that working memory representations are affected by resources, so would the resultant feelings.

Operationally, mental resources are closely tied to manipulation of cognitive load. By definition, a task that creates cognitive load uses mental resources and, as a result, leaves fewer resources for other tasks or activities. The mere resource hypothesis predicts, therefore, that an added cognitive load would reduce feelings because it would take away resources that are required for them.

While this prediction appears straightforward, there are two subtle points that we wish to make. First, one must distinguish between our hypothesis, which concerns the relationship between feelings and resources, and related hypotheses, which concern the relationship between mood and resources. Second, while the use of cognitive load reduces available resources, it may also have other effects. In particular, concurrent tasks may simply distract participants from their current mental state, and this distraction (rather than the mere lack of resources) may reduce the intensity of feelings. We now turn to reviewing the literature with these two observations in mind.

## Emotions and Resources

There are several prominent lines of research that might be instructive about the relations between emotions and resources. Following Shiffrin and Schneider (1977), it is often assumed that mental activities can become automatic, and a large number of studies have examined whether the components of emotion are automatic. Because automaticity is often associated with resource-free processing (see Shiffrin & Schneider, 1977), we briefly review the literature on automaticity in emotion perception.

### Automaticity and the Processing of Emotional Stimuli

The notion that (some) components of an emotional response can proceed and be processed automatically has a long history (Buck, 1985; Ekman, 1977; LeDoux,1996; Leventhal & Scherer, 1987; Öhman, 1986; Zajonc, 1985). Traditionally, this question has been reduced to the empirical investigation of preattentive detection of visual emotional stimuli and to studying whether, and to what extent, emotional stimuli can be processed without (or with minimal) attentional resources.

Typically, experiments of this sort involve brief presentations and masking of emotion-laden stimuli. The detection of emotional stimuli, presented subliminally, has been demonstrated using likeability judgments (Murphy, Monahan, & Zajonc, 1995; Murphy & Zajonc, 1993; Winkielman, Zajonc, & Schwarz, 1997) and skin conductance response (Flykt, Esteves, & Öhman, 2007; Öhman & Soares, 1993, 1994).

Additional evidence for people's ability to detect affect from stimuli presented below awareness comes from studies of the amygdala (Jiang & He, 2006; Morris, Öhman, & Dolan, 1998, 1999; Vuilleumier, Armony, Driver, & Dolan, 2001). Findings about the activation of the amygdala are often interpreted as markers of affective processing, given the widespread assumption that the amygdala is involved in the affective system (see, e.g., reviews by Davis, 1992; LeDoux, 2000; Phan, Wager, Taylor, & Liberzon, 2002). All these studies suggest that affective stimuli can be detected and processed even when there is no conscious awareness of them.

However, new evidence appears to challenge the extent of the automaticity of emotional perception. Several studies have shown that amygdala activity during the perception of emotional stimuli is attenuated under attentional distraction (Pessoa, 2005) and that fear-potentiated startle is reduced by manipulations of attention and load (Dvorak-Bertsch, Curtin, Rubinstein, & Newman, 2007). Thus, the degree to which emotional stimuli can be detected automatically is still an open question.

As mentioned earlier, however, the mere resource hypothesis concerns feelings, the conscious experience of emotions. The findings concerning the possible automaticity of emotion detection do not bear directly on the question of whether mental resources are required for feelings. Theoretically, one can think of a resource-free account of lower emotional processes and, at the same time, a resource-demanding account of subjective feelings at higher stages of the same process (e.g., Öhman & Soares, 1993, 1994). We now review studies that focus more directly on the relation between feelings and cognitive load.

### Concurrent Load, Distraction, and Emotion

The experiments described in this article investigated the mere resource hypothesis by comparing the feelings of individuals processing emotional stimuli under different levels of cognitive load.

As stated earlier, load manipulation can have at least two theoretically important outcomes in the current context. First, in line with our hypothesis, it can drain mental resources, therefore leaving fewer resources for the development and maintenance of feelings.[1] Second, load may provide means of distraction by shifting the focus of attention away from the emotional event and toward the load task. This shift can occur either at the perceptual level (e.g., shifting attention away from the stimulus) or at a higher cognitive level (shifting attention away from the percept, or the thoughts that it activates). We refer to this mechanism at both levels as distraction. Note that the mechanisms described by the mere resource and the distraction hypotheses are not mutually exclusive. Consequently, evidence for the latter (to be reviewed below) does not refute the former.

There is plenty of evidence supporting the distraction hypothesis or what Gross (1998) termed *attentional deployment mechanisms.* For example, when perceivers shift the direction of their gaze away from a stimulus (Harman, Rothbart, & Posner, 1997; Stifter & Moyer, 1991) or under spatial-attention load manipulation (Pessoa, 2005; Pessoa, McKenna, Gutierrez, & Ungerleider, 2002), the processing of the affect-laden stimuli is impaired. It is possible that such distraction will result in less intense feelings. Analogous effects have been shown in the study of the experience of moods: Different types of distraction were found to reduce self-report assessments of mood (Andrade, Kavanagh, & Baddeley, 1997; Erber & Tesser, 1992; Morrow & Nolen-Hoeksema, 1990; Rusting & Nolen-Hoeksema, 1998).

What are the implications of these results for the mere resource hypothesis? Can they inform us whether feelings require or do not require resources? From the perspective of the mere resource hypothesis, at least three issues arise. First, most of the paradigms in this area used a load manipulation that took place after the emotional stimulus had already disappeared and not simultaneously with its presentation. Such a practice makes it very difficult to separate between effects that are caused by resources and effects that are caused by distraction. Second, because participants in the abovementioned studies were not typically asked about the feeling they had at the time of the presentation of the emotional stimulus, one cannot tell whether their reports about their affective state reflect feelings that arose from the stimulus, general mood not directly related to the stimulus, or both.

Finally, and perhaps most important, one prominent feature of the above-cited experiments is that the time interval from the end of emotional manipulation to the point of measurement was relatively long (e.g., Erber & Tesser, 1992; Morrow & Nolen-Hoeksema, 1990; Rusting & Nolen-Hoeksema, 1998). Consequently, it is possible that the distracting manipulation affected processes that operated well after the original experience of feeling had ended. For example, Rusting and Nolen-Hoeksema (1998) used time intervals of 8 min between the end of the manipulation until the self-report. Rusting and Nolen-Hoeksema showed that the distracting task reduces anger, whereas rumination increases anger. However, if the effect of cognitive load attenuates affective reactions only by distracting subjects from ruminative thoughts, it is not necessarily relevant to those feelings of emotion that are triggered as one sees affective stimuli.

However, the distinction between mood and emotion is not always clear-cut. For example, other lines of research used a similar design (i.e., triggering stimulus, followed by a load manipulation, and ending with a self-report) but used considerably shorter time intervals between these three events (Van Dillen, Heslenfeld, & Koole, 2009; Van Dillen & Koole, 2007). Yet even such intervals between the termination of the triggering stimulus and the self-report may affect multiple mechanisms. For example, Andrade et al. (1997), using similar time intervals, showed that when cognitive load is induced after viewing the emotional picture, it impairs the vividness of the remembered image in working memory, which in turn leads to attenuation of the intensity of affect. It might be that the same mechanism operated in the Van Dillen et al. experiments (Van Dillen et al., 2009; Van Dillen & Koole, 2007).

To study the influence of a cognitive load on feelings that are directly triggered by emotional stimuli, it is important to utilize a cognitive-load manipulation that drains resources at the time the stimulus is presented and to measure the feelings in close temporal proximity to the disappearance of the stimulus. Moreover, participants should be asked about the feelings that arose from the triggering stimulus, and, to capture the specificity of feelings (in contrast to the more general mood), participants should be instructed to report their feelings about a specific object (rather than how they feel in general). Load effects, in this case, are more likely to be interpreted in terms of a link between mental resources and feelings of emotion. Our study was designed for this purpose. It tested directly the mere resource hypothesis and attempted to dissociate its effects from possible effects of the distraction from the emotional content of the triggering stimulus.

## An Overview of the Present Study

How can one distinguish between the mere resource mechanism and the distraction mechanism? We tried to do it using two main approaches. In the first set of studies (Experiments 1–4), we presented affective stimuli and manipulated concurrent cognitive load through a secondary task (counting backward). We assessed both the intensity of feeling and the overall processing level of the affective stimulus. We showed that the effect of load on the intensity of feelings cannot be predicted from its effect on the overall processing of the stimulus. Still, although these experiments asked participants directly about the feelings that emanated from the triggering stimulus and applied the load manipulation simultaneously with this stimulus, we cannot completely rule out the possibility that the secondary task may have distracted participants from the feelings themselves. To further dissociate the two alternatives, in the second set of studies (Experiments 5–6), we asked participants to focus on their feelings (rather than engage in a secondary task). Our reasoning was that the requirement to focus on any feature would demand resources and consequently lead to a reduction in the feelings, even if one were required to focus on the very same feelings. In such a situation, the participants are even more unlikely to be distracted from their feelings, since they are actually asked to focus on them. Nonetheless, to anticipate our conclusions, we demonstrated that the requirement to focus on feelings reduces the intensity of the very same feelings. These

[1] We use the term *maintenance* without implying that it has to be intentional or conscious. We mean, by it, the prolongation of feelings over time that may or may not occur automatically.

findings are predicted by the mere resource hypothesis but not by the distraction hypothesis.

We examined feelings by measuring their intensity—a major component of the emotional experience (e.g., Frijda, Ortony, Sonnemans, & Clore, 1992; Russell & Barrett, 1999). Although the exact relation between intensity and the dimensions of arousal and pleasantness is not entirely clear, there is evidence that intensity involves both dimensions (Reisenzein, 1994). In line with this perspective, the experiments reported below examined the more specific conjecture that elevating and maintaining the intensity of feelings require mental resources. Therefore, we tested the hypothesis that a concurrent load attenuates the intensity of feelings.

In each of the experiments reported below, the participants observed affect-laden stimuli and rated their feelings while observing them. In one condition, this was done under a concurrent cognitive load. In another condition, there was either no or a less demanding cognitive-load task. Our major analyses involve comparisons of the intensity of feelings between the two conditions. As noted before, two features of our paradigm are noteworthy. First, the participants were instructed to rate the intensity of the feelings they experienced while watching the picture, rather than following the viewing thereof (cf. Van Dillen & Koole, 2007). Second, the load manipulation occurred at the same time as the affective stimuli were presented, not following the presentation of the affective stimuli. This was done to maximize the influence of the load on the feelings triggered by the emotional stimuli, rather than on how the feelings or the pictorial stimuli were remembered.

## Experiment 1a

Experiment 1a was designed to examine the influence of a concurrent cognitive load on the intensity of feelings experienced while viewing emotional pictures. Our goal was to demonstrate a direct relation between the load and the reduction in feelings. However, since a concurrent task can affect additional factors involved in the processing of the pictures (e.g., perceptual and or memorial processes) and it could be argued that the reduction in the intensity of the feelings was mediated by these factors, we also measured the overall processing of the pictures by a recognition task.

The participants watched a series of pictures with negative valence under one of two conditions—a cognitive load or control (no load). They were asked to rate the intensity of the feelings they experienced while watching the pictures. In addition, a forced-choice recognition test was administered after completion of the task. In the forced-choice test, the participants were asked to recognize which of two very similar pictures was the one they had been exposed to before.

### Method

**Participants.** Twenty undergraduate students (12 female) of the Hebrew University of Jerusalem (Jerusalem, Israel) were paid approximately $4 for their participation. Here and elsewhere in this article, female and male participants were allocated randomly to the different conditions so that their relative proportions were similar in the different groups.

**Stimuli.** Twenty pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) were selected, such that they were mildly negative ($M = 2.5$, $SD = 0.5$, on a scale of 1–9[2]) and mildly arousing ($M = 5.5$, $SD = 0.5$, on a scale of 1–9). The pictures were presented in a single order during the main task.

**Assessment of intensity.** Feelings were rated on a 5-point nonverbal pictorial scale based on the Self-Assessment Manikin Scale (Lang, 1980; see the Appendix).

**Forced-choice recognition test.** We examined the memory strength of 10 (out of the 20) pictures using a forced-choice recognition test. In each trial of the recognition task, two versions of the same picture were shown on the screen, and the participants were asked to select the picture that had been presented in the experimental block. Foils were constructed to address two issues. First, based on judgments of all four authors, the differences between the original pictures and the foils were related to the affective content of the picture. Second, the differences were constructed to yield percentages of errors well above floor and well below ceiling effects.

**Design and procedure.** Participants were randomly allocated to one of two conditions, load and control (no load), and they performed, in both conditions, a practice block followed by an experimental block. Following the viewing and rating of all 20 pictures, the participants performed the forced-choice recognition task.

The participants were given extensive practice, designed to expose them gradually to different aspects of the task. First, the participants practiced the load task by counting backward from 100 to 0 in steps of 5 (e.g., 100, 95, 90, etc.). Then, they practiced counting backward while viewing pictures. Last, they practiced the full task by counting backward while viewing pictures and introspecting about their feelings. Practice for participants in the no-load condition included only the latter phase, namely, viewing the pictures and introspecting about their feelings, without counting.

The experimental block consisted of 20 trials. Each trial began with the presentation of an asterisk for 5 s. This was followed by an affective picture that remained on screen for 8 s. The participants in the load condition were asked to begin counting when the asterisk appeared and to stop doing so when the picture disappeared from the screen. The counting was monitored via intercom from another room.

After the picture disappeared from the screen, the participants were asked to rate the intensity of their feelings. Specifically, all participants were told, "The pictures you will see might elicit emotional reactions. The scale reflects the intensity of your feelings, ranging from indifference to very intense." The participants in the no-load condition were further told, "Please rate the intensity of your feelings during the time you were looking at the picture." The participants in the load condition were further instructed, "Make sure that you are looking at the picture while counting . . . . Rate the intensity of the feelings elicited by the pictures as felt during the time you were counting backward."

Following the experimental block, all participants performed the forced-choice recognition task.

[2] According to IAPS norms for all subjects (Lang et al., 2005).

## Results and Discussion

**Intensity rating.** For each participant, we computed the average rating of the intensity of feeling associated with the 20 pictures. As hypothesized, the participants in the load condition ($M = 2.64$) reported less intense feelings than the participants in the control condition ($M = 3.26$), $t(18) = 2.50$, $p < .02$, $d = 1.1$ (see Table 1).

**Recognition task.** For each participant, we computed the proportion of pictures that were recognized erroneously. The participants in the load condition ($M = 0.25$) tended to make more errors than the participants in the no-load condition ($M = 0.15$), $t(18) = 1.86$, $p < .07$, $d = 0.8$.

As the high-load condition was associated, on average, with less intense feelings and more recognition errors, it might be that the effect of a cognitive load on the overall processing of a stimulus mediates, or explains, the effect of the intensity of feelings. This question is critical for our study because the mere resource hypothesis predicts that a cognitive load diminishes the intensity of feelings independent of its effect on the overall processing of the stimulus.

An initial strategy in testing these alternative explanations involved statistical control of the overall processing of the picture as measured by the recognition task. Along this line, we performed two types of correlation analyses. First, we compared the zero-order point biserial correlation between load condition and intensity of feeling ($r = .50$, $p < .02$) and the partial correlation between these factors when recognition error was partialed out ($r = .48$, $p < .03$). The former correlation suggests that load influenced intensity. The latter suggests that this influence was unrelated to the recognition errors.[3]

These analyses are more consistent with the mere resource hypothesis than with the possibility that the reduction in the intensity of feeling is mediated by the reduction in the overall processing of the picture. This, in turn, may trigger the following question: Why is it that recognition errors, a proxy of the extent of stimuli's processing, are unrelated to feelings? Our pictures were selected to be relatively strong stimuli. Therefore, the emotional information contained in them was clear and explicit, and hence, many details were redundant in terms of conveying the emotional information. We believe that in such a case, missing one detail or another should not have had a strong effect on the corresponding emotion, while it would influence recognition memory, thereby weakening the association between intensity of feeling and memory performance. Nevertheless, we sought a more direct empirical support for the claim that the overall processing of the pictures used in our experiment did not mediate feelings. This was the purpose of Experiment 1b.

Table 1
*Recognition Error Rate and Rating of Intensity of Feelings for Load and No-Load Conditions in Experiment 1a*

| | Condition | | | |
|---|---|---|---|---|
| | Load | | No load | |
| Measure | *M* | *SD* | *M* | *SD* |
| Emotional intensity | 2.64 | 0.51 | 3.26 | 0.60 |
| Recognition errors (relative frequency) | .25 | .09 | .15 | .14 |

## Experiment 1b

The claim that the overall processing of a picture (as measured by the recognition task) mediates intensity of feeling implies that any other general manipulation of the overall processing of a picture (again, as measured by the effects on the recognition task) will also lead to a change in the intensity of feeling. Moreover, this would be the case even if these manipulations on the overall processing of a picture do not affect the amount of resources invested in the task. In contrast, we suggest that only manipulations that reduce resources (e.g., load) will lead to a reduction in the intensity of feeling. Experiment 1b was designed to test these contrasting predictions. We manipulated the overall processing of the affective pictures in two ways. In one condition, as in Experiment 1a, we required participants to perform a concurrent task and expected to replicate the results obtained in Experiment 1a. In the other conditions, we manipulated the exposure duration of the pictures. This exposure duration manipulation was expected to influence the overall processing of the pictures and therefore to affect the recognition task. Yet, at least in the context of our experiments, it was not expected to affect the amount of resources invested in the pictures. Our hypothesis and the mediation interpretation have different predictions. The mere resource hypothesis predicts that, whereas both the exposure duration and the load manipulations would influence recognition performance, only the load manipulation would affect the intensity of feelings. In contrast, the mediation hypothesis predicts that the two manipulations would have similar effects on the recognition task and on the intensity of the feelings.

## Method

**Participants.** Forty undergraduate students (24 female) from the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Design and procedure.** The procedures and stimuli of Experiment 1b were identical to Experiment 1a, with two modifications. First, the participants were randomly allocated to one of four conditions: In the L10 condition, the pictures were presented for 10 s under load (backward-counting task, as in Experiment 1a), while in the remaining conditions, the participants were not under load, and the pictures were shown for 10, 3, and 1.5 s (NL10, NL3, and NL1.5, respectively). Second, we attempted to increase the sensitivity of the recognition test. In the previous experiment, we used a recognition test in the end of the entire block, and participants were in effect required to remember all 20 pictures presented in the block. In the present experiment, we randomly selected for each participant six out of the 20 trials of the blocks. In these

[3] We assessed the direct relation between recognition errors and intensity of feelings via multiple regression analysis using intensity as a dependent variable and recognition errors and load condition as simultaneous predictors. Recognition errors did not predict intensity of feelings, $b = 0.12$, $t(17) = 0.11$, while load did, $b = 0.63$, $t(17) = 2.27$, $p < .03$, suggesting that there was an effect of load on the intensity of feelings independent of its influence on recognition errors.

selected trials, participants first reported their feelings and then were administered a recognition test for the picture used in the trial. In the remaining trials participants, only reported their feelings.

## Results and Discussion

We first considered the intensity of feelings. A one-way analysis of variance (ANOVA) revealed a statistically significant difference between the conditions, $F(3, 36) = 7.25$, $p < .01$. Planned contrasts showed that the intensity of feelings was lower under load (L10) than under no load (average of NL1.5, NL3, and NL10), $t(36) = 4.52$, $p < .01$, $d = 1.5$, suggesting that as in Experiment 1a, the intensity of feeling was reduced by the load manipulation. Importantly, the three no-load conditions were not different from one another in terms of the intensity of feelings, $F(2, 27) = 0.82$ (see also Figure 1).

Consider recognition errors next. A one-way ANOVA showed that the four conditions differed statistically from each other, $F(3, 36) = 6.07$, $p < .01$. Unlike the results obtained with the rating of the intensity of feelings, this overall difference was due to differences among the no-load conditions, $F(2, 27) = 8.22$, $p < .01$. Recognition was worst ($M_{error} = 0.45$) in the shortest duration condition (NL1.5) and best ($M_{error} = 0.15$) in the longest duration condition (NL10), $F(1, 36) = 17.89$, $p < .01$, $d = 1.41$. Recognition under the load condition fell in between ($M_{error} = 0.33$) and was similar to that of participants under moderate exposure duration (NL3; $M_{error} = 0.30$).

These results demonstrate a clear dissociation between the effect of a cognitive load on stimulus processing and its effect on feeling attenuation. These findings accord with the mere resource hypothesis, which proposes that the attenuation of feelings under load is not solely due to the reduction in the overall processing of the pictorial stimulus. The results are inconsistent with the mediation hypothesis, according to which there should have been a difference in the intensity of the feelings among the three different exposure duration conditions, a prediction that was not borne out by the results.

Perhaps the most illuminating conditions for demonstrating the dissociation between intensity of feelings and recognition performance are the load condition (L10) and the minimum-exposure no-load condition (NL1.5; see Figure 1). The participants in NL1.5 made more recognition errors ($M = 0.45$) than those in L10 ($M = 0.33$), $t(36) = 0.054$ (one-tailed), suggesting that their overall processing of the pictures was worse than, or at best similar to, that of the load condition. However, the participants in the NL1.5 condition demonstrated significantly more intense feelings ($M = 3.11$) than those in the L10 condition ($M = 2.37$), $t(36) = 3.06$, $p < .01$, $d = 1.24$ (see Figure 1). Similarly, there were no significant differences in recognition errors between the L10 condition ($M = 0.33$) and the NL3 condition ($M = 0.30$), $t(36) = 0.47$. Here, too, the feelings of the participants in the former condition were less intense ($M = 2.37$) than those in the latter condition ($M = 3.38$), $t(36) = 4.17$, $p < .01$, $d = 1.65$.

The mediation interpretation can also be tested statistically by a mediation analysis similar to the one reported in Experiment 1a. Specifically, we compared L10 and NL10 conditions. There was a correlation between load and intensity in these conditions ($r = .65$, $p < .001$). The magnitude of this correlation was minimally affected when recognition errors were partialed out ($r = .58$, $p < .008$).[4]

The combined results of Experiments 1a and 1b suggest that the effect of a cognitive load on intensity of feelings cannot be attributed to mediation by the degree of processing of the pictorial stimulus. Note that we do not make a general claim on the relation between amount of stimulus cognitive encoding and intensity of feeling triggered by it. It seems obvious that a severe degradation of stimulus encoding would affect intensity of feeling as well (see, e.g., Pessoa, 2009, for a more general review of the relation between cognition and emotion). Our findings do suggest that while controlling cognitive processing of the emotional stimulus, the fewer resources one has, the milder one's feelings will be.

Before we proceed to examine the effect of load on intensity in more detail, we describe two experiments, 2a and 2b, that were carried out to examine the possibility that the results in the previous experiments were an artifact of the instructions. Specifically, recall that we utilized a between-participant design and that the instructions in the load condition were necessarily slightly different from those in the no-load condition. This would give rise to the possibility that the influence of the load was actually an influence of the instructions.

Experiment 2a examined whether the pattern of the findings could be attributed to theories that the participants may have formed from the instructions. This was done by explicitly providing the participants in the load condition with a theory about the opposite relationship between load and feelings. Specifically, the participants were told that the intensity of their feelings should increase under a cognitive load. Experiment 2b investigated the effect of instructions using a different approach. Specifically, we varied the amount of load while keeping the same set of instructions. This allowed us to investigate the load effect independent of the instructions.

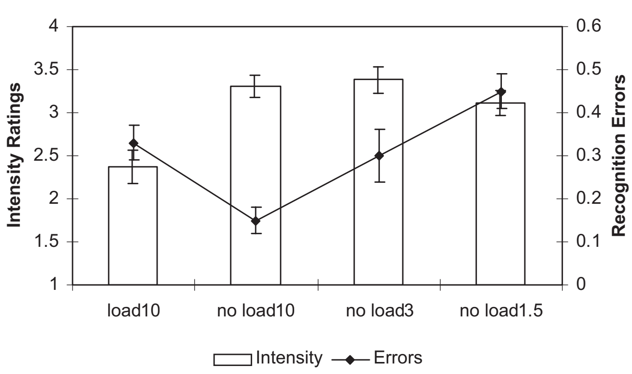


*Figure 1.* Left *y*-axis: intensity of feelings as a function of the different load conditions. Right *y*-axis: percentage of errors in the recognition test.

[4] As in Experiment 1a, we also assessed the direct relation between recognition errors and intensity of feelings using data from L10 and NL10. We performed a multiple regression analysis with intensity of feelings as dependent variable and recognition errors and load conditions as predictors. The results revealed once again that under these conditions, recognition errors did not predict the intensity of feelings, $b = 0.24$, $t(17) = 0.23$, while load did, $b = 0.97$, $t(17) = 2.99$, $p < .008$.

## Experiment 2a

### Method

**Participants.** Twenty undergraduate students of the Hebrew University of Jerusalem (11 female) participated individually, gave informed consent, and were paid $4 for their participation.

**Design and procedure.** Experiment 2a was a complete replication of the L10 and NL10 (10-s load and no-load) conditions of Experiment 1b (stimuli were the same as those used in Experiment 1a). The participants were randomly allocated to load and no-load conditions and performed the same tasks as in Experiment 1b. The only difference was that, before the experiment proper started, immediately after the practice of counting backward, the participants were told that counting backward would intensify their feelings regarding the pictures.

### Results and Discussion

In spite of being told that load manipulation intensifies feelings, the participants under cognitive load still showed lower intensity of feeling ($M = 2.58$, $SD = 0.60$) than the participants in the no-load condition ($M = 3.23$, $SD = 0.60$), $t(18) = 2.29$, $p < .03$, $d = 1.1$.

The results do not support an alternative explanation of our previous results in terms of demand characteristic. Even when the participants were explicitly told that we expected the intensity of feelings to increase under cognitive load, they still showed a lower intensity compared to the no-load condition.

## Experiment 2b

Experiment 2b investigated whether load operates in an all-or-none manner or whether progressively increasing the load leads to progressive decrease in the intensity of feeling.

### Method

**Participants.** Forty-five undergraduate students (23 female) of the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Design and procedure.** The procedure of this experiment was similar to that of Experiment 1a, with the following modifications. First, the participants were randomly allocated to one of three load conditions: low, medium, or high. In the low-load condition, the participants were asked to count from 1 to 4 repeatedly (1, 2, 3, 4, 1, 2, 3, 4, etc.). In the medium-load condition, they were asked to count from 100 backward by intervals of 5 (100, 95, 90, etc.). In the high-load condition, the participants were asked to count backward from 1,000 in intervals of three (1,000, 997, 994, etc.). Second, we selected a completely new set of IAPS pictures. As in the previous three experiments, the pictures were mildly negative ($M = 2.86$, $SD = 0.72$) and mildly arousing ($M = 5.31$, $SD = 0.60$). Last, given the results of Experiment 1b, the participants in this experiment did not receive a recognition test.

### Results and Discussion

For each participant, we computed a mean intensity of feeling by averaging responses to the 20 pictures. A one-way ANOVA revealed a significant effect of load, $F(2, 42) = 9.27$, $p < .01$, $\omega^2 = .3$ (see Table 2). The participants in the high-load condition rated their feelings as less intense ($M = 2.24$) than the participants in the medium-load condition ($M = 2.72$), $t(42) = 2.34$, $p < .03$, $d = 0.81$, whose feelings were less intense than those of the participants in the low-load condition ($M = 3.13$), $t(42) = 1.96$, $p < .056$, $d = 0.79$.

These results replicate and extend our previous findings. First, they demonstrate, once again, that load affects the subjective experience of emotion. Moreover, they suggest that as load increases, the subjective feeling of emotions decreases. Since all conditions received exactly the same instructions and practice trials, the current results rule out these factors as alternative explanations for the results of the previous experiments.

## Experiment 3

An important question, at this point, is to determine whether cognitive load interferes with the development of feelings and/or with their maintenance. The difference between these two processes is that, in the former, load may impair the buildup of intense feelings but not maintenance of feelings that were created prior to the load manipulation. In the latter, intense feelings that were in place prior to the load manipulation cannot be maintained under load. Experiment 3 investigated these alternatives by manipulating the onset of the interval in which participants performed the load task.

### Method

**Participants.** Thirty undergraduate students (26 female) of the Hebrew University of Jerusalem were paid approximately $4 for their participation.

Table 2
*Rating of Intensity for Three Levels of Load Manipulation in Experiment 2b: Low Load, Medium Load, and High Load*

| | Condition | | | | | |
|---|---|---|---|---|---|---|
| | Low load (1, 2, 3, 4, 1, 2, . . .) | | Medium load (100, 95, 90, 85, . . .) | | High load (1,000, 997, 994, . . .) | |
| Measure | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Emotional intensity | 3.13 | 0.4 | 2.72 | 0.55 | 2.24 | 0.63 |

**Stimuli.** Twelve pictures from the IAPS (Lang et al., 2005) were selected. The pictures were mildly negative ($M = 2.2$, $SD = 0.3$, on a scale of 1–9) and mildly arousing ($M = 5.3$, $SD = 0.4$, on a scale of 1–9). These pictures differed from those used in Experiments 1 and 2.

**Design and procedure.** The participants were randomly allocated to one of three conditions: (a) load and (b) no-load conditions in which the pictures were presented for 10 s (L10 and NL10, respectively) and (c) a no-load condition in which the pictures were presented for 5 s (NL5). They are described schematically in Figure 2.

In the L10 and NL10 conditions, a beep was played 5 s after each picture appeared on the screen, and the participants were instructed to rate the way they felt after the beep. Crucially, in L10, the participants began counting backward only after the beep, resulting in 5 s in which they viewed the picture without load, followed by 5 s in which they viewed the same picture under load (see Figure 2).

The participants in the L10 and NL10 conditions, thus, had 5 s to develop their feelings without a concurrent load. Accordingly, up to the beep, L10 and NL10 should have created the same intensity of feeling. After the beep, however, the participants in the L10 condition began counting, presumably taxing their cognitive resources. In line with the findings of Experiments 1a, 1b, and 2b, we hypothesized that the emotional intensity of the participants in the L10 condition would be lower than that of the participants in the NL10 condition. Notwithstanding, a reduction in intensity could occur if (a) the intensity of feeling in the NL10 increased during the second interval of 5 s while that in L10 was maintained and/or if (b) the intensity of NL10 was maintained during that interval while that of L10 decreased. The NL5 condition was included to differentiate between these interpretations.

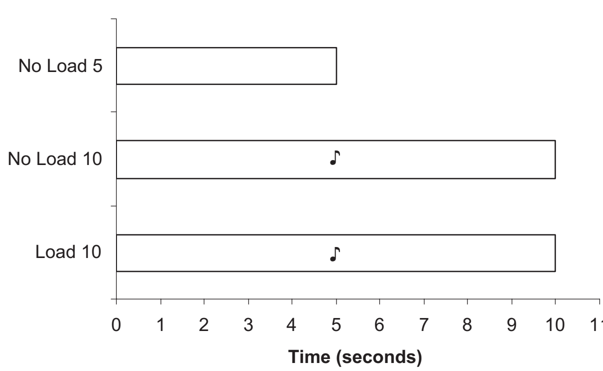


*Figure 2.* Design of Experiment 3. The left *y*-axis stands for the three load conditions. The *x*-axis represents presentation time of the pictures in seconds. Pictures in the NL5 (no-load 5-s) condition were presented for 5 s. Pictures in the L10 (load 10-s) condition were presented for 10 s: The first 5 s of exposure were without load, followed by an auditory tone and another 5 s in which participants watched the pictures while counting backward. Pictures in the NL10 condition were presented for 10 s: First, 5 s of exposure without load, followed by an auditory tone and another 5 s without load. For all three conditions, the rating of intensity of feeling was done only in relation to the last 5 s.

## Results and Discussion

Supporting the main hypothesis, the participants in L10 ($M = 2.09$) rated their feelings as less intense than the participants in NL10 ($M = 3.03$), $t(18) = 4.09$, $p < .01$, $d = 1.83$ (see Table 3). The intensity of feelings in NL5 ($M = 3.26$) was statistically similar to and numerically even higher than that in NL10. This pattern rules out an interpretation of the results on the basis of increased intensity in the NL10 condition.

These results clearly support the hypothesis that a cognitive load not only prevents the development of intense feelings but can also lead to a decrease in the intensity of already-developed feelings. The participants in L10 and NL10 were given the identical time interval—5 s—to develop their feelings while encoding and processing the pictorial stimulus, since the cognitive load was introduced only after this time interval. Nevertheless, the participants in L10 felt less intensely than those in NL10. Although our results do not rule out the possibility that load can also affect emotions by interfering with their development, our findings show that load can directly affect the maintenance of intensity of feeling.

Until now, we have presented the results from five experiments all of which demonstrate that cognitive load attenuates the intensity of feelings with negative valence (unpleasant feelings). The interesting question, at this point, is whether a concurrent cognitive task would also diminish the intensity of pleasant feelings. From the perspective of the mere resource hypothesis, one would expect to see no difference between positive and negative experiences since both types of feelings require resources and, consequently, demanding concurrent tasks that consume the same mental resources should reduce intensity of feeling. This issue was examined in the next experiment.

## Experiment 4

Experiment 4 examined whether a cognitive load attenuates the intensity of positive feelings. Studying positive feelings in the current context is more complex than studying negative feelings because of a potential interaction with the load experience. Compared to a control group, the participants under load may experience negative feelings because of the stress involved in the manipulation. Stress associated with the load task did not compromise the interpretation of the findings when we assessed the influence of load on negative feelings. If anything, we were working against our hypothesis because we predicted that load manipulation attenuates the negativity of feelings, in spite of the possibility that the load may have created negative feelings on its own. However, with regard to the attenuation of positive feelings, negative feelings that are generated by the load itself may serve as an alternative explanation for the effect of cognitive load. Accordingly, instead of the mere resource mechanism, it could be argued that the attenuation of feelings is brought about by the negative experience of effort combined with the positive feelings aroused by positive pictures. Thus, when studying positive feelings with load, it is critical to assess the possible negative experience of load per se and to partial it out from the feelings reported in the load condition. This was accomplished in Experiment 4 by using neutral pictures.

Table 3
*Rating of Intensity of Feeling for Load and No-Load Conditions in Experiment 3*

| | Condition | | | | | |
|---|---|---|---|---|---|---|
| | Load (10 s) | | No load (10 s) | | No load (5 s) | |
| Measure | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Emotional intensity | 2.09 | 0.65 | 3.03 | 0.32 | 3.26 | 0.86 |

## Method

**Participants.** Forty-five undergraduate students (34 female) of the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Materials.** Twelve pictures were selected to elicit a positive affect. The pictures were of medium intensity ($M = 2.94$, $SD = 0.60$). Twelve pictures were selected to elicit minimal (neutral) affective reactions ($M = 1.34$, $SD = 0.21$). As in all previous experiments, intensity of feeling was rated on a 5-point nonverbal pictorial scale, which appears in the Appendix.

**Design and procedure.** The participants were randomly allocated to one of three conditions. In the L10 condition, each picture was presented for 10 s under load. In the remaining two conditions, the participants were not under load, and the pictures were shown, in one condition, for 10 s and, in the other, for 1.5 s (NL10 and NL1.5, respectively). As in the previous experiments, each participant performed a practice block followed by an experimental block.

The experimental block consisted of 24 trials with 12 emotional and 12 neutral pictures. The order of the pictures in the experimental block was random. Each trial began with the presentation of an asterisk for 5 s, followed by a picture (affective or neutral) that remained on the screen for 8 s. Participants in the load condition were asked to begin counting backward from 1,000 by intervals of three (1,000, 997, 994, etc.) when the asterisk appeared and to stop doing so when the picture disappeared from the screen. The counting was monitored via intercom from another room. After the picture disappeared from the screen, the participants were asked to rate the intensity of their feelings toward the picture while they counted backward (see instructions of Experiment 1a). We also included a recognition task as in Experiment 1b.

## Results and Discussion

Consider, first, the intensity of feeling. A 3 (load: L10, NL10, NL1.5) × 2 (valence: positive vs. neutral pictures) mixed-design ANOVA, with load as a between-participants factor and valence as a within-participants factor, yielded the expected main effect of valence, that is, the intensity of feelings toward positive emotional pictures ($M = 3.22$, $SD = 0.79$) was higher than that for neutral pictures ($M = 1.43$, $SD = 0.44$), $F(1, 42) = 286.00$, $p < .0001$. Importantly, the interaction between valence and load was significant, $F(2, 42) = 3.45$, $p < .04$. The nature of this interaction is revealed by considering the planned interaction contrast, $F(1, 42) = 6.65$, $p < .01$, suggesting that the intensity was lower under load (L10) than under no-load conditions (average of NL1.5 and NL10) for the positive pictures, but not for the neutral pictures. Simple-effect analyses showed that the load yielded a reduction in the intensity of feelings following presentation of positive pictures, $F(1, 42) = 6.41$, $p < .01$, $d = 0.72$, while there was no difference as a function of load when neutral pictures were shown, $F(1, 42) = 0.15$ (see Figure 3a).

The significant interaction and the pattern of simple effects suggest that cognitive load attenuates the intensity of positive feelings. Yet this effect cannot be attributed to the unpleasant nature of the load because no such pattern was found in the neutral condition. Finally, the comparison of the two no-load conditions (NL1.5 and NL10) revealed that the length of exposure was unrelated to the intensity of affect, either when the pictures were positive, $F(1, 42) = 0.01$, or when neutral, $F(1, 42) = 0.34$ (see Figure 3b).

Consider recognition errors next. As Figure 3a illustrates, the pattern of recognition errors differs from that of intensity of feeling, demonstrating once again a clear dissociation between the effect of cognitive load on stimulus processing and its effect on intensity of feeling. Perhaps the most illuminating conditions, in this regard, are the load (L10) and no-load (NL1.5) conditions. The participants in NL1.5 made roughly the same number of recognition errors ($M_{error} = 0.38$, $SD = 0.44$) as the participants in L10 ($M_{error} = 0.33$, $SD = 0.20$), $F(1, 42) = 1.44$. However, the participants in the NL1.5 condition demonstrated significantly more intense positive feelings ($M_{feeling} = 3.38$, $SD = 0.92$) than

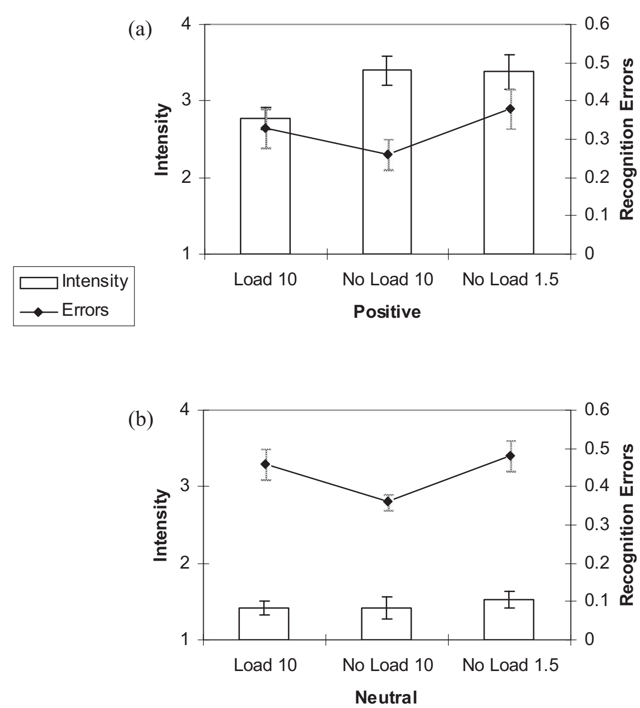


*Figure 3.* Results of Experiment 4. In both graphs, the left *y*-axis stands for intensity of feelings and the right *y*-axis for the percentage of errors in the recognition test—both intensity of feelings and errors are presented as a function of the different load conditions. Figure 3a describes the results for the positive pictures, and Figure 3b presents the results for the neutral conditions.

those in the L10 condition ($M_{\text{feeling}}$ = 2.75, *SD* = 0.57), $F(1, 42) = 4.62$, $p < .03$, $d = 0.6$ (see Figure 3a).

Last, we also performed the same correlation analyses as in Experiment 1b, using only L10 and NL10 conditions. The correlation between load and intensity of positive emotion was significant ($r = .43$, $p < .01$). As in the other experiments, this correlation was minimally affected when the recognition errors were partialed out ($r = .40$, $p < .03$), suggesting once again that the effect of cognitive load on intensity is not mediated by the degree of the overall processing of the picture.

## Experiments 5 and 6

The essence of the mere resource hypothesis is that cognitive load leads to a reduction of intensity of feelings because it consumes resources needed to maintain (or develop) the intensity of the feelings. An interesting prediction of the mere resource explanation is that cognitive load attenuates the intensity of a feeling even when the feeling itself stands at the focus of the concurrent (and therefore load-demanding) task. Hence, in Experiments 5 and 6, the load task was directed toward the feelings themselves. Specifically, the participants viewed emotional pictures and were asked to monitor their feelings, that is, to focus on changes in the intensity of their feelings. They were then asked to register the intensity of the feelings they experienced during the monitoring. Assuming that this monitoring task requires resources, the mere resource hypothesis predicts that the intensity of feelings will be attenuated even though the participants are focused on the feelings themselves.

## Experiment 5a

### Method

**Participants.** Twenty undergraduate students (23 female) from the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Design and procedure.** Stimuli were the same as those used in Experiment 3. Participants were randomly allocated to one of two conditions: monitoring and control. In both conditions, the participants first performed a practice block before going onto the main experimental block. The experimental block consisted of 12 trials. Each trial had the following sequence: (a) presentation of an asterisk (5 s); (b) presentation of an affective picture (4 s); (c) blank screen, which appeared for 10 ms; (d) presentation of the same picture for an additional 4 s; (e) presentation of a blank screen for 1 s; and (f) presentation of a rating scale. The blank screen in (c), which separated the two 4-s presentations of the same picture, (b) and (d), was experienced as a flicker, which served as a signal for the participants to start monitoring their feelings.

All participants were told, “The pictures you will see might elicit emotional reactions. The scale reflects the intensity of feelings, ranging from indifference to very intense.” The participants in the no-monitoring control condition were further told, “Please rate the intensity of your feelings during the time you were looking at the picture from the flicker until the picture vanished.” The participants in the monitoring condition were further instructed, “From the point in time that you see the flicker, begin tracking changes in the intensity of your feelings. Then, please rate the intensity of the feelings that were elicited by the pictures while you were tracking changes in the intensity of your feelings.” Thus, the participants in the two conditions rated the intensity of their feelings in relation to the same time window, namely, the 4 s from the flicker until the disappearance of the picture.

The participants were given practice designed to gradually expose them to different aspects of the task. First, they were trained to identify the flicker. Then, they practiced monitoring the intensity of their emotions while viewing pictures. Practice for participants in the no-monitoring (control) condition consisted only of viewing the pictures and rating the intensity of their feelings, without having to monitor changes in intensity levels.

### Results and Discussion

In accord with the mere resource hypothesis, the participants in the monitoring condition rated their feelings as less intense ($M$ = 2.67) than the participants in the no-monitoring condition ($M$ = 3.70), $t(18) = 4.35$, $p < .01$, $d = 1.83$.

The result of Experiment 5a supports the idea that load reduces the intensity of feeling even when the load is created by focusing attention on the feelings themselves. Experiment 5b was designed to replicate Experiment 5a using dynamic stimuli, that is, short video clips. Because video provides a dynamic stimulus, it allows a more natural setting to induce fluctuations in the intensity of feelings. Experiment 5b employed both positively valenced and negatively valenced video clips, enabling generalization to positive feelings as well.

## Experiment 5b

### Method

**Participants.** Forty undergraduate students (25 female) of the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Stimuli.** Two movie clips were selected from Gross and Levenson film clips (Gross & Levenson, 1995) to induce negative and positive feelings. Negative feelings were elicited by a short clip from *Bambi* (Disney & Hand, 1942), in which Bambi’s mother is shot by a hunter (87 s). Positive feelings were elicited by the fake-orgasm scene (117 s) from *When Harry Met Sally* (Reiner, Scheinman, Stolt, & Nicolaides, 1989).

**Assessment of intensity.** Feelings were rated as in all previous experiments using a 5-point nonverbal pictorial scale, based on the Self-Assessment Manikin Scale (Lang, 1980; see the Appendix).

**Design and procedure.** Design and procedure were very similar to Experiment 5a except that film clips were used as stimuli for the experimental trials and for practice. Participants were randomly allocated to one of two conditions: monitoring and control. The participants in both conditions performed a practice block followed by an experimental block that consisted of two trials. Each trial began with the film clip and ended with the intensity rating scale. While the film clip was shown, 10 s before the end, a pound sign (#) appeared at the bottom of the screen and remained there until the end of the clip. In the monitoring condition, the participants were asked to begin monitoring changes in the intensity of their feelings when the pound sign appeared and to keep tracking them until the end of the clip. Immediately afterward, the participants were asked to rate the intensity of their feelings during the time window in which they were monitoring the intensity of their feelings. In the no-monitoring control condition, the participants were asked to rate the intensity of their feelings in the time interval from the appearance of the pound sign until the end of the clip. The specific instructions and practice sessions were identical to that of Experiment 5b except for the use of film clips instead of pictures. The order of negative and positive film clips was counterbalanced across participants.

### Results and Discussion

Table 4 presents the mean intensity of negative and positive feelings in the monitoring and control conditions. A two-way mixed-model ANOVA with the monitoring manipulation (monitoring vs. control–no monitoring) and video-clip valence (negative vs. positive) was performed, whereby monitoring was treated as a between-participants factor and valence as a within-participants factor. As predicted, averaging over valence, the intensity of feelings was lower in the monitoring condition than in the no-monitoring condition, $F(1, 38) = 8.94$, $p < .01$, with no interaction between valence and monitoring manipulation, $F(1, 38) = 0.08$. Indeed, a significant reduction of intensity was observed within valence. Specifically, for the positive video clip, the rated intensity of feelings was lower in the monitoring condition ($M = 2.95$) than in the no-monitoring condition ($M = 3.50$), $t(38) = 2.10$, $p < .04$. Similarly, the rated intensity of feelings triggered by the negative video clip was lower ($M = 3.55$) in the monitoring condition than in the no-monitoring condition ($M = 4.20$), $t(38) = 2.39$, $p < .02$. Thus, the results of Experiment 5b replicated the findings of Experiment 5a using a dynamic stimulus and generalize the results to positive feelings.

One may object to the monitoring manipulation in Experiments 5a and 5b by arguing that the need to focus on the change in intensity is artificial and encourages distancing from the feelings (Kross, Ayduk, & Mischel, 2005). It might be proposed, for example, that the instruction to monitor the changes in intensity can lead participants to adopt an analytical attitude toward their feelings. In addition, such instructions may induce narrowing attention to specific components of feelings (i.e., changes in intensity) and, by that, lead participants to ignore other relevant aspects that might contribute to overall experience of intensity. The participants in Experiment 6 were instructed, therefore, merely to focus on their feelings, rather than to monitor the changes in the intensity of their feelings.

Table 4
*Rating of Intensity of Feelings for Monitoring and No-Monitoring Conditions in Experiment 5b*

| | Condition | | | |
|---|---|---|---|---|
| | Monitoring | | No monitoring | |
| Film | *M* | *SD* | *M* | *SD* |
| Positive | 2.95 | 0.94 | 3.50 | 0.68 |
| Negative | 3.55 | 1.05 | 4.20 | 0.61 |

## Experiment 6

### Method

**Participants.** Fifty undergraduate students (26 female) of the Hebrew University of Jerusalem were paid approximately $4 for their participation.

**Design and procedure.** Stimuli were the same as those used in Experiment 3. The procedure was identical to Experiment 5a except for the instructions. The participants in the focusing condition were asked to focus on their feelings from the flicker signal until the disappearance of the picture (4 s). Specifically, they were told, "Right after the flicker signal, focus your attention on the feelings aroused by the picture. There is no right or wrong answer, just report the intensity of the feelings you actually felt while focusing on the feelings." After the picture disappeared from the screen, the participants were asked to rate the intensity of the feelings that they experienced while focusing on their feelings.

In the no-focus control condition, the participants were asked to rate the intensity of their feelings in the time interval from the flicker until the picture disappeared. They received the same instructions as the participants in the focusing condition, except for the instruction to focus on their feelings.

Again, as in previous experiments, the participants practiced the task and were gradually exposed to different aspects of the task. First, the participants were instructed to notice the blink. Then, they practiced focusing on the intensity of their feelings while viewing the pictures. Practice for participants in the no-focusing control condition consisted only of viewing the pictures and rating the intensity of their feelings.

### Results and Discussion

In accord with the mere resource hypothesis, the participants in the focusing condition ($M = 2.71$, $SD = 0.59$) rated their feelings as less intense than the participants in the no-focusing condition ($M = 3.06$, $SD = 0.55$), $t(48) = 2.15$, $p < .01$, $d = 0.61$. These results suggest that, even if a mental load involves only focusing on the feeling itself, it still reduces the intensity of the feeling. This finding strongly suggests, as advocated by the mere resource hypothesis, that feelings require resources.

## General Discussion

The results of nine experiments support the mere resource hypothesis, according to which the intensity of feelings is partly determined by the amount of available mental resources. This hypothesis was tested in two sets of experiments. In the main conditions of the first set (Experiments 1–4), participants counted backward while watching mildly emotional pictures. Experiments 1a and 1b showed that a concurrent load led to a reduction in intensity of feeling and that this reduction was not mediated by the degree of processing of the pictures. Experiments 2a and 2b ruled out alternative explanations in terms of demand characteristics. Experiment 3 showed that a cognitive load attenuates the intensity of feelings that have already developed, and Experiment 4 replicated these findings with pictures that induce positive emotions.

Although the results of Experiments 1–4 are consistent with the mere resource hypothesis, they can also be accounted for by distraction-based models, according to which a concurrent task distracts participants from the emotional content of the stimuli. In the second set of experiments (Experiments 5a, 5b, and 6), we contrasted the distraction-based hypothesis with the mere resource hypothesis. Participants were required to focus on the feelings themselves, thereby rendering unlikely the possibility of distraction from the emotional content. In Experiments 5a and 5b, this was achieved by asking participants to monitor changes in their feelings. Experiment 6 took this examination one step further by simply asking participants to focus on their feelings. As predicted by the mere resource hypothesis but not by the distraction interpretation, intensity of feeling was reduced by these requirements in all the aforementioned conditions.

In the remainder of this discussion, we address two issues. Although very few previous studies have directly addressed the relation between feelings and resources, several lines of research bear some similarity to the present study. Some of these studies may even appear at a first glance to contradict the mere resource hypothesis. We first discuss these studies. Second, we have focused in this article strictly on emotion-based feelings. We discuss the possibility that resources may be needed for a broader range of conscious experiences.

## Previous Relevant Studies

**Online versus offline load.** Research conducted by Van Dillen and Koole (2007) appears to have the most affinity to our study, particularly to the first set of experiments. In this research, participants were shown emotional stimuli, then were asked to perform a working memory task, and then were asked to indicate the intensity of their feelings. The results of these experiments are very similar to those which we report in the first part of this article: The working memory task reduced the intensity of feelings. The authors proposed that "people can distract themselves from negative moods by loading their working memory capacity" (Van Dillen & Koole, 2007, p. 721) and that "the prevention of mood-congruent cognitions is thus a plausible mechanism that may underlie the effects of distraction" (Van Dillen & Koole, 2007, p. 716).

Why then do we propose that distraction is not a viable interpretation in our study? As mentioned earlier, there are two fundamental differences between the two sets of studies. First, in the Van Dillen and Koole (2007) study, the load was introduced only after the presentation and processing of the emotional pictures. In other words, the pictures were viewed without any additional load, and the intensity ratings were provided after the pictures had disappeared from the screen. Importantly, the presentation of the load task subsequent to that of the emotion-laden stimulus is also consistent with it being a distraction from a feeling that is already in place. Thus, these data cannot help us differentiate between distraction and mere resources processes.

**Focus on feelings versus rumination.** Our findings may appear to contradict previous findings regarding the role of self-focus and certain types of ruminations on the intensity of feeling. In this literature, it has been shown that the intensity of feeling increases when one focuses on the content of the feelings and ruminates on it (Ingram, 1990; Ingram & Smith, 1984; Kross et al., 2005; Nolen-Hoeksema, 2000; Rusting & Nolen-Hoeksema, 1998). In contrast, the manipulations in Experiments 5a, 5b, and 6 led to a reduction in the intensity of feeling. This contradiction, however, is more apparent than real. Self-focus and rumination have at least two concurrent influences. On the one hand, they induce load. On the other hand, they induce repeated thoughts (of certain types; see Kross et al., 2005) about the emotion-arousing events in their relation to the self. This latter aspect of rumination did not exist in our studies. Thus, whereas the load component in self-focus and rumination tasks may indeed reduce intensity even under these circumstances, other aspects of these tasks may actually increase intensity, thus leading to an overall effect of more intense feelings.

**Resources and emotion regulation.** We invested a great deal of effort in dissociating the mere resource mechanism from the distraction mechanism. As emphasized earlier, it is important to note here that the two explanations are not mutually exclusive. We offer the mere resource mechanism as an additional determinant of the intensity of feelings, not as a replacement for distraction. Numerous studies have shown that people can use distraction as an emotion-regulation strategy in situations that call for a reduction in the intensity of feelings (e.g., Rusting & Nolen-Hoeksema, 1998), and we have no doubt that the distraction mechanism does exist.

One interesting implication of the current results is that the efficiency of emotion regulation should depend, to some degree, on the amount of resources it requires (see also Van Dillen & Koole, 2007). All other aspects of the emotional regulation strategy being equal, effortful emotion regulation should attenuate intensity of feelings more than less effortful ones: If one wants to reduce the intensity of affect, then effortful regulation strategy should be more efficient than less effortful ones because the consummation of resources by the strategy adds to its effectiveness. Interestingly, the efficiency of emotion-regulation strategies that aim to intensify feelings should be inversely related to the amount of resources they consume. On a similar note, future research on distraction should take into account the amount of effort that is required by different distraction strategies (see Sheppes, Catran, & Meiran, 2009; Sheppes & Meiran, 2007, for a related design). In other words, to argue that Strategy X is better than Strategy Y due to inherent differences between X and Y, one has to rule out the possibility that X is simply more resource demanding than Y.

## Awareness Beyond Feelings

The interpretation we have suggested thus far is that concurrent load reduces the intensity of feelings. Yet one may suggest that the effect reported here is only one demonstration of a broader phenomenon. Specifically, given that conscious awareness is notoriously limited in capacity (e.g., Kahneman, 1973), it may well be the case that concurrent load interferes not only with feelings but more broadly with phenomenology. Several theoretical accounts that link a limited-capacity working memory system and conscious experience (e.g., Baars, 1997; Baddeley, 2000; LeDoux, 1996) are consistent with a broader interpretation of our results. Support for the broader interpretation comes also from research demonstrating that cognitive load reduces other types of mental experiences, such as vividness of remembered images (Andrade et al., 1997; Baddeley & Andrade, 2000) and pain (Eccleston, 1995; Hodes, Rowland, Lightfoot, & Cleeland, 1990). For example, Baddeley and Andrade (2000) asked their participants to rate the vividness of objects they were asked to imagine either under load or with no concurrent load. Their results showed that load led to reduced vividness of these images. Future research should try to reveal whether load reduces the intensity of all phenomenal experiences, including sensory experiences of taste, smell, and touch, and try to dissociate the mere resource hypothesis from the distraction hypothesis in these cases as well.

This issue, however, may turn out to be more complicated as it is quite likely that some experiences are more immune to load than others. The mere resource hypothesis might hold in some domains of experience more than in others. Much more research is needed to uncover the precise range of conscious experiences that are subject to the mere resource hypothesis.

## Coda

In conclusion, the current work highlights the role of mental resources in the experience of emotions and demonstrates that, when mental resources are allocated to a concurrent task, which might even be focusing on the feelings themselves, the ability to feel is dramatically impaired. We explain these results in terms of a mere resource hypothesis. According to this hypothesis, feelings consume resources, and the very same mental resources are required for concurrent cognitive task, leading to a reduction in the intensity of the feelings.

## References


Andrade, J., Kavanagh, D., & Baddeley, A. (1997). Eye-movements and visual imagery: A working memory approach to the treatment of post-traumatic stress disorder. *British Journal of Clinical Psychology, 36,* 209–223.

Baars, B. J. (1997). *In the theater of consciousness.* New York, NY: Oxford University Press.

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences, 4,* 417–423.

Baddeley, A., & Andrade, J. (2000). Working memory and the vividness of imagery. *Journal of Experimental Psychology: General, 129,* 126–145.

Barrett, L. F., Ochsner, K. N., & Gross, J. J. (2007). On the automaticity of emotion. In J. Bargh (Ed.), *Social psychology and the unconscious: The automaticity of higher mental processes* (pp. 173–217). New York, NY: Psychology Press.

Beedie, C. J., Terry, P. C., & Lane, A. M. (2005). Distinctions between emotion and mood. *Cognition & Emotion, 19,* 847–878.

Buck, R. (1985). Prime theory: An integrated theory of motivation and emotion. *Psychological Review, 92,* 389–413.

Damasio, A. R. (1999). *The feeling of what happens: Body and emotion in the making of consciousness.* New York, NY: Harcourt Brace.

Davis, M. (1992). The role of the amygdala in fear and anxiety. *Annual Review of Neuroscience, 15,* 353–375.

Disney, W. (Producer), & Hand, D. (Director). (1942). *Bambi* [Motion picture]. United States: Walt Disney Productions.

Dolan, R. J. (2002, November 8). Emotion, cognition, and behavior. *Science, 298,* 1191–1194.

Dvorak-Bertsch, J. D., Curtin, J. J., Rubinstein, T. J., & Newman, J. P. (2007). Anxiety moderates the interplay between cognition and affective processing. *Psychological Science, 18,* 699–705.

Eccleston, C. (1995). The attentional control of pain: Methodological and theoretical concerns. *Pain, 63,* 3–10.

Ekman, P. (1977). Biological and cultural contributions to body and facial movement. In J. Blacking (Ed.), *Anthropology of the body* (pp. 34–84). London, England: Academic Press.

Ekman, P. (1994). Moods, emotions, and traits. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 56–58). New York, NY: Oxford University Press.

Erber, R., & Tesser, A. (1992). Task effort and the regulation of mood: The absorption hypothesis. *Journal of Experimental Social Psychology, 28,* 339–359.

Feldman Barrett, L., Mesquita, B., Ochsner, N. K., & Gross, J. J. (2007). The experience of emotion. *Annual Review of Psychology, 58,* 373–403.

Flykt, A., Esteves, F., &. Öhman, A. (2007). Skin conductance responses to masked conditioned stimuli: Phylogenetic/ontogenetic factors versus direction of threat? *Biological Psychology, 74,* 328–336.

Frijda, N. H. (2005). Emotion experience. *Cognition & Emotion, 19,* 473–497.

Frijda, N. H., Ortony, A., Sonnemans, J., & Clore, G. L. (1992). The complexity of intensity: Issues concerning the structure of emotion intensity. In M. S. Clark (Ed.), *Review of personality and social psychology* (Vol. 13, pp. 60–89). Newbury Park, CA: Sage.

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology, 2,* 271–299.

Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition & Emotion, 9,* 87–108.

Harman, C., Rothbart, M. K., & Posner, M. I. (1997). Distress and attention interactions in early infancy. *Motivation and Emotion, 21,* 27–43.

Hodes, R. L., Rowland, E. W., Lightfoot, N., & Cleeland, C. S. (1990). The effects of distraction on responses to cold pressor pain. *Pain, 41,* 109–114.

Ingram, R. E. (1990). Self-focused attention in clinical disorders: Review and a conceptual model. *Psychological Bulletin, 107,* 156–176.

Ingram, R. E., & Smith, T. W. (1984). Depression and internal versus external focus of attention. *Cognitive Therapy and Research, 8,* 139–152.

Jiang, Y., & He, S. (2006). Cortical responses to invisible faces: Dissociating subsystems for facial-information processing. *Current Biology, 16,* 2023–2029.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice-Hall.

Kross, E., Ayduk, O., & Mischel, W. (2005). When asking “why” does not hurt: Distinguishing rumination from reflective processing of negative emotions. *Psychological Science, 16,* 709–715.

Lambie, J. A., & Marcel, A. J. (2002). Consciousness and the varieties of emotion experience: A theoretical framework. *Psychological Review, 109,* 219–259.

Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems* (pp. 119–137). Norwood, NJ: Ablex Publishing.

Lang, P. J. (1988). What are the data of emotion? In V. Hamilton, G. H. Bower, & N. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 1973–191). Norwell, MA: Kluwer Academic/Plenum Publishers.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International Affective Picture System (IAPS): Instruction manual and affective ratings* (Technical Report No. A-6). Gainesville, FL: Center for Research in Psychophysiology, University of Florida.

Lazarus, R. S. (1994). The stable and the unstable in emotion In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 79–85). New York, NY: Oxford University Press.

LeDoux, J. E. (1996). *The emotional brain.* New York, NY: Simon & Schuster.

LeDoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience, 23,* 155–184.

Levenson, R. W. (1994). Human emotion: A functional view. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 123–126). New York, NY: Oxford University Press.

Leventhal, H., & Scherer, K. R. (1987). The relationship of emotion to cognition: A functional approach to a semantic controversy. *Cognition & Emotion, 1,* 3–28.

Morris, J. S., Öhman, A., & Dolan, R. J. (1998, June 4). Conscious and unconscious emotional learning in the human amygdala. *Nature, 393,* 467–470.

Morris, J. S., Öhman, A., & Dolan, R. J. (1999). A subcortical pathway to the right amygdala mediating "unseen" fear. *Proceedings of the National Academy of Sciences, USA, 96,* 1680–1685.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology, 58,* 519–527.

Murphy, S. T., Monahan, J. L., & Zajonc, R. B. (1995). Additivity of nonconscious affect: Combined effects of priming and exposure. *Journal of Personality and Social Psychology, 69,* 589–602.

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality and Social Psychology, 64,* 723–739.

Navon, D. (1984). Resources: A theoretical soup stone? *Psychological Review, 91,* 216–234.

Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology, 109,* 504–511.

Norman, D. A., & Bobrow, D. G. (1975). On data-limited and resource-limited processes. *Cognitive Psychology, 7,* 44–64.

Nowlis, V., & Nowlis, H. H. (1956). The description and analysis of mood. *Annals of the New York Academy of Sciences, 65,* 345–355.

Öhman, A. (1986). Face the beast and fear the face: Animal and social fears as prototypes for evolutionary analyses of emotion. *Psychophysiology, 23,* 123–145.

Öhman, A., & Soares, J. J. F. (1993). On the automatic nature of phobic fear: Conditioned electrodermal responses to masked fear-relevant stimuli. *Journal of Abnormal Psychology, 102,* 121–132.

Öhman, A., & Soares, J. J. F. (1994). "Unconscious anxiety": Phobic responses to masked stimuli. *Journal of Abnormal Psychology, 103,* 231–240.

Pessoa, L. (2005). To what extent are emotional visual stimuli processed without attention and awareness? *Current Opinion in Neurobiology, 15,* 188–196.

Pessoa, L. (2009). How do emotion and motivation direct executive control? *Trends in Cognitive Science, 13,* 160–166.

Pessoa, L., McKenna, M., Gutierrez, E., & Ungerleider, L. G. (2002). Neural processing of emotional faces requires attention. *Proceedings of the National Academy of Sciences, USA, 99,* 11458–11463.

Phan, K. L., Wager, T., Taylor, F. S., & Liberzon, I. (2002). Functional neuroanatomy of emotion: A meta-analysis of emotion activation studies in PET and fMRI. *NeuroImage, 16,* 331–348.

Reiner, R. (Producer & Director), Scheinman, A., Stolt, J., & Nicolaides, S. (Producers). (1989). *When Harry met Sally* [Motion picture]. United States: Castle Rock Entertainment.

Reisenzein, R. (1994). Pleasure-arousal theory and the intensity of emotions. *Journal of Personality and Social Psychology, 67,* 525–539.

Robinson, M. D. (1998). Running from Williams James' bear: A review of preattentive mechanisms and their contributions to emotional experience. *Cognition & Emotion, 12,* 667–696.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110,* 145–172.

Russell, J. A., & Barrett, F. L. (1999). Core affect, prototypical emotional episodes, and other things called *Emotion:* Dissecting the elephant. *Journal of Personality and Social Psychology, 76,* 805–819.

Rusting, C. L., & Nolen-Hoeksema, S. (1998). Regulating responses to anger: Effects of rumination and distraction on angry mood. *Journal of Personality and Social Psychology, 74,* 790–803.

Sheppes, G., Catran, E., & Meiran, N. (2009). Reappraisal (but not distraction) is going to make you sweat: Physiological evidence for self-control effort. *International Journal of Psychophysiology, 71,* 91–96.

Sheppes, G., & Meiran, N. (2007). Better late than never? On the dynamics of online regulation of sadness using distraction and cognitive reappraisal. *Personality and Social Psychology Bulletin, 33,* 1518–1532.

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review, 84,* 127–190.

Stifter, C. A., & Moyer, D. (1991). The regulation of positive affect: Gaze aversion activity during mother–infant interaction. *Infant Behavior & Development, 14,* 111–123.

Van Dillen, F. L., Heslenfeld, J. D., & Koole, L. S. (2009). Tuning down the emotional brain: An fMRI study of the effects of cognitive load on the processing of affective images. *NeuroImage, 45,* 1212–1219.

Van Dillen, F. L., & Koole, L. S. (2007). Clearing the mind: A working memory model of distraction from negative mood. *Emotion, 7,* 715–723.

Vuilleumier, P., Armony, J. L., Driver, J., & Dolan, R. J. (2001). Effects of attention and emotion on face processing in the human brain: An event-related fMRI study. *Neuron, 30,* 829–841.

Wickens, C., D. (1984). Processing resources in attention. In R. Parasuraman & R. Davis (Eds.), *Varieties of attention* (pp. 63–102). New York, NY: Academic Press.

Winkielman, P., & Berridge, C. K. (2004). Unconscious emotions. *Current Directions in Psychological Science, 13,* 120–123.

Winkielman, P., Zajonc, R. B., & Schwarz, N. (1997). Subliminal affective priming resists attributional interventions. *Cognition & Emotion, 11,* 433–465.

Zajonc, R. B. (1985, April 5). Emotion and facial efference: A theory reclaimed. *Science, 228,* 15–21.

(*Appendix follows*)

## Appendix

### Five-Point Nonverbal Pictorial Scale for Intensity

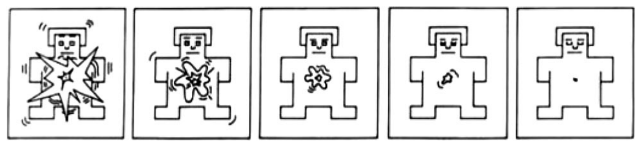

*Figure A1.* Five-point noverbal pictorial scale for intensity based on the Self-Assessment Manikin Scale for arousal (Lang, 1980).

Received June 23, 2009
Revision received March 26, 2010
Accepted April 1, 2010 ■