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<b>Citation</b>	Bar-Anan, Yoav., Timothy D. Wilson, and Daniel T. Gilbert. 2009. The Feeling of Uncertainty Intensifies Affective Reactions. <i>Emotion</i> 9(1): 123-127
<b>Published Version</b>	<a href="https://doi.org/10.1037/a0014607">doi:10.1037/a0014607</a>
<b>Accessed</b>	December 13, 2017 12:11:10 AM EST
<b>Citable Link</b>	<a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:3153298">http://nrs.harvard.edu/urn-3:HUL.InstRepos:3153298</a>
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## The Feeling of Uncertainty Intensifies Affective Reactions

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Uncertainty has been defined as a lack of information about an event and has been characterized as an aversive state that people are motivated to reduce. The authors propose an uncertainty intensification hypothesis, whereby uncertainty during an emotional event makes unpleasant events more unpleasant and pleasant events more pleasant. The authors hypothesized that this would happen even when uncertainty is limited to the feeling of “not knowing,” separable from a lack of information. In 4 studies, the authors held information about positive and negative film clips constant while varying the feeling of not knowing by having people repeat phrases connoting certainty or uncertainty while watching the films. As predicted, the subjective feeling of uncertainty intensified people’s affective reactions to the film clips.

*Keywords:* affective adaptation, uncertainty, curiosity, positive emotion

*Uncertainty* refers to the state of an organism that lacks information about whether, where, when, how, or why an event has occurred or will occur (Knight, 1921). By gaining information, organisms learn to predict and control their environment, conferring an adaptive advantage (Berlyne, 1960; Imada & Nageishi, 1982; Inglis, 2000). Consequently, uncertainty is generally viewed as an aversive state that organisms are motivated to reduce (e.g., Hogg, 2000; Weary & Edwards, 1996). The state of curiosity, for example, in which people desire more information about something in their environment, has been viewed as a negative drive state that produces pleasure only when it is satisfied (Harlow, Harlow, & Meyer, 1950; Loewenstein, 1994).

In contrast, we propose an *uncertainty intensification hypothesis*, whereby uncertainty makes unpleasant events more unpleasant (as prevailing theories suggest) but also makes pleasant events more pleasant (contrary to what prevailing theories suggest). There is empirical support for the first part of this hypothesis; namely, that uncertainty intensifies affective reactions to negative events (e.g., Arenas, Taberero, & Briones, 2006; van den Bos, Euwema, Poortvliet, & Maas, 2007; Wiggins et al., 1992). The novel part of the hypothesis is that uncertainty also intensifies affective reactions to positive events.

Related evidence comes from research on affective adaptation, or the conditions under which people’s affective reactions to events abate over time. The more people understand an event—what it is, why it occurred, how it fits into their self-concepts—the more quickly they adapt to it (Wilson & Gilbert, 2008). Thus, anything that impedes understanding, including uncertainty about

the nature of the event, will prolong affective reactions to that event. Wilson, Centerbar, Kermer, and Gilbert (2005) found support for this hypothesis with positive events. In one study, participants watched a pleasurable movie based on a true story and were then provided with two possible accounts of what happened to the main character after the movie was made. Participants who remained in this state of uncertainty were in a good mood for significantly longer than participants who were told either that the first or second account was true.

In the Wilson et al. (2005) studies, participants experienced a positive event (e.g., an uplifting movie) and then received the uncertainty manipulation (e.g., whether they knew what happened to the main character after the movie ended); thus, the manipulation could not have influenced people’s initial reactions to the events. In contrast, the uncertainty intensification hypothesis is concerned with the effects of “online” uncertainty during an emotional event. This is an important distinction, because in everyday life it is common to be in a state of uncertainty while experiencing an emotional event (e.g., not knowing how a movie or a sporting event will turn out).

Why might online uncertainty amplify reactions to an ongoing event? One possibility is that uncertainty heightens people’s attention. That is, just as uncertainty keeps an event accessible after it occurs (Wilson et al., 2005), so might it keep people’s attention on an ongoing event, intensifying their reactions to it. Another possibility is that uncertainty increases people’s curiosity about an emotional event, so that they become more emotionally engaged with it. That is, people may pay equal attention to an emotional event, but those who are uncertain may be more curious about what is happening, which makes them more engaged in the event.

The main purpose of the present studies was to demonstrate that uncertainty intensifies affective reactions to ongoing positive and negative events and to explore the cognitive mechanisms by which this might occur. We also sought to refine the definition and operationalization of uncertainty. Uncertainty has both an informational component (a deficit in knowledge) and a subjective component (a feeling of not knowing; Smith & Washburn, 2005), which have been confounded in previous research. Researchers typically induce uncertainty by depriving people of information

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We acknowledge the support of Research Grant RO1-MH56075 from the National Institute of Mental Health and Research Grant BCS-0722915 from the National Science Foundation.

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(e.g., what happened to the main character in a movie); thus, it is not clear which of these components is responsible for uncertainty's effects. In the present studies, we developed a technique to induce a feeling of not knowing while holding constant the information that people received.

### Studies 1–3

Participants watched a 5-min clip of either a pleasant or unpleasant scene from a movie they hadn't seen before. During the film, some of the participants repeated phrases connoting certainty (e.g., "I see what's happening"), whereas others repeated phrases connoting uncertainty (e.g., "I'm not sure what's happening"). All participants then rated their affective reactions to the film.

### Method

**Participants.** Participants were undergraduate students enrolled in psychology courses who had not seen the movie shown in their condition of the study. There were 51 participants in Study 1 (31 women), 52 in Study 2 (38 women), and 100 (65 women) in Study 3. We eliminated from the analyses participants who did not say the lines aloud (5 in Study 1, 4 in Study 2).

**Procedure.** Participants performed the task on computers in individual cubicles. They were told that the researchers were interested in how people perform simultaneous tasks while watching movies and that they would watch a short film clip while performing a secondary task. Participants read that they would be randomly assigned to the role of listeners, who would overhear taped comments supposedly emitted by another moviegoer, or talkers, who would generate verbal comments during the film. All participants learned that they had been assigned to the role of talker and were given three lines to read aloud during the movie clip. Those randomly assigned to the uncertain condition received the lines, "I wonder," "I'm curious," and "I'm not sure what's happening." Those assigned to the certain condition received the lines, "I see," "I understand," and "I see what's happening." The lines were numbered from 1 to 3 and displayed at the bottom of the screen during the film clip. Participants were instructed to say the line aloud when its corresponding number appeared on the screen, which happened twice for each line.

In Study 1, participants watched a positive clip from either *The Natural* (Breen, Colesberry, Johnson, Towne, & Levinson, 1981) or *Chariots of Fire* (Crawford, Fayed, Putnam, Eberts, & Hudson, 1981); thus, in Study 1, we used a 2 (certainty)  $\times$  2 (clip) design. In Study 2, all participants watched an unpleasant clip from the documentary *Dark Days* (Mesdon, Paul, Seganti, Swinski, & Singer, 2000) about homeless people in New York City. In Study 3, participants were randomly assigned to see a positive (*The Natural*) or negative (*Dark Days*) film clip; thus, in Study 3, we used a 2 (certainty)  $\times$  2 (valence of film) design.

**Dependent measures.** Participants rated the positivity of their feelings toward the clip, how happy the clip made them feel, how sad it made them feel, how much they liked the film, how intense their emotions were during the clip, how much they felt they understood what was happening in the clip, and how curious the film made them feel. In Study 3, we also asked how confusing and perplexing the clip was, how much participants felt they understood exactly what was going on in the clip, how closely they paid

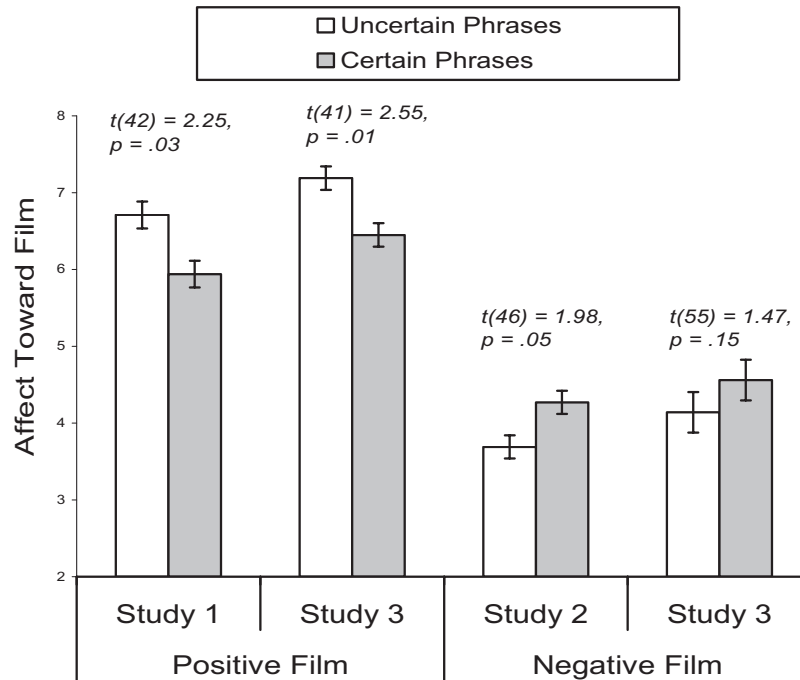
attention to the clip, whether they found it easy or hard to pay attention, and the extent to which they found their mind wandering during the clips, all on 9-point scales with appropriate labels at the endpoints. During the debriefing, no participant guessed that the meaning of the lines was supposed to influence their reactions to the film.

### Results and Discussion

The main dependent measures were participants' ratings of how positive, happy, and sad the film clips made them feel and how intense their emotional reactions were. In the positive film clip conditions, we averaged people's ratings of positivity, happiness, sadness (reverse scored), and intensity, and we tested the hypothesis that participants who uttered the uncertain phrases would have more extreme ratings on this index. In the negative film clip conditions, we averaged people's ratings of positivity (reverse scored), happiness (reversed scored), sadness, and intensity, and we tested the hypothesis that participants who uttered the uncertain phrases would have more extreme ratings on this index. To compare the results in the positive and negative film conditions on the same scale, we reverse scored the ratings in the negative condition. The alphas on this overall index were .75, .63, and .78 in Studies 1, 2, and 3, respectively.<sup>1</sup>

As predicted, participants in the uncertain phrase condition gave the positive and negative films more extreme ratings. In Studies 1 and 3, in which participants saw positive clips, those in the uncertain phrase condition rated the film more positively than did participants in the certain phrase condition, whereas in Studies 2 and 3, in which participants saw negative clips, those in the uncertain phrase condition rated the film more negatively than did participants in the certain phrase condition. The means and significance levels are summarized in Figure 1. In Study 3, the Certainty  $\times$  Valence of Film interaction was significant,  $F(1, 96) = 7.87, p < .01, \eta_p^2 = .08$ , reflecting the fact that uttering the uncertain phrases increased positive reactions in the positive clip condition and negative reactions in the negative clip condition. As seen in Figure 1, the effect of the uncertainty manipulation was in the predicted direction but not significant in the negative clip condition of Study 3 ( $p = .15$ ). However, when the results of this condition are combined with the results of Study 2, the effects of uncertainty on negative affect is significant,  $z = 2.40, p = .02$ .

<sup>1</sup> When we examine the valenced reactions (ratings of positivity, happiness, and sadness) and the ratings of intensity separately, similar results were found. On the valenced measure, participants in the uncertain condition rated the positive films more positively and the negative films more negatively than did participants in the certain condition,  $z_s > 2.03, p_s < .05$ , averaged across studies. On the intensity measure, participants in the uncertain condition reported more intense reactions to the positive and negative films than did participants in the certain condition: For the positive films,  $z = 3.33, p = .0009$ ; for the negative films,  $z = 1.69, p = .09$ . In Study 3, which included both positive and negative films, the Certainty  $\times$  Film Valence interaction was significant on the measure of valence,  $F(1, 96) = 5.13, p = .03$ . As predicted, the main effect of certainty was significant (with no interaction) on the measure of intensity,  $F(1, 96) = 5.10, p = .03$ , supporting our hypothesis that uncertainty increased the intensity of ratings to both positive and negative films.



*Figure 1.* Affective reactions to the positive and negative film clips as a function of certainty condition. For the positive films, the index is the average of participants' ratings positivity, happiness, sadness (reverse scored), and intensity so that high ratings reflect more extreme and intense reactions to the films. For the negative films, we first averaged participants' ratings of positivity (reverse scored), happiness (reversed scored), sadness, and intensity, and then we reversed scored the averages so that low ratings reflect more extreme and intense reactions to the films.

One possible explanation of these findings is that uttering the certainty phrases made people tune out and pay less attention to the films, thus reducing their impact. However, we found no support for this “tuning-out” hypothesis. In Study 3, the main effect of the certainty manipulation failed to reach significance on any of the seven questions assessing attention (e.g., how closely they paid attention to the clip),  $p_s > .28$ . In Study 2, there was a hint of support for an alternative hypothesis, namely that uttering the uncertain phrases made people more curious about the films,  $t(46) = 1.81$ ,  $p = .08$ ,  $d = 0.52$ . However, the effect of the certainty manipulation on reported curiosity was not significant in Studies 1 or 3. Study 4 allowed a more sensitive test of the curiosity hypothesis with the use a within-participant design. This study examined only positive affect, the novel contribution of this research.

#### Study 4

##### Method

Participants were 31 students (16 women, 15 men) from undergraduate psychology courses. The procedure was identical to Studies 1–3 except for these changes: Participants spoke the uncertain lines during one positive film clip and the certain lines during another in counterbalanced order. Between the two positive films, participants viewed a neutral clip and spoke lines unrelated to certainty/uncertain (“my phone rings,” “I’m in a movie,” “I will call you later”). The two positive movie clips were the same 5-min

excerpt from *Chariots of Fire* used in Study 1 and a 5-min clip from *An Officer and a Gentleman* (Elfand, Stewart, & Hackford, 1982) shown in counterbalanced order. The neutral clip was from *On the Set of “Elephant”*: *Rolling Through Time* (Van Sant, Wolf, & Andrew, 2004). The lines spoken in the certainty and uncertainty conditions were slightly different from those used in Study 1: “I wonder,” “Huh?” and “I don’t get it” in the uncertainty condition; and “I see,” “That makes sense,” and “Of course” in the certainty condition.

We simplified the dependent measures by asking people to rate their positive feelings (1 = *least positive* to 9 = *most positive*) and curiosity (1 = *least curious* to 9 = *most curious*) toward each clip immediately after watching it. We also included some filler questions that were not used in the analyses (e.g., ratings of boredom and anger caused by the clip) aimed to cover our main interest. We asked participants to rate their feelings and curiosity toward each of the three clips again after performing a 7-min filler task to determine whether any effects of condition persisted over time. Finally, we tested participants’ memory with five questions about each positive clip.

##### Results and Discussion

Two participants were clearly distracted by noise outside the lab room; thus, their data were eliminated from the analyses. We conducted a 2 (certainty condition: certainty vs. uncertainty lines)  $\times$  2 (time of measurement: immediately after the clip vs.

after the filler task)  $\times 2$  (order of film: *Chariots of Fire* vs. *An Officer and Gentleman* shown first)  $\times 2$  (condition order: certainty vs. uncertainty lines spoken first) ANOVA on participants' positivity ratings, with the first two factors treated as repeated measures. As predicted, there was a main effect of certainty condition,  $F(1, 25) = 4.46, p < .05, \eta_p^2 = .15$ , reflecting the fact that participants reported more positive feelings toward the clip when they spoke the uncertain lines ( $M = 7.00, SD = 1.42$ ) than when they spoke the certain lines ( $M = 6.43, SD = 1.88$ ). The Certainty  $\times$  Time interaction was not significant,  $F(1, 25) < 1, ns$ .<sup>2</sup>

There was no significant difference in participants' recall for the two positive clips,  $t(28) < 1$ , suggesting that they did not pay more attention when uttering uncertain phrases. Participants did, however, report significantly greater curiosity about the clip when they spoke the uncertain lines ( $M = 6.14, SD = 2.04$ ) than when they spoke the certain lines ( $M = 5.17, SD = 2.26$ ),  $F(1, 25) = 9.95, p < .005, \eta_p^2 = .22$ . We tested whether people's ratings of curiosity mediated the effects of the uncertainty manipulation on affective reactions, using procedures recommended by Judd, Kenny, and McClelland (2001) for testing mediation in within-participant designs. We regressed the difference between positive feelings toward the certain versus uncertain clips,  $P_{\text{uncertain}} - P_{\text{certain}}$ , onto the sum of the curiosity ratings of the two clips,  $C_{\text{uncertain}} + C_{\text{certain}}$ , and the difference in curiosity ratings of the two clips,  $C_{\text{uncertain}} - C_{\text{certain}}$ . The difference in curiosity predicted the difference in positive feelings,  $\beta = 0.53, t(28) = 3.17, p < .01$ , indicating mediation by curiosity. The sum of curiosity ratings did not predict the difference in positive feelings,  $t < 1$ , indicating no moderation of curiosity. The intercept of the regression equation was not significant,  $t < 1$ , indicating no effect of certainty condition on positive feelings beyond the effect of condition on curiosity. In short, these results indicate that the effect of certainty condition on positivity ratings was completely mediated by the effects of condition on curiosity (Judd et al., 2001).

### General Discussion

The present studies supported the hypothesis that uncertainty intensifies affective reactions. Participants in the uncertain phrases conditions rated the positive film clips more positively and the negative film clips more negatively, relative to participants in the certain phrases conditions. These studies are the first to show that uncertainty intensifies affective reactions to an ongoing positive event and are the first to show intensification to positive and negative events in the same study. The studies also demonstrated that the psychological effects of uncertainty may have less to do with what people do not know than with what people feel. Participants watched the exact same clips, yet those who repeated phrases connoting uncertainty reported more intense affective reactions.

One interpretation of the results is that uttering the uncertain phrases made people pay more attention to the films. However, there were no significant differences on questions designed to measure people's level of attention (e.g., how closely they paid attention). Furthermore, in Study 4, there were no significant differences in people's recall of the clips. Although these are null findings, they suggest that people who uttered the certain phrases

did not simply tune out. The results of Study 4 suggest instead that participants who uttered the uncertain phrases became more curious about the films, which intensified their affective reactions. The exact mechanisms by which curiosity intensifies affective reactions remain to be identified. One possibility is that curiosity led to greater psychological engagement in the film clips, whereby people identified more with the characters and became more involved in the stories. Put differently, people in the certain conditions may have paid equal attention to the films as people in the uncertain conditions, but they may have adopted a more distanced stance and failed to get as caught up in the narrative, reducing the impact of the film clips.

Our results appear to be inconsistent with theories that posit a relationship between interest and comprehensibility. Silvia (2008), for example, suggested that people are most interested in (i.e., curious about) stimuli that they find both novel and comprehensible. In contrast, we found that people were most curious about the films in the uncertain condition. As Hebb (1955) and Berlyne (1960) argued, however, there may be a curvilinear relationship between interest and comprehensibility. Events that are either too familiar and easily understood, or too novel and difficult to understand, may not spark people's interest. A moderate degree of novelty and incomprehensibility may be most likely to induce curiosity.

Uncertainty can have other effects besides intensifying affective reactions. Clarkson, Tormala, and Rucker (2008), for example, examined the effects of uncertainty about one's attitudes on information processing and attitude change and found that certainty strengthened the effects of unambivalent attitudes but weakened the effects of ambivalent attitudes. These effects appear to be independent of the effects of certainty on affective reactions to valenced events, as documented here.

In closing, Wilson et al. (2005) referred to the positive effects of uncertainty as a pleasure paradox: People want to reduce uncertainty about positive events, so that they can increase the likelihood that the events will recur, but by so doing, they may unintentionally spoil the pleasure the events bring. If a scientist gives a colloquium that is entertaining and clear, for example, the audience may comprehend the talk but not enjoy it, at least not as much as people who find the talk entertaining but not fully comprehensible. The present studies, however, also suggest a possible resolution to the pleasure paradox: People can obtain all the information they want about pleasurable events without reducing their enjoyment if they maintain a subjective sense of uncertainty. It is not clear whether people can accomplish this voluntarily, although it may help to utter the occasional "I wonder" while experiencing a pleasurable event.

<sup>2</sup> There was also an unpredicted (and uninterpretable) three-way Certainty Condition  $\times$  Film Order  $\times$  Condition Order interaction,  $F(1, 25) = 6.10, p < .05$ .

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Received June 2, 2008

Revision received October 6, 2008

Accepted October 8, 2008 ■