

**Over-the-Counter Relief from Pains and Pleasures Alike:
Acetaminophen Blunts Evaluation Sensitivity to Both Negative and Positive Stimuli**

Supplementary Materials
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Study 1 Results

Evaluations

On evaluations, participants' overall evaluation extremity to all stimuli in Study 1 was submitted to an independent-samples *t*-test, with treatment as the between-participants factor. As expected, participants taking acetaminophen reported overall less extreme evaluations ($M = 1.99$, $SD = 0.49$) than participants receiving placebo ($M = 2.26$, $SD = 0.52$), $t(72) = 2.25$, $p = .027$, $\eta_p^2 = .066$.

Next, we accounted for differences between stimulus categories by submitting participants' evaluation extremity to a 2 [Treatment: acetaminophen, placebo] x 3 [Normative Rating: neutral, moderate, or extreme image] mixed-model ANOVA, with treatment as between-participants and normative rating as within-participants factors. Mauchly's test indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 4.03$, $p = .122$, so sphericity was assumed. A main effect of category was found, $F(2, 144) = 639.91$, $p < .001$, $\eta_p^2 = .899$, such that participants rated neutral stimuli least extremely (in either a positive or negative direction), moderate stimuli relatively more extremely than neutral stimuli, and extreme stimuli relatively more extremely than moderate stimuli, reflecting normative ratings.

As expected, however, this analysis yielded a main effect of treatment, $F(1, 72) = 4.79$, $p = .032$, $\eta_p^2 = .062$, and the predicted interaction pattern of treatment by category, $F(2, 144) = 2.07$, $p = .129$, $\eta_p^2 = .028$, although the interaction was not significant in this study. Contrast analyses within each category revealed that participants taking acetaminophen evaluated extreme stimuli ($M = 3.08$, $SD = 0.73$) significantly less extremely (in either a positive or negative direction) than did participants receiving placebo ($M = 3.45$, $SD = 0.76$), $t(72) = 2.12$, $p = .037$. Likewise, participants taking acetaminophen evaluated moderate stimuli ($M = 1.51$, $SD = 0.67$) marginally significantly less extremely than participants receiving placebo ($M = 1.79$, $SD = 0.62$), $t(72) = 1.86$, $p = .067$. Evaluation extremity toward neutral stimuli did not differ as a function of treatment, $p = .600$.

Finally, participants' raw evaluations were submitted to a 2 [Treatment: acetaminophen, placebo] x 5 [Normative Rating: extremely unpleasant, moderately unpleasant, neutral, moderately pleasant, extremely pleasant] mixed-model ANOVA. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(9) = 61.91$, $p < .001$, so degrees of freedom were corrected using Huynh-Feldt estimates of sphericity since the epsilon value was less than or equal to 0.75 ($\epsilon = 0.67$). A main effect of category was found, $F(2.8, 202.6) = 669.43$, $p < .001$, $\eta_p^2 = .903$, such that participants rated extremely unpleasant pictures more negatively and extremely pleasant pictures more positively in a linear fashion, reflecting normative ratings. There was no main effect of treatment on evaluations, $F(1, 72) = 0.49$, $p = .487$, $\eta_p^2 = .007$, indicating that participants taking acetaminophen did not evaluate stimuli overall in either a relatively more negative or more positive direction.

These effects were qualified by a significant interaction of treatment by category, $F(2.8, 202.6) = 2.71$, $p = .050$, $\eta_p^2 = .036$, as hypothesized. Contrast analyses revealed that participants taking acetaminophen tended to rate extremely unpleasant stimuli ($M = -3.41$, $SD = 0.84$) less negatively than participants receiving placebo ($M = -3.73$, $SD = 0.83$), $t(72) = 1.63$, $p = .107$.

Likewise, participants taking acetaminophen rated extremely pleasant stimuli ($M = +2.75$, $SD = 0.93$) significantly less positively than participants receiving placebo ($M = +3.17$, $SD = 0.91$), $t(72) = 1.95$, $p = .055$.

Participants taking acetaminophen also rated moderately pleasant stimuli ($M = +1.34$, $SD = 0.96$) marginally significantly less positively than participants receiving placebo ($M = +1.73$, $SD = 0.94$), $t(72) = 1.75$, $p = .085$. Finally, participants taking acetaminophen additionally tended to rate moderately unpleasant stimuli less negatively ($M = -1.59$, $SD = 0.98$) than participants taking placebo ($M = -1.74$, $SD = 0.99$), although this difference was not significant in this study, $t(72) = 0.68$, $p = .501$. Evaluations of neutral stimuli did not differ as a function of treatment, $t(72) = 0.15$, $p = .878$.

Emotional Arousal

On emotional arousal, we first submitted participants' overall emotional arousal to all stimuli in Study 1 to an independent-samples t -test, with treatment as the between-participants factor. As expected, participants taking acetaminophen were tending overall to be less emotionally aroused by the stimuli ($M = 4.32$, $SD = 1.12$) than participants receiving placebo ($M = 4.70$, $SD = 1.24$), $t(72) = 1.39$, $p = .169$, $\eta_p^2 = .026$, although in this study this difference was not statistically significant.

Next, we submitted participants' emotional arousal to the stimuli as categorized by their neutral, moderate, or extreme normative ratings to a 2 [Treatment: acetaminophen, placebo] \times 3 [Normative Rating: neutral, moderate, or extreme] mixed-model ANOVA, with treatment as between-participants and normative rating as within-participants factors. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 16.55$, $p < .001$, so degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.83$). A main effect of category was found, $F(1.7, 119.2) = 457.67$, $p < .001$, $\eta_p^2 = .864$, such that participants were least emotionally aroused by neutral stimuli, were relatively more emotionally aroused by moderately pleasant and unpleasant stimuli, and were most emotionally aroused by extremely pleasant and extremely unpleasant stimuli, reflecting normative ratings.

As expected, however, this analysis yielded a main effect of differences in arousal due to treatment, $F(1, 72) = 1.60$, $p = .211$, $\eta_p^2 = .022$ (although it was not statistically significant in this study), and these effects were qualified by the predicted (though marginally significant) interaction of treatment by category, $F(1.7, 119.2) = 2.49$, $p = .095$, $\eta_p^2 = .033$. Contrast analyses within each category of stimuli revealed that participants taking acetaminophen tended to be less emotionally aroused by extreme stimuli ($M = 5.94$, $SD = 1.33$) than were participants receiving placebo ($M = 6.43$, $SD = 1.42$), $t(72) = 1.55$, $p = .125$, although this difference was not statistically significant in this study. Likewise, participants taking acetaminophen were less emotionally aroused by moderate stimuli ($M = 3.79$, $SD = 1.37$) relative to participants receiving placebo ($M = 4.37$, $SD = 1.72$), $t(72) = 1.61$, $p = .112$, although this difference was again not statistically significant in this study. Participants' emotional arousal toward neutral stimuli did not significantly differ as a function of treatment, $p = .871$.

Finally, we submitted participants' emotional arousal ratings within each of the five normative categories across studies to the same 2 \times 5 mixed-model ANOVA as with their evaluations. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(9) = 28.14$, $p < .001$, so degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.83$). A main effect of stimulus category was obtained, $F(3.3, 240.3) = 249.72$, $p < .001$, $\eta_p^2 = .776$, such that participants expressed higher emotional arousal toward stimuli that

were normatively more extreme in valence in a quadratic fashion, with the highest arousal toward extremely unpleasant and extremely pleasant stimuli, and the lowest arousal toward neutral stimuli.

As expected, however, a main effect of treatment (though not significantly significant in this study) was obtained, $F(1,72) = 2.15, p = .147, \eta_p^2 = .029$, as was the predicted interaction (although it was not statistically significant in this study), $F(3.3, 240.3) = 1.15, p = .330, \eta_p^2 = .016$. Contrast analyses indicated that participants taking acetaminophen were marginally significantly less emotionally aroused by extremely pleasant stimuli ($M = 5.01, SD = 1.75$) than were participants taking placebo ($M = 5.65, SD = 1.55$), $t(72) = 1.67, p = .099$. Similarly, participants receiving acetaminophen were less emotionally aroused by extremely unpleasant stimuli ($M = 6.88, SD = 1.25$) than were participants assigned the placebo condition ($M = 7.23, SD = 1.84$), although this difference was not statistically significant in this study, $t(72) = 0.96, p = .341$. Furthermore, participants taking acetaminophen tended to be less emotionally aroused by moderately pleasant stimuli ($M = 2.91, SD = 1.64$) than participants taking placebo ($M = 3.49, SD = 1.89$), $t(72) = 1.44, p = .155$, and participants taking acetaminophen also tended to be less emotionally aroused by moderated unpleasant stimuli ($M = 4.68, SD = 1.42$) than participants taking placebo ($M = 5.25, SD = 2.02$), $t(72) = 1.42, p = .161$, although these differences were not statistically significant in this study. Participants did not differ significantly in their emotional arousal toward neutral stimuli as a function of treatment, $p = .871$.

Study 2 Results

Evaluations

On evaluations, participants' overall evaluation extremity to all stimuli in Study 2 was submitted to an independent-samples t -test, with treatment as the between-participants factor. As expected, participants taking acetaminophen reported overall less extreme evaluations ($M = 1.93, SD = 0.62$) than participants receiving placebo ($M = 2.24, SD = 0.47$), $t(77) = 2.51, p = .014, \eta_p^2 = .075$.

Next, we accounted for differences between stimulus categories by submitting participants' evaluation extremity to a 2 [Treatment: acetaminophen, placebo] x 3 [Normative Rating: neutral, moderate, or extreme image] mixed-model ANOVA, with treatment as between-participants and normative rating as within-participants factors. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 15.22, p < .001$, so degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = 0.85$). A main effect of category was found, $F(1.7, 130.3) = 516.80, p < .001, \eta_p^2 = .870$, such that participants rated neutral stimuli least extremely (in either a positive or negative direction), moderate stimuli relatively more extremely than neutral stimuli, and extreme stimuli relatively more extremely than moderate stimuli, reflecting normative ratings.

As expected, however, this analysis yielded a main effect of treatment, $F(1,77) = 5.45, p = .022, \eta_p^2 = .066$, and the predicted interaction of treatment by category, $F(1.7, 130.3) = 3.49, p = .041, \eta_p^2 = .043$. Contrast analyses within each category revealed that participants taking acetaminophen evaluated extreme stimuli ($M = 2.95, SD = 1.01$) significantly less extremely (in either a positive or negative direction) than did participants receiving placebo ($M = 3.46, SD = 0.67$), $t(77) = 2.60, p = .011$. Likewise, participants taking acetaminophen tended to evaluate moderate stimuli ($M = 1.55, SD = 0.70$) less extremely than participants receiving placebo ($M = 1.73, SD = 0.63$), although this difference was not statistically significant in this study, $t(77) =$

1.23, $p = .223$. Evaluation extremity toward neutral stimuli did not differ as a function of treatment, $p = .558$.

Finally, participants' raw evaluations were submitted to a 2 [Treatment: acetaminophen, placebo] x 5 [Normative Rating: extremely unpleasant, moderately unpleasant, neutral, moderately pleasant, extremely pleasant] mixed-model ANOVA. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(9) = 134.54$, $p < .001$, so degrees of freedom were corrected using Huynh-Feldt estimates of sphericity since the epsilon value was less than or equal to 0.75 ($\epsilon=0.51$). A main effect of category was found, $F(2.0, 157.2) = 629.92$, $p < .001$, $\eta_p^2 = .891$, such that participants rated extremely unpleasant pictures more negatively and extremely pleasant pictures more positively in a linear fashion, reflecting normative ratings. There was an unexpectedly marginal main effect of treatment on evaluations, $F(1,77) = 3.69$, $p = .058$, $\eta_p^2 = .046$, such that participants taking acetaminophen evaluated stimuli overall relatively more negatively ($M = -0.32$) than participants taking placebo ($M = -0.17$).

These effects were qualified by a significant interaction of treatment by category, $F(2.0, 157.2) = 3.77$, $p = .024$, $\eta_p^2 = .047$, as hypothesized. Contrast analyses revealed that participants taking acetaminophen tended to rate extremely unpleasant stimuli ($M = -3.39$, $SD = 1.14$) less negatively than participants receiving placebo ($M = -3.74$, $SD = 0.74$), $t(77) = 1.60$, $p = .115$, though this contrast was not itself statistically significant within this study. Participants taking acetaminophen also rated extremely pleasant stimuli ($M = +2.51$, $SD = 1.07$) significantly less positively than participants receiving placebo ($M = +3.19$, $SD = 0.88$), $t(77) = 3.06$, $p = .003$.

Participants taking acetaminophen also tended to evaluate moderately pleasant stimuli ($M = +1.15$, $SD = 0.91$) less positively than participants receiving placebo ($M = +1.42$, $SD = 0.89$), $t(77) = 1.30$, $p = .198$, although this difference was not statistically significant in this study. Finally, participants taking acetaminophen tended to rate moderately unpleasant stimuli less negatively ($M = -1.84$, $SD = 0.99$) than participants taking placebo ($M = -1.93$, $SD = 0.95$), although this difference was not significant in this study, $t(77) = 0.42$, $p = .678$. Evaluations of neutral stimuli surprisingly differed as a function of treatment, $t(77) = 2.94$, $p = .004$, such that participants taking acetaminophen evaluated these stimuli significantly less positively ($M = -0.05$, $SD = 0.42$) than did participants taking placebo ($M = +0.22$, $SD = 0.38$).

Emotional Arousal

On emotional arousal, we first submitted participants' overall emotional arousal to all stimuli to an independent-samples t -test, with treatment as the between-participants factor. As expected, participants taking acetaminophen were overall significantly less emotionally aroused by the stimuli ($M = 4.10$, $SD = 1.42$) than participants receiving placebo ($M = 5.05$, $SD = 1.21$), $t(77) = 3.14$, $p = .002$, $\eta_p^2 = .114$.

Next, we submitted participants' emotional arousal to the stimuli as categorized by their neutral, moderate, or extreme normative ratings to a 2 [Treatment: acetaminophen, placebo] x 3 [Normative Rating: neutral, moderate, or extreme] mixed-model ANOVA, with treatment as between-participants and normative rating as within-participants factors. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 41.14$, $p < .001$, so degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon=0.72$). A main effect of category was found, $F(1.4, 111.5) = 425.69$, $p < .001$, $\eta_p^2 = .847$, such that participants were least emotionally aroused by neutral stimuli, were relatively more emotionally aroused by moderately pleasant and unpleasant stimuli, and were most emotionally aroused by extremely pleasant and extremely unpleasant stimuli, reflecting normative ratings.

As expected, however, this analysis yielded a significant main effect of treatment, $F(1,77) = 8.70, p = .004, \eta_p^2 = .102$, and the predicted interaction of treatment by category, $F(1.4, 111.5) = 3.04, p = .068, \eta_p^2 = .038$, although this interaction was marginally significant in this study. Contrast analyses within each category of stimuli revealed that participants taking acetaminophen were significantly less emotionally aroused by extreme stimuli ($M = 5.76, SD = 1.93$) than were participants receiving placebo ($M = 7.08, SD = 1.59$), $t(77) = 3.28, p = .002$. Likewise, participants taking acetaminophen were marginally significantly less emotionally aroused by moderate stimuli ($M = 3.87, SD = 1.67$) relative to participants receiving placebo ($M = 4.51, SD = 1.44$), $t(77) = 1.81, p = .074$. Participants' emotional arousal toward neutral stimuli unexpectedly differed marginally significantly as a function of treatment, $t(77) = 1.89, p = .063$, such that participants taking acetaminophen were less emotionally aroused by these stimuli ($M = 1.02, SD = 1.32$) than were participants taking placebo ($M = 1.52, SD = 0.97$).

Finally, we submitted participants' emotional arousal ratings within each of the five normative categories across studies to the same 2x5 mixed-model ANOVA as with their evaluations. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(9) = 73.7, p < .001$, so degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = 0.69$). A main effect of stimulus category was obtained, $F(2.7, 205.7) = 247.84, p < .001, \eta_p^2 = .763$, such that participants expressed higher emotional arousal toward stimuli that were normatively more extreme in valence in a quadratic fashion, with the highest arousal toward extremely unpleasant and extremely pleasant stimuli, and the lowest arousal toward neutral stimuli.

As expected, however, a significant main effect of treatment was obtained, $F(1,77) = 8.29, p = .005, \eta_p^2 = .097$, as was the predicted interaction, $F(2.7, 205.7) = 2.46, p = .071, \eta_p^2 = .031$, although it was marginally significant in this study. Contrast analyses indicated that participants taking acetaminophen were significantly less emotionally aroused by extremely pleasant stimuli ($M = 4.79, SD = 1.93$) than were participants taking placebo ($M = 6.42, SD = 1.58$), $t(77) = 4.08, p < .001$. Similarly, participants receiving acetaminophen were significantly less emotionally aroused by extremely unpleasant stimuli ($M = 6.74, SD = 2.36$) than were participants assigned the placebo condition ($M = 7.74, SD = 1.97$), $t(77) = 2.02, p = .047$.

Furthermore, participants taking acetaminophen were significantly less emotionally aroused by moderately pleasant stimuli ($M = 2.69, SD = 1.78$) than participants taking placebo ($M = 3.44, SD = 1.44$), $t(77) = 2.03, p = .046$. Finally, participants taking acetaminophen tended to be less emotionally aroused by moderately unpleasant stimuli ($M = 5.05, SD = 2.15$) than participants taking placebo ($M = 5.58, SD = 1.92$), although this difference was not statistically significant in this study $t(77) = 1.15, p = .252$. Participants also unexpectedly differed in their emotional arousal toward neutral stimuli as a function of treatment to a marginally significant extent, $t(77) = 1.89, p = .063$, such that participants taking acetaminophen were less emotionally aroused by these stimuli ($M = 1.02, SD = 1.32$) than participants taking placebo ($M = 1.52, SD = 0.97$).

Methodological Note: Participants did not provide a DNA sample for genotyping in either study.