

Soften the Pain, Increase the Gain: Enhancing Users' Resilience to Negative Valence Feedback

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Content creators fear receiving unnecessarily harsh criticism when posting creative work in online platforms. We refer to feedback written in an unnecessary harsh tone as negative feedback. We conducted an online experiment to investigate the efficacy of three coping activities for mitigating the influence of negative feedback: self-affirmation, expressive writing, and distraction. Participants (N=480) received feedback sets with different balances of neutral and negative valence content and revised their essays after performing the assigned activity. We measured participants' affective states, extents of revision, and their perceptions of the feedback and its providers. Our results showed even a small amount of negativity had significant adverse effects on all the measures. For the coping activities, we found that expressive writing encouraged essay revision, distraction improved affective states and feedback provider perception, and self-affirmation had no significant effects on the measures. Our results contribute further empirical knowledge of how negative valence feedback impacts content creators and how the coping activities tested mitigate these effects. We also offer practical guidelines regarding when and how to use the activities tested in online feedback platforms.

CCS Concepts: Human-centered computing~Human computer interaction.

KEYWORDS

Design feedback; crowdsourcing; emotional coping.

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1 INTRODUCTION

Online feedback collection platforms enable content creators to amass a wide range of critiques quickly [57]. A frequent problem is content creators receiving feedback with negative valence, which is a comment written using an unnecessarily negative tone. We refer to this kind of feedback as negative feedback. For example, when a novice content creator posted a website design for feedback on a popular online forum, one of the feedback providers wrote, “the design

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is so bad that no one wants to criti[que it].” This problem can occur in face-to-face settings but may be exacerbated in online platforms for two reasons. First, anonymity in online platforms links to aggressive behavior [47]. Second, users contributing negative valence content are more active than average users [42]. Negative feedback also snowballs, as exposure to it encourages everyday users to compose more negative content [12]. Prior work shows negative valence information substantially reduces people’s affective states [5] and erodes their task performance [1,10]. Also, the negativity may mask the constructive advice in the feedback. For these reasons, we envision a future where online feedback collection platforms implement workflows that enable content creators to build resilience to the effects of negative feedback.

In this paper, we examined three coping activities which we hypothesize may mitigate the effects of negative feedback: self-affirmation, expressive writing, and distraction. All three coping activities have the potential to increase people’s resilience to negative feedback as suggested by prior work. Self-affirmation activities inhibit defensive reactions to ego-threatening information, such as negative feedback, by affirming people’s core values [13,44]. The affirmation could uphold people’s self-worth and encourages feedback reception. Expressive writing facilitates recognition and expression of stress-related thoughts and negative emotions [26]. By reducing the interference from distress, expressive writing also improves performance in cognitively loaded tasks, such as test-taking [36]. In our study, we hypothesize that expressive writing can lessen the distress caused by the negative feedback and increase participants’ performance on the experimental task. Distraction relieves distress and anxiety by directing a user’s attention away from the source [11,20]. A short duration of mind wandering has been shown to improve people’s affective states and also stimulates the development of novel solutions to previously encountered problems [2]. After receiving negative feedback, distraction may help content creators to recover from distressful affective states, interpret the feedback from a new perspective, and conduct more effective revision.

Researchers have explored additional coping activities but many of these activities are not suitable for online environments, such as physical exercise [41], meditation [52], spirituality and religion [43]. In our work, the three selected activities have pathways to be implemented as standalone interventions compatible with existing feedback collection workflows. Besides comparing these activities in the context of iterative design process, our work is also original because we study the activities with feedback sets containing different balances of negative valences, such as mainly negative or all neutral. Prior work has examined the activities when participants receive stark negative valence information from a single source [11,13,20,26,44]. But in online environments, content creators usually receive a set of feedback with mixed valences from multiple sources. Here we simulated this setup and evaluated the activities in a realistic setting.

To compare the three coping activities, we conducted a full factorial experiment with coping activities and valence balances as factors. Each feedback set had three pieces of feedback, where the valence balance ranges from all negative to all neutral. The experiment included two phases. In the first phase, participants wrote an essay on a complex social issue. In the second phase, participants performed one of the coping activities and revised their essay based on a provided feedback set. All participants received feedback referencing the same aspects of their essay but with different valence balances based on experimental condition. We measured participants’ affective states and extents of revision to quantify the impact of negative feedback and the coping activities. Following prior work [28,33], we also measured participants’ perception of the feedback and its providers as they relate to the receptivity of the feedback.

Our results showed that receiving a feedback set containing one piece of negative feedback significantly raised participants' ratings of negative affects by 55%, reduced ratings of positive affects by 15%, reduced the extent of the revision by 28%, and lowered the perception of feedback and its providers by 24%. This result highlights that even a small amount of negative feedback can have a notable impact. Among the three activities tested, expressive writing encouraged essay revision while distraction improved participants' affective states and their perception of the feedback providers. Self-affirmation had no significant effects. Our results showed that no single activity outperformed the others. Platform designers could choose which activity to use based on how the designers prioritize different measures or situational needs. Future work can build upon our results and explore other activities to offer more coping methods within this emergent framework.

The HCI contributions of this work are (i) empirical knowledge of how feedback sets with different valence balances impact users' affective states, revision behaviors, and perceptions for a writing task; (ii) deeper empirical understanding of how three theoretically-based coping activities mitigate the effects of negative feedback; and (iii) practical guidelines regarding when to use the coping activities to improve users' resilience to negative feedback online: using expressive writing when valuing revision behavior the most and using distraction when prioritizing users' affective states or perceptions of the feedback providers.

2 RELATED WORK

We describe how prior work addresses the problem of negative feedback and how our approach differs. We also discuss the underlying theories and related empirical studies for the selected coping activities.

2.1 Negative Feedback on Feedback Collection Platforms

Researchers have approached the problem of negative feedback from multiple perspectives. One perspective is to curb negative valence content by controlling its source. Prior work shows a small group of online users with antisocial tendency are more eager to generate negative valence content [4,9]. To limit the influence of these users, platform designers may attempt to block them from future participation [22]. Many online communities rely on either centralized [35] or distributed moderation [24] to identify users with such characteristics. Prior work shows such moderation facilitates community interaction and helps to sustain growth [35]. Platform designers can also implement reputation systems to assist community moderation. Users are less likely to exhibit antisocial behaviors when the system logs malicious actions [14]. A reputation system also makes it easier for moderators to identify users who habitually generate negative content. However, a recent study shows users with a benign feedback history may also contribute negative feedback when experiencing negative moods or after exposure to negative valence content [12]. Existing practices targeting users with antisocial behaviors are less effective in these situations.

Another perspective researchers have explored is to deter users from generating negative feedback. Prior work shows expert rubrics help novices to follow principles of effective feedback and lead to more positive and higher quality critiques [59]. Greenberg et al. use feedback examples to help novices compose positive valence feedback (i.e., it contains praise) [18]. These approaches have shown promise, but feedback providers may choose to disregard the templates. Also, it may not always be possible to develop an effective rubric for every design or locate a model example.

A third perspective has been to develop mechanisms that help content creators filter negative feedback. Rzeszutarski & Kittur built a framework that surfaces high-quality content [39,40]. Content creators can select a few constructive feedback examples and then browse only the feedback that shares similar characteristics. Wu & Bailey developed a machine learning model that predicts the level of effort invested in the feedback composition, which allows content creators to filter the low effort feedback [53]. Though these methods make it easier to locate higher quality feedback, they cannot always filter all the negative feedback. Also, with filtering, content creators may miss the insights contained in the feedback.

Researchers have proposed scaffolding processes that can limit the negativity of the feedback as a fourth perspective. These processes require feedback providers to compose responses with pre-defined foci, such as identifying design elements or articulating their impressions [29,55]. The scaffolding limits the negativity of the feedback, but also restricts the scope of the content. Yatani et al. construct a word cloud using key phrases in a feedback set [56]. This aggregated view reduces the salience of the negative feedback (assuming it is infrequent) and serves as a buffer between the content creator and full content of the negative feedback. However, the aggregation method is most appropriate for large sets of feedback. For smaller sets, Wu & Bailey show that reordering the feedback set and presenting positive valence feedback first can mitigate the influence of negative feedback [54]. But this mechanism may work only with feedback sets where most of the feedback are of positive valence.

In our work, we explored three activities that could be implemented in existing feedback collection workflows without the needs to edit the feedback content or filter out any collected feedback. The activities tested are not exclusive and could be implemented in parallel with the other approaches described in this section.

2.2 Coping Activities

In this section, we discuss the theoretical foundations and related empirical studies for self-affirmation, expressive writing, and distraction. We also explained why we think these activities could help address the problem of negative feedback.

2.1.1 Self-Affirmation. Prior work shows self-affirmation is an effective ego-protection mechanism [44,46]. Facing information that threatens self-integrity, people are more likely to react defensively and become less receptive [44]. Affirming people's self-worth before exposure to ego-threatening information deters them from taking defensive measures [13]. The affirmation on people's core values serves as a buffer against the information that threatens the perceived integrity of the self. Prior work shows self-affirmation reduces resistance to disconfirming evidence in social-political discussions [45], negative valence health-risk information [19,37], and critical feedback on a public speaking task [49]. In online feedback collection, the affirmation of core values may neutralize the effects of negative feedback. In our experiment, we hypothesize self-affirmation can help participants to preserve their self-worth in the face of negative feedback and maintain positive affective states. At the same time, self-affirmed participants may stay receptive to the constructive critiques despite the negative tone of the feedback.

2.1.2 Expressive Writing. In expressive writing, people recognize their current emotional states and express them in written form [34]. The activity allows people to cope with stress by reexamining and reinterpreting their experiences via writing [25]. Prior work reports expressive writing reduces students' anxiety level during exams for high test anxious students [30]. On the other hand, writing helps students to reflect on the feedback they received and increases task performance [16]. Feedback evokes content creators to reflect on their design and the writing

process facilitates a deeper level of contemplation. In our work, we hypothesize that expressive writing can help participants recognize and process their emotions and lead to more positive affective states after they read the negative feedback. Meanwhile, the writing process may also stimulate participants to reexamine the feedback and gain insight.

2.1.3 Distraction Intervention. Distraction can attenuate depressive mood [7] and relieve anxiety [48]. It is a common coping strategy that people frequently initiate to abstain from brooding over existing problems. Focusing on neutral or pleasant tasks occupies people's cognitive load and stop them from rumination. Distraction may help content creators recover from emotional discomfort and increase creativity [38]. In addition, a short duration of mind wandering facilitates creative problem solving [2]. Thoughts generated during the distraction may help people to view the existing problem from a new angle. In online feedback collection process, performing an unrelated task could stop people from ruminating over the negative feedback and improve their affective states. The distraction may also stimulate creative thoughts and lead to higher quality revision.

In this paper, we empirically compare how these three coping activities mediate the influence of negative feedback on participants' affective states, perceptions of the feedback and its providers, and performance for a content generation task. We realize there are other activities that could also possibly mitigate the influence of negative feedback. The three activities studied in this work therefore represent a starting point for understanding how to promote user's resilience to negative feedback received online. The results of the experiment may lead to future work that explores additional activities. Our work is original because it compares these coping activities developed in independent threads of prior research and tests these activities for feedback sets that contain different balances of negative valence content.

In sum, based on the prior work, we focus on answering two research questions:

- RQ1: How do feedback sets with different balances of valence affect participants' affective states, extents of revision, and perceptions of the feedback and its providers?
- RQ2: To what degree can coping activities based on theories of self-affirmation, expressive writing, and distraction, mitigate the influence of negative feedback on these same measures?

Answers to these questions will deepen empirical knowledge about the effects of receiving negative feedback and how to reduce those effects. Answers will also provide insights regarding practical interventions that improves user's resilience to negative feedback received online.

3 METHODOLOGY

In this section, we describe how we conducted the study and what measurements were collected.

3.1 Experimental Design

To answer the research questions, we conducted a full-factorial between-subjects experiment with two factors: coping activity and valence balance. Coping activity examines four interventions: self-affirmation, expressive writing, distraction, and a control (no activity). Valence balance refers to the number of pieces of feedback in a set with a neutral / negative orientation. This factor had four levels: all neutral, mainly neutral, mainly negative, and all negative.

3.2 Task Setup

The experimental task was an essay composition task including a writing phase and a revision phase. In the writing phase, participants wrote an essay about whether they would support stricter gun control laws in the U.S. This topic was selected because it is widely debated and familiar to a general audience in the U.S. In addition, participants may have an existing stance

on the topic and genuinely care about the feedback. The task instructions stated that vague or plagiarized essays would not receive payment. We enforced a 100-250 word limit and a 30-minute time limit so each participant invested similar amount of effort in the task. Participants could track word counts by selecting a button on the task interface. In the revision phase, participants received three pieces of feedback and revised their essays in a text box pre-filled with the content. Participants had 30 minutes to finish this phase.

Task Instruction

Please write a short essay on the following topic:

Why would you support (or not) stricter gun control laws in the United States?

Your essay should be 100 words minimum and 250 words maximum. Essays that are too vague or plagiarized from other sources will be rejected. Note you may be invited to perform a HIT of similar length and payment in two days.

Check Word Count

Submit

Core Values Questionnaire

Please rank the following six values in the order of personal importance (1 = most important). Then explain why the top ranked value is most important to you.

Values:

- Business
- Art, music, theater
- Social life, relationships
- Science, pursuit of knowledge
- Religion, morality
- Government, politics

Reset Ranking

1	2	3	4	5	6
---	---	---	---	---	---
2	1	6	5	4	3
---	---	---	---	---	---

Write why your top most important value is important to you:

Next

Reflective Writing

In the following space we would like you to work on understanding your feelings regarding the feedback you received. Just take some time and feel free to experience and express your emotions in the text box. You can read the original feedback listed below.

The ending is terrible. Perhaps the author should at least come up with some less boring and plain ending material.

One big obvious error here is the use of personal pronouns. The first thing I learned from Writing 101 is to avoid using "I" or "me" in essays. Only newest rookie uses personal pronouns.

I don't really buy any of the points you have made. I would add the argument of the protection of civil liberties to make this essay closer to being convincing, if that's ever possible.

Next

Article Summarization

Please read the following article and summarize the main arguments.

Energy

I think a lot about how important cheap, safe, and abundant energy is to our future. A lot of problems—economic, environmental, war, poverty, food and water availability, bad side effects of globalization, etc.—are deeply related to the energy problem.

I believe that if you could choose one single technological development to help the most people in the world, radically better energy generation is probably it. Throughout history, quality of life has gone up as the cost of energy has gone down.

[article abbreviated for compact presentation]

your summarization:

Next

Fig. 1. Screenshots of the writing phase of the experimental task (top left), self-affirmation (bottom left), expressive writing (top right), and distraction (bottom right).

3.3 Coping Activity Factor

Four coping activities were tested: self-affirmation, expressive writing, distraction, and control. See Figure 1 for screenshots of the intervention interfaces. All activities happened in the revision phase. As prior work has not evaluated the efficacy of these activities in the context of receiving design feedback, here we test each activity individually to isolate the effects and leave the study of synergies of different activities for future work.

In the self-affirmation condition, a participant reflected on the positive aspects of oneself. Following [31], a participant ranked six core values (business; art, music, and theater; social life and relationships; science and pursuit of knowledge; religion and morality; and government and politics) by how important these values were to him or her. After the ranking, a participant explained the importance of the top-ranked value. Prior work reports timing is crucial for the efficacy of self-affirmation, which needs to happen before participants face the ego-threat [13]. In our experiment, participants perform the intervention before reviewing the feedback.

In the expressive writing condition, a participant reviewed the feedback, reflected on his emotional reactions, and expressed them in a provided text box. The task interface displayed the feedback for reference. The instructions were adapted from prior work on emotional coping [3].

In the distraction condition, the participants were instructed to perform a reading comprehension task to divert their attention away from the feedback reflection. Participants read an article about energy consumption, an issue orthogonal to the essay topic, and summarized it in a text box. We conducted a pilot study to select an article with appropriate length that required similar time to complete relative to the other conditions. The distraction intervention happened after feedback review and before the revision.

In the control condition, participants received feedback and revised their essays, but did not perform any coping activity.

Table 1. Feedback set for the revision task. In total, there are three pieces of authentic feedback on structure, style and content. Each piece has two versions with neutral (left) and negative (right side) tone. Every participant receives one piece of feedback from each row.

	Neutral	Negative
Structure	A stronger ending is in order. Perhaps the author can come up with more gripping and distinguished ending material.	The ending is terrible. Perhaps the author should at least come up with some less boring and plain ending material.
Style	The first error in my opinion is the use of personal pronouns. I was taught not to use “I” or “me” in essays because it makes the essay sound less professional.	One big obvious error here is the use of personal pronouns. The first thing I learned from Writing 101 is to avoid using “I” or “me” in essays. Only newest rookie uses personal pronouns.
Content	I pretty much agree with all of the points you have made. I would add the argument of the protection of civil liberties.	I don't really buy any of the points you have made. I would add the argument of the protection of civil liberties to make this essay closer to being convincing, if that's ever possible.

3.4 Valence Balance Factor

Valence balance had four levels: *all negative* (three pieces of negative feedback; labeled as “3-” in the tables and figures), *mainly negative* (two negative; labeled as “2-”), *mainly neutral* (one negative; labeled as “1-”), and *all neutral* (zero negative; labeled as “0-”). All participants received feedback on the same aspects of the essay but phrased with different valence balances. In this way, only the feedback valence, rather than its content, differed in the experiment. There were in total three pairs of feedback (Table 1). Within each pair, the only difference between the two pieces of feedback was the phrasing of the content: one neutral and one negative. During the experiment, each participant received one piece of feedback from each pair and three pieces of feedback in total. In case participants did not find the provided feedback useful, we allowed them to reject any piece of feedback and revise the essay in any way they deemed appropriate.

The feedback delivered to participants was derived from authentic feedback compiled online. We first collected five essays from Amazon Mechanical Turk (AMT) and used them to solicit a large feedback pool on three core aspects of the essays: content, structure, and style [32]. For each aspect, we selected the piece of feedback that was the most generalizable and actionable, and had neutral valence. To ensure the selected feedback is applicable to the essays, we used a script to filter out incompatible essays during the experiment. Since many people have strong beliefs about gun control policy, we only chose feedback with a neutral stance and a sole focus on the essay quality. We corrected misspellings and grammatical errors in the selected feedback to prevent language bias. For the feedback selected for each aspect, we created a piece of

complementary feedback by modifying its language to be more negative. This formed a neutral / negative pair in the final feedback set. The final set had one pair of feedback for each of the three aspects. In the essay revision phase, each participant received three pieces of feedback covering all core aspects. For example, a participant in the *mainly negative* condition might receive one piece of negative feedback on the content aspect, one negative on structure, and one neutral on style. This setup could mitigate any confounding effects caused by participants being more receptive to feedback on specific aspects.

Three graduate research assistants not affiliated with this project reviewed the final feedback set. They reported no difference in the valence among the negative feedback and among the neutral feedback. They also reported that the negative feedback had a notably more negative valence than the neutral feedback.

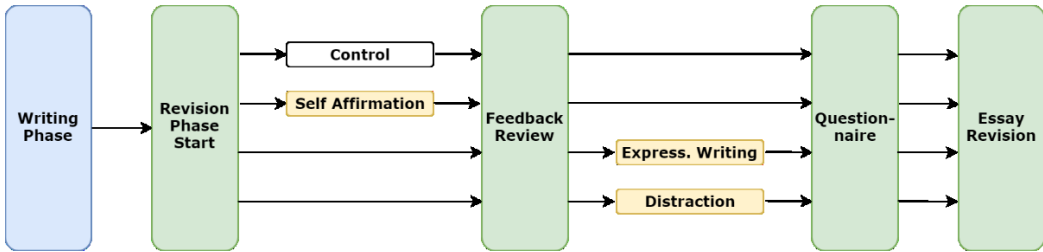


Fig. 2. Graphical summary of the procedure.

3.5 Participants

We recruited 681 participants in total, among which 518 participants finished both phases. 38 excess data points collected at the end were excluded. Given the scale of the experiment, the recruitment took place on AMT. We configured the task to require all participants to reside in the U.S. given the topic of the essay and to mitigate issues of language proficiency. 77% of participants completed an optional demographic survey. Among these participants, 50% reported their gender as female and nearly all (99%) selected English as their first language. For age, 81% reported being between 18-44 years of age and 19% reported being 45 years of age or older. The highest level of education was reported as high school (41%) and an undergraduate degree or higher (58%).

3.6 Procedure

Figure 2 shows the experiment workflow. At the start of the writing phase, participants signed an IRB consent form and read an overview of the workflow. After they completed the writing phase, a script filtered out 3% of the essays that used personal pronouns or keywords related to civil liberties, as it would be inconsistent with the feedback on style or content (Table 1). Since participants might question the viability of receiving feedback immediately after they finished the essay, we instrumented a two-day delay to simulate realistic feedback collection from an online platform. The delay also mitigates potential confounding effects caused by valence arousal during the writing phase. In the revision phase, we assigned participants a set of feedback with a valence balance determined by the assigned experiment condition. Participants completed a survey (see Measurement) immediately after performing the coping activity. We rewarded participants \$2 for completing the writing phase, and an additional \$3 for completing the revision phase. The payment rate was determined by a pilot study to be consistent with U.S. minimum wage. A follow-up survey asked participants about how important the gun control

issue is for them and how frequently they write on this topic. The collected ratings were used as covariates in the analysis. After the study, participants were debriefed via email.

3.7 Measurement

We measured three categories of dependent variables: participants' affective states and perceptions, extents of the revision, and behavioral data from both task phases.

For the affective states and perceptions, we collected the measurements via a survey including eleven questions:

- Four items regarding how happy / enthusiastic / annoyed / frustrated the participant feels. The questions were adapted from PANAS [50].
- Three items regarding how positive / useful / fair the feedback is.
- Four items regarding how considerate / polite / knowledgeable / (exhibiting) expertise the feedback providers are. The items were adapted from previous work on feedback reception [33].

For each statement, participants rated their degree of agreement on a seven-point scale (1=Strongly Disagree, 7=Strongly Agree).

For behavioral data, a script counted the number of characters edited during revision and calculated the final edit distance from the original essay [27]. We also asked participants to report how many and which piece of feedback they incorporated into their essay. We also logged the time participants spent composing essays, reviewing feedback, performing coping activities, and revising essays.

Given the scale of the data, we recruited 288 judges from MTurk to rate the quality of the initial and revised versions of the essays. We provided rubrics defining the three core aspects of the essays, namely content, style, and structure, together with examples for each aspect. Following the rubrics, the judges evaluated the quality of the essays on a 7-point scale (7=high quality). To calibrate the rating scales, each judge rated a set of 10 essays randomly assigned by a script. At the end of the rating session, the judges could adjust their ratings on a page displaying the essays and their ratings.

We discarded 4.4% of the ratings which took the judges too little time (less than three seconds) or too much time (two standard deviations above the mean) to assign. In the end, each essay received ratings from at least three independent judges. If the judges reached a consensus where the maximum difference among ratings was fewer than or equal to three units, we averaged the ratings to produce the final rating; if no consensus was reached, we collected two additional ratings and discarded the highest and lowest ratings. If the discrepancy remained, an expert in writing was recruited from Upwork to assign the final rating. Overall, the judges reached a consensus in the first round for 74.6% of the essays and the expert resolved the discrepancy for 3.1% of the essays. Figure 3 shows the essay evaluation workflow.

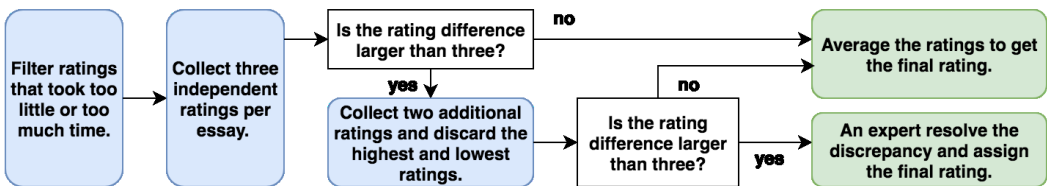


Fig. 3. Graphical summary of the essay rating procedure.

Table 2. ANOVA results for all measures.

happy					enthusiastic			
	sum sq	df	F	PR(>F)	sum sq	df	F	PR(>F)
valence balance	217.02	3	35.00	<0.01	155.71	3	22.91	<0.01
coping activity	13.62	3	2.20	0.09	8.47	3	1.25	0.29
v:c	17.23	9	0.93	0.50	19.14	9	0.94	0.49
residual	958.93	464			1050.97	464		
annoyed					frustrated			
valence balance	497.29	3	50.94	<0.01	310.61	3	34.93	<0.01
coping activity	0.89	3	0.09	0.96	6.84	3	0.77	0.51
v:c	25.61	9	0.87	0.55	28.28	9	1.06	0.39
residual	1509.80	464			1375.27	464		
edit duration					edit distance			
valence balance	371.70	3	5.71	<0.01	8.88e5	3	5.80	<0.01
coping activity	391.10	3	6.01	<0.01	3.27e5	3	2.14	0.09
v:c	279.01	9	1.43	0.17	5.09e5	9	1.11	0.35
residual	1.01e4	464			2.36e7	464		
positive					useful			
valence balance	598.58	3	118.76	<0.01	390.33	3	47.95	<0.01
coping activity	6.34	3	1.26	0.29	28.95	3	3.56	0.01
v:c	7.68	9	0.51	0.87	30.95	9	1.27	0.25
residual	779.53	464			1258.93	464		
fair					considerate			
valence balance	462.88	3	62.70	<0.01	834.84	3	152.75	<0.01
coping activity	16.23	3	2.20	0.09	18.14	3	3.32	0.02
v:c	19.03	9	0.86	0.56	15.22	9	0.93	0.50
residual	1141.80	464			845.30	464		
polite					knowledgeable			
valence balance	1022.71	3	195.23	<0.01	360.83	3	61.59	<0.01
coping activity	14.71	3	2.81	0.04	9.28	3	1.58	0.19
v:c	11.10	9	0.71	0.70	21.72	9	1.24	0.27
residual	810.23	464			906.13	464		
expertise					feedback accepted count			
valence balance	240.58	3	38.64	<0.01	36.81	3	11.43	<0.01
coping activity	10.69	3	1.72	0.16	4.51	3	1.40	0.24
v:c	9.26	9	0.50	0.88	11.65	9	1.21	0.29
residual	963.07	464			498.23	464		
original rating					revised rating			
valence balance	2.81	3	1.03	0.38	0.68	3	0.25	0.86
coping activity	4.75	3	1.74	0.16	3.87	3	1.42	0.24
v:c	6.39	9	0.78	0.64	6.04	9	0.74	0.67
residual	422.98	464			420.64	464		

4 RESULTS

We report how valence balance and coping activity influence participants' affective states, extents of revision, and their perceptions of the feedback and its providers. Participants found the topic of gun control moderately important with a rating of 3.97 (SE=0.11) out of 7. The essays have an average word count of 171.6 (SE=10.5), which is substantially higher than the 100-word minimum limit.

In this section, we focus on reporting statistically significant results and highlight patterns of interest for follow-up discussion. Using how much participants care about gun control and how frequent they wrote on this topic as covariates did not change significance levels. Therefore, we report the results of the analysis without using covariates. See Table 2 for all ANOVA results.

Table 3. Mean affective state ratings across *valence balance* and *coping activity* conditions. The label “[0, 1, 2, 3]-” refers to the valence balance condition in which participants received [0, 1, 2, 3] pieces of negative feedback. Fisher’s LSD (Least Significant Difference) [51] was used for post hoc test. Means with the different superscripts are significantly different ($p < .05$). For example, 3.40^a is significantly different from 3.81^b . Neither 3.40^a nor 3.81^b is significantly different from 3.59^{ab} .

	happy	enthusiastic	annoyed	frustrated
0-	4.48 ^a	4.18 ^a	2.03 ^a	1.93 ^a
1-	3.85 ^b	3.54 ^b	3.29 ^b	2.87 ^b
2-	3.14 ^c	2.97 ^c	4.56 ^c	3.99 ^c
3-	2.72 ^d	2.69 ^c	4.41 ^c	3.70 ^c
control	3.40 ^a	3.27 ^a	3.63 ^a	3.24 ^a
self-affirmation	3.59 ^{ab}	3.36 ^a	3.58 ^a	2.92 ^a
expressive writing	3.40 ^a	3.19 ^a	3.55 ^a	3.13 ^a
distraction	3.81 ^b	3.55 ^a	3.52 ^a	3.18 ^a
LSD	0.36	0.38	0.45	0.44

4.1 Affective States

A MANOVA analysis showed valence balance had a main effect on participants’ affective states ($F[12, 1389]=1.22, p<.001$). In comparison with the *all neutral* condition, increments in the feedback negativity significantly reduced participants’ affective states ratings until the feedback set became mainly negative (Table 3). An ANOVA showed coping activity had a marginal effect on the happiness rating ($F[3, 468]=2.20, p=.088$). No significant interaction effect was detected between coping activity and valence balance.

Among the coping activities, distraction is the only activity that had significant influences over participants’ ratings of affective states. The distraction intervention significantly increased participants’ happiness rating ($M=3.81, SE=0.15$) in comparison with the control condition ($M=3.4, SE=0.14$). The other two activities had no significant influences over the affective states, but we did observe some trends consistent with prior work. In the *all negative* condition, expressive writing and self-affirmation tended to improve participants’ affective states (Figure

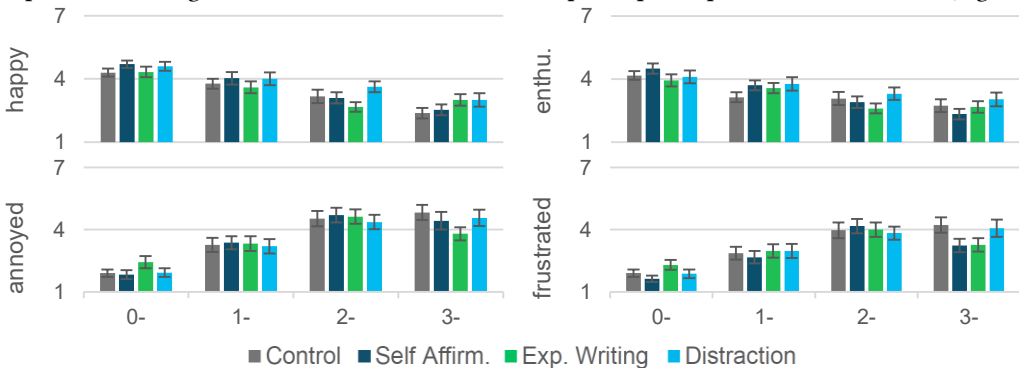


Fig. 4. Bar charts for affective states. Distraction increased happiness rating. The y-axes refer to the 7-point Likert scale rating.

	edit duration	edit distance
0-	6.11 ^a	260.6 ^a
1-	4.54 ^b	187.3 ^b
2-	4.25 ^b	181.2 ^b
3-	3.77 ^b	141.5 ^b
control	6.11 ^a	229.3 ^a
self-affirm.	4.29 ^b	166.7 ^b
exp. writing	4.61 ^b	205.4 ^{ab}
distraction	3.64 ^b	169.2 ^b
LSD	1.18	57.3

Table 4. Mean edit duration and distance across *valence balance* and *coping activity* conditions.

4). When all three pieces of feedback were negative, participants in the expressive writing condition reported being happier ($M=3.0$, $SE=0.28$), less annoyed ($M=3.8$, $SE=0.32$), and less frustrated ($M=3.27$, $SE=0.33$) than the control condition ($M=2.37$, $SE=0.25$; $M=4.83$, $SE=0.36$; $M=4.23$, $SE=0.37$), an average difference of 0.87 units on the measurement scale. Participants in the self-affirmation condition rated their frustration lower ($M=3.23$, $SE=0.32$) than the control condition ($M=4.23$, $SE=0.37$).

4.2 Essay Revision

Valence balance had main effects on the edit distance ($F[3, 468]=5.80$, $p<.001$) and edit duration ($F[3, 468]=5.71$, $p<.001$). Participants in the *all neutral* condition spent significantly more time and edited the essay to significantly greater extent than the participants in the other valence conditions. In comparison with the *all neutral* condition, edit duration decreased by 38.3% and edit distance decreased by 45.7% in the *all negative* condition (Table 4). Participants receiving more negative balanced feedback spent less time in revision and edited the essays less (Figure 5).

Coping activity had a main effect on the edit duration ($F[3, 468]=6.01$, $p<.001$), and a marginal effect on the edit distance ($F[3, 468]=2.14$, $p=.094$). Participants in the control condition

	positive	useful	fair
0-	4.56 ^a	5.73 ^a	5.91 ^a
1-	3.30 ^b	4.83 ^b	4.84 ^b
2-	2.31 ^c	3.94 ^c	4.01 ^c
3-	1.58 ^d	3.34 ^d	3.28 ^b
control	2.98 ^a	4.73 ^a	4.60 ^{ab}
self	2.82 ^a	4.40 ^{ab}	4.48 ^{ab}
affirmation			
expressive	2.85 ^a	4.08 ^b	4.23 ^a
writing			
distraction	3.11 ^a	4.60 ^a	4.73 ^b
LSD	0.3	0.42	0.40

Table 5. Mean feedback perception ratings across *valence balance* and *coping activity* conditions.

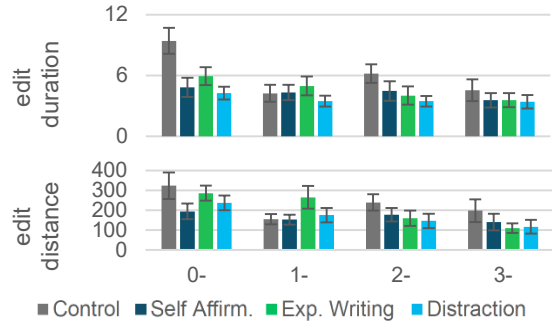


Fig. 5. Bar charts for extents of revision. Participants in the control condition performed no additional activities and edit the essays more. Expressive writing encourages revision in comparison with the other two coping activities.

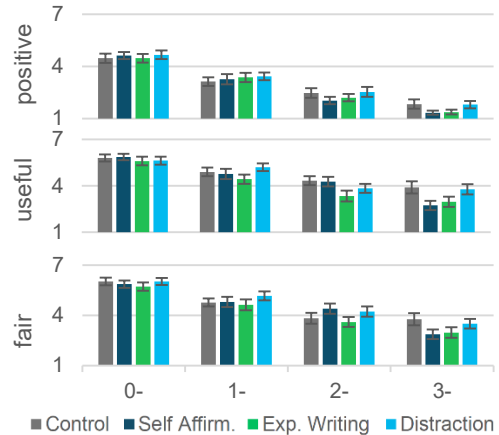


Fig. 6. Bar charts for participants' perception of the feedback set.

Table 6. Mean feedback provider ratings across *valence balance* and *coping activity* conditions.

	considerate	polite	knowledgeable	expert
0-	5.74 ^a	5.83 ^a	5.38 ^a	4.38 ^a
1-	4.07 ^b	3.98 ^b	4.30 ^b	3.40 ^b
2-	2.95 ^c	2.73 ^c	3.63 ^c	2.97 ^c
3-	2.25 ^d	1.97 ^d	3.05 ^d	2.46 ^d
control	3.85 ^{ab}	3.76 ^{ab}	4.25 ^a	3.49 ^a
self-affirmation	3.63 ^a	3.46 ^a	3.91 ^a	3.18 ^a
expressive writing	3.52 ^a	3.44 ^a	4.01 ^a	3.14 ^a
distraction	4.02 ^b	3.83 ^b	4.20 ^a	3.40 ^a
LSD	0.34	0.34	0.35	0.37

spent significantly more time editing essays than the other three activity conditions (Table 4). Also, participants edited significantly more characters in the control condition than in the self-affirmation and distraction conditions. In comparison, participants in the expressive writing condition reported similar level of edit distance as in the control condition.

Participants receiving negative feedback edited their essays to half the extent that participants did when receiving the same feedback written in a neutral tone. Regarding the coping activities, participants in the control condition spent more time on the revision task. This may be caused by the fact participants received the same payment despite needing to perform additional work in the coping activity conditions. Notably, expressive writing leads to same amount of essay revision even after participants wrote a short essay on their emotions.

4.3 Perception of Feedback Set

A MANOVA analysis showed valence balance had a main effect on participants' perception of the feedback set ($F[9, 1392]=28.68, p<.001$). Participants perceived negative feedback significantly less fair, less useful, and less positive compared to the all neutral condition (Table 5). Showing an additional piece of negative feedback significantly lowered participants' perception of the feedback set in all valence balance conditions.

Coping activity had a main effect on the usefulness rating ($F[3, 468]=3.56, p=.014$). In the expressive writing condition, feedback was rated significantly less useful than in the control condition (Table 5). Overall, self-affirmation had no significant effects. But in the *all negative* condition (Figure 6), we did observe self-affirmation notably lowered the ratings of positivity ($M=1.33, SE=0.12$), usefulness ($M=2.73, SE=0.30$), and fairness ($M=2.87, SE=0.29$) in comparison with the control condition ($M=1.83, SE=0.27$; $M=3.90, SE=0.39$; $M=3.77, SE=0.37$), an average decrease of 0.86 units on the measurement scale.

4.4 Perception of Feedback Providers

A MANOVA analysis showed valence balance had a main effect on the ratings about feedback providers ($F[12, 1389]=27.05, p<.001$). Participants gave feedback providers significantly less favorable ratings as the negativity in the feedback set increased (Table 6). Similar to the trend observed in feedback perception ratings, showing one more piece of negative feedback significantly lower participants' perception of the feedback providers in all valence balance conditions.

Coping activity had main effects on the consideration ($F[3, 468]=3.32, p=.020$) and politeness ratings ($F[3, 468]=2.81, p=.039$). Participants in the distraction condition rated the feedback providers significantly more considerate and polite than in the self-affirmation and expressive

writing conditions (Table 6). In the distraction condition, participants also tended to rate the providers as more considerate and polite than in the control condition. Self-affirmation had no significant effects. But similar to trends observed in previous sections, self-affirmation tended to lower the evaluation of the feedback providers in the *all negative* condition. In this condition, self-affirmed participants rated the providers less considerate ($M=1.7$, $SE=0.19$), less polite ($M=1.5$, $SE=0.15$), and less knowledgeable ($M=2.43$, $SE=0.23$) than in the control condition ($M=2.57$, $SE=0.31$; $M=2.2$, $SE=0.28$; $M=3.63$, $SE=0.31$; see Figure 7), an average decrease of 0.92 units on the measurement scale.

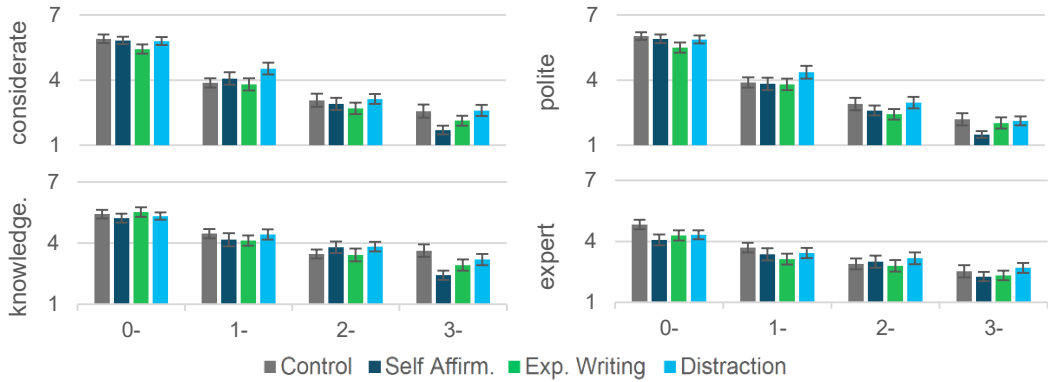


Fig. 7. Bar charts for participants' perception of feedback providers. Distraction improves how considerate and polite participants perceived the providers to be in comparison with the other two coping activities.

4.5 Essay Quality

Revised essays ($M=4.75$, $SE=0.09$) received significantly higher quality ratings than the original essays ($M=4.6$, $SE=0.09$; $F[1, 958]=9.77$, $p=.002$). Neither valence balance nor coping activity had a main effect on the ratings. There was also no interaction effect between the factors and the essay version. Although valence balances and coping activities significantly impacted participants' affective states and their perceptions of the feedback and its providers, these effects did not translate into higher quality essays after revision.

4.6 Accepted Feedback Count

Participants were more open to neutral feedback. Valence balance had a main effect on the number of feedback items reported to be accepted ($F[3, 468]=11.42$, $p<.001$). Participants reported accepting more pieces of feedback in the *all neutral* condition ($M=1.68$; $SE=0.09$) than the *all negative* condition ($M=0.93$, $SE=0.09$; $LSD=0.262$, $p<.05$). Consistent with prior work, neutral feedback was more likely to be accepted than negative feedback [6]. Overall, 80% of neutral and 50% of negative feedback was accepted by participants. Coping activity had no statistically significant effect on this measure.

5 DISCUSSION

Our experiment showed that valence balance had significant effects on participants' affective states: the *all negative* valence balance condition reduced participants' ratings of their positive affects (happiness and enthusiasm) by 38% and raised the ratings of negative affects (annoyance and frustration) by 110% in comparison with the *all neutral* condition. Negative feedback

significantly lowered the average rating of feedback being positive, useful, and fair by 49%, the average rating of the providers being considerate, polite, knowledgeable, and having expertise by 54%, and extents of revision by 46% relative to receiving all neutral feedback.

For the coping activities, self-affirmation had no statistical effects on the measures. However, in the *all negative* condition we observed self-affirmed participants had more positive affective states, which is a trend consistent with prior work [44,46]. Expressive writing encouraged significantly more revision in comparison with the other two activities. Distraction significantly improved participants' ratings of happiness and made them perceive the feedback providers to be significantly more considerate and more polite compared to the other two coping activities.

Our results show various measures have different levels of sensitivity to negative feedback. Showing one additional piece of negative feedback significantly lowered participants' perception of the feedback and its providers in all valence balance conditions. For affective states, we observed a similar trend but there was no statistical difference between the *mainly negative* and the *all negative* conditions. For edit duration and edit distance, only participants in the *all neutral* condition reported significantly higher measurements than the other valence balance conditions. This pattern of results indicates that platform designers should aim to eliminate any occurrence of negative feedback, as even one piece of negative feedback adversely affects edit duration, edit distance, and perceptions of the feedback content and its providers. For situations where users' affective states or their perceptions of the feedback are most important, such as when novice designers are collecting feedback, platform designers should focus on deterring negative feedback, especially snowballing effects [12]. Prior work has focused on examining whether presenting negative valence information lowers people's affective states and task performance in various contexts [1,5,10]. Our results show an equally important question is whether increasing negativity will continue to lower these measures. Even when we cannot eradicate the negative feedback, increasing the valence balance of the feedback set may still significantly improve the user experience.

While prior work suggested the selected coping activities could mitigate the influences of negative feedback over participants' affective states, our results indicated the activities were not as effective as we expected. Other than distraction, both expressive writing and self-affirmation had no significant effects over participants' affective states. One potential reason may be the mixed valence balance conditions we tested in our experiment were more nuanced than the binary valence conditions in prior empirical studies, where participants received either entirely negative or entirely non-negative information. While we did observe expressive writing and self-affirmation tend to improve participants' affective states in the *all negative* condition, a trend consistent with prior work [25,30,44,46], the activities were not effective enough in the other valence balance conditions to show significant effects across conditions. Future work is needed to evaluate these activities with feedback sets that exhibit valence properties to further tune the associated theories. It is also possible that the activities were less effective because design feedback is more subjective than the negative valence information used in prior work, such as health-risk information [37]. Participants may view the provided negative feedback as a matter of opinion rather than a direct threat to their ego and thus did not benefit from the coping activities that address the potential threat.

In authentic settings, platform designers could offer users optional opportunities to perform the coping activities. In this way, only the users who feel the need for assistance would perform the activities; while not affecting others. Our results show expressive writing encourages significantly more revision and distraction significantly improved participants' affective states

and their perception of the feedback providers. Platform designers could decide which activity to use based on how they prioritize these measures and compatibility of the activity with the existing workflow. Future work could explore the effectiveness of other coping activities and incorporate them into this framework.

Platform designers should implement an expressive writing activity if revision outcomes are the priority. For example, promoting revision outcomes may be most important in learning contexts where content creators may need to demonstrate depth of revision for course credit. It may also be important in professional contexts where showing depth of revision is a critical part of managing client relations. To implement expressive writing, platform designers could allow users to write private comments on each piece of feedback or write their reactions on the set of feedback holistically [58]. Writing comments on feedback could also have additional benefits, such as enabling reflection to promote interpretation of the content.

If platform designers value users' affective states or their perception of the feedback providers most, then they should consider implementing an intervention that enables a brief distraction from negative feedback. For example, affective states might be most important for platforms that cater to novice content creators. Prior work shows reduced affective states negatively impacts learning outcomes such as new skill development and demotivates future participation [17]. The perception of the feedback and its providers are also important on platforms that promote social interactions between members. Higher evaluation of the feedback providers helps to avoid conflicts among members and increase future engagement [60]. A short distraction improves users' perception of the feedback providers while allowing their affective states to restore to more neutral levels. More positive affective states could further protect the relationships between members by reducing aggressive behaviors on the platform. For distraction, platform designers could present links to view related content or perform non-feedback tasks in the community or to browse one's own project histories. Additionally, platform designers could disallow postings of revised content for a short duration to suggest that the user should first perform tasks unrelated to the content revision.

6 LIMITATIONS

Participants recruited from AMT are usually driven by extrinsic motivations, e.g. financial incentives. Future work needs to test how well our results generalize to content creators driven by intrinsic motivations, such as the desire to learn or produce content for personal enjoyment. We chose AMT as our participant source because of the scale of the study ($n=480$). To overcome the limitation, we intentionally chose a topic that would be familiar to many participants, i.e. gun control, in order to increase participants' intrinsic motivation. On average, participants rated the topic moderately important (3.97 out of 7) and wrote 171.6 words, which was substantially higher than the 100-word minimum limit.

Participants in our experiment received general feedback drawn from a pre-defined pool. Future work could repeat our experiment with feedback customized to the specific essay. We decided to use generic feedback because it enables us to control the suggested amount of revision and the valence levels of the feedback. To offset the limitation of feedback compatibility, we created a set of feedback that could be applied to most essays and filtered essays with obvious incompatibilities. Since task autonomy increases participants' extrinsic motivation on AMT [21], we also allowed participants to accept any number of pieces of feedback and revise their essays in any way they deemed appropriate. In total, 75% of the participants accepted at least one piece of the feedback voluntarily.

7 FUTURE WORK

We tested the coping activities on three pieces of feedback because this was sufficient to test the different conditions of interest. Future work should test the generalizability of our results to larger feedback sets. Our experiment did not incorporate positive valence feedback because prior work has shown that positive feedback can interact with the effects of negative feedback [54], thereby making it difficult to isolate the effects of the factors of interest in the experiment. Future studies may test additional conditions with positive valence feedback, and conditions for which each piece of feedback has a mix of content with positive and negative phrasing. Participants in our experiment were novices in writing. Future work is needed to test how our results would generalize to users with more domain expertise since these users may have developed their own mechanisms to cope with negative feedback. Future work should also test how our findings transfer to other types of creative work such as visual design or programming. We hope our study serves as a starting point for future work that proposes mechanisms for improving resilience to negative feedback, such as relaxation [23], music therapy [8], and social support [15].

8 CONCLUSION

This paper empirically compared three coping activities for increasing users' resilience to negative feedback for a writing task. Our work has made three contributions. First, our results showed that a feedback set with negative valence has adverse effects on participants' affective states, revision extents, and perception of the feedback and its providers. Even one piece of negative feedback caused significant reduction on these measures compared to a feedback set where all the content was written with a neutral tone.

Second, we provided empirical evidence that expressive writing encouraged essay revision and distraction improved participants' affective states and their perception of the feedback providers. Self-affirmation had no significant effects on the measures taken in the experiment.

Finally, we offered practical guidelines regarding when and how to use these three coping activities in online feedback collection platforms. Platform designers should select an appropriate activity based on situational needs, using expressive writing when valuing revision extents most and using distraction when valuing affective states and perception of the feedback providers most. We hope our work can encourage future work to explore other promising activities and, together with the three tested here, to construct a framework of coping methods that promote a more pleasant and productive feedback collection experience online.

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