WIP: Intervention to Improve Students' Emotional and Study Strategies Responses to ECE Exam Success and Failure

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In engineering as a profession and in engineering education, failure is commonplace--attempted designs fail, experiments fail about 90% of the time, and students do not achieve the scores they desire on homework, quizzes, and exams. Thus, the ability to navigate and respond to failure as an opportunity for growth and learning is a key component of the scientific enterprise. Our team has been researching engineering students' responses to failure and success, and in the present WIP we report on the design of a Fall 2025 post-exam coping strategies intervention. More specifically, we recorded ten 3–5-minute testimonials from course completers on how they had dealt with their performance on exams, which included getting support from friends and family, using physical activity to cope, and multiple office hours and study strategies suggestions. Students reviewed and reflected on these testimonials.

Research on response to failure has been extensive in workplace settings, in which there is a very wide range of negative and positive responses to failure, including denial, anger, bargaining, depression, acceptance, working harder, working smarter, shock, fear, renewed dedication, increased susceptibility to stereotypes, blame, shame, despair, changes in interest, reassessing career, reassessing self-perceived ability, and learning from failure [1, 2]. Thus, these responses may include combinations of emotional, cognitive, and behavioral responses. Results from our last 2 years of research in a 200-level ECE course are consistent with these findings of a broad range of reactions involving emotions and planned changes to study strategies [3, 4].

The range of reactions students exhibit following exam feedback can be understood through established theoretical frameworks that explain how students interpret evaluative and high-stakes events and regulate their subsequent emotions and behaviors. In particular, Control-Value Theory (CVT), provides a lens for understanding how perceived success or failure shapes achievement emotions, while self-regulated learning (SRL) frameworks explain how students use performance feedback to adjust their study strategies and coping behaviors [5,6]. Together, these perspectives suggest that interventions targeting students' interpretations of exam outcomes and modeling adaptive regulatory responses may promote more constructive emotional and behavioral adjustment over time.

In this WIP, we have created a video-based intervention to support students after they experience exam success and failure in engineering courses. This intervention builds on our prior interview and survey development and validation work over the last 2 years [3, 4]. Brief video-and-reflection interventions in STEM education like this one have shown statistically significant results with medium-large effect sizes for student achievement [7], academic achievement motivation [8], and persistence in majors [9]. Thus, our video-and-reflection approach is well grounded in the STEM education literature. We analyze the effect of the intervention on three fronts: post-exam emotions, planned changes to study strategies, and coping strategies.

The study design and research questions are grounded in CVT and SRL frameworks. From a CVT perspective, exam feedback represents a high-stakes evaluative event that can elicit distinct

emotional responses depending on students' perceived success or failure and their sense of control over future outcomes. By presenting testimonials that normalize a range of exam experiences and emphasize controllable study and coping strategies, the intervention was designed to support more adaptive interpretations of exam feedback. From an SRL perspective, exams function as feedback cycles that inform subsequent goal setting and strategy adjustment. The video-and-reflection format was intended to scaffold reflective processing of performance outcomes and model adaptive regulatory responses, including changes in study strategies and coping behaviors.

Therefore, the overarching goal of this project is to understand how engineering students emotionally and behaviorally respond to exam success and failure, and whether targeted, low-cost instructional supports can promote adaptive responses following these high-stakes academic events. Building on prior qualitative and survey development work examining students' post-exam emotions, planned study strategy changes, and coping responses [3,4], the present study is guided by the following research questions and hypotheses.

RQ1. To what extent does engagement with the intervention predict increases in students' post-exam positive emotional responses and decreases in negative emotional responses following perceived exam success or failure from Exam 1 to Exam 2?

We hypothesized that greater participation in the intervention (i.e., writing more reflections) would be associated with decreases in negative emotions and increases in positive emotions following exams. However, students who perceived they did worse than expected would still have more negative emotions than those that perceived they did better than expected.

RQ2. To what extent does engagement with the intervention predict changes in students' planned study strategies following perceived exam success or failure from Exam 1 to Exam 2?

We hypothesized that greater participation in the intervention would be associated with decreases in using more distant strategies and increases in more course-relevant study strategies.

RQ3. To what extent does engagement with the intervention predict changes in students' use of adaptive and maladaptive coping strategies following perceived exam success or failure from Exam 1 to Exam 2?

We hypothesized that greater participation in the intervention would be associated with decreases in maladaptive coping strategies and increases in adaptive coping strategies from Exam 1 to Exam 2.

Method

Participants. For the 254 students who provided any demographics, the mean age was 19.5 (SD = 1.0); one was a freshman, 177 were sophomores, 66 were juniors, and 10 were seniors. 197 identified as male, 56 as female, and 1 preferred not to say. 184 self-identified as Asian, 51 as White, 8 as Hispanic, 5 as Middle Eastern, 3 as Black, and 3 of some other race. Only 73 participants provided ACT scores, for reading they had a mean score of 33.2 (*SD* = 3.6) and for

mathematics they had a mean score of 33.9 (*SD* = 2.6). With regard to major, 123 were in computer engineering, 93 were in electrical engineering, 30 were in systems engineering, and 7 were undeclared/other.

Procedure. After receiving scores on their first semester exam and consenting to release (or not release) their data for research purposes, students in a 200-level ECE course in September 2025 completed three pre-intervention questionnaires assessing post-exam emotions, planned changes to study strategies [3, 4], coping strategies [10], and a demographics form. Following the pre-intervention measures, students engaged with the intervention materials as part of their course homework. They completed homework assignments involving watching two brief testimonial videos per week, along with reflections of about 75-150 words on the videos. They watched and wrote reflections on up to 10 videos spread over 5 weeks between the release of exam scores on Exam 1 and Exam 2. After the intervention was complete in October 2025 and students received their Exam 2 scores, participants again responded to the 3 questionnaires. All data were captured in a Canvas site.

Materials.

The intervention materials consisted of a series of response to failure or success testimonial videos paired with short written reflection assignments delivered through the course LMS. We created 12 testimonial videos featuring students who had previously completed the engineering course; these students were compensated for serving as actors during filming in summer 2025. Student actors were not given scripts or specific content requirements, rather we asked the student to describe their own academic performance experience in the course and after their first exam (e.g., doing better or worse than expected) and share strategies for coping with the outcome and preparing for subsequent exams. The testimonial videos were designed to capture a broad and authentic range of post-exam experiences and coping responses.

Ten of the videos were posted to the course LMS for student participation. These videos were selected for use to ensure representation of diverse reactions and coping strategies. These included, for example, celebrating by buying a treat, spending time with friends, delaying celebration until a personally meaningful performance goal was reached, changing study routines, using physical activity to manage stress. This allowed students to observe multiple pathways for responding to both success and failure and this variability was intentional, as one of the goals of the intervention was not to prescribe a single “correct” response, but rather to normalize a range of experiences and provide students with relatable examples from which they could draw strategies that fit their own goals and circumstances. Across the 10 posted videos, six featured testimonials describing better-than-expected performance and four described worse-than-expected performance; six featured speakers who self-identified as male and four who self-identified as female. Each video was approximately two to four minutes long and was paired with a homework assignment prompting a brief reflection (75-150 words) after viewing. We also created pre-intervention and post-intervention questionnaires to assess students’ exam-related emotions, study strategies, and coping strategies before and after the intervention.

Measures.

Perceived Success. After each exam, students were asked to report the extent to which they did better or worse than expected (1 = *Much, much worse than you thought you would do*, 5 = *Did exactly as you thought you would do*, 10 = *Much, much better than you thought you would do*).

Post-exam emotions questionnaire. Emotions experienced immediately after receiving exam scores were assessed using a validated questionnaire developed by the research team [3] and administered after each exam score release (pre-intervention measures following Exam 1; post-intervention following Exam 2). The first question asked about perceived performance on one most recent exam "Compared to how I thought I would do, on the last exam I: did better than expected, did as expected, did worse than expected." Students then rated their agreement with emotion statements using the following prompt: "Please rate ***each of the choices below*** for your agreement regarding how you felt ***after learning about your last exam grade*** in this engineering course." Items were rated on 4-point response scale (1 = *Strongly disagree* to 4 = *Strongly agree*). The questionnaire had 8 positive emotions items (Cronbach's alpha = .91), 11 negative emotions (Cronbach's alpha = .93), and 3 'surprise'-related items (e.g., "Surprised by my score, in a good way," not analyzed here). Items were presented in alphabetical order (from Afraid through Worth it) to reduce potential ordering effects.

Post-exam study strategy changes questionnaire. Planned changes to study strategies immediately after receiving exam scores were measured using a validated 19-item questionnaire administered after each exam score release. Instructions were as follows: "Please indicate how you ***plan to change your exam study strategies*** listed below to prepare for the next exam in the same course, after learning about your last exam grade in an engineering course." Students responded using a 5-point scale: *Use it more* (including strategies not previously used but plan to use it for the next exam), *Use it the same amount, Use it less (but still use it on the next exam), Drop it,* and *Never used it and don't plan to use it.* Items were presented in alphabetical order (Course communication tool through Tutoring session). An open-ended item at the end allowed students to report additional strategies not listed, but these data were not analyzed. We created a subscale called distant strategy use which comprised of three items (using the internet, going to exam review sessions, and using the textbook).

Coping strategies questionnaire. Coping strategy use was measured using a revised version of the Coping Strategies Questionnaire developed by Santor and colleagues [10]. Students were instructed to "Think about how you responded to your grade on your most recent ECE [4] exam when answering these questions." Items were rated on a 4-point scale (*not at all, a little, a lot, far too much).* The measure included 38 items, with minor wording modifications to contextualize items to exam performance (e.g., "I blamed others for my exam performance."). The measure included four subscales: adaptive social coping (10 items; Cronbach's alpha = .80), maladaptive social coping (5 items; Cronbach's alpha = .69), adaptive task coping (10 items; Cronbach's alpha = .72), and maladaptive task coping (13 items; Cronbach's alpha = .85). Means were calculated for each subscale.

Written Reflections. After watching each video, students were given this prompt "Write a 75-150 word reflection on [actor's name] statement, including how [actor's name] reaction/how they felt

was similar to or different from your own reaction/how you felt, and any actions you might take based on what you heard and your own experiences. Your actions might be similar to [actor's name] actions, or just something that [actor's name] statement inspired in you."

Data analysis. To analyze the questionnaire data, we use number of reflections written (i.e., extent of participation) to predict changes from pre-intervention to post-intervention in the 3 scales. Specifically, we use repeated-measures ANCOVAs, one per questionnaire/subscale, with pre-intervention scores and extent of participation as predictors of post-intervention scores.

Results

Descriptives

We collected data during the Fall 2025 semester. The three pre-intervention questionnaires were collected, N = 227, during the first week of October, immediately after students received their exam 1 grades. The three post-intervention questionnaires were collected, $N = 182$, at the end of October, immediately after students received their exam 2 scores. The open-ended video reflections were collected from $N = 248$ students (2,105 reflections) during the month of October. The distribution of number of reflections written per student is shown in Table 1. We are working with an expert in NLP to analyze these reflections, so no formal analysis has been conducted on them yet. However, in reading the reflections and creating root word lists and lists of synonyms for both emotions and study strategies, we do not see additional emotions or additional study strategies beyond what we documented in our Year 1 interview [3] and Year 2 questionnaire [4] research.

Table 1. Number of Reflections Written

Number	Frequency	Percent
2	1	0%
4	10	4%
5	1	0%
6	31	13%
7	2	1%
8	58	24%
9	6	2%
10	134	55%
Total	243	100%

Table 2 shows descriptives on and intercorrelations among variables; due to non-normality on several variables, we report Spearman (rank) correlations. All correlations were in the expected direction based on prior research, such as more-positive emotions when students did better than expected, and more negative emotions when students did worse than expected. We also saw the expected strong stability coefficients (e.g., correlation between negative emotions at pre-intervention with negative emotions at post-intervention). Interestingly, those with higher positive test emotions scores reported less use of coping strategies of all types (perhaps they did

not see the need to use coping strategies), whereas those with higher negative test emotions scores reported more use of coping strategies of all types.

Table 2

Intercorrelations among and descriptive statistics on all variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PreI Adaptive Social Coping																
PreI Maladaptive Social Coping	.079															
PreI Adaptive Task Coping	.409**	.219**														
PreI Maladaptive Task Coping	.280**	.484**	.439**													
Exam 1 Perceived Level of Success	-.061	-.189**	-.143*	-.273**												
PreI Positive Emotions	-.024	-.373**	-.204**	-.385**	.709**											
PreI Negative Emotions	.227**	.442**	.397**	.612**	-.610**	-.730**										
PreI Planned Distant Strategies	.121	-.071	.159*	-.017	-.099	-.147*	.101									
Num. of Written Reflections	-.046	-.089	-.108	-.206**	.193**	.183**	-.154*	.072								
PostI Adaptive Social Coping	.586**	.152*	.381**	.259**	.041	-.054	.215**	.065	.066							
PostI Maladaptive Social Coping	.043	.434**	.180*	.254**	-.056	-.163*	.211**	.013	-.016	.134						
PostI Adaptive Task Coping	.199**	.235**	.642**	.291**	-.082	-.164*	.337**	.161*	.053	.403**	.323**					
PostI Maladaptive Task Coping	.215**	.266**	.317**	.493**	-.073	-.248**	.366**	.028	-.087	.369**	.438**	.434**				
PostI Positive Emotions	.127	-.149	-.065	-.111	.158*	.321**	-.195**	.028	.088	.029	-.297**	-.129	-.297**			
PostI Negative Emotions	.123	.293**	.339**	.393**	-.106	-.287**	.443**	.031	-.050	.241**	.453**	.421**	.516**	-.659**		
PostI Planned Distant Strategies	.042	-.014	.145	.014	-.069	-.053	.051	.529**	.188*	-.022	.011	.101	-.039	-.095	.110	
N	227	227	227	227	232	232	232	231	243	182	182	182	182	181	181	181
M	1.63	1.29	1.61	1.32	0.66	2.70	1.87	2.73	8.66	1.63	1.30	1.66	1.33	2.51	2.10	3.03
SD	0.40	0.39	0.32	0.37	2.34	0.74	0.73	1.86	1.78	0.44	0.36	0.35	0.36	0.71	0.69	1.91
Skewness	1.43	3.44	0.11	3.19	-0.10	-0.32	0.53	-0.52	-1.22	1.22	2.22	0.50	2.12	-0.14	-0.03	-0.92
Kurtosis	4.77	19.97	-0.33	16.60	-1.09	-0.54	-0.68	0.57	0.72	1.60	8.92	0.73	7.16	-0.59	-0.90	2.11

Note. * $p < .05$, ** $p < .01$. PreI represents surveys given before the intervention and PostI represents surveys given after the intervention.

Research Question 1: Changes in emotions

A repeated-measures ANCOVA on positive emotions from the pre-intervention to the post-intervention score, covarying with the level of participation showed a non-significant time by participation interaction (F [5, 170] = 0.829, MSE = .337, p = .530), inconsistent with our hypothesis that the intervention would increase positive emotions. Regardless of the number of video reflections submitted by a student, the level of positive emotions did not increase differentially from pre-intervention to post-intervention.

A repeated-measures ANCOVA on negative emotions from the pre-intervention to the post-intervention score, covarying with the level of participation showed a non-significant time by participation interaction (F [5, 170] = 0.543, MSE = .261, p = .543), inconsistent with our hypothesis that the intervention would decrease negative emotions. Regardless of the number of video reflections submitted by a student, the level of negative emotions did not increase differentially from pre-intervention to post-intervention.

Research Question 2: Changes in more-distant study strategies

A repeated-measures ANCOVA on distant study strategies from the pre-intervention to the post-intervention score, covarying with the level of participation showed a marginally significant ($p >$ .05) time by participation interaction (F [5, 170] = 1.929, MSE = 1.675, p = .09), leaning towards supporting our hypothesis , inconsistent with our hypothesis that the intervention would increase plans to drop less-effective study strategies. The more video reflections submitted by a student, the bigger the decrease in students' course-distant strategies, such as *using the Internet*, from pre-intervention to post-intervention.

Research Question 3: Changes in coping strategies

A repeated-measures ANCOVA on adaptive social coping subscales from the pre-intervention to the post-intervention score, covarying with the level of participation (i.e., number of video reflections) showed a significant time by participation interaction (F [5, 172] = 6.048, MSE = .045, p = .015), consistent with our hypothesis that the intervention would increase adaptive coping. The more video reflections submitted by a student, the more students' adaptive social coping strategies, such as *calling family for support,* increased from pre-intervention to post-intervention.

A repeated-measures ANCOVA on adaptive task coping subscales from the pre-intervention to the post-intervention score, covarying with the level of participation showed a marginally significant time by participation interaction (F [1, 168] = 1.941, MSE = .045, p = .09), leaning towards supporting our hypothesis that the intervention would increase adaptive coping. The more video reflections submitted by a student, the more students' adaptive task coping strategies, such as *taking responsibility and looking forward*, increased from pre-intervention to post-intervention.

A repeated-measures ANCOVA on maladaptive social coping subscales from the pre-intervention to the post-intervention score, covarying with the level of participation showed a non-significant time by participation interaction (F [5, 168] = 1.120, MSE = .066, p = .352), inconsistent with our hypothesis that the intervention would decrease maladaptive coping. Regardless of the number of video reflections submitted by a student, the level of maladaptive social coping strategies, such as *I lied about my exam performance* did not increase differentially from pre-intervention to post-intervention.

A repeated-measures ANCOVA on maladaptive task coping subscales from the pre-intervention to the post-intervention score, covarying with the level of participation showed a non-significant time by participation interaction (F [5, 168] = 1.070, MSE = .054, p = .379), inconsistent with our hypothesis that the intervention would decrease maladaptive coping. Regardless of the number of video reflections submitted by a student, the level of maladaptive task coping strategies, such as *I broke objects/hit things* did not increase differentially from pre-intervention to post-intervention.

In summary, the intervention did not affect students' negative or positive emotions, but the larger the number of video reflections submitted by a student, the bigger the decrease in ineffective

study strategies. The larger the number of video reflections submitted by a student, the bigger the increase in students' adaptive coping strategies. However, regardless of the number of video reflections submitted by a student, there was no differential decrease in maladaptive coping strategies. The intervention moved students towards more adaptive coping strategies but did not decrease maladaptive coping strategies.

Conclusions

Failure and success are routine features of engineering learning, yet students can vary wildly in terms of how they emotionally respond to exam outcomes and how effectively they adjust their studying and coping behaviors afterward. In this WIP, we described the design and preliminary evaluation of a brief video and reflection intervention intended to support students' post-exam emotional responses, study strategy planning, and coping in a 200-level ECE course. Grounded in prior qualitative and survey development work [3,4], the intervention leveraged short testimonials from previous students who completed the course who normalized both struggling, improvement, and success and who offered coping and study strategies that students could reflect on and adapt to their own situations.

Preliminary results suggest that this brief intervention approach has promise, particularly given its minimal time demands and straightforward delivery via the course website. After accounting for relevant pre-intervention scores, greater engagement with the intervention (i.e., completing more reflections) was related to improvements in self-reported coping strategies. Specifically, students who completed more reflections demonstrated increased in adaptive task coping (e.g., studying more, seeking academic help) as well as increases in adaptive social coping (e.g., leaning on friends or family for support). These findings align with prior work showing that students' responses to exam outcomes include both emotional reactions and behaviorally meaningful decisions about how to move forward in the class [5,11].

The measures employed replicated findings from prior research [3,4]. Students who perceived that they performed better than expected reported a greater number of positive emotions, while still experiencing some negative emotions. Conversely, students who perceived that they performed worse than expected reported a greater number of negative emotions, while still experiencing some positive emotions. This coexistence of positive and negative emotions may help students maintain emotional balance; in particular, positive emotions among students who performed worse than expected may serve as a motivational resource for continued learning efforts.

From a CVT perspective, the absence of significant emotional change suggests that brief testimonial exposure may not substantially alter students' immediate affective responses to evaluative feedback, which are tied to perceived control and expectancy violations. However, consistent with SRL frameworks, the intervention was associated with increases in adaptive coping and study-related behaviors, suggesting that brief modeling may more readily influence strategic responses than emotional reactions in the short term.

A possible long-term positive effect from the success of this intervention is that the effective study and coping strategies learned from these videos may be applied to other courses that

students take in the future, leading to increased success. Additionally, this project contributes an intervention model that is highly scalable and should be easily transferable to other courses. The materials were delivered in an existing course structure through the course LMS as a homework assignment, required limited instructor time once developed, and the prompts used for the actors in the videos could be applicable to other courses. As a result, this intervention represents a promising, low-barrier approach for helping students respond to both success and failure with strategies that can support persistence and continued learning.

Limitations, Ongoing Analyses, and Next Steps

Although there are many strengths of the present study, there is one important limitation worth noting, which is potential variability in participation. Although the intervention and reflections were delivered as part of homework assignments, not every student in the course consented to release their data for research purposes. Further, this study was only conducted in one course, limiting generalizability. Future research should consider implementing this intervention in other courses. Additionally, due to the relatively small sample size, we did not include additional covariates (e.g., course motivation), but these may explain more of the variance in outcomes. We were also not able to get exam scores and course final grades, which limits our ability to say what effects this intervention had on learning outcomes.

In addition to the design limitations noted above, several analytic considerations warrant attention. First, the study did not employ random assignment to intervention exposure; rather, participation was operationalized as the number of reflections completed. As a result, students who engaged more extensively with the intervention may differ systematically from those who engaged less (e.g., in motivation, conscientiousness, or prior coping tendencies), limiting causal inference. Although we controlled for pre-intervention scores, unmeasured confounds may still influence observed changes. Further, the present analyses relied on multiple repeated-measures ANCOVAs across subscales. Given the number of tests conducted and the relatively modest sample size, some marginal findings (e.g., $p = .09$) should be interpreted cautiously. These results are best understood as preliminary indicators of potential trends rather than definitive evidence of intervention effects.

With regard to the written reflections, although 2,105 written reflections were collected, formal qualitative or NLP-based analyses have not yet been completed. Thus, the present report focuses on questionnaire-based outcomes and may not fully capture shifts in students' meaning-making processes.

As a Work-in-Progress, several analyses and extensions are currently underway to further develop this research. First, we are conducting analyses of students' open-ended reflection responses to better characterize how students make sense of the testimonial videos and which emotional, cognitive, and behavioral themes emerge across repeated reflections. These analyses will allow us to examine whether and how students articulate shifts in coping strategies, emotional responses, and study approaches that may not be fully captured by the questionnaire measures. Second, future analyses will examine potential moderators of intervention effectiveness. In particular, we plan to explore whether demographic or experiential matching

between testimonial speakers and students (e.g., gender matching) is associated with stronger changes in coping or study strategy outcomes.

Finally, future iterations of this work will test the generalizability of the intervention across additional engineering courses and instructional contexts. Replicating the intervention in other courses will allow us to examine its robustness and scalability, as well as to refine the testimonial prompts and reflection activities to better support students' post-exam learning and coping processes.

Lessons Learned for Researchers and Instructors

Several lessons have emerged from the design and early implementation of this intervention that may be useful for researchers developing post-exam or reflection-based supports in engineering and STEM courses.

First, brief, unscripted testimonial videos can effectively capture student experiences while still supporting theoretically meaningful intervention goals. Allowing former students to describe their own responses to exam success and failure without scripting increased ecological validity and yielded a wide range of emotional and coping strategies. At the same time, ensuring videos represented diverse responses allowed the intervention to remain theoretically aligned without constraining students' narratives. Second, embedding the intervention within existing course structures facilitated scalability and participation. Delivering the videos and reflections as routine homework assignments through the course LMS minimized instructional burden and allowed students to engage with the materials over time rather than in a single session. This design also enabled the use of participation (i.e., number of reflections completed) as a meaningful indicator of exposure when random assignment was not feasible.

This work also highlights the value of exam-to-exam designs for studying student adaptation. Measuring changes from one exam cycle to the next allowed us to capture adjustments in coping and study strategies that would be missed in cross-sectional or single-timepoint designs. Researchers interested in academic adaptation may benefit from aligning intervention timing with naturally occurring feedback points, such as exams or major assignments. Finally, the combination of questionnaire data and repeated short reflections offers a promising mixed-methods approach for capturing students' post-exam responses. While the present WIP focuses on survey-based analyses, the reflection data provide rich opportunities for future qualitative and integrative analyses that can inform both theory development and intervention refinement.

Overall, findings from the present study provide evidence that a brief, testimonial video and reflection assignment intervention can help promote more adaptive coping in response to exam outcomes in a challenging 200-level ECE course. With further refinement and additional testing in other courses, this approach has the potential to offer engineering programs a practical and scalable tool for supporting students' emotional and behavioral responses to experiences of success and failure.

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