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Rich Lewine

University of Louisville, rllewi02@louisville.edu

Alison Sommers

University of Louisville, alison.sommers@louisville.edu

Rachel Waford

University of Louisville, rachelwaford@gmail.com

Catherine Robertson

University of Louisville, catherinerobertson85@gmail.com

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Abstract

Most current efforts to enhance critical thinking focus on skills practice and training. The empirical research from the fields of cognition and affect sciences suggest that positive mood, even when transiently induced, can have beneficial effects on cognitive flexibility and problem solving. We undertook this study to test this hypothesis in a practical setting. Using an A-B-A-B within subject design, we measured the impact of positive (*versus* neutral) mood on critical thinking demonstrated on four essay exams in an undergraduate course in personality. There was a significant enhancing effect of positive mood on critical thinking in female students, but not in male students. We discuss possible sex differences that may account for the partial support of the mood-critical thinking effect.

Keywords

critical thinking, affect, paedagogy

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Setting the Mood for Critical Thinking in the Classroom

Rich Lewine, Alison Sommers, Rachel Waford, and Catherine Robertson

Psychological and Brain Sciences, University of Louisville, Louisville, KY, USA

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Most current efforts to enhance critical thinking focus on skills practice and training. The empirical research from the fields of cognition and affect sciences suggest that positive mood, even when transiently induced, can have beneficial effects on cognitive flexibility and problem solving. We undertook this study to test this hypothesis in a practical setting. Using an A-B-A-B within subject design, we measured the impact of positive (versus neutral) mood on critical thinking demonstrated on four essay exams in an undergraduate course in personality. There was a significant enhancing effect of positive mood on critical thinking in female students, but not in male students. We discuss possible sex differences that may account for the partial support of the mood-critical thinking effect.

INTRODUCTION

Teaching students how to evaluate information, analyze an argument, integrate facts into theory, and take different points of view—generally captured by the term “critical thinking”—focuses on skills training (Dunn, Halonen & Smith, 2008; Lai, 2011; Lloyd & Bahr, 2010). We assign students problems to solve, have them form groups to argue data, flip the classroom, ask them to write reports, and generally engage in cognitive tasks that are viewed as teachable and trainable. Largely missing from this approach is the role of mood on cognitive processing (Lai, 2011). Yet cognitive science has much to add regarding the substantial role of mood in shaping our cognitive processes.

Recent reviews of the impact of mood on cognitive performance generally agree that in the controlled conditions of the laboratory, negative mood serves to focus attention on local, sensory, and rule driven aspects of learning, while positive mood serves to broaden attention to alternative, conceptual, and integrative learning (Clare & Palmer, 2009; Nadler, Rabi & Minda, 2010). The “broaden-and-build theory” suggests that positive mood enhances cognitive flexibility and creative problem solving (Fredrickson & Losada, 2005). Induced positive mood has been reported to “widen(s) the scope of attention”, “broaden(s) behavioral repertoires” and “increase(s) intuition” (Fredrickson & Losada, 2005, p.678). Put another way, positive mood appears to facilitate creative, integrative thinking that incorporates multiple perspectives, a significant aspect of critical thinking.

There is a major gap, however, between what is feasible to do in the lab and what is possible in the classroom. This study is an initial effort to try to bridge that gap by asking if there are practical interventions that can be applied in the classroom, especially in large classes, that could create positive mood and thereby enhance creative thinking. Although not studying mood per se, Ramsburg and Youmans (2013) reported that six minutes of meditation training prior to an instructional video in Introductory Psychology classes improved retention of the material on a post-video quiz. However, we are interested in creative thinking over an entire course, not just retention cross-sectionally, a condition that more resembles lab conditions than the in-vivo classroom.

To address this, we turned to well-established procedures for mood induction (IAPS; Lang et al, 2008; Mitterschiffthaler et al, 2007). The mood induction procedures had to be brief and able to be implemented in a large lecture class. We hypothesized that inducing positive mood just prior to students taking an exam would improve their creative critical thinking (operationalized below) on

that exam relative to neutral mood induction.

METHODS

Participants

We recruited volunteers from among students registered for an undergraduate psychology course at a mid-sized public, research university. Although the course incorporated the research design (described below) such that all students were exposed to mood induction prior to exams, we only used the exams of those students giving written, informed consent for data analysis. Of 140 students registered for the class, 95 provided written informed consent to participate. Of these 95, 52 students had complete (all four exams) data sets. The results from the students with complete versus incomplete data were essentially the same. We have chosen, therefore, to present the data from the complete data set to avoid addressing the issue of missing data, a particularly important point given the study design. The study was approved by the local IRB.

Measures

Critical thinking. The dependent variable was the rating of critical thinking (CT) on a two-page essay that comprised half of each exam; the other half of each exam consisted of multiple-choice questions intended to measure information. The essay questions were designed to assess students’ ability to apply the information and exhibit critical thinking. They were permitted to bring in one standard size sheet of notebook paper of notes as the emphasis was on critical thinking, not recall of content.

The critical thinking ratings were based on a 4-point scale. Each rating point represented an integration of multiple elements of critical thinking, with the scale ranging from 1, poorest critical thinking, to 4, best critical thinking (see Appendix). CT raters, all without prior experience in scoring, trained together by meeting weekly (see below) and blindly co-scoring 32 essays to estimate inter-rater reliability. Of 192 pair-wise comparisons, 97 (50.5%) were identical; a further 75 were within one point of each other, yielding a combined rate of 91.1% ratings that fell no more than one point apart. The Cronbach alpha was .82 and the intraclass correlation (single measure) was .53 ($df = 31, 93; p < .0001$).

Mood. The independent measures were the stimulus conditions, “neutral” and “positive”, used for mood induction. We combined both visual and auditory stimuli to maximize the impact on mood.

We selected images from the original set of International Affective Picture System (IAPS; Lang et al, 2008) to create a set of

“neutral” (e.g. a picture of mushrooms) and a set of “positive” (e.g. a smiling baby) images. The neutral set consisted of 16 slides with ratings ranging from 5.07 to 5.22; the positive set consisted of 16 slides with ratings from 8.00- 8.32 (further details of images and music selection are available on request).

Mitterschiffthaler et al (2007) found that both self-report and neuroimaging established the efficacy of selected pieces of nonlyrical music to create “positive” and “neutral” moods. We chose four selections, two neutral and two positive. Neutral pieces were: Handels’ Suite in F Major and Suite in D-G Major. Positive pieces were: Mozart’s Eine Kleine Nachtmusik G- Allegro and Rondo-Allegro

Students rated their mood and their energy level on a 9-point scale. Mood ranged from 1 (sad) to 9 (happy) with 5 marked as neutral. Energy ranged from 1 (sluggish) to 9 (energized) with 5 marked as neutral. We included energy ratings to control for possible effects of arousal level.

Procedures

We used a within subject A-B-A-B study design in which A represents neutral mood induction and B represents positive mood induction. The strength of this design lies in students serving as their own controls, thereby providing a strong test of the hypothesis.

The mood inductions preceded each of the four exams and consisted of a 2-minute presentation of slides and nonlyrical music simultaneously. Students completed the mood rating scales just prior to mood induction and again immediately following mood induction termination.

The PI, blind to which students had consented to allow their exams to be analyzed in the study, graded all exams as usual, but did not contribute to the rating of essays for critical thinking. We waited until after the course was finished before undertaking the study analyses. We anonymized the essays and the PI randomly generated the order in which the essays were rated. Four trained raters, blind to course grades, scored the essays.

RESULTS

Mood induction

The mood induction procedures yielded highly significant differences in post-induction self-rated mood. Neutral mood induction had no effect on sad-happy, mean ratings being identical at 5.4 for pre- and post-neutral mood induction. Mean arousal ratings actually decreased from 5.0 to 4.8, pre- to post-induction ($t_{102} = 2.175$, $p = .032$). In contrast, post-positive mean mood rating (6.5) was significantly higher than the pre-induction mean rating (5.6; $t_{97} = -10.015$, $p < .00001$). There was a significant increase in self-rated arousal as well (5.2 vs 5.7, $t_{97} = -4.785$, $p < .0001$), although it was approximately half the increase in mood. The impact of mood induction on male and female students was comparable, with almost identical increases in mood post-induction for men (5.5 vs 6.5) and women (5.6 vs 6.5). In contrast, there was virtually no change in men’s energy level (5.3 versus 5.2), while women had a significantly higher post-positive mood induction energy rating (5.2 versus 5.7, $p < .0001$).

Critical thinking

We used both parametric and nonparametric procedures to test mood induction effects on critical thinking, as there are reasonable arguments to be made about the psychometric properties of the

critical thinking rubric. That is, the rubric can be viewed as an ordinal scale or an interval scale. Rather than argue this issue, we have chosen a dual statistical strategy that yields comparable results as described below.

Parametric tests: within subjects repeated measures ANOVA. The means (standard deviations) of critical thinking scores after neutral mood and positive mood inductions were 3.2 (1.1) and 3.9 (1.3), respectively; $F_{1, 50} = 11.353$, $p = .001$. There was also a significant main effect of sex ($F_{1, 50} = 4.170$, $p = .046$) with women receiving significantly higher critical thinking ratings than men. Table 1 presents the results separately for female and male students. There is a difference between the sexes with female students’ results yielding an effect size twice that of male students.

Nonparametric test: Wilcoxon Matched Pairs Sign Test. Table 2 summarizes the frequency of assigned scores by sex and mood induction condition. For example, in examining the first row of Table 2, we find that the frequency of the poorest CT (score of 1) drops from 40 to 20 following positive vs neutral mood induction for women, a reduction of 50%. For men, however, the drop is only 21% (from 14 to 11).

As summarized in Table 2, nonparametric tests yielded comparable results to the repeated measures ANOVA. Specifically, the distribution of critical thinking scores reflected significantly better performance following positive versus neutral mood induction for women, while the results were not conventionally statistically significant for men.

Finally, we calculated the correlation between the change in self-rated mood and the change in self-rated energy following positive mood induction as an indirect attempt to assess the contribution of energy increase, rather than positive mood, to the change in critical thinking ratings as a function of mood induction. The cor-

TABLE 1. Mean (standard deviation) critical thinking essay scores following induced mood.

Mood Condition	Female	Male
Neutral	3.5 (1.1)	2.0 (1.0)
Positive	4.4 (1.4)	3.4 (1.1)
F	22.41	2.119
p value	< .0001	< .176
Partial eta squared	0.359	0.175

TABLE 2. Distribution of critical rating scores by sex and mood induction condition.

Mood	Female		Male	
	Neutral	Positive	Neutral	Positive
CT Rating				
1 [Poorest]	40	20	14	11
2	24	33	6	7
3	18	23	2	4
4 [Best]	0	6	0	0

Wilcoxon Matched Pairs Sign Test based on difference [Positive-Neutral] scores. Female: $z = -3.808$, $p < .0001$; Male: $z = -1.677$, $p = .096$.

relation was .24 ($p = .034$) for women and .70 ($p < .00001$) for men, suggesting that self-rated mood and energy were minimally associated for women, but highly associated for men.

Summary. We found consistent evidence for a significant effect of positive mood induction (compared to neutral mood induction) on critical thinking scores among female, but not male students. The mood induction effect on female students' critical thinking scores did not appear attributable to changes in arousal. Nor were the results attributable to sex differences in the effectiveness of the mood induction procedures as self-rated positive mood was increased equally in the sexes as a result of the mood induction procedures.

DISCUSSION

Mood & cognitive performance in the classroom

First, we note that a mere two minutes of appropriately selected music and images can have a significant group impact on students' reports of their mood, even in the setting of a large lecture hall prior to the administration of an exam. Mood induction is a practical and effective intervention not only in the lab (Mitterschiffthaler et al., 2007), but also as this study has revealed, in the classroom. The move from controlled experimental setting to the more complicated classroom environment is, in itself, a useful finding.

Interestingly, while the mood induction effect was similar in the sexes, there was a significant sex difference in the self-reported arousal level following positive mood inductions. Women reported being significantly more aroused-energized than did men, although this difference did not account for effects on cognitive performance (as discussed below). There was virtually no change in men's energy and a .5 rating scale increase in women in response to the positive mood induction. We know of no published studies that report this sex difference, although the personality literature supports sex differences in the expression of affect that could account for the finding (Kring & Gordon, 1998).

Despite comparable mood changes in male and female students, only female students showed improved critical thinking following positive mood induction. The finding for female students is consistent with experimental studies reporting that thinking becomes more creative and fluid under positive mood conditions (Clare & Palmer, 2009; Fredrickson & Losada, 2005; Mitchell & Phillips, 2007; Nadler, Rabi & Minda, 2010). That such cognitive changes can be facilitated in the context of a large class and in the "real world" conditions of course exams is encouraging.

But why should this effect be restricted to women in our sample? One possibility is that women are more generally affected or differentially affected by mood than are men, although the cognitive science literature does not address this adequately and the results are mixed (Kring & Gordon, 1998). Future explicit analyses of sex differences in the empirical study of cognition and affect interactions should help resolve the issue.

It might be argued that increased energy is an important component of the positive mood effect; if so, men were sub-optimally aroused which could account for their not showing a positive mood effect on critical thinking. We do not view this as a favored explanation, however, given that self-reported mood and energy were minimally correlated in women suggesting that energy was not a contributor to the effect.

Practical considerations and limitations of study

There are several factors that require attention in follow up studies. Despite the strength of the within subject design, the role of instruction in critical thinking (versus the impact of mood) was partially confounded with mood manipulation. That is, it is possible that the improvement in critical thinking scores were a response to ongoing exercises and instructions in critical thinking over the course of the semester rather than reflecting the impact of positive mood induction. An argument against this interpretation is that critical thinking essays were better after the first positive mood induction than after the second neutral mood induction. In other words, despite continued pedagogical attention to critical thinking over the course of the semester, positive mood induction appeared to slightly raise critical thinking essay ratings. We cannot rule out, however, experimenter bias in the form of unintended variations in classroom instruction as the instructor (RL) was fully informed about the study design. We can, however, rule out bias in the rating of critical thinking as essays from all four exams were pooled and randomly ordered, and scored blind as to when the exam was administered during the course.

We also do not know how those students who agreed to have their data analyzed in the study differed from those who did not consent. Perhaps there are individual differences in disposition toward critical thinking that led students to agree to participate. We will want, in future studies, to assess such dispositional and motivational characteristics.

There were large individual self-report differences in response to mood induction that require an idiographic approach to complement the nomothetic one adopted in this report. It will be interesting to compare, for example, those students with minimal response to the mood induction procedures to those with large responses. Further, would those students with minimal mood change be responsive to more intense mood induction procedures with a concomitant improvement in critical thinking?

Blind ratings of critical thinking essays in large classes are prohibitive. Consider that in this study, a team of four researchers unaffiliated with the course rated 349 essays. Thus while the mood induction procedure is feasible, large-class study of critical thinking awaits more efficient but reliable methods of assessing critical thinking.

Conclusion

Overall, the results are encouraging and support further consideration of the role of mood in facilitating critical thinking. The procedures for inducing positive mood are practical, brief, and effective as reflected in student self reports. The induction of positive mood apparently lasts long enough to affect performance on in-class essays, at least for female students. Obviously, listening to music and looking at images that induce positive feelings do not suddenly make students think critically, but it just might put them in the right mood to try.

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APPENDIX

ACTUP.2 Assessment of Critical Thinking: Understanding Psychology

4 Presents clear understanding of the context, intent, and complexities of the essay question.

Answers all parts of the essay question. Information is accurate and supported by empirical evidence from lectures or readings. Compares and/or contrasts fairly at least two different theoretical or conceptual perspectives, including: assumptions, implications, strengths and weaknesses. Clearly takes a position and provides reasoning for selection.

3 Presents clear understanding of the content, intent, and complexities of the essay question.

Incompletely answers all parts of the essay question. Information is accurate, generally complete, and largely supported by empirical evidence from lectures or reading. Compares and/or contrasts fairly at least two different theoretical or conceptual perspectives, including: assumptions, implications, strengths and weaknesses. Clearly takes a position and provides partial reasoning for selection.

2 Presents simple understanding of question.

Omits one or more part(s) of question. Presents accurate information that is not supported by empirical evidence from lectures or reading. Presents two or more theories/perspectives but fails to compare and/or contrast them. Takes a position and provides no reasoning for selected position.

1 Presents simple and incorrect understanding of question.

Omits one or more part(s) of essay question. Presents inaccurate information and unsupported by empirical evidence from lectures or readings. Presents only one theoretical or conceptual perspective. Fails to provide reasoning for position.