

Study Protocol

SkillJoy Randomized Controlled Trial

Lucas S. LaFreniere, Ph.D.^{1,2}

Michelle G. Newman, Ph.D.²

Department of Psychology

Skidmore College¹

Pennsylvania State University²

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Method

Participants

Participants were identified through the Pennsylvania State University subject pool. All those invited to participate via email met DSM-5 criteria for GAD on the *Generalized Anxiety Disorder Questionnaire-IV* (GAD-Q-IV; Newman et al., 2002). Those who accepted the invitation were then screened on the phone for GAD a second time by clinical interview (the GAD section of the Mini-International Neuropsychiatric Interview (MINI); Sheehan et al., 2015). They were required to meet full criteria for GAD on both the GAD-Q-IV and the MINI to participate. All participants were 18 years of age or older, spoke English, and were able to consent.

Measures

Primary outcome measures

The Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) is a 16-item self-report scale of the severity and frequency of worry. It has strong internal consistency .91, retest reliability ($r = 0.92$), convergent and discriminant validity, and sensitivity to change from psychotherapy (Brown, Antony, & Barlow, 1992; Meyer et al., 1990). In our sample, internal consistency was $\alpha = .78$ at pre-trial, .87 at post-trial, and .89 at follow-up.

The Positive and Negative Affect Schedule, Expanded Form: Joviality Scale (PANAS-X Joviality; Watson & Clark, 1994) is an 8-item measure of positive emotions. This joy sub-factor had an average factor loading of 0.73 (Egloff, Schmukle, Burns, Kohlmann, & Hock, 2003; Watson & Clark, 1994). It had strong internal consistency (median $\alpha = .93$) across eight studies of various time intervals (e.g., momentary, daily, past few days, past week, or past month; $\alpha = .88$ to .94), as well as convergent and discriminant validity (Watson & Clark, 1994). In our

sample, internal consistency was good (pre: $\alpha = .90$; post: .88; follow-up: .92).

The Savoring the Moment Subscale of the Savoring Beliefs Inventory (SBI; Bryant, 2003). The SBI is a 14-item survey that measures beliefs about one's ability to savor. The savoring the moment subscale measures savoring of present-moment emotional experience. Confirmatory factor analysis showed all subscales had good fit (Bryant, 2003), had good-retest reliability ($r = .88$), and internal consistency reliability ($\alpha = .78$ for total scale), convergent and divergent validity. In our sample, internal consistency was good (pre: $\alpha = .80$; post: .86; follow-up: .84).

Secondary Outcome Measures

Responses to Positive Affect Scale (RPAS; Feldman, Joormann, & Johnson, 2008) was used to measure kill-joy thinking (a.k.a. "dampening"). Participants rated eight dampening items on a 5-point scale. The RPAS showed good model fit (RMSEA = 0.043; CFI = 0.94; RMSR = 0.049), internal consistency ($\alpha = 0.76 - 0.83$), convergent and discriminant validity (Feldman et al., 2008; Nelis, Holmes, & Raes, 2015). In our sample, internal consistency was good (pre: $\alpha = .86$; post: .88; follow-up: .88).

The Prioritizing Positivity Scale (PPS; Catalino et al., 2014) measured the degree to which participants prioritized seeking positive experiences on six items with which participants either agree or disagree on a nine-point scale. It had good model fit (CFI = .99; RMSEA = .04), internal consistency reliability ($\alpha = .81$), and good construct validity (Catalino et al., 2014). In our sample, internal consistency was good (pre: $\alpha = .83$; post: .88; follow-up: .91).

The Life Orientation Test – Revised (LOT-R; Scheier, Carver, & Bridges, 1994) measures optimism. It has 10 items rated on a four-point scale. It showed good model fit (CFI = .99, TLI = .99, RMSEA = .04), convergent, and discriminant validity (Glaesmer et al., 2012; Herzberg,

Glaesmer, & Hoyer, 2006). Internal consistency was acceptable in our sample (pre: $\alpha = .78$; post: .82; follow-up: .82).

The Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996) is a widely used, 21-item self-report survey that measures the presence and severity of depressive symptoms. It has repeatedly demonstrated high internal consistency, such as $\alpha = 0.93$ (Beck et al., 1996). Convergent and discriminant validity have been demonstrated as well (Beck et al., 1996). In our sample, internal consistency was good (pre: $\alpha = .88$; post: .93; follow-up: .95).

Smartphone Software Applications

PACO: The Personal Analytics Companion (PACO Developers, 2018) is a mobile application software package for designing ecological momentary studies. It allows for fixed, user-editable, and stratified random prompting on personal iOS and Android phones. *Quip* (Taylor & Gibbs, 2018) is a mobile application for creating documents, task lists, and embedded spreadsheets that can be edited in real time by multiple users across multiple devices.

Procedure

All data was collected prior to the COVID-19 pandemic. Eligible participants were randomly assigned to either the SkillJoy treatment condition or the active self-monitoring (ASM) control condition. The interventions and organization of prompt times were informed by several rounds of pilot testing. After arriving at the laboratory, all participants were provided informed consent. They then completed baseline questionnaires using PsychData on a laboratory computer as well as a computerized task (for another study). They were then given a description and rationale for their assigned treatment conditions regarding how it would reduce their GAD symptoms and increase positive emotions (see supplementary materials). Subsequently, participants downloaded and started study apps. Each participant also received a Quip document

with their condition's rationale and instructions on how to complete each part of the intervention, an organized scheduling spreadsheet, and a note-taking space. They were trained on how to use their assigned app, assisted with a PowerPoint presentation to which participants had access throughout the study. At the end of the training session both groups were given information on following steps of the study, were reminded of the compliance check phone call on their fifth day of EMI use, and post-trial study tasks, and were given opportunities to ask questions.

The EMI was delivered by the PACO app and involved seven days in participants' natural environments. Each day participants received 8 prompts that required engagement and assessment. A 9th prompt in the afternoon reminded them to engage in a scheduled activity. Each day's first and last prompt times were user-editable, to fit their sleep schedules. Other prompts were delivered at random times within pre-determined intervals between 9:00 AM and 10:30 PM daily. All prompts included EMA ratings not reported here for brevity, but were identical between conditions. Four daily prompts in both conditions included the PANAS-X Joviality scale. Participants also received a compliance check phone call on the fifth day of the trial, which asked about rate of compliance and level of effort, if any harm had occurred, and encouraged full participation in the study. Participants were then directed to complete mid-measures online before midnight that day (not included in the current study). Participants returned to the laboratory on the eighth day of the study where they completed the same series of questionnaires and tasks given at baseline. On the 30th day, they received an email with a link to PsychData to complete follow-up measures and were compensated for their participation.

SkillJoy Condition

SkillJoy Training: SkillJoy participants were initially trained in savoring practice exercises that resembled their intervention. They were guided through remembering and

describing a positive moment from their past, as well as one good experience from their current day. Next, they engaged in present-moment savoring. They first chose a small candy or dried fruit from multiple options. They were then guided through attending to the sensory, emotional, and cognitive experience of eating it in the moment, purposefully attempting to amplify and extend the resulting positive emotion. After, they brainstormed, and scheduled daily enjoyable activities for the week that were rated a 7 or greater on a 10 point enjoyable scale and recorded them in a Quip template along with five suggested activities.

SkillJoy EMI: Present-moment savoring prompts were delivered within the stratified random prompting. All other prompts were delivered at fixed times distributed across the day. SkillJoy included a variety of savoring interventions modified to target GAD pathology. These interventions included 1) *Enjoyable Activity Savoring*. Participants were prompted at a time of their choosing (before 11:30 AM) to schedule an exact time for an enjoyable activity for the following day. They were then reminded and later prompted to practice savoring upcoming positive activities. At the end of the day, they were asked to focus on what they liked about their enjoyable activity; 2) *Present-Moment Positive Evaluation*. Participants received three identical daily prompts guiding them to focus on and savor what they enjoyed about the present moment; 3) *Savoring recent memories*. Participants received two daily prompts to encourage savoring of recent activities and events, focusing on amplifying and extending the duration of positive emotions ; 4) *“Counting Blessings” Technique*. Two times a day participants received prompts guiding them to consider and write about events that turned out better than expected and events that were enjoyable or went well. 5) *Looking forward to the day’s events*. During participants’ first daily morning prompt, they were asked to savor an upcoming activity for that day.

Active Self-Monitoring Control EMI

Active Self-Monitoring (ASM) Training: ASM control participants were trained using identical structure and content to SkillJoy participants, *omitting* aspects theorized to increase positive emotion. They were guided through remembering a day one week in the past, as well as an event from the current day, to practice reflective thinking. After, they engaged in present-moment self-awareness. They chose a small candy or dried fruit and were asked to focus on and describe their thoughts and feelings while eating it. This activity resembled a mindfulness exercise, but did not direct attention to any specifically *positive* emotions or thoughts. Next, participants described and scheduled possible future events they had to do or planned to do during each day of the following week and recorded them in a condition-specific Quip template.

ASM EMI: The ASM control included self-monitoring activities mirroring SkillJoy interventions, but omitting components to increase or sustain positive emotion. Careful attention was paid to match SkillJoy in its tone of language. Interventions included: 1) *Planning tomorrow's activities*. Each morning at a time of their choosing (before 11:30AM) participants received a prompt to think about major events that would take place in the following day using their daily Quip schedule and notes and were directed to stay apprised of their scheduled events. They also received a daily prompt about attending to their thoughts, feelings, and plans. At the end of the day, they were asked to remember, record and focus on their thoughts and feelings from that day; 2) *In-the-moment thoughts and feelings*. Participants received three identical stratified random prompts to attend to their thoughts and feelings at the present moment: 3) *Remembering*. Participants received two prompts to encourage remembering recent activities and events from their day, no matter what events these were. These prompts asked them to think of an event from their day, take 60 seconds to remember the event in detail, and complete a series of ratings about the event. 4) *Recording the day's events*. Two times a day participants received

prompts guiding them to record and think about events from their day. 5) *Anticipating the day's biggest event*. Each day during participants' first morning prompt they were asked to anticipate and record that days most important event.