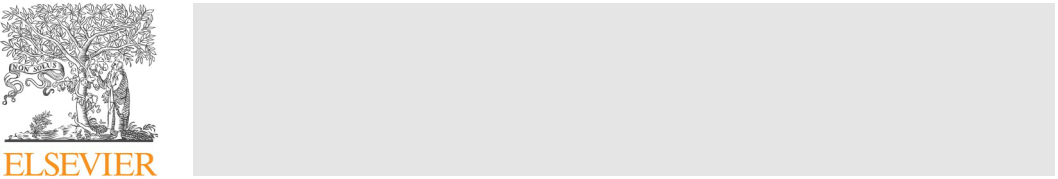
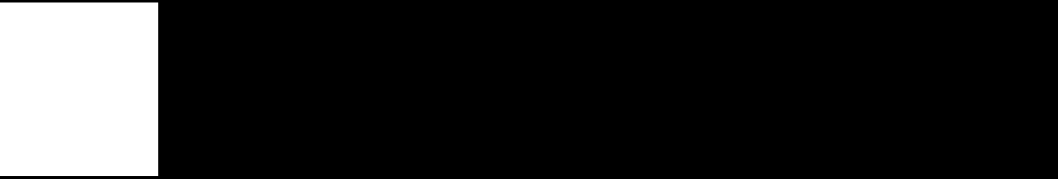
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ABSTRACT

*Background:* Training in improvisational theater is a widely available, popular and entertainingactivity. It also is linked to a variety of psychological benefits, such as reductions in anxiety and depression in adult psychiatric patients (Krueger et al., 2017) and in social anxiety among adolescent public-school students (Felsman et al., 2019). However, research on its benefits has generally lacked the rigor of randomized experiments.

*Aims:* This paper follows an experimental method from previous research linking improvisationtraining to improvements in divergent thinking in the laboratory (Lewis & Lovatt, 2013), and includes an additional dependent variable, uncertainty tolerance, which has been broadly im-plicated in anxiety and depression (McEvoy & Mahoney, 2012).

*Method:* In two experiments (*n* = 74, *n* = 131), participants completed measures of divergentthinking, uncertainty tolerance, and affective well-being before and after engaging in 20 min of improv exercises or a matched control condition including social interactions.

*Results:* This paper replicates the prior finding that improvisational theater training can improvedivergent thinking (e.g., Lewis & Lovatt, 2013; Sowden et al., 2015), and provides new findings that improv can boost positive affect and increase uncertainty tolerance relative to other social interactions.

*Conclusions:* As a means to enhance psychological health, improvisational theater training offersbenefits without the negative stigma and difficulties in access surrounding other therapeutic interventions. These results support its popular use beyond the theater to improve social and personal interactions in a variety of settings (e.g., Tint & Froerer, 2014).

**1. Introduction**

Since the 1960s, improvisational theater (*improv*) training has grown exponentially in popularity (Seham, 2001), and now nearly every major city in the United States has an improv theatre (Steitzer, 2011). Although Chicago is still a destination for improv students seeking training in the U.S., a developing international presence now shares many of its techniques (Seham, 2001), as evidenced by hundreds of improv theaters around the globe (for a list of improv theaters around the world, see “Improv Map of the World, ” n.d.). Beyond celebrity actors and writers (e.g., Tina Fey; Fey, 2013) and business moguls (e.g., Dick Costolo, Twitter CEO;



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Bilton, 2012) who attribute their success in life to their improv training, many people believe that it has broad benefits for everyday living ([Madson, 2005](#page14)).

Improv is defined by unplanned collaborative performance (Halpern, Close, & Johnson, 1994) where process and product co-occur (Sawyer, 2000; Sowden, Clements, Redlich, & Lewis, 2015). This can be contrasted with scripted theatre, in which much of a play’s creative choices (e.g., writing a script, casting actors) are preplanned and may be made by designated individuals (e.g., the playwright) rather than collaboratively. The most widely cited lesson of improv training, “Yes, and…” (e.g., DeMichele, 2015; [Hines,](#page14) [2016](#page14)), addresses the need for improvisers to agree on the reality of a scene in order to move forward in it (Besser, Roberts, Walsh, & Wengert, 2013). Each improviser accepts the information their partner offers (the “yes,”) and adds more to it (the “and”) ([Hines,](#page14) [2016](#page14); Jagodowski, Pasquesi, & Victor, 2015). Depending on stylistic preference (Arnett, 2017), different teachers may emphasize different lessons related to “Yes, and…,” such as behave and respond honestly (Jagodowski et al., 2015); find what is interesting or funny and explore that (Besser et al., 2013); or do something, notice what you did, and keep doing that while processing your partner’s choices through your character ([Napier, 2004](#page14)).

Applications of improv training abound. For example, arguably the most influential theater from which modern improv origi-nates, Second City (Seham, 2001), now has a “Wellness Program” (n.d.), offering distinct improv courses for those with anxiety or autism, for seniors, for clinicians, and a “Professional Development Program” (n.d.), offering distinct improv courses for workplace innovation, for public speaking, and for teachers. The Applied Improvisation Network lists over 7000 global members interested in using improv in non-theatrical settings for personal development, team building, creativity, innovation, and/or meaning-making [Tint](#page14) & Froerer, 2014).

*1.1. Emerging evidence for improv’s applications*

Despite widespread applications, there is little experimental evidence for improv’s benefits (e.g., Lewis & Lovatt, 2013; DeMichele, 2015; Sowden et al., 2015). Historically, much of the applied literature has either used improv concepts as a metaphor to describe how organizations and their members handle unexpected circumstances, or reported on case studies, interviews, and an-ecdotal evidence (for a review, see Hadida, Tarvainen, & Rose, 2015). There is some evidence for improv’s usefulness in the domain of mental health from two notable pre-post studies: Felsman, Seifert, and Himle (2019) link participating in improv to reduced social anxiety in low-income teens, and Krueger, Murphy, and Bink (2017) link participating in improv to reduced generalized anxiety and depression and increased self-esteem among adult psychiatric patients.

There is also some evidence of improv’s usefulness in the domain of creative thinking from recent quasi-experimental research (i.e., lacking random assignment). Creative teams involved in improv training (versus an inactive control) showed increased workplace playfulness and creativity (West, Hoff, & Carlsson, 2017). Middle school students participating in improv (versus sports) at lunchtime showed gains in creative flexibility and originality (Hainselin, Aubry, & Bourdin, 2018). High school students in an improv class (versus a writing class) showed increased word and sentence usage (DeMichele, 2015). And, college students in an improv (versus consumer behavior) class showed increased creative fluency and greater self-efficacy on a marketing task measure ([Mourey,](#page14) [2019](#page14)).

However, to establish a causal relationship between improv and psychological benefits, evidence from experiments with random assignment is needed (Aronson, Carlsmith, & Ellsworth, 1990; Cook, Campbell, & Shadish, 2002). The randomized experiment (in which participants are assigned at random to treatment group) is the most compelling methodology for causal inference because group differences can be attributed to differences in the manipulated treatment rather than third variables such as the selection of participants ([Aronson et al., 1990](#page13); [Cook et al., 2002](#page13)).

In the literature on specific benefits of improvisational theater, to our knowledge, only two randomized experiments have been published. They both concluded that even short sessions of improv cause increases in divergent thinking relative to a control con-dition with social interactions, among college students (Lewis & Lovatt, 2013), and among children (Sowden et al., 2015). Because brief social interactions can increase positive emotions and a sense of belonging (Argyle, 2013; Sandstrom & Dunn, 2014a, [2014b](#page14)), it is important that these studies control for the non-specific effects of social interaction.

*1.2. Increasing divergent thinking with improv*

Divergent thinking, the ability to explore multiple solutions to a given problem, is often contrasted with convergent thinking, the ability to arrive at a single appropriate solution (Lubart, 2016). Divergent thinking processes occur in a spontaneous and non-linear manner, so that many unique ideas can be generated in a short amount of time (Carr & Borkowski, 1987) and in unexpected combinations (Walton, 2003). Although creative problem solving includes both convergent and divergent thinking (Cropley, 2006), divergent thinking ability is considered a reliable index of creative potential (Runco, 2017). Strategies to promote divergent thinking are important in part because creative thinking is increasingly valued in today’s economy ([Williams & McGuire, 2010](#page14)).

Lewis and Lovatt (2013) argue that improv should increase divergent thinking compared to social interactions due to schemas; that is, everyday conversation draws heavily on preplanned social scripts and convergent thinking, whereas improv draws on a much wider variety of possible scripts and phrases, thereby engaging more creative, flexible and divergent processes. We add to this explanation the fact that the improv script is necessarily co-creative; as a result, the variety of available scripts and schemas are further combined in novel ways, increasing divergent thinking.

Lewis and Lovatt (2013) measured divergent thinking ability through the Alternate Uses Task (AUT) (Guilford, 1967), perhaps the most common measure of divergent thinking in psychology (Dumas & Dunbar, 2014). In Lewis and Lovatt’s experiment (2013),

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participants completed the AUT by generating as many alternative uses as possible for a common object (e.g., a paperclip; a remote control) before and after engaging in 20 min of improv or a matched control condition with social interaction activities. Examining divergent thinking subscales – fluency (number of legal responses), flexibility (number of response categories in their response set), elaboration (additional details in responses), and originality (uniqueness among a sample, conventionally given by 5 % or fewer participants) – Lewis and Lovatt (2013) found that a short improv experience caused increased fluency, flexibility, and originality (but not elaboration) compared to a social interaction control condition.

That improv causes increases in divergent thinking (Lewis & Lovatt, 2013) helps explain the success of improv in creative fields such as business and entrepreneurship (Lubart, 2016). It also may help explain successful applications in mental health because flexible thinking is a goal of mainstream therapies (Clark & Beck, 1999), although creative performance has been historically as-sociated with both career success and symptoms of psychopathology (e.g., Simonton, 2012).

*1.3. Increasing uncertainty tolerance with improv*

The same features of improv training (moment-to-moment co-creative decisions) that may increase divergent thinking likely have other consequences. Of these, one that may distinguish improv experiences from everyday social interactions is that uncertainty about what will happen from one moment to the next is seen as desirable (Napier, 2004). Tolerance for uncertainty may have broad psychological benefits. To detect potential threats, uncertainty is often experienced as anxiety (Hirsh, Mar, & Peterson, 2012); however, even when no serious threat exists, uncertainty can lead to anxious behaviors such as avoidance and attentional biases (Herry et al., 2007). Indeed, intolerance of uncertainty has been recognized as a dispositional risk factor in anxiety and depression (e.g., Carleton et al., 2012; McEvoy & Mahoney, 2012), and thus a transdiagnostic target for mental health treatments (e.g., [Carleton,](#page13) [2012](#page13)).

From a behaviorist perspective, improv may promote uncertainty tolerance via exposure, a key ingredient in traditional therapies (Wolitzky-Taylor, Zimmermann, Arch, De Guzman, & Lagomasino, 2015). Each successive moment in improvisation is one of many (perhaps infinite) possibilities; as such, an improv encounter provides direct and repeated experience with social uncertainty. The underlying mechanism for exposure as an effective treatment may be learned habituation, initial fear activation followed by fear reduction, or inhibitory learning in emphasizing the development of new, non-threatening associations that become more accessible across time and context (Craske et al., 2008). Since improvisation involves encountering uncertainty in a non-judgmental, trusting and mutually supportive environment (Berk & Trieber, 2009), new associations developed through improv are likely non-threatening or even pleasant. Thus, if improv causes increases in uncertainty tolerance, such a relationship could provide a parsimonious ex-planation of its applications in broad domains of psychological health.

**2. Experiment 1**

No existing studies have tested whether engaging in improv causes increased uncertainty tolerance. Additionally, no experiment has replicated Lewis and Lovatt’s (2013) finding that improv experience causes increases in divergent thinking in adults. To address these gaps, Study 1 aims to replicate the Lewis and Lovatt (2013) finding using the same outcome measure for divergent thinking while adding a measure of uncertainty tolerance. Since Lewis and Lovatt (2013) did not find any differences in Profile Of Mood States (POMS) scores (McNair & Heuchert, 2003) between their two groups (but did find an overall increase in positive emotions across conditions), we decided to replace the POMS with a common single-item measure of how people feel, i.e. “affective well-being” (e.g., Kross et al., 2013) in our replication. To measure uncertainty tolerance, we used Dalbert’s Uncertainty Tolerance Scale ([1996](#page13)) as a pre- and post-treatment measure.

Lewis and Lovatt’s (2013) study included a social interaction control condition that involved familiar interactions presumed to rely strictly on social scripts and schemas; for example, participants were asked to discuss their hobbies and university life. We modeled our social interaction control condition in Study 1 off of this premise. We also considered, however, that everyday con-versation might be more like an improv experience when negotiated, flexible, playful, collaborative, and unstructured (e.g., two friends “riffing,”) and less like improv when following conventions and norms (e.g., ordering in a restaurant; Bower, Black, & Turner, [1979](#page13); Sawyer & Sawyer, 2003). Because improv experiences are defined by repeated encounters with the unplanned, we modified the social interaction control group tasks in Study 2 to be even less like improv by literally providing scripts to guide interactions.

**Hypotheses**. As inLewis and Lovatt (2013)and Sowden and colleagues (2015), we expected that improv, relative to socialinteraction control, would cause increases in divergent thinking subscales, and that there would be no difference between conditions in affective well-being (only an increase across conditions). We also expected that improv, relative to a social interaction control, would promote tolerance for uncertainty.

*2.1. Method*

*2.1.1. Participants*

Seventy-four undergraduates at a midwestern university (*M*age = 18.83 years, *SD* = 1.74 years; 28 (37.8 %) male, 46 (62.2 %) female; 48 (64.9 %) White, 24 (32.4 %) Asian/Asian-American, 2 (2.7 %) Black/African American) participated for course credit. This study received an exempt determination by the University of Michigan Institutional Review Board. All participants completed written consent forms.

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**Table 1**

Experiment 1 treatment condition tasks and descriptions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Task |  |  | Improv |  |  | Control |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  | Task | Description | | Task | Description |  |
|  |  |  |  |  | |  |  |  |
| 1 | Group |  | Unstructured counting | Count up to twenty, one number | | Structured counting | Count up to twenty, one |  |
|  |  |  |  | at a time. There shouldn’t be an | |  | number at a time. Take turns by |  |
|  |  |  |  | order to who speaks. If two people | |  | going clockwise in a circle. |  |
| 2 | Group |  | Unstructured alphabet | speak at once, restart. | | Structured alphabet | When finished, repeat. |  |
|  | Recite the alphabet, one letter at a | | Recite the alphabet, one letter |  |
|  |  |  |  | time. There shouldn’t be an order | |  | at a time. Take turns by going |  |
|  |  |  |  | to who speaks. If two people | |  | clockwise in a circle. When |  |
| 3 | Group |  | Word at a time original | speak at once, restart at. | | Word at a time familiar | finished, repeat. |  |
|  | Going around the circle, each | | Going around the circle, each |  |
|  |  |  | content | person will add one word at a | | content | person will add one word at a |  |
|  |  |  |  | time to form a coherent story. If a | |  | time to recite the first verse of |  |
|  |  |  |  | story is completed, begin a new | |  | Twinkle Twinkle.[a](#page4) If finished, |  |
| 4 | Partner |  | Co-creating physical reality | one. | | Imitating physical action | repeat. |  |
|  | Without speaking, one person will | | One person will name a |  |
|  |  |  |  | demonstrate a physical activity. | |  | physical activity and then |  |
|  |  |  |  | When their partner can guess | |  | demonstrate it. Without |  |
|  |  |  |  | what it is, they will join in with | |  | speaking, when the |  |
|  |  |  |  | the same physical activity. When | |  | experimenter says, their partner |  |
|  |  |  |  | the experimenter says, reverse | |  | will join in with the same |  |
|  |  |  |  | roles. | |  | physical activity. When the |  |
|  |  |  |  |  |  |  | experimenter says, reverse |  |
| 5 | Partner |  | Co-creating a character | Pretend you know someone in | | Describing someone | roles. |  |
|  | Taking turns, describe someone |  |
|  |  |  |  | common. Taking turns, describe | |  | you know. |  |
| 6 | Partner |  | Mirroring spontaneous | that person. | | Partner-facing non- | Engage in a staring contest with |  |
|  | Imagining you are each your | |  |
|  |  |  | movement | partner’s mirror image, one | | spontaneous movement | your partner, without speaking. |  |
|  |  |  |  | person will initiate movement | |  | When the game ends, repeat. |  |
|  |  |  |  | that their partner will mirror, | |  |  |  |
|  |  |  |  | without speaking. When the | |  |  |  |
| 7 | Group |  | Co-creating a shared | experimenter says, reverse roles. | | Discussing an experience | Describe a movie you have |  |
|  | Pretend you have all just seen a | |  |
|  |  |  | experience | movie called “Transformation.” | |  | seen. Take turns by going |  |
|  |  |  |  | Have a group discussion about the | |  | clockwise in a circle. |  |
|  |  |  |  | movie. | |  |  |  |



1. For the first control group, we used the school song in case students were unfamiliar with *Twinkle Twinkle, Little Star* (used in [Lewis & Lovatt,](#page14) [2013](#page14)). However, in the first group, some students did not know the words to the school song; so, all other control groups had a printed lyric sheet with the first verse of *Twinkle Twinkle*.

*2.1.2. Design overview*

This experiment was a conceptual replication of Experiment 1 in Lewis and Lovatt (2013). The 2 × 2 mixed design included a between-groups factor of interaction condition (*improv* or *control*) and a within-groups factor of time (pre- and post-treatment). Participants were randomly assigned to conditions and completed surveys before and after participating in a set of social interaction tasks. Replicating the Lewis and Lovatt (2013) paradigm required implementing the improvisation and social interaction control tasks following the published study (Lewis & Lovatt, 2013). Accordingly, we conducted short group experiences with either improvisa-tional theater exercises or similarly structured social interactions (the control). Because the information about the training tasks and how to present them in the prior study was limited (Lewis & Lovatt, 2013), we 1) modified exercises when necessary based on improvisational theater warm-up exercises (Spolin, 1983) and 2) fixed time dedicated to each task at two minutes, so that all seven tasks as well as added time for instructions and switching partners could be completed within 20 min. In the *improv* condition, participants engaged in exercises based on improvisational theater training as described in Lewis and Lovatt (2013). In the *control* condition, participants engaged in social interactions similar to the improvisational exercises but without the “co-creative” feature of improvisational theater (See Table 1 for more detail).

*2.1.3. Facilitation*

In the procedure from Lewis and Lovatt (2013), an experimenter (with undefined prior improv experience) facilitated both the *improv* and *control* conditions from a scripted protocol. In the current study, an advanced undergraduate student (with no priorimprov facilitation experience) facilitated all sessions using a scripted protocol.

*2.1.4. Improv condition*

The *improv* condition included standard improvisation exercises designed to elicit moment-to-moment “co-creation.” The tasks started at a simple level, with participants reciting numbers or the alphabet in sequence (exercises 1 and 2) without a predictable

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order of turn-taking. Next, the experimenter explicitly described the “Yes, and” heuristic, saying, “A helpful strategy is to accept each other’s contributions and build on them.” Then, the group told a story by taking turns contributing one word at a time (3). Then, working with partners, one person mimed (silently enacted) a physical activity and their partner joined in, then switched roles (4); then, with a new partner, they described an imaginary person they “have in common” (5); next they took turns “mirroring” one another’s movements (6); finally, the experimenter offered another version of the “Yes, and” heuristic: “Try to use the information added by others. When someone introduces information, accept it as reality.” Then, the group as a whole discussed an imaginary movie they had “just seen together” (7). The task sequence was designed to increase in complexity, from joint recitation to co-creating physical movements and characters to synchronizing movements to discussing a shared (imaginary) experience (see Table 1 for more detail).

*2.1.5. Control condition*

The social interaction *control* condition included a matching set of tasks that were similar in structure to the *improv* exercises and also increased in complexity across the series. Participants first worked in groups to recite numbers and letters taking turns in a predictable order while standing in a circle (tasks 1 and 2); next, taking turns one word at a time around the circle, they recited lyrics to a standard song (3). then, working with partners, they named and then demonstrated physical activities for their partner (4); then, they each described someone they knew to one another (5); then, facing each other, participants maintained a non-spontaneous position and engaged in a staring contest (6). Finally, taking turns around the circle, they reported a movie they had seen to the group (7; see Table 1 for more detail).

*2.1.6. Measures*

Pre and post-treatment measures included standardized scale measures of affective well-being (e.g., Kross et al., 2013), un-certainty tolerance (Dalbert, 1996), and divergent thinking (scored as fluency, flexibility, elaboration, originality; Guilford, 1967).

*2.1.7. Affect*

Lewis and Lovatt (2013) found no differences on the Profile of Mood States (POMS) scale (McNair & Heuchert, 2003) between *improv* and *control* conditions. To maintain the survey’s brevity, we replaced the POMS with a widely-used single item measure ofaffective well-being (e.g., Felsman, Verduyn, Ayduk, & Kross, 2017; Kross et al., 2013): “How do you feel right now?” with a scale from 0 (“very negative”) to 100 (“very positive”).

*2.1.8. Uncertainty tolerance*

To assess changes in tolerance of uncertainty, we used the Uncertainty Tolerance Scale (UTS), (Dalbert, 1996), which has been shown to have good reliability (Dette & Dalbert, 2005; Otto & Dalbert, 2010; Otto, Dette-Hagenmeyer, & Dalbert, 2004) and pre-dictive validity (Otto & Dalbert, 2012). Lower scores on the UTS indicate that people tend to worry more, and view uncertain situations as more threatening (Otto & Dalbert, 2010). Higher scores predict higher psychic well-being, finding positive meaning in challenge, participation in new learning contexts and enduring longer in an uncertain situation (Dalbert, 1999). Although the test has not been previously used as a within-subjects measure of change, its frequent use of the verb “to like” is consistent with attitudinal measures known to be sensitive to change (Bohner & Dickel, 2011). The scale included 8 items, such as “I like change and excite-ment,” “I like to try things out, even if nothing comes out of it,” and, “I like to engage in tasks for which there is a solution (reverse-scored).” Participants rated each item on a six-point scale, from 6 (*strongly agree*) to 1 (*strongly disagree*). In the current study, our pre-treatment UTS reliability (Cronbach α = .629) and post-treatment reliability (Cronbach α = .743) was comparable to UTS reliability reported in prior literature using this scale (Cronbach α = .710; Bardi, Guerra, Sharadeh, & Ramdeny, 2009).

*2.1.9. Divergent thinking*

To measure changes in divergent thinking, we used the Alternative Uses Task (AUT) (Guilford, 1967), a widely-used measure (Kaufman, Plucker, & Baer, 2008). As in Lewis and Lovatt (2013), we administered an AUT before and after treatment, asking each participant to come up with as many different uses as they can for “a remote control” and “a paperclip.” The ordering of the two objects was randomized and counterbalanced across participants so that mean changes could be attributed to treatment and not differences in task materials. As in Lewis and Lovatt (2013), the instructions were as follows:

“You will be given the name of a common object. I would like you to list as many different uses for it as you can. This can be anything other than what the object was originally intended for. You will have three minutes to complete this task and write down as many alternative uses as you can. Are there any questions?”

*2.1.10. Scoring the AUT*

Three independent raters scored the AUT for fluency, flexibility, and elaboration following the instructions in Lewis and Lovatt [(2013)](#page14). Lewis and Lovatt (2013) used expert coders (researchers with publications on creativity), but this was not feasible. Following recommendations on novice rater reliability (Baer, Kaufman, & Riggs, 2009), we recruited 3 upper level psychology students enrolled in a course on creativity as coders. Raters were trained by viewing and discussing a practice data set. Then, the raters worked independently to code the current study’s full dataset while blind to both treatment and pre/post condition. Two-way random ICCs were calculated for each subscale to indicate inter-rater agreement on fluency, flexibility, and elaboration subscales. For the paperclip AUT, raters showed good reliability on fluency, ICC = .996, 95 % CI [994, .997], flexibility, ICC = .986, 95 % CI [.979, .991], and

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elaboration, ICC = .822, 95 % CI [.738, .882] judgments, based on criteria set in Cicchetti (1994). For remote control, AUT raters were similarly reliable on fluency, ICC = .975, 95 % CI [.962, .983], flexibility, ICC = .959, 95 % CI [.940, .973], and elaboration, ICC = .830, 95 % CI [.750, .888]. Following Lewis and Lovatt (2013), the originality subscale was coded by evaluating the entire dataset of responses while blind to condition. A single coder created a lexicon of all responses, and each response produced by 5 % or fewer participants received a point. A second coder independently assessed 10 % of the data, and a comparison showed high re-liability (Landis & Koch, 1977), Kappa = 0.938 (*p* < 0.001), 95 % CI (0.869, 1.000) for paperclip; Kappa = 0.866 (p < 0.001), 95 % CI (0.768, 0.964) for remote control. Where discrepancies occurred between coders, judgements were discussed to consensus.

*2.1.11. Procedure*

Participants arrived for the study and were placed in small groups of five to eight participants; each group was assigned at random to an interaction condition. The testing room included chairs arranged in a circle around the room, with open space in the middle for group and partner exercises. The experimenter sat at a separate desk in the front of the room and provided instructions for each activity.

Participants were told that the study “looks at how our social interactions relate to our attitudes and task performance,” and that they would complete several surveys about their emotions, behaviors, and experiences. They were also informed that they would engage in brief social tasks with the other participants in the study. The participants then completed the pre-treatment questionnaire.

Next, the experimenter guided the group through the set of activities in one of the two treatment conditions (assigned at random). The procedure followed the descriptions in Lewis and Lovatt (2013) for both the improvisation and control conditions as closely as possible. The first three and the final tasks were performed as a full group. The fourth through sixth were done in different subgroups of two (or three if a group had an odd number of participants). Groups in both conditions completed seven exercises within a total of twenty minutes.

Following the social interactions in both conditions, participants again individually completed the same measures of affect, uncertainty tolerance, and divergent thinking, followed by a few exploratory items and demographic information. The post-treatment survey included items to assess the training experience, feelings toward the study, enjoyment of the social interactions, willingness to repeat the study, and interest in improvisation classes. Because the participants were enrolled in an introductory psychology course, we also asked whether they had previous experience with the AUT.

*2.2. Results*

To test whether condition influenced any of our outcomes, as in Lewis and Lovatt (2013), one-way ANCOVAs were conducted with condition as a between-groups independent variable. Pre-treatment scores were entered as co-variates, and post-treatment scores as the dependent variable. See Table 2 for means and standard deviations of repeated measures.

*2.2.1. Affect*

Overall, participants’ affect increased from pre-treatment (*M* = 67.16, *SD* = 20.83) to post-treatment (*M* = 75.58, *SD* = 19.14), *t*

1. = 6.04, *p* < 0.001, 95 % *CI* (5.64, 11.20). However, this increase in affect did not differ by condition, *F* (1,71) = 1.63, *p* = .206, partial η2 = .022 (see Fig. 1).

*2.2.2. Uncertainty tolerance scale*

Overall, participants’ uncertainty tolerance increased from pre-treatment (*M* = 3.10, *SD* = 0.565) to post-treatment (*M* = 3.25, *SD* = 0.633), *t* (73) = 4.08, *p* < 0.001, 95 % *CI* (0.077, 0.225). However, this increase also did not differ by condition, *F* (1,71) = .479, *p* = .491, partial η2 = .007 (see Fig. 2).

*2.2.3. Divergent thinking*

The measures of performance on the AUT suggest levels of divergent thinking similar to those observed in Lewis and Lovatt [(2013)](#page14). Participating in *improv* (versus *control*) predicted a marginal increase in fluency scores, and a significant increase in ori-ginality scores (see Fig. 3 for means and standard errors and Table 3 for ANCOVA results and effect sizes). There were no significant differences between conditions on flexibility or elaboration subscales.

*2.2.4. Post-experiment exploratory items*

There were no significant differences between conditions in enjoyment of the experiment, willingness to repeat the study, fa-miliarity with the AUT, prior experience with improvisation, or interest in taking an improv class.

*2.3. Discussion*

As in Lewis and Lovatt (2013), we found no differences in reported affective well-being between *improv* and *control* participants. Although participating in the study was associated with feeling better, this improvement did not depend on condition. Also, as in Lewis and Lovatt (2013), divergent thinking differed between conditions. Improvising resulted in relative gains in fluency (mar-ginally significant) and originality compared to engaging in the social interaction control. While we found similar gains in flexibility as in Lewis and Lovatt (2013), this pattern was not significant. It is notable that originality was boosted by improv compared to control treatment because it is considered the most important of the AUT subscales for creative thinking (Runco & Jaeger, 2012).

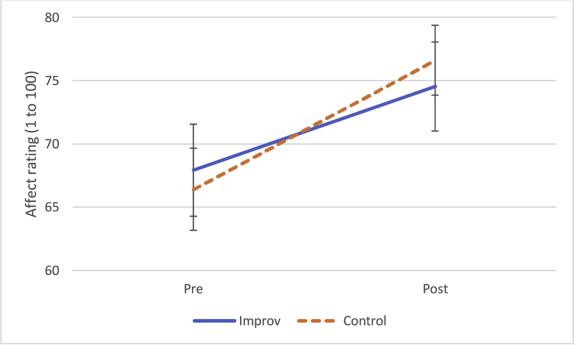
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**Table 2**

Experiment 1 mean (S.D.) pre- and post-treatment repeated measures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Repeated Measures | Improv (*n* = 37) |  |  | Control (*n* = 37) |  |  |
|  |  |  |  |  |  |  |
|  | Pre | Post |  | Pre | Post | |
|  |  |  |  | |  |  |
| Affect | 67.92 (22.17) | 74.54 (21.42) | 66.41 (19.68) | | 76.62 (16.79) |  |
| Uncertainty Tolerance | 3.04 (.488) | 3.22 (.532) | 3.16 (.635) | | 3.29 (.727) |  |
| Fluency | 6.76 (3.18) | 7.23 (2.67) | 5.73 (2.92) | | 5.76 (2.81) |  |
| Flexibility | 6.36 (2.96) | 6.50 (2.40) | 5.26 (2.48) | | 5.37 (2.65) |  |
| Elaboration | 2.99 (2.10) | 3.18 (2.35) | 2.76 (1.56) | | 2.77 (2.48) |  |
| Originality | 2.32 (1.78) | 3.03 (1.91) | 2.14 (2.24) | | 1.81 (1.68) |  |
|  |  |  |  |  |  |  |



**Fig. 1.** Experiment 1 mean affect ratings and standard errors at pre- and post-treatment.

Also, originality is the only subscale found to consistently differ between conditions across the two experimental improv studies using this paradigm. Lewis and Lovatt (2013) showed improv increasing fluency, flexibility, and originality (but not elaboration), and Sowden et al. (2015) found improv increased elaboration and originality (though on a figural divergent thinking task). The differ-ences between Lewis and Lovatt’s (2013) AUT results and those reported in our Experiment 1 may reflect differences between coders; while Lewis and Lovatt (2013) had expert coders who had published research in the field of creativity, our coders were upper-level psychology students.

Finally, contrary to our hypotheses, we found that both treatments – improv experience and social interaction control – were associated with increases in uncertainty tolerance. This result was surprising because, as in Lewis and Lovatt (2013), the social control tasks were designed to be more familiar than the improv tasks, and thus involve less moment-to-moment unpredictability.

**3. Experiment 2**

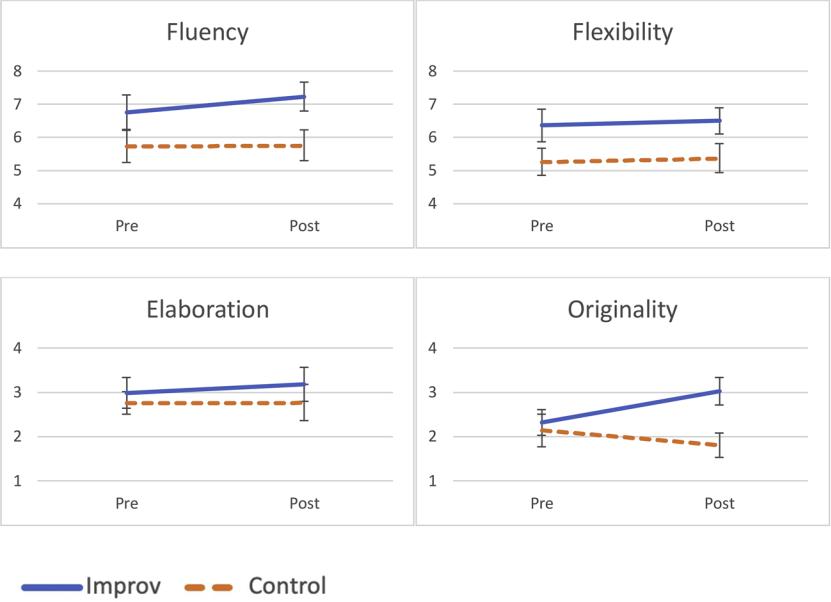
We expected uncertainty tolerance would differ between our *improv* and *control* conditions in Experiment 1 because the *improv* tasks required students to generate ideas for what to say and do in the tasks on the spot. Typical social interactions (as in the control group) may include idea generation, but they are less like improv when following scripts, conventions and norms (e.g., ordering in a restaurant; Bower et al., 1979; Sawyer & Sawyer, 2003; Schank & Abelson, 1997). Even though the *control* tasks were designed to more closely resemble everyday interactions (e.g., telling someone about a friend or a movie you’ve seen), participants still needed to generate ideas the later, more complex *control* tasks. While tasks 1–3 provided the content (a “script” to be enacted), we recognized



**Fig. 2.** Experiment 1 mean UTS ratings and standard errors at pre- and post-treatment.

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**Fig. 3.** Experiment 1 AUT subscale means and standard errors at pre- and post-treatment.

**Table 3**

Experiment 1 summary ANCOVA table for AUT subscales.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| AUT Subscore | Co-variate: pre-score | | ANCOVA (partial η2) | |
| Fluency | *F*(1, 71) | = 68.23\*\*\* | *F*(1, 71) | = 3.19\* (0.043) |
| Flexibility | *F*(1, 71) | = 68.14[\*\*\*](#page8) | *F*(1, 71) | = .961 (0.013) |
| Elaboration | *F*(1, 71) | = 29.31[\*\*\*](#page8) | *F*(1, 71) | = .273 (0.004) |
| Originality | *F*(1, 71) | = 2.87[\*](#page8) | *F*(1, 71) | = 8.20[\*\*](#page8) (0.104) |

* Marginally significant (p = .079, .094).
* p = .005.
* p < 0.001.

that creative input was required from the *improv* participants in tasks 4–7; specifically, deciding who and how to describe, which physical actions to demonstrate, what to do to win a staring contest, and which movie to talk about and how to describe it. While these *control* tasks were not co-creative with a partner (as in the *improv* condition), they required generating impromptu speech in a form of solitary improvisation ([Cohen, 2015](#page13)).

To better clarify the difference between our improvisation and control conditions in a second experiment, we identified a defining property of improv: Performance *without preparation or planning* (Halpern et al., 1994). We then revised the instructional scripts for the latter four control tasks, ensuring that participant contributions in the *control* interactions would be “prepared.” Specifically, we created a list of gestures to perform, a character description to read aloud, specific times to depict using one’s own arms as the hands of a clockface, and a movie description to read. These changes provided prepared content for the social interaction control groups to minimize their need to create new ideas during the tasks. However, the control tasks remained equivalent from Experiment 1 to Experiment 2 in the amount of social interaction occurring, the general content knowledge engaged, and the general purpose and length of each task, all of which, in both Experiments, were designed to match the improv tasks.

*3.1. Method*

*3.1.1. Participants*

One hundred thirty-one undergraduate students from a midwestern university (*M*age = 18.92 years, *SD* = 1.10 years; 65 male, 66 female; 64.9 % White, 19.1 % Asian/Asian-American, 6.1 % Black/African-American, 9.9 % other (including Latino, Hispanic, and multiracial) participated for course credit. This experiment received an exempt determination from the Institutional Review Board. All participants completed written consent forms before beginning the study.

*3.1.2. Design overview*

The design (as in Experiment 1) was a 2 × 2 mixed design with condition (*improv* or *control*) between groups and time (pre- and post-treatment) within-groups. The only difference in Experiment 2 was the adjustment of four *control* group exercises to reduce the

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individuals’ need to generate creative input during social interactions.

*3.1.3. Facilitation*

Two experimenters in the current study facilitated both conditions from a scripted protocol as in Experiment 1. Both were advanced undergraduate students with no prior improv facilitation experience.

*3.1.4. Improv condition*

Participants in the *improv* groups engaged in the same improvisation tasks as in Experiment 1.

*3.1.5. Control condition*

As in Experiment 1, participants in the *control* groups engaged in exercises designed to be similar to the *improv* groups’ exercises, but without encouraging moment-to-moment co-creative behavior. For four of the *control* tasks, we provided scripted materials to support interactions, limiting the need for individual creative ideas. Table 4 describes how these four exercises changed in more detail. For task 4, rather than choosing a physical action to demonstrate, participants followed a list of prepared gestures; for task 5, rather than describing someone they know, participants read aloud a written description of a film actor; for task 6, rather than a staring contest, participants demonstrated times of the day (announced by the experimenter) as if their arms were the hands of a clock; and in task 7, rather than describing a movie they have seen, participants read aloud a written movie description. These four changes made the social interaction control group tasks require less creative input from participants.

*3.1.6. Measures*

As in Experiment 1, pre and post-treatment measures included affect, uncertainty tolerance (measured by the UTS), and divergent thinking (measured by the AUT). As in Experiment 1, our pre-treatment UTS reliability (Cronbach α = .652) and post-treatment reliability (Cronbach α = .733) was comparable to UTS reliability reported in prior literature using this scale (Cronbach α = .710; Bardi et al., 2009).

*3.1.7. Scoring the AUT*

The same raters for the Experiment 1 AUT subscales scored the Experiment 2 AUT subscales following the same directions. The raters worked independently to code the current full dataset while blind to both treatment and pre/post conditions. For the paperclip AUT, two-way random ICCs calculated for each subscale indicated good agreement for fluency (ICC = .997, 95 % CI [.996, .998]), flexibility (ICC = .987, 95 % CI [.983, .991]), and elaboration (ICC = .782, 95 % CI [.708, .840]), based on criteria set in [Cicchetti](#page13) [(1994)](#page13). For the remote control AUT, raters were again reliable on fluency (ICC = .955, 95 % CI [.940, .967]), flexibility (ICC = .948, 95 % CI [.931, .962]), and elaboration (ICC = .782, 95 % CI [.709, .840]). Following Lewis and Lovatt (2013), originality scores were coded by evaluating the entire dataset of responses while blind to condition. A single coder created a lexicon of all responses, and each response produced by 5 % or fewer participants received a point. A second coder independently assessed 10 % of the data, and a comparison showed high reliability (Landis & Koch, 1977), Kappa = 0.766 (*p* < 0.001), 95 % CI (0.680, .852) for paperclip; Kappa = 0.889 (p < 0.001), 95 % CI (0.820, 0.958) for remote control. Where discrepancies occurred, cases were discussed to consensus.

*3.1.8. Procedure*

The procedure (aside from the different *control* tasks) was the same as in Experiment 1.

**Table 4**

Changes to control tasks from Experiment 1 to Experiment 2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Group/ | Task | Experiment 1 Control | Experiment 2 Control |  |
|  | Partner |  |  |  |  |
|  |  |  |  |  |  |
| 4 | Partner | Imitating physical action | One person will name a physical activity and then | As the experimenter calls them out, take turns |  |
|  |  |  | demonstrate it. Without speaking, when the | demonstrating the physical gesture from the list of |  |
|  |  |  | experimenter says, their partner will join in with the | 30 gestures. |  |
|  |  |  | same physical activity. When the experimenter says, |  |  |
| 5 | Partner | Describing someone | reverse roles. | Taking turns, one paragraph at a time, read aloud |  |
| Taking turns, describe someone you know. |  |
| 6 | Partner | Partner-facing non- | Engage in a staring contest with your partner, | the description of an actor you were given. |  |
| As the experimenter says, take turns demonstrating |  |
|  |  | spontaneous movement | without speaking. When the game ends, repeat. | a time of day to your partner, as if your arms are the |  |
| 7 | Group | Discussing an experience | Describe a movie you have seen. Take turns by | hands of a clock, so your partner can read the time. |  |
| Taking turns, one movie at a time, read aloud the |  |
|  |  |  | going clockwise in a circle. | descriptions of movies you were given. |  |
|  |  |  |  |  |  |

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*3.2. Results*

As in Experiment 1, a 2 × 2 mixed design ANCOVA was conducted on the repeated measures: affect, uncertainty tolerance, and divergent thinking. Table 5 provides means and standard deviations for the repeated measures.

*3.2.1. Affect*

Overall ratings of affective well-being were similar to those in Experiment 1; that is, averaging 71.37 in Experiment 1 and 72.92 in experiment 2 on a 100-point scale. However, in Experiment 2, self-reported affect increased for participants in the *improv* relative to the *control* condition, *F*(1,127) = 22.22, *p* < 0.001, partial η2 = 0.149 (see Fig. 4).

*3.2.2. Uncertainty tolerance scale*

Unlike in Experiment 1, uncertainty tolerance scores increased for participants in the *improv* relative to the *control* condition, *F*1,128 = 5.33, *p* = 0.023, partialη2= .040 (seeFig. 5).

*3.2.3. Divergent thinking*

Following Lewis and Lovatt (2013), one-way ANCOVAs were conducted on each AUT subscale with treatment condition as the between-groups factor (improvisation and control). When AUT pre-test scores were covaried out, participating in the *improv* (versus *control*) condition resulted in (marginally significant) increases in fluency, flexibility, and elaboration scores, but no increase inoriginality scores (see Fig. 6 for means and standard deviations and Table 6 for ANCOVA results and effect sizes).

*3.3. Discussion*

The results of Experiment 2 suggest that improvisation (vs. a social interaction control) improves affective well-being and un-certainty tolerance. While the improv tasks required participants to collaboratively create original ideas (e.g., describe a character), participants in Experiment 2’s interaction control engaged in matched tasks supported by written directions about when and what to contribute (e.g., they read a description of a character, alternating paragraphs).

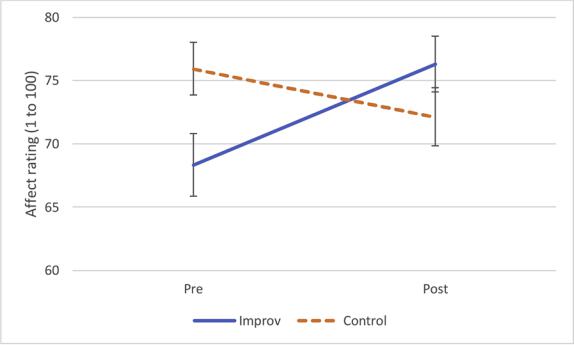
This provides the first evidence that improv causes increases in uncertainty tolerance and positive affect relative to a social interaction control. These effects can be attributed to distinguishing features of improv because the non-specific features of improv (e.g., content, social interaction, length) were designed to be highly similar across conditions.

Prior studies have shown that the autonomy experienced in creative tasks boosts affective well-being (Bujacz et al., 2016). The improv training likely led to a relative gain in positive affect because the autonomy of participants in the control condition was

**Table 5**

Experiment 2 mean (S.D.) pre- and post-treatment repeated measures.

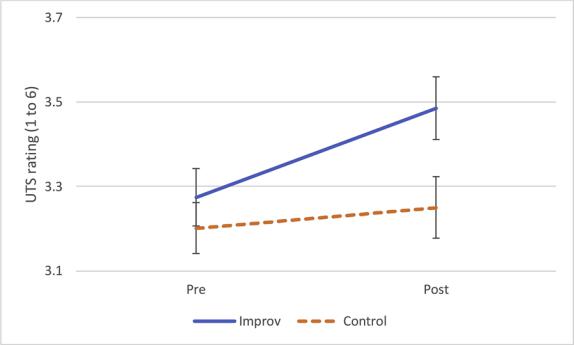
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Repeated Measures | Improv (*n* = 67) |  |  | Control (*n* = 64) |  |  |
|  |  |  |  |  |  |  |
|  | Pre | Post |  | Pre | Post | |
|  |  |  |  | |  |  |
| Affect | 68.33 (20.25) | 76.31 (17.94) | 75.94 (16.55) | | 72.14 (18.14) |  |
| Uncertainty Tolerance | 3.27 (.554) | 3.49 (.608) | 3.20 (.480) | | 3.25 (.585) |  |
| Fluency | 6.47 (2.76) | 7.13 (3.12) | 5.92 (2.96) | | 5.99 (3.09) |  |
| Flexibility | 6.21 (2.55) | 6.81 (2.83) | 5.59 (2.60) | | 5.69 (2.83) |  |
| Elaboration | 2.33 (2.00) | 2.54 (1.79) | 2.54 (2.00) | | 2.07 (1.94) |  |
| Originality | 2.12 (1.54) | 2.30 (2.22) | 1.55 (1.55) | | 1.89 (1.77) |  |
|  |  |  |  |  |  |  |



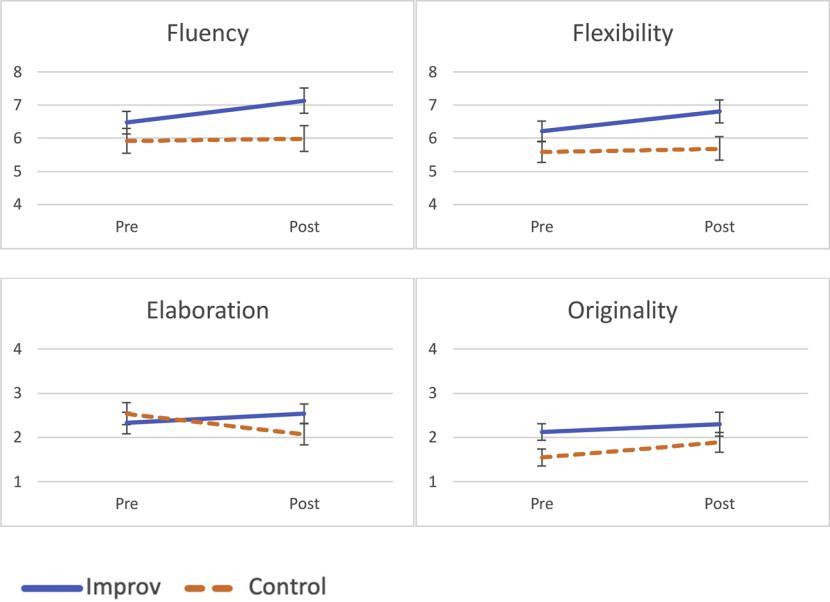
**Fig. 4.** Experiment 2 mean affect ratings and standard errors at pre- and post-treatment.

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**Fig. 5.** Experiment 2 mean UTS ratings and standard errors at pre and post-treatment.



**Fig. 6.** Experiment 2 AUT subscale means and standard errors at pre- and post-treatment.

**Table 6**

Experiment 2 summary ANCOVA table for AUT subscales.

|  |  |  |  |
| --- | --- | --- | --- |
| AUT Subscore | Co-variate: pre-score | ANCOVA (partial η2) | |
| Fluency | *F*(1, 128) = 33.38\*\*\* | *F*(1, 128) | = 3.17\* (0.024) |
| Flexibility | *F*(1, 128) = 28.56[\*\*\*](#page11) | *F*(1, 128) | = 3.28[\*](#page11) (0.025) |
| Elaboration | *F*(1, 128) = 31.54[\*\*\*](#page11) | *F*(1, 128) | = 3.62[\*](#page11) (0.027) |
| Originality | *F*(1, 128) = 14.83[\*\*\*](#page11) | *F*(1, 128) | = .244 (0.002) |

* Marginally significant (p = 0.077, 0.072, 0.059).
* p < 0.001.

relatively restricted. This difference is important because prior research (which did not use a scripted control) did not find that improv promoted affect relative to a control ([Lewis & Lovatt, 2013](#page14)).

Interestingly, although improv training resulted in nominally increased divergent thinking relative to a control, these differences were only marginally significant. One explanation is that even the highly structured social interaction control tasks (e.g., reading about a specific character or movie description aloud one paragraph at a time) forced participants to engage in novel interactions. Thus, improv’s divergent thinking benefits may have been partly cancelled out by our social interaction task inadvertently engaging participants in novel situations.

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**4. General discussion**

Across two experiments, we found evidence that improvisational theater training (relative to a matched social interaction control) causes increases in divergent thinking, uncertainty tolerance, and affective well-being. Previous research has suggested ways to promote divergent thinking, often involving unhealthy behaviors (e.g. Jarosz, Gregory, & Wiley, 2012). Our replication of the impact of improvisation on divergent thinking measures (Lewis & Lovatt, 2013; Sowden et al., 2015) suggests improv as a healthy and effective alternative. In addition, improvisation may be a more cost-effective compared to more expensive methods of promoting divergent thinking, such as traveling abroad (Lee, Therriault, & Linderholm, 2012) and classes targeted at improving divergent thinking processes ([CPS Institute, 2019](#page13); [Scott, Leritz, & Mumford, 2004](#page14))

Prior work suggests that psychotherapies drawing on traditional psychotherapeutic methods can promote uncertainty tolerance (Carleton, 2012), which is implicated in broad issues of mental health (e.g., Carleton et al., 2012; McEvoy & Mahoney, 2012). Our finding that a brief (20 min) session of improvisation training causes increases in uncertainty tolerance is important because it is potentially more accessible than traditional therapies, for which there are many barriers (Harvey & Gumport, 2015). It also suggests a mechanism for how improvisational theater overlaps with psychotherapy in producing positive changes (Bermant, 2013; Krueger et al., 2017), and why practitioners suggest that improvisation is, not just good for performance, it’s good for life (e.g., [Madson, 2005](#page14)).

The two experiments found different effects based on the nature of the social interactions provided in the control treatment. This tracks the heterogeneity in social interactions more generally. More specifically, in Experiment 1, improvisation was compared to a social interaction control that involved more creative thinking, providing creative control (as in Lewis & Lovatt, 2013) over which friend they chose to talk about, which movie to discuss, and which physical actions to demonstrate; in Experiment 2, the social interaction control was limited to scripted tasks so that each individual’s contributions were less creative, as in many forms of social interaction (e.g., buying a coffee, or greeting an acquaintance) and *only* improvisation tasks allowed participants to create or “write” the scripts for their interactions.

These unique comparisons relate to distinct psychological benefits. Improv as a co-creative process seems to be important in explaining its benefit for divergent thinking (as in Experiment 1). Improvisational co-creativity shakes up familiar schemas and scripts and encourages their flexible deployment to create novel combinations and get people thinking more uniquely (e.g., Lewis & Lovatt, 2013). The fact that improv is unscripted (vs. predetermined by a script) seems to be important in explaining its benefit for increasing uncertainty tolerance and feeling good (as in Experiment 2). Although most human interactions don’t involve literal scripts, their use does help offset the novelty of a lab study by providing some predictable or highly structured grounding for the tasks. Thus, these findings highlight two key qualities of improvisational theater: pleasant, intentional encounters with unpredict-ability (likely causing increases in uncertainty tolerance and affect in Experiment 2), and co-creative experiences with novelty (likely causing increases in divergent thinking in Experiment 1).

*4.1. Limitations and future directions*

Scoring the results of creative thinking tasks often relies on non-expert raters (Amabile, 1982), as in the present studies. Baer et al. suggest that non-experts are adequate for simple creative tasks like generating sentences ([2009](#page13)) and the AUT is judged by non-experts in other work (e.g., Lucas & Nordgren, 2015). However, judgements of experts and non-experts sometimes diverge (Kaufman & Baer, [2012](#page14)), and Lewis and Lovatt’s (2013) studies employed expert researchers highly familiar with the AUT task. As a result, the larger effects of improv on later AUT performance in their work may be due to superior rater reliability or inferences about the task. While not as strong an effect, the present studies support the conclusion that divergent thinking is enhanced by improvisation training.

While we took care to follow Lewis and Lovatt’s (2013) methodology as closely as possible, their report did not specify the length of each of the seven training tasks. It is possible our procedure (2 min for each of the 7 tasks and time for instructions for a total of twenty minutes overall) may have differed from the length of training in their study. Further, implementing their tasks in both training conditions involved some implementational assumptions. While the design of our experiment does not allow us to observe which tasks might be more or less important for driving the observed effects, a future study may investigate the impact of each training task more systematically. Indeed, future research could examine these implementational decisions more systematically to answer questions about how, for example, length of training, level of facilitator experience, playfulness of exercises, and engagement in theatrical aesthetic might influence outcomes. Along these lines, the current experiments are also limited by the replication of the brief intervention pre-post design from the study by Lewis and Lovatt (2013). It will also be important for future research to examine the impact of improv interventions over a longer period of time.

Some post-experiment exploratory measures from Experiment 1 were not included in Experiment 2; instead, we chose to focus on our main pre-post outcome measures. In Experiment 2, it is possible that participants in the improv condition – reporting increased affective well-being and uncertainty tolerance – may have had more interest in taking an improv class than those in the control condition, but such interest was not measured. Future experiments might include interest in further improv experiences as an outcome variable.

An additional limitation is that the Uncertainty Tolerance Scale (Dalbert, 1996) was developed as a trait measure and not to our knowledge previously used to measure change in brief interventions such as our experiments. Since the effect sizes reported here are small, future work should 1) test whether the potency of improvisation for promoting uncertainty tolerance increases with duration (or “dose”), and 2) whether improvisation leads to longer term, lasting improvements in trait uncertainty tolerance.

While these two experimental studies provide the highest level of evidence on the factors influencing outcomes of improvisational theater training to date, certain confounds should be considered. For example, differences between conditions in uncertainty tol-erance and affective well-being occurred only in Experiment 2; in that experiment, explanations for each change –pleasant

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unpredictability (believed to promote uncertainty tolerance) and creative activity (shown to boost affect via experienced autonomy; Bujacz et al., 2016), are not tested separately. Future work is needed to test each of these explanations independently. Another example is that differences between conditions in originality were only significant in Experiment 1; in that experiment, participants in the improvisation condition co-created fictional characters and circumstances, whereas participants in the control condition con-tributed ideas based on their individual realities (e.g., talked about a familiar person or film). Hence, co-creative or imaginative thinking (which engages fictional status) could explain the effect of improvisation on originality and future controls may separate these explanations.

**5. Conclusions**

Training in improvisational theater is widely available, and seen as a popular and entertaining activity. It is also believed to produce a variety of psychological benefits. It is associated with reductions in anxiety and depression in adult psychiatric patients (Krueger et al., 2017), as well as reductions in social anxiety among adolescent public-school students from a non-clinical sample (Felsman et al., 2019). However, research on its benefits has generally lacked the rigor of randomized experiments. This paper highlights two important features of improvisation as an intervention: 1) it engages co-creativity and idea discovery by working with others, and 2) it is unpredictable because the “script” is generated in the moment. While other social interactions may offer similar benefits, improvisation is shown in these experiments to produce benefits beyond every day, routinized social interactions.

This paper replicates a prior finding that improvisational theater training can improve divergent thinking (e.g., Lewis & Lovatt, [2013](#page14)), and provides new findings that it can boost positive affect and increase uncertainty tolerance relative to other social inter-actions. As a means to enhance psychological health, improvisational theater training can offer benefits without the negative stigmas and difficulties in access surrounding other therapeutic interventions. These results support its popular use beyond the theater to improve social and personal performance in a variety of settings (e.g., Tint & Froerer, 2014).

**CRediT authorship contribution statement**

**Peter Felsman:** Writing - review & editing, Methodology, Formal analysis. **Sanuri Gunawardena:** Writing - original draft,

Investigation. **Colleen M. Seifert:** Writing - review & editing, Methodology, Supervision.

**Declaration of Competing Interest**

None.

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