

Beyond the Bare Stage: Exploring Props as Potential Improviser-Controlled Technology

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ABSTRACT

While improvised theatre (improv) is often performed on a bare stage, improvisers sometimes incorporate physical props to inspire new directions for a scene and to enrich their performance. A tech booth can improvise light and sound technical elements, but coordinating with improvisers' actions on-stage is challenging. Our goal is to inform the design of an augmented prop that lets improvisers tangibly control light and sound technical elements while performing. We interviewed five professional improvisers about their use of physical props in improv, and their expectations of a possible augmented prop that controls technical theatre elements. We propose a set of guidelines for the design of an augmented prop that fits with the existing world of unpredictable improvised performance.

Author Keywords

Improvisational Theatre; Performer-Controlled Technology; Props

CCS Concepts

•Human-centered computing → User centered design;

INTRODUCTION

Improvised theatre (improv) is when actors create cohesive, interesting storylines and scenes without a script. Within improv, there is a wide variety of formats, from short-form games to long-form, complex storylines woven throughout multiple scenes or shows [6]. Actors often perform improv on a bare stage with only basic lighting to highlight their faces for the audience. Some improv troupes such as Loose Moose¹, Rapid Fire Theatre², and the Upright Citizens Brigade³ incorporate improvised technical theatre elements (light, sound) controlled by a technician in a tech booth. The physical distance of the tech booth from the stage limits improvisation as there is a delayed reaction between an improviser's actions

¹<https://www.loosemoose.com/>

²<https://rapidfiretheatre.com/>

³<https://ucbtheatre.com/>

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Figure 1: Participants could select among (a) fourteen different objects as potential props. (b) Harvey and Henry hold a lantern upside-down while exploring its properties.

and a technical element being cued. Actors must slow down or over-exaggerate actions, like miming turning up a car radio, to convey their intended reaction from the tech booth.

Performers can control some technical elements. In improv formats such as improvised musicals [14], performers directly control their own diegetic (exists within the scene) and non-diegetic (exists for the audience but not the characters in the scene) sound by playing instruments. However, not all actors are able to improvise with a musical instrument, limiting the added layer of playfulness to those performers who are also musicians. Past performer-controlled technologies [4, 11, 17] have resulted in new formats of improv designed to serve the system's technical capabilities [1]. Our goal is to design technology that fits the existing world of improv, but where light and sound technical elements are controlled through actors' tangible interactions with on-stage props.

We conducted an exploratory qualitative study (see Figure 1) to understand existing improv practice and inform the design of an augmented prop. We interviewed five professional improvisers split into three groups, offering them a series of fourteen props to use throughout the interview. These props helped improvisers describe their existing use of props, reflect on characteristics of useful on-stage props, and speculate on the expected capabilities of an augmented prop in improv. Based on our findings, we propose a set of guidelines for the

design of an augmented prop that controls technical elements in improvised theatre.

Our research offers the following contributions: (a) examples of existing uses of props and of technical elements in improvised theatre, (b) a discussion of suggested capabilities of performer-controlled technology, and (c) design guidelines for the creation of an augmented prop.

RELATED WORK

In our related work, we primarily focus on tangibles as they relate to theatrical performance. While past work has looked at physical 'props' as controllers in the context of gaming [19, 20], we focus on the specific role of props in live theatre. First, we discuss past work on improvising with props, and improvising with technical theatre elements (light, sound). Then, we discuss past human-computer interaction research systems that offer performer-controlled technology.

Improvising with Props

Props are "*a discrete, material, inanimate object that is visibly manipulated by an actor in the course of performance*" [16]. In a theatrical scene, props must be 'triggered' by an actor in order to become a prop [16]. Therefore, unless an object is touched by an actor, the object remains set dressing on-stage or a costume piece on the actor. For example, a handkerchief on a table is set dressing and a handkerchief in a suit jacket pocket is costume, but once the handkerchief is interacted with or held by a performer it is a prop.

Props is also an improv game⁴ where players are tasked with repurposing a given prop in as many ways as possible. Improvisers are encouraged to think outside the box and explore different interpretations of the same object.

In a performance, props can constrain the possible space of actions, which can inspire innovative ideas [5]. When actors integrate a prop into a scene, it reflects both a creative constraint as well as inspiration or opportunity. While some amount of choice is necessary, having too much can be counterproductive. A narrowed focus in a creative space can push people to explore the problem in original ways [7]. Thus, the introduction of a prop can force the performer to think of new and creative ways to incorporate the object in a scene.

We go beyond the *Props* game and uncover how improvisers use props in a range of situations. Our goal is to identify object qualities that constrain or inspire, and show how those qualities affect how actors choose to use that prop within a scene. In our augmented prop concept, tangible interactions with props will ultimately be paired with technical elements.

Improvised Technical Theatre Elements

Technical elements for rehearsed performances are often designed and created in advance by specialized professionals. However, several improv troupes also include technicians in a tech booth. The technicians, often trained improvisers themselves [15], must improvise light and sound technical elements based on the dialogue and actions of the performers on-stage.

However, the physical distance of the tech booth from the improvisers can cause a time delay between the actions on-stage and the technician responding with a technical element.

Improvised musicals [14] are an established format of improvised theatre where the performers make up songs on the spot to create a musical. Music is used to heighten the emotions of a character, and provides a quick way for the audience to understand the mood of the scene. This format often includes improvising music with instruments on-stage as the performers create and sing new songs on the fly. However, both singing and playing an instrument require skill and training outside of acting. Improvising live music provides a low-cost alternative for incorporating sound and music into improv, but not all improvisers feel comfortable improvising a musical on-stage.

Our research goal is to better understand how improvisers use and respond to technical elements (light, sound) while creating a scene. We hope to clarify what controls for technical elements are appropriate via performer-controlled technology.

Performer-Controlled Technology

Rehearsed performances incorporate technology as pre-made technical elements – the control and timing of technical elements are rehearsed alongside the on-stage performance. Performer-controlled technology allows performers – from music, dance, or theatre– to include some of these technical elements such that the technology is more responsive to their performance.

Previous HCI researchers have explored technology to enhance dance performance [9], including improvised dance. For example, MotionDraw [13] allows dancers to interact with a 3D trail of their movements. Using MotionDraw, dancers can use defined gestures with a Kinect to alter the color and width of the trail or change how the trail is captured. The researchers found that while dancers were excited to improvise with the technology to enhance their performance, they preferred having one person take the role of an external conductor rather than trying to simultaneously perform and control the technology. Clay et al. [3] discusses a similar need for external control with the "augmented reality engineer," a technician overseeing and sometimes controlling the augmentations on-stage. Although dance and theatre can both be improvised live, there are fundamental differences between the two disciplines. Therefore, technology made for dance does not necessarily translate to the needs of improvisers performing live.

For live theatre, The Dynamic Lighting System (DLS) [2] adjusts stage lighting based on a tracking system that monitors an actor's position using signals from their on-stage microphone. This provides perfectly timed lighting effects when an actor reaches specific scripted points on-stage – a cue that would otherwise be difficult to time consistently across performances from a tech booth. Thus, actors have limited direct control over effects during an otherwise tightly scripted performance.

Other systems are tailored for improvised theatre, and provide improvisers some creative control from the stage. Improv Remix [4] extends the idea of *callbacks* – improvised ideas that are re-referenced throughout a show – to create a system for long-form improv. Performers use defined gestures to

⁴<http://improvencyclopedia.org/games/Props.html>

Object	Rationale for Inclusion
Lantern	Uses light, Uncommon
Flashlight	Uses light
LED Candle	Uses light
Tambourine	Instrument, Uses sound
Bike Horn	Uses sound
Rubber Gloves	Costume, Common
Umbrella	Common
Two Plastic Cups	Common
Jumbo Remote	Oversized, Controller
Wooden Bowl	Round, Could be repurposed
Frisbee	Round, Could be repurposed
Rubik's Cube	Square, Simple
Cardboard Box	Square, Container, Common
Old-Fashioned Hat Box	Container, Uncommon

Table 1: List of props used during the study, and research rationale for including the objects.

record and interact with live playback of themselves and other performers on-stage. The gestures are distinctly different compared to existing techniques used to organize the format of an improvised show. For example, improvisers often run in front of fellow performers to “sweep” away a scene; Improv Remix allows a performer to stand over a playback performer and delete it with an arm gesture. This distinction of formats allows for the system to co-exist with current improv practice.

RIPT [11] allows audience members to create dialogue-gesture pairs for a robot arm who performs random dialogue-gesture pairs in scenes with an improviser. While the robot acts as a voice for the audience, an audience member or fellow improviser controls when the robot actually speaks. Performers can play with comedic timing as they choose the best time for the robot to interject random dialogue into the scene.

The above systems incorporate advanced technology into performances but also lead to performances made to serve the technical capabilities of the system [1]. Our goal is to provide performers direct, instantaneous control of light and sound technical elements. We hope to blend new performer-controlled technology with the existing world of improv such that it can handle the unpredictable nature of improv and fit with improvisers’ existing tangible interactions with physical objects when building a scene on-stage.

INTERVIEWING IMPROVISERS

We conducted a series of 90-minute semi-structured interviews with five professional improvisers. We scheduled our interviews based on the improvisers’ availability, resulting in two sets of dyad interviews and one solo interview. This setup allowed for both a group dynamic and individual perspective [10]. The interview took place in a theatre studio space where the interviewer and improvisers stood the entire time to allow for any movement or demonstration that may occur when talking about the improvisers’ experience.

Selected Objects	Participant Selection Rationale	Groups
Lantern	Multiple features, Challenging	1, 2, 3
Rubber Gloves	Wearable, Soft	1, 2
Bike Horn	Simple	1, 2
Umbrella	Multiple features, Versatile	1, 2, 3
Jumbo Remote	Oversized, Controller	1, 2, 3
Wooden Bowl	Simple, Versatile	2
Frisbee	Simple, Versatile	3
Rubik's Cube	Distracting	1, 2, 3

Table 2: List of props that participant groups interacted with and talked about for longer than two minutes. Also, participant rationale for selecting the prop, and the specific groups that used each prop.

The interview was structured into three sections. The first section focused on concrete examples of recent shows the participants had done and their experience improvising with props. During the second section, we introduced a box of fourteen potential props (see Table 1) displayed on a table for improvisers to use (see Figure 1). We obtained these objects from the prop room at a nearby theatre, and selected these props for their ubiquitous use in theatre, basic shapes, and the ability to produce light or sound. Participants were also told to consider the furniture in the studio space as objects for them to use (tables, chairs, black boxes). We asked the improvisers about their creative practice in relation to which objects they had seen in improv, which objects inspired them, and if anything was creatively limiting among the objects.

The last section tasked the participants to imagine an augmented prop and consider how performer-controlled technology could impact improv. We asked them to grab an object that inspires them for improv and, once selected, imagine how they would respond to being able to control light or sound directly with that prop. Improvisers could swap out what they were using for something they thought may work better throughout this portion of the interview.

Data Collection

We collected demographic questionnaires, including improvisers’ past experience with improv. We video and audio recorded interviews, and transcribed all audio and general movements of the participants. By asking open-ended questions in the interview, participants utilized their retrospective nature as improvisers to provide in-depth responses [10].

Data Analysis

One researcher performed open coding [18] on transcribed video data over two iterations: the first iteration immediately after conducting and transcribing each interview, and the second iteration after completing and reviewing initial findings from all interviews.

Participants

We recruited five professional improvisers from local improv troupes, four male and one female. Each participant had three to nine years of improv experience (average: 6 years) and had worked with at least two professional improv troupes;

our most veteran participant had worked with six professional improv troupes over the past nine years. When reporting our findings, we refer to our participants by pseudonyms. The researcher who conducted the interviews is a part of the improv community; all participants were recruited either directly or indirectly from this connection. Participants in the dyad interviews (Group 1: *Harvey-Henry*; Group 2: *Emily-Evan*) were acquaintances from performing together once or twice when their improv troupes had collaborated. This was a coincidence, but not surprising as the local improv community is small.

FINDINGS

From our interviews, it is clear that *“props are not crucial, but they are a gift”* (Todd). Although improvisers can perform without props, they are happy to use anything they are given in a scene. In our findings we discuss current uses of props in improv, current uses of improvised technical elements, and the expectations for future performer-controlled technology for technical elements in improv.

Current Use of Props

We looked at the properties of the eight objects commonly used among the study participants (see Table 2) to understand why the participants chose those objects during the study, and to help inform the design of an augmented prop. Through open coding [18], we identified five qualities that drew our improvisers to use particular props: *recognizability, functionality, stage-safe durable material, multiple possible interpretations, and avoiding distraction from the performance*. We also learned how the presence of a prop influences audience expectations of how it will be used in an improvised scene.

Recognizability

Distinct, recognizable objects help improvisers generate ideas for what to do with a prop and provide inspiration for creating a scene. However, if an object is too commonplace like *“a generic cup, ... it’s not as inspiring”* (Evan). The lantern was a favored prop as participants found it inspiring because *“it’s challenging”* (Evan) and *“not something normal”* (Todd). While at least one person in each group was inspired by the lantern at some point during the study, the participants were inspired in very similar ways (see Figure 2). These consistent interpretations were similar to *Lazzi*, stock comic routines spontaneously performed in traditional Commedia dell’Arte [8]. Participants fixated on the lantern because they had never used a lantern in improv, yet the lantern was recognizable and offered a clear story line. However, this initial inspiration could lose its appeal over time if the object only inspires one type of story line (e.g. navigating in the dark).

The objects were recognizable to participants, but some objects had unusual properties that provoked curiosity. The rubber gloves were intriguing because they were white, not a stereotypical yellow or blue dish glove color, and they were *“soft on the inside”* (Henry). The bike horn was an unusual prop for participants because *“[actors] use them to, like, end scenes [non-diegetically]”* (Harvey) rather than bringing the prop into a scene. The umbrella is a well-known, versatile object in theatre [16]. Our umbrella had additional appeal because *“it’s a broken umbrella, and everyone owns a broken umbrella”*

(Todd). Finally, the oversized remote, while recognizable, was presented at an unfamiliar scale: *“now I’m three years old again and everything’s too big”* (Emily). Overall, these objects were decidedly “good” for improv among all the participants because they were recognizable but offered something slightly different than what the participants had used already.

Harvey: You learn what inspires you. You learn what inspires your other improvisers, right? So I feel like, both [Henry] and I were very easily like “oh, that one, that one” (gestures at props table) ... I think as improvisers we need to know what specifically inspires us.”

Functionality

Functional items – *“the practical stuff”* (Todd) – were appealing as props *“because you can use them, like, [you] can open that umbrella on-stage”* (Todd). It is clear to the performers, and their audience, how or why a character would use a functional item during a scene. Our participants liked objects that could relate to a specific character or place because the object *“is actually something real, like, we’re not make believing”* (Emily). It gives a starting point for creating a scene, *“and then from there [they’re] creating the rest of the world”* (Emily).

Performers can mime practical props but scenes function better with the physical object because fellow performers may not understand how the mimed prop is functioning.

Evan: Turning [the flashlight] on and off, like, that opens a lot of possibilities ... You don’t have to be like, “okay, now the flashlight’s on” or if you’re in the dark and it’s like, “okay, now the flashlight’s off”. So you’re not ... trying to pretend not to see your fellow improvisers, it’s like you actually can’t.

“Stage Safe” Durable Material

Performing improvised theatre is active and unpredictable. When given objects on-stage, the improviser must not be afraid of breaking the object or potentially hurting someone. With many objects in our study, the participants’ first instinct was to grab them and wave them around to get a feel for the object. The rubber gloves are naturally soft so, *“I would slap someone across the arm, and/or face, depending on my comfort level with them”* (Henry). The lantern, although much more solid, also offered some carefree use as it was durable, lightweight plastic, but looked like it was made of glass.

Harvey: Plastic! So, (waving lantern around) you know, if I do have to smack my fellow improvisers with it, I’m not going to hurt them as much (hits lantern on own hand) as if it were a real metal, glass, like (taps lantern).

Although the ability to hit a fellow performer on-stage is not something we encourage as the goal of a prop, the improvisers should not be concerned that an object could cause harm. If a prop is safe, durable, and lightweight, the actors have more opportunity to be playful with it.

Multiple Possible Interpretations

Having multiple possible interpretations of an object offered the participants more ways to work with a prop. For example, the lantern had a handle, a compass, and a dial to turn it on/off. Since the object has multiple features, there is more use as inspiration when exploring the possibilities of the object.



Figure 2: Three participants from the three separate study groups being inspired in similar ways by (a) the lantern prop. (b) Harvey hunched over on a camping trip, (c) Evan hunched over navigating in the dark, and (d) Todd hunched over exploring a cave.

Henry: I think, like, maybe the more facets it has (playing with handle of old-fashioned hat box), the more, uh, well, intrigue it can inspire.

Multiple interpretations of an object might offer more playfulness, especially if the improvisers want to re-purpose the prop into something new based on the scene. While objects like the bowl and Frisbee are simple and versatile, the desire to “make it look real” (Todd) is unnecessary with these objects because the task is simple and “miming goes a long way” (Todd). For example, using a Frisbee as a plate while eating is simple to convey, either with the Frisbee or miming. Participants agreed simple objects are more outwardly versatile because they’re “not complex to the point where everyone’s going to think it’s one thing” (Evan). Although the participants spoke of the simple objects serving a purpose, none of the participants chose a simple object when initially told to choose an inspiring object for improv. Participants gravitated towards objects with more features as inspiration for improv: lantern (Harvey, Todd), rubber gloves (Henry, Evan), jumbo remote (Emily).

While some creative re-interpretation of objects is possible, there are limits to what an audience will accept. Some props can become a “gag” – an object or action that provokes an immediate audience reaction that is briefly funny: a cheap laugh.

Henry: It’s like the difference between a head laugh and a belly laugh. And a belly laugh is something that you’re, like, you know it’s hilarious because it comes up naturally. Where, like, a head laugh is, like, [when] someone says “dildo” or, like, “cock” or whatever.

At one point, Henry suggested using the rubber gloves to become a chicken – a visually silly idea. While the immediate “gag” is that he is a chicken made from rubber gloves, the idea must then be integrated into the rest of the improvised scene.

Harvey: We can use these props to, like, inform character. Or to, like, make yourself a chicken. But then after that, you’re the chicken. You’re committing [to the scene], don’t keep worrying about the gag.

This limits the types of re-interpretations that are reasonable to perform in a scene. While some re-interpretations are possible, improvisers are looking to push beyond the “gag” into something that works throughout the rest of the scene.

Emily: I can’t really pretend this [box] is a ball because [the audience isn’t] going to believe me, they’re not going to suspend their disbelief with me up until that point, ... they’re just going to laugh at the fact that I’m using a box as a ball.

Any “gag” element needs to have a purpose in the scene: “A person [can] walk [on-stage] with a baseball bat and be like, ‘oh, it’s a pool noodle’ or, ... ‘nice dildo, right?’ ... but [it’s] not deeply, intelligently funny” (Henry). Being funny is not necessarily the goal of improv; objects that provoke an interesting story line will ultimately be more successful than a “gag.” Thus, the actors do not need the audience to see, for example, an umbrella as more than an umbrella.

Avoiding Distraction from the Performance

Our participants advocated for using props as a means to focus a performance, yet they felt that offering too many objects to select from on-stage could be distracting or problematic. They said they would feel pressured to use every object at some point in a show but “with all [the] choices, it [is] almost too much because the improv [isn’t] focused” (Evan).

Similarly, individual objects may distract from a performance and not necessarily benefit the audience. Each study group had one participant playing with the Rubik’s cube while answering interview questions. However, the Rubik’s cube was considered “a very limiting object” (Henry) for improv because “it’s not interesting unless you’re playing with it” (Evan).

Presence and Audience Expectation

Beyond the qualities of the prop itself, it is also important to consider how props are deployed within a performance. When an object is sitting on-stage, the audience expects the object to eventually be used in a particular way – “[obeying] Chekhov’s famous dictum that a gun shown in the first act should always go off in the last” [16]. Even with minimal props, a single object sitting on-stage can dictate a format for using that prop

for the duration of the scene or an entire show. Performers can “never deny what the audience sees. ... If [they] have something sitting on-stage, [the audience] can see it” (Harvey). If an object on-stage is never touched, the audience will spend the entire time wondering why the object is there at all.

Todd: At the [school festival], um, we only had two chairs on-stage. There’s a couple groups that, the chairs just sat on-stage and didn’t move, ever. And I, as an audience member, ... if there’s something on-stage, I want to see it used.

Someone from each group had experience working with an improv troupe that has a supply of props backstage for use. However, there is no pressure to use everything because “the audience doesn’t know what they don’t know, ... they don’t know what the potentials are” (Harvey). These backstage props can inform or dictate the start of a scene, particularly if an actor walks into a scene as a character based on the object. There is also little incentive to grab a backstage prop mid-scene because “anything can be mimed if needed” (Todd).

Harvey: [If] we’re starting a scene where we’re in a dark campsite ... and I’m like, “there’s a lantern backstage and I love it!” ... If I run [backstage], grab [the lantern] and guess what everyone? Now I have this cool lantern. ... I did a disservice by bringing [it] out and I should have just mimed it.

If improvisers had every prop applicable to their scene location, they may feel overwhelmed when keeping track of all the props. Additionally, improv relies on the audience using their imagination. Not everything is physically needed in an improvised scene for the audience to suspend their disbelief.

Todd: People don’t rely on props, [they] just mime stuff. Like [an improvised] barber shop scene I [set the stage for], [the performers] just mimed shaving [someone’s] head. They just mimed scissors, they mimed a comb, they mimed [a lot of small props]... In a scripted scene, having all those things is nice because you can work through them and work with ... the timing of everything. ... Whereas if you actually had [those small props in improv], you’d have to search for [them], you’d have to do all this stuff that you wouldn’t necessarily want to waste time doing.

Performers need to understand what is required of the format prior to the show to determine the correct amount of props and how they will be accessed on-stage. A participant in each group had experience with a professional improv troupe whose defined format includes stagehands that bring out objects when necessary. The stagehands are fellow improvisers, familiar with the backstage supply, taking turns determining what pieces need to come out, on the fly.

Todd: Sometimes you’ll have people come ... to you before their scene [starts] and say, “we need you to set up a doctors office with a knife.” ... Other times [they’re performing and] ... say, “we need a cave”, and you’re just like, “how do I make a cave?” and you just have to [improvise].

Improvisers will also use *opportunistic props* – objects that are, by chance, on the improviser when performing and fit the scene. When doing a scene on an empty stage, “[improvisers] still have [their] phone, wallet, [and] keys” (Todd). Just like

backstage props, the audience does not know what they are missing until the object is shown, but when the improviser can instantly access the right object it provokes a surprise.

Henry: It’s so rewarding. ... If someone’s like, “twenty bucks for that” and you’re like, “sure” and you take out a twenty dollar bill, people are like, “what? How did he know that was going to happen!”

Current Improvisation with Technical Elements

Of the fourteen objects provided during our study, three involved light and two involved sound (see Table 1). While some troupes, venues, or formats improvise technical elements, they are not an expected feature of improvised theatre. Our participants primarily discussed existing practices of improvising music and lighting.

Improvised Sound & Music

Performers already improvise sound and music. Improvised music is even a necessity in formats such as “musical improv, where, like, there’s an instrument and people are singing to it” (Emily). Some participants felt “it’s such a joy to have [live music] on-stage” (Henry) because they were confident performing improvised musicals themselves. Others were simply happy that other people could do it, but had no desire to improvise music as part of their own creative practice.

Todd: (picks up tambourine) Musical improv is really cool. I’m really bad at it so I don’t usually do it, but ... when people are good at musical improv, it’s, like, one of the best things to watch.

Although sound also adds a lot to a scene, a performer “could always make the sound [themselves]” (Todd) instead of relying on performer-controlled technology or an augmented prop.

Improvised Lighting

While actors can mime missing objects or use their voice to create sound effects, they cannot make light on their own while on-stage. For this, they rely on technicians in a tech booth who are able to control overall sound and lighting on-stage. Although technicians can change the lights whenever they see fit, they are always watching for cues from the actors that communicate an intended lighting change.

Todd: A lot of the time you can mime lights. ... If you’re [on-stage] having someone over for a date ... you can just do this (slowly mimes using a dimmer light switch) and the tech booth will see that and slowly lower the lights.

In our study, two participants had experience doing improvised lighting. We currently see improvisers in the tech booth improvising lighting because, “like an actor on-stage, you have to have that kind of mindset when you’re in the tech booth” (Todd). The resulting technical element responds to the performers on-stage and is, in its own right, a creative act.

Emily: [The improvisers on-stage] asked to be in, like, a dream, so I was [in the tech booth] lowering dim, I was dimming and brightening the lights all throughout the scene while I was changing colors with it. ... We had, like, more blue when it was calmer, more red as [the scene content] got darker. There was some yellow and pink going on for, like, when [the scene

content] was, like, light and fluffy and that was matched with brighter lights because it was nicer.

These existing ways that performers improvise both sound and light influenced our participants' expectations for new performer-controlled technology.

Expectations of Performer-Controlled Technology

The concept of performer-controlled technical elements conflicts with the traditional relationship between actors on-stage and the tech booth controlling technical elements on-stage. When discussing future uses of technology in theatre, participants initially had trouble looking beyond the connection with the tech booth that they are accustomed to on-stage: "You could play fun games of, like, once the cup hits the ground, the lights come down" (Todd). However, collaborating with the tech booth from the stage can sacrifice timing and creative decisions, since "sometimes the tech booth nails it, and sometimes they just, like, put something really weird on" (Todd).

Directly controlling stage lighting was clearly appealing to our improvisers. We also discuss two ways to integrate an augmented prop. In one approach, both the performer and the audience learn about the prop's interactivity live on-stage. In the second approach, the performer surprises the audience with the interactivity.

Controlling Light

By having an object on-stage that manipulates light, the improviser has the option to use that object purely as a light control. As discussed with improvised musicals [14] allowing performers to directly control their own diegetic and non-diegetic sound, an object that manipulates the light could now offer similar direct control.

Evan: [The improviser is] not part of the scene but they're still operating music and lights, right? So, they have the power to alter mood and environment and all that stuff as well. ... If they were seen [on-stage], and they had like an object [that acts as the control] (picks up lantern and turns dial), I don't know. It would definitely be interesting.

The idea of controlling lights on-stage offered more varied uses than controlling sound.

Evan: (holding lantern) It's, like, a super emotional scene or something with, like, a grandma or whatever. ... Someone can come turn the light out (slowly turning off lantern), and that's a metaphor for, like, death.

Among the groups, the bike horn and the umbrella stood out as "good" controls for lights on-stage. The simplicity of the bike horn offered a way of quickly changing the dynamics of the lighting. Coordinating lighting changes with the instantaneous sound from the horn would also be difficult to accomplish from a tech booth.

Harvey: (squeaking bike horn) I think maybe the squeaking changes the color of the light.

Evan: (squeaks bike horn repeatedly) Like constantly changing lights and it's simple. ... It's hilarious, I think, like, if you just

see a clown horn and then (squeaks horn) all of a sudden the lights shift.

Participants from each group also felt a logical connection between the properties of stage lighting and the properties of the umbrella.

Henry: (holding umbrella) It would be a level, like, it would get brighter as [the umbrella] opened.

Emily: (holding umbrella) Bigger is more expanded [light] and if you close it, it's more direct [light].

Todd: Whenever this umbrella is open, you're going to have the lights at full. And when it's closed, you're going to have the lights all the way off. And when it's, like, halfway, you could have, like, dimmer lights.

Learning Interactivity On-Stage

While scripted performance mandates well-coordinated expertise with any technology interface before integrating it into a performance, an improviser can have a lot of fun learning about the possibilities and limitations of an object on-stage, in front of a live audience. Together, both the improviser and the audience learn what a prop can do (a "magical" creative experience [12]) and, from there, the improviser can creatively use it to their advantage (an "expressive" spectator experience [12]).

Evan: If you had time before a show to use these props and figure it out, you'd almost be cheating yourself out of the discovery on-stage.

Todd: One time on-stage, [my fellow improviser's] character got super angry and she was on-stage with a couch and she grabbed the cushion off the couch and tried to pull it off and it didn't come off. Like, it was sewn on, but she pulled so hard that it tore. So then, as an actor they're like, "oh my God", and the audience is going, "wow, she didn't know it was going to tear. She actually just broke something on-stage." But now, ever since then, I don't think I've seen her get angry on-stage without tearing the couch apart, because now she knows that the couch, like, well now [the cushions] move.

By controlling technical elements with a prop, the prop offers new uses within a scene. The improviser can choose to use it solely as the controller for a technical element, even within the scene, because the audience witnessed the discovery process.

Todd: If [the audience] understands that [the umbrella] controls the lights, that I could just go like this (closes umbrella) and the lights would come down, then it doesn't need to be an umbrella anymore because it's just a light switch.

However, an augmented prop still needs to be simple enough that an actor can learn what it does simply by playing with it briefly on-stage. Once the audience understands what the prop does, there is an expectation that the prop always works as demonstrated for the rest of the show.

Todd: [If] I closed [the umbrella] and the lights came down, everyone would kind of get that the umbrella controls the lights. And then if [the umbrella] came back, it should probably [still] control the light, because the whole audience sees that umbrella and they're like, "it's going to happen again!"

Emily: If I figured ... out [how the controls worked], it would be fun. If I didn't, then I would probably just spend the entire show wondering who was screwing around with the lights.

Surprising Audiences with Interactivity

While one approach to an augmented prop is to slowly introduce the audience to its capabilities, an alternative approach is to surprise the audience with the augmented prop (a "secretive" spectator experience [12]). Once an improviser has discovered an object's capabilities on-stage, they will have that knowledge for future performances. The improvisers can use the object for its "normal" functionality, and the technology it controls becomes an external force in the scene. The audience may see an umbrella, but they may not necessarily see that it manipulates the lights.

Todd: Someone walking in and then being like, "oh, thank God, we're inside now" and then (closing umbrella) "woosh" the lights come down and that's the scene.

DESIGN GUIDELINES

Given our findings on the use of props and technical elements in improv, as well as feedback on the augmented prop concept, we offer several design guidelines.

Function as a real object. Without purposely using any augmentation with technology, the object should still have its "normal" function. For example, an augmented umbrella would still open, close, shield the performer from water, and communicate the idea of an umbrella to an audience just like a standard umbrella. These "normal" functions can serve as the controls for manipulating technical elements if desired.

Avoid the "gag." Any prop augmentation needs to avoid becoming a "gag." While an augmented prop that behaves like a whoopee cushion may get a cheap laugh from the audience, it may not ultimately fit the scene or help the improviser continue the story. The augmentation should instead blend with the original look of the object.

Offer varied story lines. Some objects may inspire similar story lines (e.g. the lantern used to navigate in the dark (see Figure 2)), which diminishes the long-term appeal of those props. Improvisers should continually want to find new inspiration from both the physical form and the technical elements of an augmented prop. By adding controls for technical elements, the object becomes a complex, versatile prop that offers varied story lines for different scenes.

Actor- and Audience-discoverable interactions. One suggestion for integrating the augmented prop into a performance was to allow the actor to familiarize themselves with the prop on-stage, during the show. In this format, both the actor and the audience learn about the augmented prop on-stage, and the actor can demonstrate how they can improvise scenes with the new, mystery object. This particular approach would require simple controls that can easily be discovered, and technical elements that are clearly visible and associated with the prop. While this design guideline is universally applicable to any system with good usability, it is particularly important in this setting as the interactivity must not only be discovered by the actor, but also by the audience.

Technical element controls are always "ON." If a feature on the augmented prop controls a technical element, it must consistently control that technical element for the duration of an improvised show. Any failure or inconsistency will indicate to the audience that the object is "broken."

DISCUSSION & CONCLUSION

The design guidelines for an augmented prop are important, but fundamental to our approach is that an augmented prop be well-suited for improv:

- Recognizable to fellow actors and the audience
- Clear functional purpose
- Made of "stage safe" durable material
- Multiple ways to interpret the object
- Avoids distraction

While the above design guidelines offer some clear directions, there are still design trade-offs that remain open questions, even after our investigation: Should tangible controls for technical elements be obvious or hidden to the audience? Should the prop be visible on-stage or introduced from off-stage as needed? Should technical elements be triggered as part of the prop's "normal" function, or controlled independently of normal use? Should there be a clear semantic link between the object and the technical element (e.g., opening an umbrella cues light and sound for a rainstorm)?

Many of these design trade-offs depend on the improv format itself. A more subtle augmented prop may involve more subtle tangible interactions, subdued technical elements, or be hidden backstage only to be brought out when the prop makes sense in a scene. The augmentation may then require the semantic link between the object and the technical elements it controls.

If always on-stage, the augmented prop could, in itself, define a new format of improv, such as an improv game where players must make sense of a strange, multifaceted augmented prop. Such a prop may need big, obvious technical elements that may or may not have a clear connection to the prop itself.

By turning a prop into a tangible interface for controlling technical elements, we allow more room for play with instantaneous timing and provide a different layer of possibilities for the scene. Our work illustrates the critical role of both props and technical elements in improv, discusses how these elements fit within a broader improv performance, and proposes design guidelines for building augmented props for improv. Although our work is still in its preliminary stages, we hope our initial findings serve as a guide for integrating technical elements into the ever-changing world of improv. Our new-found understanding of props in improvisation could also inform technology support for improvising in the rehearsal process of scripted theatre, or tangible interfaces built into set and costume design.

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