Supporting Conversation Dynamics around Media in Remote Participatory Art

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The goal of participatory art is to give community and professional participants an equitable voice. In the context of two community opera open pilots, we evaluate the dynamics of the Co-Creation Space (CCS) [1], an artistic co-creation tool that supports asynchronous and multifaceted discussion and reflection dynamics. The first pilot, a 12-week Irish music composition workshop with 13 participants, focused on *materials co-creation*. In contrast, the second pilot, a 43-week choral co-creation experience with 206 Spanish participants, focused on *performance co-creation*. Our results show that the CCS inspired camaraderie and supported discussion and reflection, however, we found that the dynamics and roles inherent to the pilots ultimately shaped the value of the tool. We thus identify several needs to support artistic co-creation; 1) *flexible space segmentation*, 2) *explicit and implicit communication methods* for technical and emotional needs, and 3) *the importance of considering feature affordances* in context of existing app ecosystems.

CCS Concepts: • **Human-centered computing** → **Collaborative and social computing systems and tools**; **Computer supported cooperative work**.

Additional Key Words and Phrases: Opera; Toolkit

1 INTRODUCTION

The goal of artistic co-creation in community art is to help participants share, test, and reflect on their experiences [29] by giving them a voice throughout the entire art creation process [5, 47, 50]. However, there is a gap in supporting equitable discussion and reflection around media in artistic co-creation technology because such processes are complex [29]. One challenge is that artistic co-creation is defined broadly; Matarasso [16, 28] describes a spectrum of co-creation where, on one end, professional users are in control of the co-creation process, and on the other end, non-professionals are in control. In parallel to working with different loci of control, artistic co-creation may be segmented into two types of activities: mutual modification of contributions, and contribution to a joint production [8]. In this work, we refer to the former as *materials co-creation*, and the latter as *performance co-creation*.

Current research in participatory design (PD) and media practices often limit complexity by involving participants in clearly defined roles [12, 14] at particular moments of the co-creation process [23, 47] in service of predefined goals [11, 51]. Yet literature [13] recognizes the importance of working openly with complex relationships within participatory art communities; Clarke et al. argues that "insight and change [comes] from not trying to tidy up contradiction and uncertainty but finding ways to work with it." Wilson et al. [50] explains these processes must consider how to represent participant intentions, adapt for communication differences, and support contradictory needs and expectations. Complexity further comes from the relationship dynamics of users; Nouwens et al. [32] suggests that

while many app "ecosystems" exist with comparable functional capabilities, end users create different communication spaces based on defined membership rules, perceived purposes, and emotional connotations.

In response to this gap, previous work [1, 2], published in CSCW, developed the Co-Creation Space (CCS) to support asynchronous and multifaceted discussion and reflection dynamics. This work evaluates the tool in two opera co-creation contexts to understand its' value; a *materials co-creation* open pilot with 13 Irish participants in a composition workshop, and a *performance co-creation* open pilot with 206 Spanish choral participants of a large scale opera performance, as part of the [Name] European Project. First, the related work describes the goals of community art processes, and contrasts them to the practices in PD and media co-creation. After this, we present the Co-Creation Space, and describe the two open pilots. Our key contributions are 1) an understanding of CCS usage and value across the two open pilot trials, and 2) a set of technology needs to support artistic co-creation. Our findings suggest that the CCS inspired a sense of togetherness in service of discussion and reflection, but that differences in co-creation activities, social structure, and sizes of the pilots affected the use of the tool. We thus identify 3 needs to support artistic co-creation; 1) *flexible space segmentation*, 2) *explicit and implicit communication methods* for technical and emotional needs, and 3) *the importance of considering feature affordances* in context of existing app ecosystems.

2 RELATED WORK

2.1 Co-creation in Community Art

Community art results from the equitable [1] collaboration of art by professional and non-professional artists [29]. In contrast to professional work, this practice values process equally to outcome, and includes the 1) conception of an idea, objectives, and anticipated outcomes, 2) negotiation of mutual obligations and benefits, 3) co-creation, the making and presenting of artistic work, and 4) reflection, evaluation, and future planning of art [28]. Step 3, *the co-creation process*, is the focus of our work. It considers how work is planned, what control non-professionals have over participation and creative contributions, what risks participants face, and what success and failure may look like [16, 28, 29].

The co-creation process encourages iterative dialogues, feedback and reflection dynamics. In this stage, community participants engage in synchronous and asynchronous activities with professional artists and with one another, discovering their own feelings and ideas, engaging with others through stories and images, and processing, testing, and sharing their experiences through artistic play [28]. A fundamental goal of community co-creation is thus to give community participants an equitable voice through the entire creation process [5, 47, 50] by creating a reflective space that allows participants to open up about personal experiences [13]. When designing creative support tools, Sturdee et al. [43] asserts the value of creative art practice at the intersection of aesthetics, culture, and technology; work that brings together creatives, researchers, and participants in meaningful discussion and reflection collaboration dynamics.

2.2 Co-creation Practices in HCI

In HCI, co-creation research primarily focuses on improving participatory design (PD) and media practices. In PD, co-creation has been studied in practical environments, such as public deliberation in political and commercial environments [14], community management of renewable energy [12], tool creation [23, 51] and education [11]. Common PD design goals are to describe future objects, concerns, and opportunities [36], and are thus often tied to product outcomes or process impacts rather than participant empowerment and process democratisation [7].

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[1]This work defines equitable as that which promotes understanding and meaning for all participants [46].

In media, HCI has considered different forms of social collaboration, including hybrid ecosystems in participatory video practices where community participants engage at different steps of the co-creation process. For instance, Frohlich et al. [18] describes a mobile multimedia narrative application used with rural South African participants that allowed them to create narratives by recording and stacking video and audio files together. Similarly, Hoadley et al. [21] employs participatory video for collaborative learning in rural villages, and Yelmi et al. [52] employed such practices to create a nonlinear interactive documentary about Istanbul. While media co-creation includes community participants, such practices focus on the creation of a media product rather than on supporting equitable process dynamics.

As well as having pre-defined goals, many PD and media practices involve participants in clearly demarcated roles during co-creation [23, 34, 36, 44, 47], using linear and non-linear PD frameworks to define different modes of participation that connect activities to project goals [44]. PD participants may develop design concepts [14] or help construct artifact ecologies [6] at the beginning of a process, or may be involved later, during workshop and prototyping phases [34], using methods such as design probes, prototyping toolkits, and prototype feedback techniques [36]. Similar to PD, polyvocal media ecosystems often use participatory design practices (e.g. workshops, interviews, iterative design, high-fidelity prototypes, e-voting and online participation systems [21]) to include community participants in media creation. As in PD, participation in media co-creation can happen in different stages of the design process; Bulterman et al. [9] differentiates between "early binding" authoring that is appropriate for generalist broadcasts like YouTube, vs. "late-binding" media that allows end-viewers to have more control over media segments and their placement.

Participants have limited roles for practical reasons; since non-professionals are not expected to become experts [23] expanding participation may constrain the possibilities of the design process, which may limit the success of community engagement [22]. This illustrates the notable difference between community art co-creation and co-creation in HCI; in the former, the artistic goal develops through the iterative design process, whereas in the latter, co-creation goals (such as project decision making, processes, or products) are clearly defined by researchers and external evaluators [44], often for a researcher and practitioner audience [7].

2.3 Supporting Equitable Discussion and Reflection Dynamics in Community Co-creation

A primary difference between HCI research practices and community art is in the equitability of participation dynamics; HCI often includes non-professional participants in limited roles at distinct stages of co-creation [36, 44], whereas participatory art aims to create evolving participation dynamics between professionals and community members throughout co-creation, and regards non-professionals as artists in their own right. While important, supporting the latter process is complex; Rossitto [33] suggests that participants, art, and context are relationally interdependent with participation technology and spaces in which artistic negotiation takes place, and expert designers often struggle to include participants as equals in a setting where inevitably there are power differences [22, 45].

There is a gap in supporting equitable discussion and reflection around media creation in artistic co-creation technology [16, 40, 42]. Bartindale et al. [4] outlines several needs for social community media collaboration that supports self-reflection, peer support, and group discussion, and Sturdee et al. [42] emphasizes the importance of HCI technology supporting the art creation process, particularly focused on discussion, emotional response, and reflection. Such reflection processes includes *reflection-in-action* that arises during design activities [49], and *reflection-on-action* [38] that helps designers evaluate and reflect on unconscious aspects of their experience [39]. Considering the landscape of codesign research, early work by Sanders et al. [35] envisioned a diverse future of codesign that would include collaboration between all stakeholders in the design development process, leading to new domains of "collective creativity" that distribute ownership in virtual hybrid environments. Yet when Frich et al. [17] reviewed the landscape

of creative-support tools in 2019, they found that only that only 18% of tools evaluated or critiqued ideation concepts, and discussion tools that supported an entire co-creation process were not even part of the landscape.

In response to these gaps, we developed the Co-Creation Space (CCS) to support group discussion and reflection around media through *media storage*, *media sharing*, and *media commenting* capabilities [1, 2]. Having designed the tool, we consider its' ecosystem of affordances that emerge through two open pilots.

3 THE CO-CREATION SPACE

The Co-Creation Space was designed through a user-centered process [24]. First, we gathered high-level requirements for the tool through focus groups with leaders from 3 community opera projects. After this, we developed *user personas* [3] with project leaders. We likewise defined *scenarios* and *use cases*, first grouping personas into a set of scenarios, then brainstorming a set of possible use cases for how the CCS could support different community opera project goals. Next, we *storyboarded* a subset of these interactions, sketching use cases by hand, then using the web-based sketching tool Figma.[2] Finally, we created *wireframes* of the interface based on the storyboard interactions. Throughout the process, we received feedback from project leaders about the design and implementation of the tool. After development, we conducted a usability pilot test of the CCS with community opera participants [1]. A detailed description of the development process and tool functionality is described in [Author] [2].

In preparation for the open pilots, project leaders were introduced to the functionality and workflow of the CCS during a preliminary meeting. At this time, they were given the opportunity to make small feature requests and suggest improvements to the user interface. This input was paired with feedback from the interface validation, collected in the project's issue tracker, and expedited for implementation before the start of the open pilots.

3.1 Overview of Functionality

The end result of this user-centered process was a web-based application implemented in TypeScript,[3] backed by a relational Postgres[4] SQL database. The application was deployed on a virtual cloud server, and takes advantage of several external services. Among these are hierarchical data storage, content distribution, video transcoding, transcription of speech from video or audio files, and translation of the related text transcripts into several different languages.

CCS functionality includes *creating an account, exploring posts, creating posts* with different types of media, and *commenting and reacting* to posts and media with text and emojis. Screenshots from the tool are shown in Figure 1. First, users sign into or create an account, select interest topics, and choose a preferred interface language. Users can explore posts using a text and media preview timeline, filtering for interests and tags, or searching for keywords and phrases. When creating posts, users add a title and description, choose a relevant topic from a drop-down menu, and add tags. When viewing posts, users can select from 70 languages to subtitle videos, and can react to posts through likes and comments. Users can also react to videos with emojis that appear on an emoji timeline below the video. The tool is meant to for remote and asynchronous communication.

The top left of the figure shows how users select interest topics, and the top right of the figure shows the interaction with the media timeline. The bottom left of the figure shows users creating a post, and the bottom right shows users commenting on a video with emoji reactions. An overview of affordances is presented in Table 1, and a detailed description of the development process and tool functionality was published in CSCW last year [Author] [1].

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[2] *http://figma.com/*
[3] *https://www.typescriptlang.org/*
[4] *https://www.postgresql.org/*

3.2 Data Collection

The front-end of the Co-Creation Space was instrumented with code to collect user data. This includes navigation on the page itself, interaction with the site's media player, and record creation and modification in the back-end using timestamps. The code responsible for loading pages in response to user interaction transmits navigation activity by signed-in users to the back-end, where it is inserted into the application's database. Moreover, the media player is fitted with code to track interactions with the playback controls. Tracked data was inserted into a separate database with creation and modification timestamps. Each record was assigned with a unique identifier, making it possible to link all data together into a graph data structure. For analysis, all records were exported into a CSV format.

Table 1. Co-Creation Space Affordances

| Type	Affordances
Interface	*Simple/intuitive interface; onboarding, Standardized tags; Feedback (commenting and tagging); Password protected user profiles; Edit profile settings after onboarding; Content moderation; Privacy settings; Mobile/Desktop Support*
Media	*Playback support for HD audio and video; Adaptable video quality for device/bandwidth context; Image previews; Transcode video files into CCS video format; Upload and store standard image and video files and 360° videos; 360° video player; Store, upload, and visualize 3D models; Timestamped media reactions*
Accessibility	*Caption overlays for videos; Subtitles/descriptions (edit offline, download, upload); W3C Compliance; Multi language translation; Offline interface that syncs with online database; Admin permissions*
Summary	*Public-facing co-creation summary timeline; Post notifications; Post thread timeline; Daily digest; Calendar schedule.*
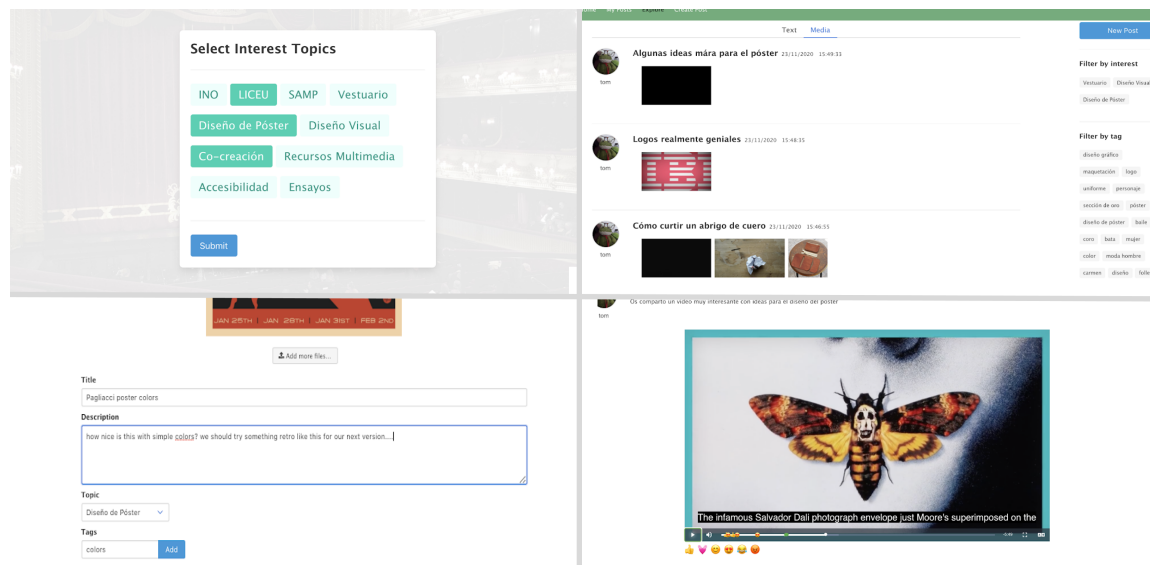
Fig. 1. Screenshots from the Co-Creation Space tool. Top Left: Selecting interest topics. Top Right: Interacting with the Media timeline. Bottom Left: Creating a post. Bottom Right: Commenting on a video with emojis.

4 OPEN PILOT 1: MATERIALS CO-CREATION WITH AN IRISH COMPOSITION WORKSHOP

We explored the value of the Co-Creation Space for *materials co-creation* through an open pilot with an Irish opera composition workshop, who were co-creating audio materials for a VR opera. Participants joined a private group which

kept their interactions separate from the other pilot, and interacted with the CCS functionality described in section 3. The pilot ran over the course of 12 weeks from April to June 2021; it was originally scheduled to last one month, having 4 weekly sessions, but due to enthusiasm, it was extended to 10 sessions over 12 weeks. Thirteen (13) participants were recruited by the project. Participants included 2 professional facilitators, and 11 non-professionals from the Dublin suburb Tallaght between the ages of 30 and 70. During the pilot, participant navigation and interactions with the tool were tracked with timestamps, and post and comment text was recorded.

4.1 Method

The workshops took place over Zoom, with the CCS as the primary tool for discussion and to respond to creative task prompts. Each workshop was approximately 2 hours, and were held weekly. During the workshop, participants used the tool to upload creative task responses, and to share and discuss content in a free form. Before the open pilot began, participants were virtually introduced to the tool by a workshop facilitator, and were given a quick-start reference guide. During the introduction, the facilitator helped participants create accounts, and answered questions. At this time, participants were told that they would use the tool to communicate about different forms of media, and were told that they could decide how formally or informally they should use the tool. Participants were also reminded that the tool is not a media editor, and that anything they post would be seen by everyone in their group.

At the end of the last session, 6 participants reflected on their experience through group discussion questions. These six participants included a female professional participant in her thirties, 3 male non-professionals between 50 and 70, and 3 female non-professionals, one in their thirties, and two between 50 and 70 years old. The focus group was held over Zoom, and took approximately one hour. The session was organized by workshop facilitator, and included the participants that were part of the last session. Participants were asked *how often they used the tool*, *how useful it was for co-creation*, and *how it compared to other social media tools*. [5] Users were also asked what the *most and least useful features* were, and *how their use of the CCS compared with their expectations*.

4.1.1 Sample Interaction. During the workshop, participants used the CCS to complete creative tasks and respond to one another's work. Figure 2 shows a sample composition and reactions based on the following task: *Compose or improvise a short piece of music using some of the [composition] techniques we discussed today, or think of new ones inspired by today. You can use any sound with your body or mouth/voice, but without singing or humming. You do not need to notate the piece. Record it using your phone or another recording device. Please upload it to the Co-Creation Space. Please also spend a few minutes listening to some of your classmates' recordings, and commenting/interacting with them. Please note, even though improvisation is allowed (and encouraged) and notation is not necessary, I would like you to be able to recreate the piece. Therefore, if you improvise, make sure that it is structured, so that the general idea can be performed again.*

In response to this prompt, a participant created a post called "Anxiety" (Figure 2) that included an audio track that mimicked the sounds of physical anxiety and calming methods (left). In complement to the audio track, the participant included a graphic score (right) of the sounds she created. Over the next week, fellow participants responded to her post through emojis and comments. Two participants reacted with emojis in the audio file (a thumbs up at 18 seconds, and a heart emoji at 35 seconds), and five users (4 fellow participants and the instructor) commented on the post. Two comments responded to a particular moment in the audio track (at 39 and 40 seconds, respectively), while the others praised the participant's creative use of musical layering. In complement, the instructor suggested that the composition group perform the piece together at the next workshop meeting. Even though they did not directly comment on the

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[5]We refer to social media as virtual content that facilitate the creation and sharing of information, ideas, interests, and other forms of expression [25].

post, a sixth workshop participant endorsed the first comment by responding to it with a heart emoji reaction. Over the course of the workshop, we recorded 57 views to this post, suggesting that participants revisited it several times.

4.2 Results

Our research asked whether the CCS would be valuable to participants during moments when they needed to discuss and reflect on co-creation materials. To answer this question, we triangulated four methods: 1) a quantitative report summarizing usage of the tool across the workshop period, 2) a content analysis of CCS text, 3) a network analysis of interactions, and 4) a qualitative group interview of participant feedback collected on the last day of the workshop.

4.2.1 Summary of Use. The workshop was conducted over 10 sessions from April through mid-July. Over this period, the 2 professional participants made on average 90.67 independent page views [6] [SD=62.44] per week, and 15.25 multimedia interactions [7] [SD=20.44]. Further, they made 1.75 posts [SD=1.87], 1.42 multimedia uploads [SD=3.48], 4.92 comments [SD=6.82], .08 likes [SD=.29], and 1.41 emoji reactions [SD=1.44]. In complement, the 11 non-professional participants made 240.75 views [SD=261.67]], and 110.83 multimedia interactions [SD=118.14]. Further, they made 4.33 posts per week [SD=4.46], 4.42 multimedia uploads [SD=6.87], 8.00 comments [SD=9.68], 6.25 likes [SD=6.50], and 9.50 emoji reactions [SD=10.93].[8]

The top left of Figure 3 shows a pie chart summarizing activity by the two professional and non-professional participants. The two professionals (a composition teacher and workshop facilitator) made up 21.2% of the total activity, while the non-professionals made up 78.8% of the total activity. This indicates a relatively equitable distribution in contribution between professionals and non-professionals. The figure also shows the weekly number of views, comments, multimedia interactions, likes, emoji reactions, posts and multimedia uploads, divided by professional and non-professionals. For the non-professional participants, the figure shows unevenly distributed behavior through the 12 weeks, which may have been due to individual differences in usage that occurred when the workshop was extended; all of the interactions have a peak in activity at week 4 (when the workshop was scheduled to end), and then a second peak at week 9. The highest activity happened during the first four weeks of the workshop; during this time, participants familiarized themselves with the Co-Creation Space, completed, and gave feedback on individual creative tasks. When the workshop was extended, participants engaged with the Co-Creation Space through group composition work that was led by the instructor, which may have accounted for a decrease in the overall number of activities. In contrast, the two professionals show relatively stable activity across the metrics, particularly, page views, comments, multimedia interactions, emoji reactions, and posts. This makes sense, as professionals facilitated the workshop, and thus regularly posted tasks and gave feedback to participants through the 12 weeks.

4.2.2 Text Content Analysis. A content analysis of the open pilot text was performed through a qualitative coding procedure. First, two coders (including one author) independently looked for open codes across the text of the Irish and Spanish open pilots. [9] After this, the coders created a codebook (Table 2) of 13 codes grouped into 5 high level categories representing the focus of discussion; *Technology, Focus on Media, Co-creation Process, Social Media*, and *Miscellaneous*. For instance, codes in the Focus on Media category (sharing and explanation of materials, art process, and synthesis) discussed media in service of co-creation. In contrast, codes in the Co-creation category (Co-creation

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[6] All interactions include engagement with personal and others' posts.

[7] This includes uploading, editing media, or interacting with a video player.

[8] Due to the CCS being a web application, some metrics, such as "length of visit" were not tracked, as they were not a clear proxy for engagement behavior.
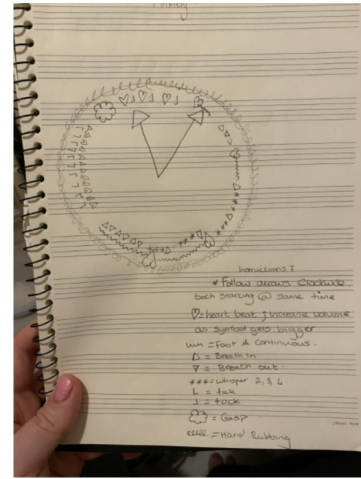
[9] Text data from two open pilots were analyzed together.

Fig. 2. A screenshot of a sample interaction from the Irish open pilot. At the top is a sample composition piece called "Anxiety" that was uploaded to the CCS. This includes an audio file and image of a score representation. Below the composition, the figure shows participant and instructor reactions and feedback to the piece.
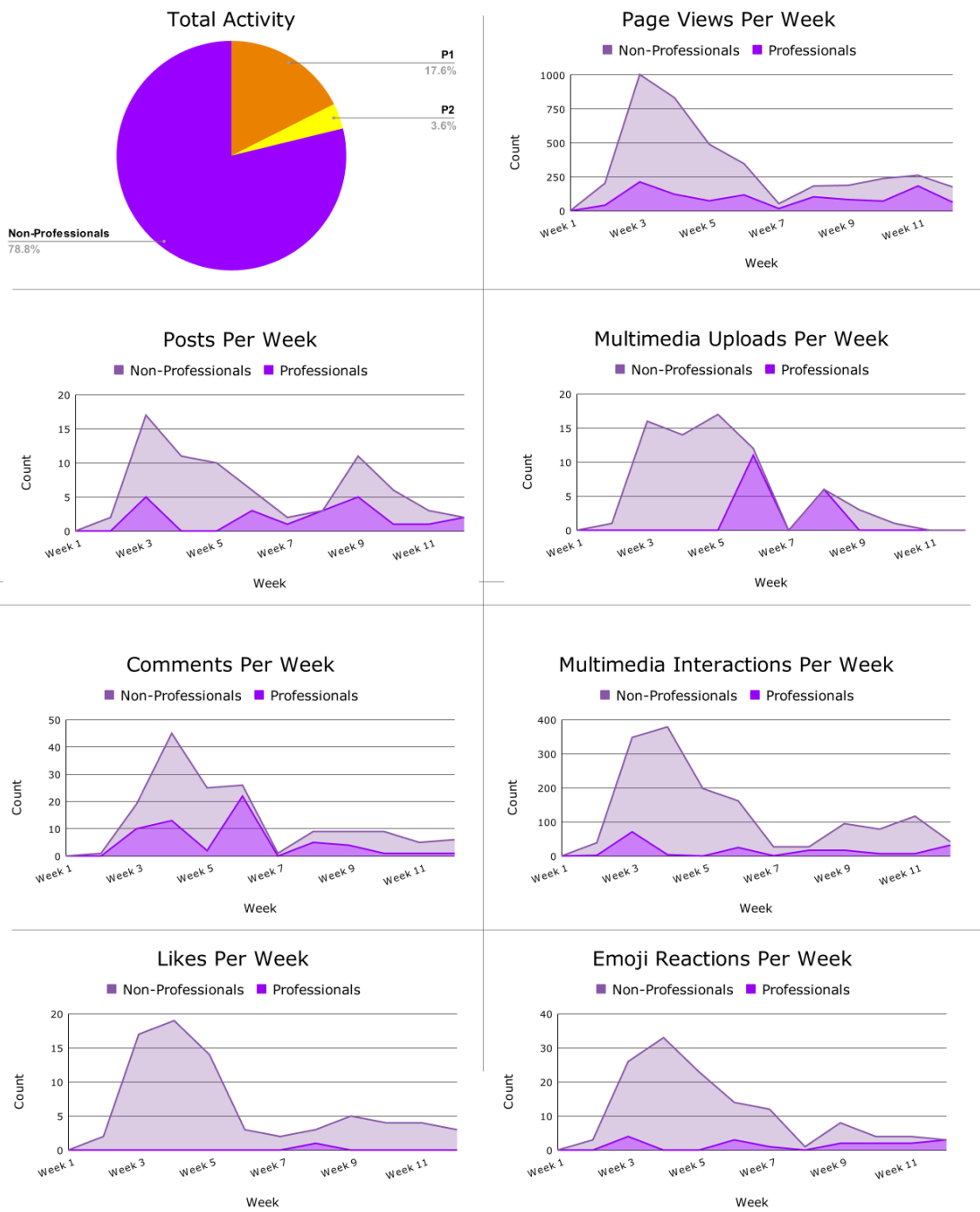
Fig. 3. Top Left: Overall Activity by Irish workshop participants, divided by the 2 professionals and 11 non-professionals. The figure also shows the weekly number of views, posts, multimedia uploads, comments, multimedia interactions, likes, and emoji reactions, divided by professional and non-professional activity.

Process, Excitement/Thanks, Reflections on in Person Events, Coordination) focused on discussions that were related to the evolution of the co-creation process.

After creating an initial codebook, the coders performed an IRR analysis on a subset of data, and generated an initial score of 85%. The coders discussed the text together, added two categories, and performed a second IRR, with a score of 94%. After this, one coder coded the rest of the dataset, and made notes on what they were not sure about. Finally, both coders went through the text together, and came to agreement about uncertain codes. In addition to the text coding, an automatic sentiment analysis was performed on the text using the AWS Comprehend[10] cloud service that generated a *positive, neutral, negative*, or *mixed* response for each text. In parallel to coding the text, the coder that coded the full dataset checked agreement with the sentiment analysis, and made notes on disagreements. As coders went through the text together, they came to an agreement about uncertain sentiment valuations.

Table 2. Overview of text codes used in the content analysis of the Irish and Spanish pilots.

Category	Code Name	Description
Technology	CCS Usability/Use	*Comments on the interface or interactions with the tool.*
Technology	General Technology	*Talking about technology in general.*
Focus on Media	Sharing/Explanation of Materials	*Sharing/explanation of materials, referring to specific moments.*
Focus on Media	Art Process	*Discussing art process, including the ideas about materials, resources or techniques. Includes reflection on how to improve or edit work, and asking/offering assistance about media.*
Focus on Media	Synthesis	*Discussing synthesis process. Includes planning next steps with media, integrating/synthesizing media in the next step of co-creation, or synthesizing materials to use externally.*
Co-creation	Co-creation Process	*High-level reflections on the co-creation process. Includes thinking about successful/unsuccessful moments of the process, next steps, or ways to improve it.*
Co-creation	Excitement/Thanks	*Emotional response to process, including being excited or thankful for work being done, or for participating.*
Co-creation	Reflections on in-Person Events	*Discussion or emotional responses to an event.*
Co-creation	Coordination	*Discussion about coordination or planning.*
Social Media	Sharing Social Media	*Sharing media about events, rehearsals, performances, or informal gatherings.*
Social Media	Responding to Social Media	*Responding specifically to media about the social experience. This is different than reflecting on in-person events, because of the focus on the media.*
Miscellaneous	Personal communication	*Comments unrelated to co-creation, such holiday greetings or discussion about life.*

A treemap of the results are shown in Figure 4, with higher saturation indicating more positive sentiment. During the open pilot, participants primarily responded and reflected on media (44.04%), shared and explained materials (22.02%), and discussed their art process (10.11%). This makes sense, given that the goal of the workshop was to create and discuss composition materials. Participants also used the tool for personal communication (5.05%) and for discussing the synthesis of their work (4.69%). They infrequently used the tool for other purposes, such as being excited or thankful for work (3.61%), talking about technology (2.89%), discussing the broader co-creation process (2.89%), responding to

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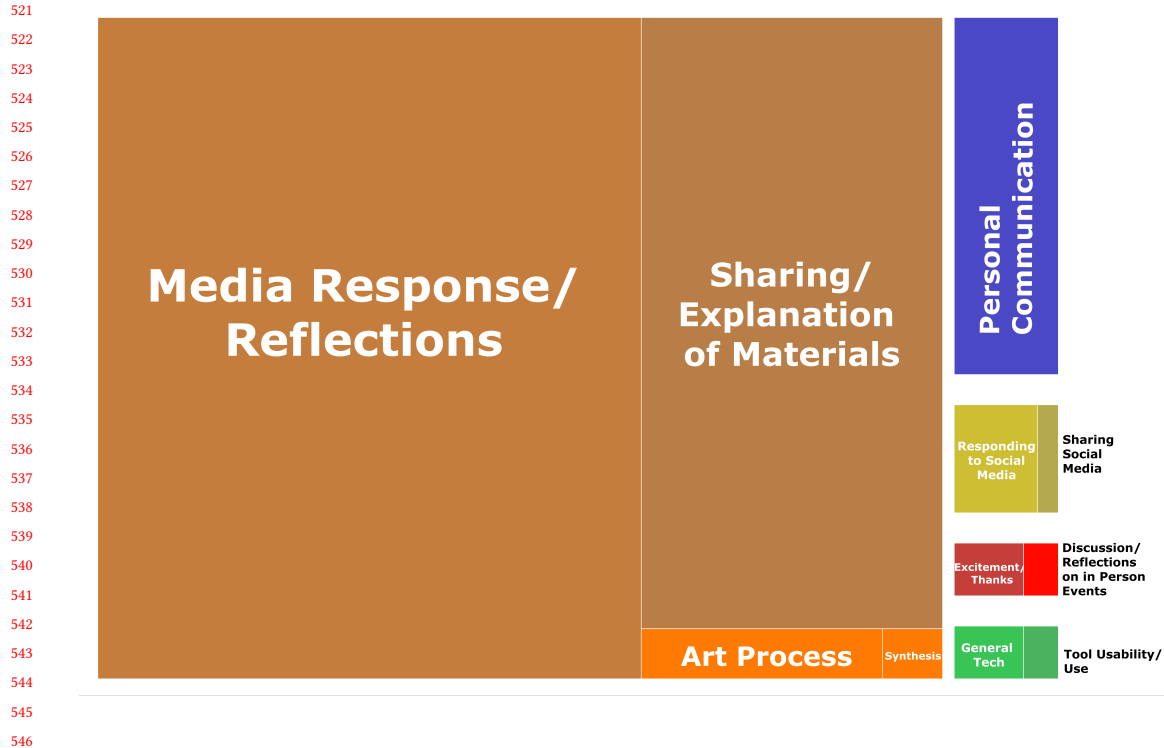[10] *https://aws.amazon.com/comprehend/*

Fig. 4. Analysis of the Irish open pilot CCS text, shown as a treemap: 13 codes organized by 5 categories: *Technology, Focus on Media, Co-creation Process, Social Media*, and *Miscellaneous*. Differences in average sentiment for the 13 codes are visualized by color saturation, with higher saturation indicating more positive sentiment. Participants primarily responded and reflected on media, shared and explained materials, and discussed their art process.

social media (1.44%), and discussing coordination (1.08%) or the use of the CCS (1.08%). Finally, as the workshop was entirely online, participants barely used the tool to share social media (.36%) or reflect on in-person events (.36%).

4.2.3 Network Analysis. We performed a network analysis of interactions from the 1st through the 12th week of the pilot to understand the structure of the discussions taking place. We built a network with users as nodes, using node size corresponding to total posts and comments a user created. We used size to order the network in a circular layout, and color to distinguish between professionals and non-professionals. Links between nodes represent the comments made by a user to a post by another user, with line width proportionally representing the number of bidirectional replies.

To understand how this structure evolved over time, we graphed all content that had been created up to a point in time; for example, the graph for week 3 counts all posts and comments created in weeks 1, 2 and 3. Thus, the network grows by increasing nodes, links, or strengthening links between users. Figure 5 shows four graphs corresponding to weeks 3, 6, 9 and 12 of the Irish pilot. The evolution of the networks shows that although one professional user dominated discussion, professionals and non-professional participated in conversations with one another throughout the pilot. In week 12, the network contains 13 nodes (users), and 37 edges (interactions).

4.2.4 Group Interview Feedback. Six (6) users participated in a qualitative group interview on the last day of the workshop. Participant responses were analyzed by grouping responses to usage of the tool, and to its value.
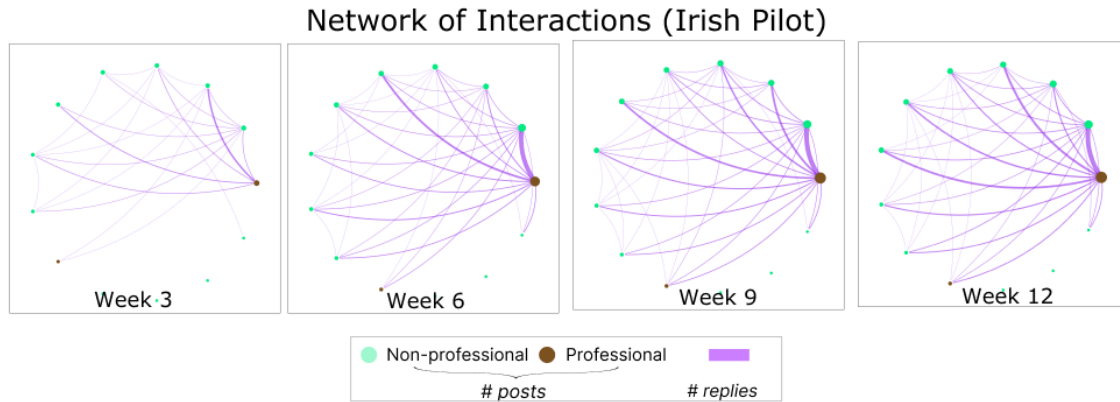
Fig. 5. A network visualization of Irish pilot interactions between users. While one professional user dominated the discussion, both professionals and non-professional users interacted with one another throughout the pilot.

Usage: Overall, participants used the Co-Creation Space to upload recordings and their composition pieces, and to listen and comment on other participant recordings. Participants explained that the primary usefulness of the tool was that it created a sense of unity. One participant related that it was a good way for musicians to share music, while another explained that "*hearing pieces together felt like you were in the same room*"(P1). Further, the emoji reactions created a sense of positive encouragement, allowing the tool to "*became a sort of self-help group* (P5)."

When asked about their use of the tool, participants explained that while they did not have expectations about *how* they would use the Co-Creation Space, the tool was faster and "*more user friendly than I expected*" (P4, P5). The user-friendly interface motivated participants to create visual content that complemented the audio compositions. The CCS "*opened up a new world for creative expression that we didn't expect...we started making little videos to share*," P3 explained. While they enjoyed responding to each other's work, the CCS activity may have changed due to the nature of the tasks changed over time; at the beginning of the workshop, participants were uploading individual compositions, whereas as toward the end of the workshop, participants tasks were more passive; the composer created a piece out of individual compositions, that participants reflected on together.

Value: Compared to other social media tools, participants felt that the Co-Creation Space was "*simpler...easy to use, not overloaded with features.*" (P4) They elaborated that "*social media these days tries to be everything (e.g. Instagram copies reels from TikTok).*" Instead, the Co-Creation Space was more focused because it was "*purpose-built...[I] won't be distracted by other media, compared to if the interaction was happening on private Facebook group*" (P4). Some participants also explained that they "*wouldn't have bothered if this was on a regular social media.*" (P5) A reason for this was the tool *felt* private, and created a "*virtual safe space*" (P7) in which they felt comfortable singing or "*putting up weird sounds that they would never want someone to hear*"(P4). Participants explained that this was vital for creativity, because they felt comfortable that their raw work wasn't going to judged in a performance setting.

5 OPEN PILOT 2: PERFORMANCE CO-CREATION WITH SPANISH CHOIRS

We explored the value of the Co-Creation Space for *performance co-creation* through a Spanish choir open pilot, the goal of which was to support 11 choirs to learn to perform a new opera together. In this context, co-creation refers to "[recognizing] the specificity" of work [16], by collaboratively interpreting elements of musical expression, such as

dynamics, tempo, and articulation [37, 41] so that a consistent style could emerge. As in the Irish pilot, participants joined a private group, and interacted with the CCS functionality described in section 3.

The pilot ran for 10 months, from October 2021 to July 2022. The beginning of the pilot coincided with the beginning of rehearsals; first the choirs rehearsed separately, then began to work together, preparing concerts of the opera throughout the process. In the first week, the tool was introduced to choir directors, and over the next weeks, participants were onboarded onto the tool. During the first 2 months, choirs rehearsed independently, performing small concerts in weeks 6 and 11. After this, choirs had their first big rehearsal together in week 16, and sang together in an important showcase in week 22. Then, in weeks 31-34, the choirs started working together, and had their first rehearsals with dancers and soloists in week 36. Finally, in weeks 40-43, choirs worked consistently together, and gave several small concerts.

Two hundred and six (206) users from 11 community choirs participated in the trial, including 198 non-professionals and 8 professionals from 11 choirs. All users were participating in the creation of [Name] opera being co-created by the [Name] opera house in Barcelona. Choir participants ranged in age and experience in opera and technology; the youngest participants were from a children's choir and were 11 years old, and the old choir participants were 80 years old. A description of the choirs is shown in Table 3. As in the Irish pilot, navigation and interactions with the tool were tracked with timestamps, and post and comment text was recorded.

Table 3. Overview of Spanish Pilot Choir participants

Choir	Participants
Cor Drassanes	58 participants, between 11 and 79 years old
Grup Mon Raval	7 participants, between 53 and 76 years old
Cor Les Flors de Maig	16 participants, between 56 and 80 years old
Cor Turull	13 participants, between 34 and 63 years old
Grup Coral de Universitat de Barcelona	24 participants, between 18 and 73 years old
Cor de Dones de Xamfrà	3 participants, between 40 and 56 years old
Kudyapi Choir	21 participants, between 11 and 18 years old
Musicals' choir	46 participants, between 14 and 25 years old
Dona Gospel	4 participants, between 24 and 43 years old
Korraval Evolution	7 participants, between 59 and 70 years old
TrencaCors	1 participant, 52 years old

5.1 Method

Before the open pilot began, authors met with the primary choir director and opera house facilitators to discuss the use of the tool. The directors and facilitators decided that the CCS would be used to share sheet music, audios, and videos, and for participants to hear one another's interpretations of the music and get feedback from one another. In addition, participants would be given the opportunity to discuss content related to the opera in a free form.

At the beginning of the pilot, choir directors learned about the CCS during a general meeting at the opera house, filled out consent forms, and registered for the tool. Over the next two weeks, opera house facilitators introduced the tool to individual choirs, and helped participants register for the CCS and fill out consent forms online. Participants were given a chance to ask questions, and were given a quick-start reference guide and tutorial video. At this time,

participants were told that they would use the CCS to communicate about different forms of media, and that they could decide how formally or informally they should use the tool. As in the Irish pilot, participants were reminded that the CCS is not a media editor, and that anything they post would be seen by everyone in their group.

Then, after the open pilot ended, 5 focus groups were conducted with 3 choir directors, 2 facilitators, and 9 non-professional participants for users to reflect on their experience with the tool. The focus groups were organized by role, choir, and age. One focus group was held with the primary choir director, a female in her 40s, and a second was held with 1 female and 1 male choir directors, each in their 50s. The third focus group was held with a male choir director in his 50s, and 3 participants from his choir, 2 females and one male in their 30s and 40s. The fourth focus groups was held with 2 male choir participants in the 50s, and the final focus group was held with 2 female and one male teenagers from a children's choir. All of the focus groups included the two professional female participants who helped answer questions during discussion, and added their perspectives to the conversation. The sessions were held over Zoom, and took approximately 1.5 hours. [11] Similar to the Irish open pilot, the focus groups asked users to consider *how they envisioned using the tool* at the beginning of the study, and *how it compared to their actual use*. They were also asked *what formal and informal purposes* they used the CCS for, *how useful* the tool was for them, and how the pilot experience would had been different on *another social media platform*.

5.1.1 Sample Interaction. Over the course of the Spanish pilot, participants used the CCS to share social media about the progress of the opera. Figure 6 shows a sample social media and reactions of a video documentary that two choir participants from the Flors de Maig choir recorded for the TV3 documentary in a cafeteria in Plaza Molina.

Over the next week, fellow participants responded to this post through 6 comments, 7 likes, and 108 reactions on the emoji timeline. One community participant responded to the post by expressing his enthusiasm; "*listening to our audios?? i love it lol*." [12] This response was liked 3 times, and a facilitator responded to them, "*look what you provoke!*" The first community participant also commented that "*I think they need practice but they are going very well,*" which was liked 3 times. The facilitator also commented "*Very good! The disbelief face of the lady sitting on the left makes me laugh!*", which was also liked 3 times. A second facilitator commented, "*Thanks for sharing!!!*" and a choir director commented, "*Very good work,*" comments that were both liked once. Over the course of the open pilot, we recorded 49 visits to this post, suggesting that participants revisited the post several times.

5.2 Results

Our research asked whether the Co-Creation Space would be valuable to participants during moments when they needed to discuss and reflect on the progress of the performance co-creation experience. In parallel to the Irish pilot, we answer this question by triangulating four methods: 1) a quantitative report summarizing usage of the tool across the workshop period, 2) a content analysis of CCS text, 3) a network analysis of interactions, and 4) a set of qualitative group interviews of participant feedback collected at the end of the pilot.

5.2.1 Summary of Use. The open pilot was conducted over ten months from October 2021 through mid-July 2022. Over this period, the 8 professional participants made on average 1.045 page views [SD=2.44] per week, and 79.83 multimedia interactions [SD=94.55]. Further, they made 1.21 posts [SD=1.23], 1.05 multimedia uploads [SD=2.44], 6.67 comments [SD=4.30], 17.22 likes [SD=10.43], and 6.11 emoji reactions [SD=19.39]. During this period, the 198 non-professional participants made .97 views [SD=2.44], and 37.19 multimedia interactions [SD=49.57]. Further, they made 1.09 posts per

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[11]Although the open pilot was conducted in Catalan, English speaking participants were chosen for the focus groups, as the authors did not speak Catalan.
[12]All sample quotes are translations from Catalan.

Fig. 6. A screenshot of an interaction from the Spanish open pilot. At the top of is a video of a documentary that two participants from the Flors de Maig choir recorded for the TV3 documentary in a cafeteria in Plaza Molina. The video has several timeline emoji reactions, and 6 comments below the video.

week [SD=1.24], 0.977 multimedia uploads [SD=2.44], 6.48 comments [SD=4.24], 15.25 likes [SD=9.51], and 4.57 emoji reactions [SD=18.50].

The top left of Figure 7 shows a pie chart summarizing activity between professional and non-professional participants. The 8 professionals (a primary choir director that conducted 3 choirs, 5 secondary choir directors, and 2 facilitators) made up 53.8% of the total activity, while the 198 non-professionals made up 46.2% of total activity on the tool. Further, P1, the primary choir director, made up 21.7% of the total activity, while the other 7 professionals made up 32.1% of activity. This suggests an extremely uneven distribution between professionals and non-professionals. However, this makes sense given the goal of the co-creation pilot, since the primary director was using the tool to upload sheet music and audio files, and other professionals were using the CCS to broadcast information. [13] The figure also shows the weekly number of views, comments, multimedia interactions, likes, emoji reactions, posts and multimedia uploads, divided

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[13]Some choir participants created accounts but dropped out of the project, which may have also contributed to such an uneven distribution in participation.

by professional and non-professionals. Both professionals and non-professional groups show unevenly distributed behavior through the 10 months. In both groups, there are peaks in activity, corresponding to the timeline of the opera co-creation process; for instance, a peak in all the statistics at week 16 corresponded to the first time non-professionals sang together, and the major peak at week 21 corresponded to preparing for an important showcase at the opera house. In contrast to the Irish pilot, professional activity in the Spanish pilot matched non-professional participation, suggesting both groups viewed and responded to content at similar intervals.

5.2.2   Text Content Analysis. A content analysis of Spanish pilot text was performed using the procedure described in section 4. [14] The original text was in Catalan, so it was automatically translated into English using AWS Translate,[15] and corrected by a native Catalan speaker for clarity before analysis. A treemap of the results are shown in Figure 8, with higher saturation indicating more positive sentiment. During the open pilot, Spanish participants primarily used the tool to express excitement or thanks (37.4%), and to respond to and reflect on media (18.8%). This makes sense as the overwhelming number of participants were responding to the choral co-creation content they were learning. Further, participants used the tool to discuss coordination (7.2%), to talk about the use of the Co-Creation Space (7.0%), to share and explain materials (7.0%), to reflect on in-person events (5.5%), and to respond to social media (4.5%). This is reflected in the professionals' work of sharing the co-creation media files to learn, and using the tool to coordinate the choirs. Further, discussions about in-person and social media events correspond to the social events that happened as choirs began to rehearse together. Participants infrequently used the tool for discussing art process (2.7%), for personal communication (2.7%), sharing social media (2.7%), and discussing the broader co-creation process (2.5%). Finally, they seldom used the CCS to discuss general technology (1.2%), and synthesis within the co-creation process (.08%).

5.2.3   Network Analysis. As with the Irish pilot, we performed a network analysis of content interactions between Spanish participants from the 1st through the 43rd week, with the goal of representing the structure of the discussion taking place in the pilot. Figure 9 shows four network graphs for weeks 10, 20, 30, and 43. In contrast to the Irish pilot, professionals dominated the discussion. Notably, the evolution of the network shows that while non-professionals interacted with one another at the beginning of the pilot (week 10), by week 43, most interactions were happening with professionals. In week 43, the network contains 34 nodes (users), and 37 edges (interactions).

5.2.4   Group Interview Feedback. Five (5) focus groups were conducted with 3 choir directors, 2 facilitators, and 9 non-professional participants in the last week of the open pilot. As with the Irish pilot, participant responses were analyzed by grouping responses to usage of the tool, and to its value.

Usage: Overall, participants used the Co-Creation Space to upload and discuss sheet music, audios, and choreography for the chorus, give calendar updates, and to share social experiences. One participant explained that it was "*a space to compile rehearsal materials and [important] moments*" (P6), and to comment on technical errors or corrections in music, such as German spelling (P13). The tool was also used by participants to reflect. For instance, P13 (a facilitator) described posting poetry that a singer had written about their participation experience, as well a letter another singer had written voicing frustration with a choral part that had been cut. The director of the choral group also explained that the purpose of the tool changed as the choirs transitioned from learning music independently, to rehearsing together. After the fifth month, the goal became to "*[show] the show*"(P1), sharing media about rehearsals and performances of the opera.

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[14]Irish and Spanish content analyses were performed together to generate the codebook described in Table 2.
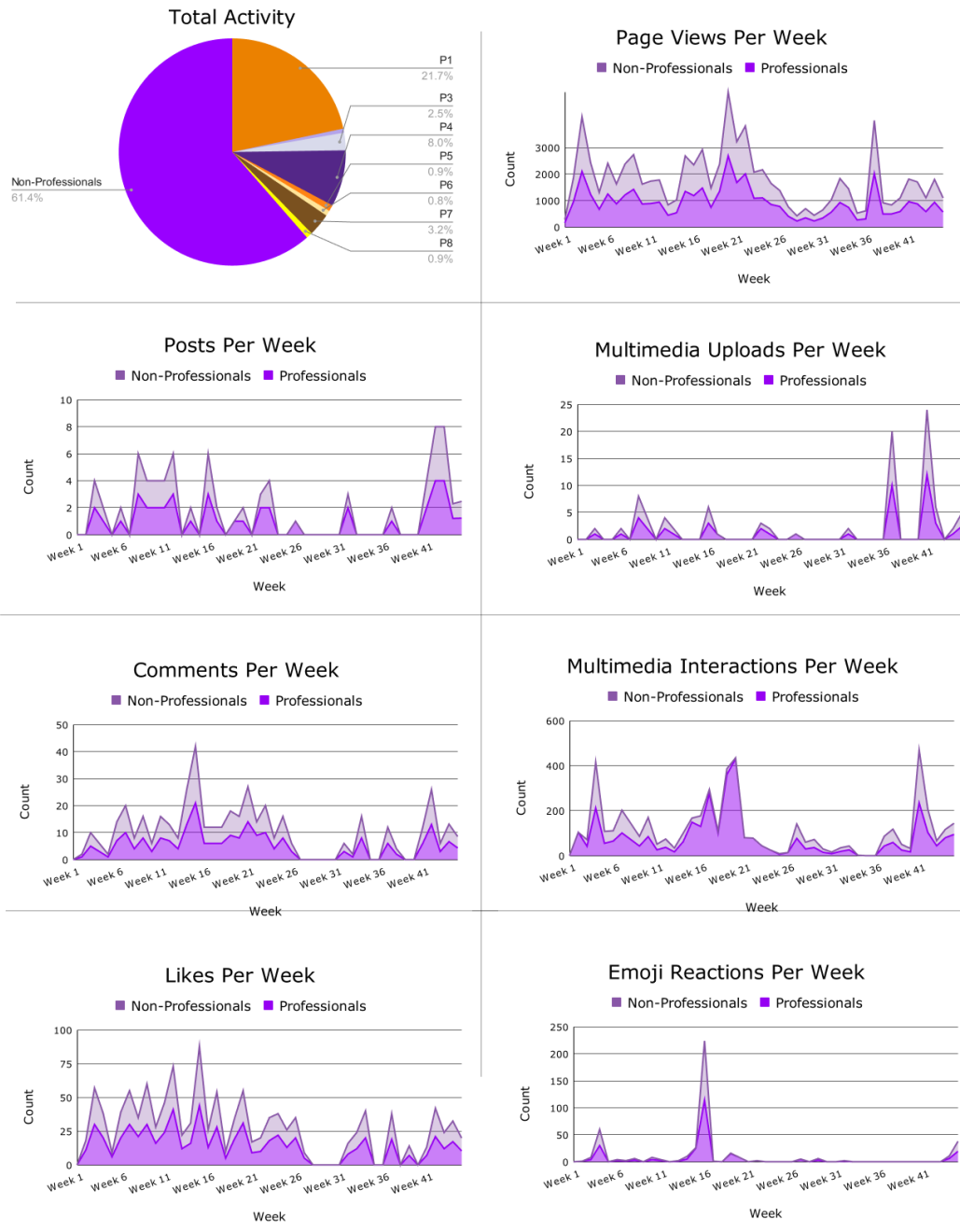
[15]*https://aws.amazon.com/translate/*

Fig. 7. Top Left: Overall activity by Spanish pilot participants, divided by professionals and non-professionals. The figure also shows the weekly number of views, posts, multimedia uploads, comments, multimedia interactions, likes, and emoji reactions, divided by professional and non-professional activity.

17
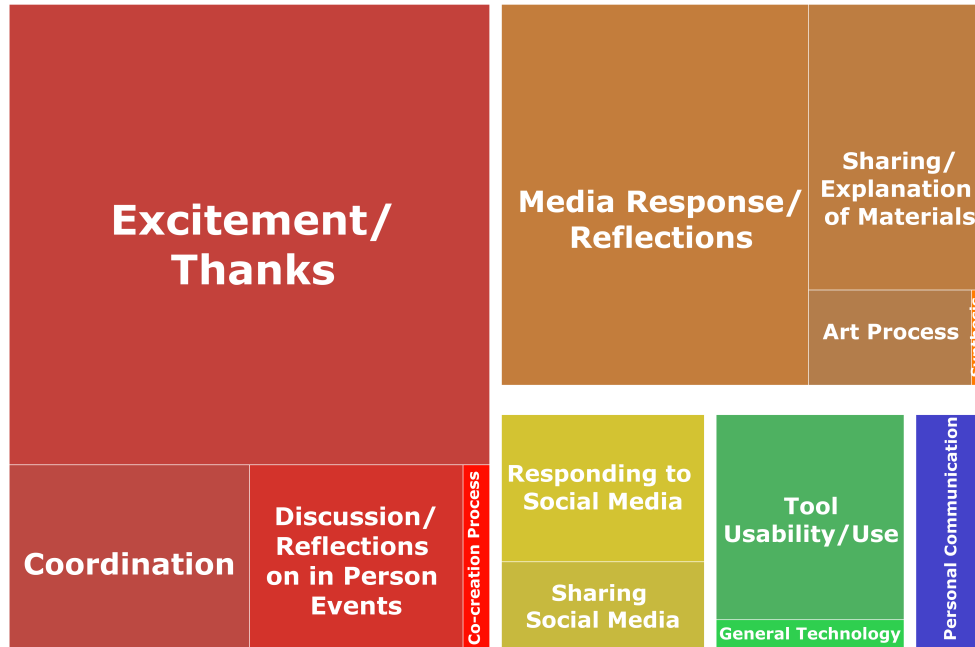
Fig. 8. Analysis of the Spanish open pilot CCS text, shown as a treemap: 13 codes organized by 5 categories: *Technology, Focus on Media, Co-creation Process, Social Media*, and *Miscellaneous*. Differences in average sentiment for the codes are visualized by color saturation. Participants primarily used the tool to express excitement or thanks, and to respond to and reflect on media.
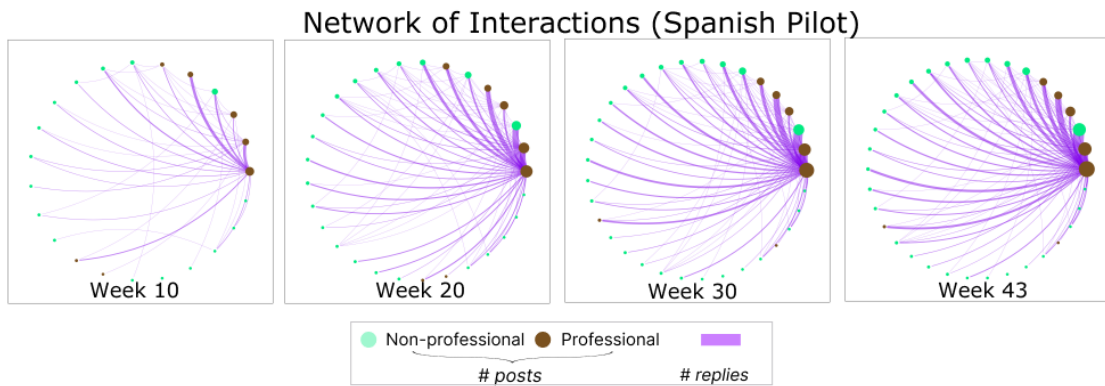
Fig. 9. A network visualization of Spanish pilot interactions between users. While non-professionals interacted with one another in week 10, by week 43, most interactions were happening with professionals.

While some directors used the CCS to communicate with community members, we found that community participants did not engage significantly with the tool, and many did not log in after onboarding. One reason for this was that the choirs had pre-established social communication channels; "*they were already using other tools where they share audios and other materials*"(P8). For instance, one director explained that they had created several Telegram channels in their

group, "*one for events, the calendar, a channel for soprano, contralto, and another for chat.*" People used existing tools for informal communication, such as telling participants not to wear flip-flops to rehearsal (P1), or for private information, such as communicating emotions (P2), because they "*already had each other's WhatsApp accounts*"(P1). Participants likewise used familiar tools to share social media about the co-creation process. Several interviewees said they had posted pictures and recorded stories of their experience on Instagram (P5, P6, P9), and one participant commented that "*there's tons of pictures and videos in the WhatsApp group shared this week*"(P9). Notably, one participant thought that they would have used the CCS more if Instagram was integrated into the tool (P5) because they wanted to share what they were doing with family and friends. In addition to using familiar channels, participants explained that they did not need to formally document their social experience because the [Name] opera house had a monthly newsletter that showcased the choir, and there was a mini-series being developed about the new opera.

Value: Participants differed in their valuation of the Co-Creation Space. The primary choir director appreciated that the CCS was a single place to share music in a more organized way than having a Google Drive folder. Further, communicating through the tool was better than "*getting late night messages*"(P1) on her phone. In contrast, another choir director just wanted "*a fast and easy way [to get the music]... I don't need all this complication*" (P7). Further, since choir directors sent singers the files through other apps, one singer "*never felt the need to get into the tool, because...[other] people in choir [will] send [me] midis,*" explaining "*[I'm] not going to log in because its an extra tool*"(P9). This resulted in many participants not finding the Co-Creation Space valuable; "*seeing the use that the directors are doing is fine, but I don't see need to be participating,*" P5 explained. Notably, some users began to use to the tool, but stopped using it when it didn't pick up traction; "*when they presented the tool, I thought that it would be great [and] started uploading pictures, text,*" P6 comment. However, they stopped using the CCS when other "*singer [didn't] upload things.*"

6 DISCUSSION

We consider how technology may support artistic co-creation discussion dynamics through the evaluation of the *Co-Creation Space* (CCS), to help community artists generate raw artistic ideas, and discuss and reflect on the shared meaning of those ideas in a multilingual safe space. In the context of community opera, we conducted two open pilots of the tool; the first, a 12 week open pilot with 13 Irish participants focused on materials co-creation of a opera composition, whereas the second, a 43 week open pilot with 206 Spanish chorus participants focused on performance co-creation of a new opera developed for the [Name] neighborhood in Barcelona. We analyze our results using mixed quantitative and qualitative methods; the quantitative use metrics allowed us to understand the actual usage of the CCS in the wild by professional and non-professional participants, the text content analysis allowed us to understand the types of activities participants engaged in using the tool, and the group interviews provided a human perspective on CCS usage and value.

While the CCS generated camaraderie and supported discussion and reflection, we found that the tool was over-whelmingly more valuable for the (smaller) materials co-creation pilot. This section thus reflects on the differences in dynamics between the two pilots, and identifies three technology needs to support divergent artistic co-creation: 1) *flexible space segmentation*, 2) *explicit and implicit communication methods* for technical and emotional needs, and 3) *the importance of considering feature affordances* in context of existing app ecosystems.

6.1 Limitations

The Co-Creation Space was originally designed for and tested in the context of opera [1, 2], as part of the [Name] European Project; this project also included the two opera co-creation projects that the two pilots were part of. The user-centered process and tool requirements were thus informed by the needs of these particular groups, which may

be different from the needs of other artistic co-creation activities. Our work is further limited by the dynamics of the real world pilot activities; we introduced the tool to the facilitators of the open pilots, but did not obligate them to use the tool, or restrict them from using other social network and communication tools, as we wanted to understand the natural value of the emergent dynamics. Further, the co-creation activities were not chosen or managed by us; leaders and facilitators had their own interpretations of CCS affordances, and used the tool accordingly. [16] Finally, as both pilots were community projects, some participants dropped out after signing up for the tool.

Due to being tested in-the-wild, it is difficult to determine whether the dynamics that resulted from the pilots were due fully to the different types of co-creation activities, respective size, and other factors, such as differences in community culture dynamics. Future work will validate our findings through open pilots in different performing art contexts and community production processes, as described by Green and others [4, 20, 21], and in more controlled contexts where the the CCS is the primary tool being used.

6.2 Considering Artistic Co-creation Based on Co-creation Activities, Social Structure, and Size

We found that co-creation activities and social structures affected the use of the Co-Creation Space; in the smaller Irish pilot, participants contributed to music materials for an opera, whereas the larger Spanish pilot engaged singers in the co-creation of a performance. Irish participants completed a defined sequence of creative tasks, such as making compositions using household items (e.g. Figure 2). This finding is reflected in the text content and network analyses; Irish participants primarily responded and reflected on media (44.04%), shared and explained materials (22.02%), and discussed their art process (10.11%) (Figure 4), resulting in a network with professionals and non-professionals participating in conversations with another throughout the pilot (Figure 9). In contrast, Spanish participants used the tool to disseminate music files (notes, audios, and videos), to learn music for an opera, and to share media from rehearsals and performances. The text content analysis (Figure 8) shows that Spanish participants primarily used the CCS to express excitement and thanks about the project (37.4%), and respond and reflect on rehearsal media (10.8%), and the network diagram (Figure 9) shows the resulted "broadcast" model, with few interactions between non-professional participants. This resulted in different valuations of the tool; Irish participants felt that the tool "*opened up a new world for creative expression*" (P3), and made people feel that they were all "*in the same room*" (P1), whereas Spanish participants felt the tool was redundant.

One reason for such differences in valuation may be attributed to the *clarity of the co-creation goals* [29] for which the tool was used, and the *conspicuity and reciprocity of non-professional participation* [16] in those goals. In the composition pilot, non-professional users had a clear goal, to upload and give feedback on composition materials, and clear conspicuity and reciprocity needs (they saw each other's work and gave feedback on materials). In contrast, during the choral pilot, professionals used the tool to broadcast information, but community users did not have an explicitly defined interaction goal other than downloading materials (something they needed to do once), giving feedback on materials, and sharing social media about the progress of the opera. While some users gave feedback on materials (e.g. a participant correcting the pronunciation of a passage in German), such instances were exceptional because the co-creation activities did not explicitly ask for feedback, and did not create an environment of reciprocity. This is reflected in literature in learning and games, that clearly defined goals and clear feedback are vital to sustain motivation [19, 26, 27, 30], and in social network literature expressing the importance of creating content that actively engages users in discussion [25]. Since Spanish participants did not have an explicit role in the tool, the quantitative

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[16]Notably, some media editing features (image annotation and video segmenting features developed in response to requests from Spanish pilot leaders) were not used at all by participants, and were not included in our analyses because they were not comparable across the two pilots.

metrics show that they did not engage significantly with the tool; compared to the 11 Irish non-professional participants who made on average 240.75 views and 4.33 posts per week, the 198 Spanish non-professionals made only .97 views and 1.09 posts per week. This is also reflected in the interviews, where participants explained that they shared social media posts through more familiar channels.

Social structures and pilot size were likewise different. The Irish pilot was guided by one composition instructor, and consisted of a new group of participants who did not know one another. In contrast, Spanish participants were guided by several choir directors, and consisted of choirs that already knew one another. Further, the Spanish pilot included a 'pyramid' (P5) of leadership; one leader managed all of the choirs, working with choir directors, who worked with their respective choir members. This pyramid leadership is reflected in the text content analysis and network diagrams, showing that participants primarily used the tool to express excitement and thanks about the project and reflect on media, and interacted with professionals rather than each other.

These differences helped us identify a second challenge: how to design for artistic co-creation on a large scale. Social network literature [25] suggests that a successful network continually engages users with fresh content, and resolves ambiguity across communication channels. This is consistent with our findings; in the Irish pilot, the primary facilitator gauged participant needs and respond with engaging content, whereas in the Spanish pilot, the participant pool was so large that facilitators used a depersonalized broadcast model, which may have made users feel less connected [10]. This finding is shown in the network analysis across the two pilots, wherein the Irish participants show more equitable conversation dynamics between professional and non-professional participants than in the Spanish pilot. Further, Spanish pilot interviews suggested that participants used a number of existing channels to communicate, which may have created ambiguity about how and when to use our tool.

While networks can make users feel connected and emotionally supported [10, 15], within a large network, activity fluctuates rapidly; a majority of users display little activity, with only a small fraction of users that are highly active [48]. This is consistent with the Spanish pilot, that showed user activity fluctuating in response to co-creation events (Figure 7), and many users did not engage with the tool. Even though the CCS united all of the choirs and could have created a support network between non-professional users, many participants stopped using the tool in favour of other communication channels. Thus a secondary challenge is to create and sustain social engagement [31] in context of volatile participant activity. As non-professional artists are volunteers (often with limited time and resources), designing for artistic co-creation on a large scale is particularly challenging.

Finally, it is not obvious whether professional and non-professional artists should have equitable roles as a community co-creation project scales. This is because inherent inequality in dynamics between professional and non-professional users introduces a discrepancy between the equitable definition of co-creation in participatory art [16], and the dynamics of performance co-creation; *perhaps the definition of artistic co-creation should be reconsidered to account for the divergent needs of materials and performance co-creation.* Such co-creation dynamics may benefit from a different set of tools, that prioritize coordination tasks, and employ existing social channel dynamics.

6.3 Supporting Discussion in Different Co-creation Dynamics

The Co-Creation Space addresses a gap in supporting equitable discussion and reflection around media in artistic co-creation technology, by helping community artists generate raw artistic ideas, and discuss and reflect on the shared meaning of those ideas in a shared safe space. However, the relative differences in use and value of the tool between the two trials suggests that designing technology in this context must account for differences in contextual needs. We thus present 3 technology needs for this domain; 1) artistic co-creation technology should support flexible space

segmentation, 2) direct and indirect communication channels, and 3) should consider new tool features in the context of existing app ecosystems.

6.3.1 Need 1: Support Flexible Space Segmentation. A primary difference between the Irish and Spanish pilots were the number of participants and the existence of sub-groups; in the Irish pilot, all participants worked together as a group, whereas the Spanish pilot was formed from pre-existing groups. This resulted in differences in use and value of the CCS. While Irish participants liked the simplicity of the text timeline, Spanish participants thought that it was "*difficult to find files*"(P5) on the timeline, and when they were trying to look for old files they "*really [had] to scroll*" (P7). Instead, they wanted to create clearly marked sections for different voices, similar to that which one choir leader had done using Telegram (P11). Further, Spanish participants wanted a distinct photo repository of memories. "*We took a lot of good photos, it would be a shame not share...maybe [you would be] surprised to be in a photo that you weren't expecting*," P9 explained. This highlights a notable difference between the pilots; since the Irish pilot was conducted over Zoom and did not include a rehearsal or show, participants did not need to separate technical from informal media, whereas Spanish participants did. This suggests that artistic co-creation tools should support flexible space segmentation that allows communities to self-segment into sub-groups, and to segment posts into distinct channels.

6.3.2 Need 2: Support Direct and Indirect Communication Channels. Differences in participant groups led to differences in direct and indirect communication needs. Unlike Irish participants, Spanish participants wanted segmented "*professional and internal*"(P2) channels that differentiated official notifications from teachers and directors (e.g "*today's rehearsal has been canceled*") from messages like "*have a great summer*"(P1). For official channels, Spanish participants requested ways to gauge participant comprehension. For instance, one choral director wanted a reading check confirmation "*like in WhatsApp...[but where] participants would click to confirm that they had actually read what was sent to them.*" (P11). Further, Spanish participants needed indirect ways of communicating emotions; whereas the smaller Irish group felt the CCS was a "*virtual safe space*"(P7), Spanish participants reported that they did not feel comfortable posting personal concerns to a forum of so many people. Instead, one interviewee suggested including an indirect "*how you are feeling*" rating system about rehearsals, with a chance to provide "*clarification and comments*" (P9) about positive or negative experiences. To support such differences in communication, artistic co-creation tools should support both direct and indirect communication channels that give users a chance to view and respond to content in ways they feel most comfortable. Future work should consider differences in long and short communication forms, as well as communication to support technical vs. emotional needs.

6.3.3 Need 3: Consider Features in Context of Existing App Ecosystems. Maximizing user experience and ease of development led to practical design choices, such as building a responsive web-based tool that could be used on both computers and mobile devices. Further, we scoped the CCS to focus on discussion and reflection dynamics based on gathered user requirements [1, 2], and created a clean aesthetic that could fit different co-creation needs. However, our open pilot findings reveal tension between our practical design choices and some affordances users were accustomed to, such as getting pop-up phone notifications, a difficult feature to implement in browser applications. Relatedly, younger users from the Spanish pilot were put off by our simple interface because they expected a tool connected to existing social media. Notably, this is a stark contrast to Irish participants, who valued the private space afforded by our tool. These findings highlight tensions between using existing tools for artistic co-creation, and designing new community tools in an already saturated social app ecosystem [25, 31, 32]; existing tools carry emotional connotations, which may affect participants' willingness to engage in the co-creation process. For instance, a participant in the Irish pilot

noted that they would not have had such deep interactions if the pilot had happened in a Facebook group. Further, designers should consider the relative value of developing standalone artistic co-creation tools with specific affordances, vs. integrating those tools with existing apps, which may lead to contradictory messages across different channels [25].

Aesthetics must likewise be considered in context of existing tools, particularly one dominated by industry giants; companies who routinely spend millions on user research and development, and whose goal is often to create beautiful visuals rather than meaningful interactions. While Irish participants appreciated the purpose-built design of the tool, positively contrasting it to social media like Instagram and TikTok, young Spanish participants were put off by an aesthetic that did not match that of highly visual social media tools. This leads to a dilemma of whether to design for use or aesthetics; "*we have to consider...if we want the tool to be truly useful, or if we want to be attractive*" (P1) a choir director considered. Future work may address this need by giving co-creation participants some customization of the visual presentation of the interface through layout and color templates for the high-level presentation of media, and by allowing participants to feel that "*the platform is something that is [theirs]*" (P9) through simple engagement, such as allowing participants to make different avatars for their profile (P11).

7 CONCLUSION

There is a gap in supporting equitable discussion and reflection around media creation in artistic co-creation technology. In response, this work considered how technology may support conversation dynamics around media in participatory art through the evaluation of the *Co-Creation Space* (CCS), to help community artists generate raw artistic ideas, and discuss and reflect on the shared meaning of those ideas. We evaluated the tool in two opera co-creation contexts; a *materials co-creation* open pilot with 13 Irish participants in a composition workshop, and a *performance co-creation* open pilot with 206 Spanish choral participants of a large scale opera performance. We found that the tool inspired a sense of togetherness and positive discussion and reflection dynamics in the materials pilot, but did not fully fit the needs of the performance co-creation pilot. In response to these findings, we consider the differences in co-creation activities, social structures and size of the two pilots, and identify three needs to support diverse co-creation activities: 1) flexible space segmentation, 2) explicit and implicit communication methods for technical and emotional needs, and 3) the importance of considering feature affordances in context of existing app ecosystems. Through our work, we hope to support artistic co-creation in participatory art experiences.

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