

Exquisite Score: A System for Collaborative Musical Composition

Daniel Manesh
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, Massachusetts
maneshd@alum.mit.edu

Eran Egozy
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, Massachusetts
egozy@mit.edu

ABSTRACT

Exquisite Score is a web application which allows users to collaborate on short musical compositions using the paradigm of the parlor game exquisite corpse. Through a MIDI-sequencer interface, composers each contribute a section to a piece of music, only seeing the very end of the preceding section. Exquisite Score is both a fun and accessible compositional game as well as a system for encouraging highly novel musical compositions. Exquisite Score was tested by several students and musicians. Several short pieces were created and a brief discussion and analysis of these pieces is included.

Author Keywords

Collaborative Composition, Surrealism, NIME

ACM Classification

H.5.3 [Information Interfaces and Presentation] Group and Organization Interfaces – Collaborative Computing,
H.5.5 [Information Interfaces and Presentation] Sound and Music Computing

1. INTRODUCTION

Exquisite corpse is a game popularized by surrealists in the 1920's wherein artists collectively assemble an image. In one variation of the game, also known as picture consequences, three players begin by folding a paper into thirds. Player one draws a head in the top third of the paper, extending the lines just over the edge to the middle third. Player one then folds the paper and passes it on to player two. Player two, seeing only the bottom edge of player one's drawing, draws a torso and arms on the middle third of the paper, again extending lines slightly over into the bottom third. Player two then folds the paper again, passing it to player three, who, seeing only the bottom lines from the arms and torso, finishes by drawing the legs [10].

In another, word-based variation, players begin by agreeing on a sentence structure, for example "The *adjective noun verbs* the *adjective noun*." Players then pass around a paper, filling out the sentence one word at a time, unaware of the preceding words. The name exquisite corpse comes from a particular sentence created in this manner: "*Le ca-*

uvre exquis boira le vin nouveau," meaning "the exquisite corpse shall drink the new wine" [7].

Exquisite Score aims to bring the creativity and novelty of the exquisite corpse paradigm to musical composition.

1.1 Elements of the Exquisite Corpse Paradigm

While many variations of the exquisite corpse game exist, all share the same basic idea: a piece of art is collaboratively constructed by several artists and each artist receives only limited information about the previous artists' contributions.

To describe aspects of the exquisite corpse, this paper will make use of the following terminology:

Fragment The artistic contribution of one individual. Multiple fragments are stitched together to form a complete piece.

Occlusion Refers to what is blocked from each contributor. In the drawing game, all but the edge of the paper are occluded.

Hint The section of the previous fragment or fragments that a contributor sees when they create their own fragment.

Shared Region The area of a contributor's fragment that will be seen by other contributors. The shared region for one contributor becomes the hint for the next.

Contextual Backbone The extra context a contributor has beyond the hint. For example, a contributor might know they are meant to be drawing legs.

2. BACKGROUND AND PRIOR ART

The exquisite corpse paradigm easily lends itself to musical composition and several musical exquisite corpses exist. One example is an hour-long exquisite corpse piece commissioned and performed by the Zephyr Quartet for the Adelaide Festival of the Arts in 2016 [4]. The piece was constructed by twelve composers who each saw only the end of the previous composer's fragment. Another example is a set of collaborative pieces featured on the website Think Jar Collective, where each piece was assembled by six composers. Instead of breaking up the composition into temporal segments, composers each contributed a single track and the finished product is all the tracks played simultaneously [2].

Exquisite Score aims to bring the musical exquisite corpse to a wider audience by enabling easy exquisite-corpse style composition in an online environment. Similar online applications exist for non-musical exquisite corpses. One example is Xavier Barrade's *Epic Exquisite Corpse*, an online implementation of a drawing-based exquisite corpse. The



Licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). Copyright remains with the author(s).

NIME'17, May 15-19, 2017, Aalborg University Copenhagen, Denmark.

website is a single, massive black-and-white collage composed of over 75,000 contributions [9]. Unlike in Picture Consequences, where the complete picture is supposed to be a human-like figure, Epic Exquisite Corpse has no contextual backbone: there are no guidelines for what the completed picture should be.

Another online example is *Folding Story*, a website which lets users play a word-based version of exquisite corpse. In *Folding Story*, each user contributes a fragment to a story based only on the previous fragment, where each fragment is fewer than 180 characters. Additional context is given to contributors in the form of their fragment's position and the total number of fragments in the story [3].

3. GOALS AND MOTIVATION

3.1 Design goals

The overall goal of this project is to make an online system which allows users to compose a piece of music using the exquisite corpse paradigm. Before starting, we set out three design goals which informed the development of Exquisite Score and which can serve as a framework for evaluating the project's success. The goals are as follows:

3.1.1 *Compelling Collaborative Pieces*

Individual contributions should be stitched together to create a complete piece, and the system needs to be powerful and general enough such that the resulting piece can be musically interesting and compelling. It should be clear who composed which sections of the piece so listeners can understand the overall compositional narrative.

3.1.2 *Meaningful Occlusion*

Enough of the previous work on a composition should be hidden so that the next composed section is surprising and perhaps unusual, but not a total non-sequitur. The occlusion should facilitate pieces to be locally cohesive but globally meandering.

3.1.3 *Accessibility to Non-composers*

A good comparison for accessibility is the paper-and-pencil version of exquisite corpse. Most people can fold over a paper, pick up a pencil, and draw. Naturally better artists may produce better individual sections, but that does not preclude amateur artists from enjoying the game and producing a satisfying result. Similarly, someone with minimal compositional experience should be able to contribute to a piece with this system.

3.2 Motivation

Apart from being an amusing diversion, a system like Exquisite Score has educational and artistic value.

3.2.1 *Educational Value*

Applying the exquisite corpse paradigm to music allows users to explore musical composition through both practice and observation. In terms of practice, the exquisite corpse lowers some of the barriers to composition, making it easier for novices to engage with music. One such barrier is commitment: it is easier to commit to writing a single fifteen-second fragment than a complete two-minute piece. Another barrier is self-consciousness or fear: a composer has less pressure in an exquisite corpse because composition is presented as a game where pieces are expected to sound strange and disjoint as the result of occlusion. Besides simply encouraging composition, the exquisite corpse provides the unique challenge of working off of someone else's composition, forcing the composer to start from source material

that might be very different from what they would have composed themselves.

In addition to compositional practice, the exquisite corpse encourages users to engage with music through observation and listening. Users are exposed to several fragments from a variety of composers with different styles and skill levels. Furthermore, if the hints and shared regions are marked in the final composition, the listener can examine closely how each composer connects their fragment to the hint they were given. This provides a more directed listening experience and allows the user to consider what they might have done differently given the same information.

3.2.2 *Artistic Value*

André Breton described the exquisite corpse as “an infallible means of sending the mind's critical mechanism away on vacation and fully releasing its metaphorical potentialities” [1]. In a way, the exquisite corpse enforces artificial creativity. Pieces composed using the exquisite corpse paradigm probably would not have come about without the occlusive elements. The resulting pieces may be meandering or disjoint, but they might also be creative and adventurous. There is a tradeoff: unity and intention versus creativity and surprise.

If one views the exquisite corpse as a method for generating spontaneity and surprise in music, it is worth comparing it with the ultimate form of spontaneous collaboration in music: improvisation. In improvisation, players typically get to hear all other contributions, but they must produce music on the spot, and players do not necessarily have the time or memory to fully process everyone else's contributions. The spontaneity and creativity in improvisation are the result of the immediacy of sound creation. Through occlusion, the exquisite corpse provides a different avenue for spontaneity, resulting in less pressure and more time to think.

4. SYSTEM DESIGN AND DESCRIPTION

4.1 A Musical Exquisite Corpse

As discussed earlier, there are many variants of the exquisite corpse paradigm across different media, with different contextual backbones and differing levels of occlusion. Exquisite Score implements a musical variation with partial occlusion and a weak contextual backbone. The game is played as follows: First, someone sets up the parameters of the piece, such as instrumentation, fragment length, and piece length. Then, the first user composes a fragment of music, maybe eight measures long. Each consecutive composer will see a short hint from the previous composer, say the last four measures. In addition, each composer is told where their fragment occurs in the piece, e.g. “now composing fragment 6 of 8.” This constitutes the only additional information for the contextual backbone.

This scheme can be thought of as linear, temporal occlusion. It is linear because the fragments are composed in the order they will be played in the final piece, and it is temporal because composers have full information about what the hint sounds like and about what their fragment will sound like: no sounds are hidden during those time slices. A possible alternative to temporal occlusion is part-wise occlusion, for instance, if one composer writes a bassline and two other composers write a duet over the bassline, only seeing the bassline and not the other melody. Temporal occlusion was chosen because of its conceptual simplicity and because it encourages local cohesion: even if composers cannot control what happens before and after their fragment, they can at least have complete control over their temporal slice.

Besides arranging the fragments in the order they are composed, there are many other plausible arrangements. For example the beginning and end of a piece could be composed first, and the middle fragment last, wherein the middle fragment would receive a hint from both of its neighbors. We chose the linear construction because of its simplicity, though additional models are briefly explored in [5].

4.2 System Description

Exquisite Score is a web application which uses the Python Flask framework connected to a PostgreSQL database. It is hosted on a virtual machine and is, at the time of writing, accessible at <https://exquisitescore.xyz>.

The client presents a musical editor created in HTML and Javascript using SVG and HTML5 canvas elements. For audio playback, Exquisite Score makes use of the MIDI.js library which synthesizes notes by playing samples via the WebAudio API.

Exquisite Score has individual user accounts and uses Google to authenticate and log in. With user accounts, we can assign an identity to each fragment. This allows users to see who composed each fragment and also ensures that a composer is unable to compose two consecutive fragments.

A user signs in and is presented with a list of pieces, some in-progress and some completed. From here, the user can click on an in-progress piece to contribute a fragment, click on a finished piece to listen, or create a new piece.

4.3 Composing a Fragment

The compositional interface is a piano-roll style MIDI sequencer, similar to the standard MIDI editors found in many digital audio workstations like Ableton Live or Garage Band. Notes occupy a large grid, where the x-axis denotes time and the y-axis denotes pitch. A user can create new notes and move, lengthen, shorten or delete existing notes. Users can toggle audio playback so they can listen to what they have composed so far.

If the fragment being composed is not the first fragment, the composition starts off with a greyed-out, un-editable hint section, the end of the previous composer's fragment. An example is shown in Figure 1. If the current fragment is not the final fragment of the piece, the section at the end of the fragment is marked as the shared region, which becomes the hint for the next composer. Figure 2 shows how the shared region is demarcated. A composer cannot submit a piece if there are no notes in the shared region.

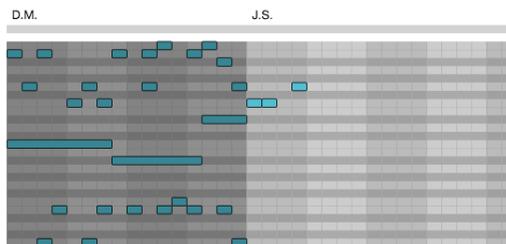


Figure 1: At the start of each fragment, the composer is presented with a hint from the previous fragment.

When a user starts composing, a lock is placed on the piece which prevents other users from composing a new fragment for that piece at the same time. To finalize a fragment, the user clicks the submit button, which saves that fragment and releases the lock on the piece. If a user leaves a fragment unattended for more than thirty minutes, the fragment is deleted and the lock on the piece is released.

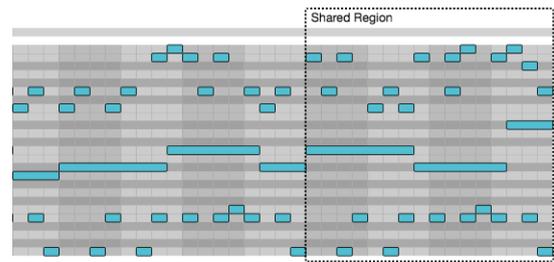


Figure 2: The end of a fragment with the shared region marked. This fragment immediately precedes the fragment in Figure 1, so the shared region here is presented as the hint in Figure 1

4.4 Viewing Pieces

Once a fragment is submitted, the composer is allowed to view the entire piece up to and including their contribution. This is done so the composer can see how their fragment fits in with the previous sections while their contribution is still fresh in memory. The alternative is to prevent anyone from viewing a piece until it is completed. This would be impractical because there is no guarantee for how long it takes to complete a piece and it is possible a piece will never be completed at all, meaning the composer would never get to see how their fragment is incorporated.

Any user can view any completed piece, even if they are not signed in. When viewing a piece, users are brought to a screen similar to the compositional interface, but with editing disabled. The start of each fragment is labelled with the composer's name so that users can follow the narrative of how the piece was created as it plays.

If a user has not yet contributed to an in-progress piece, that user is not able to view it, since this would enable them to bypass the occlusion.

4.5 Creating a Piece

When creating a piece, the user chooses a variety of parameters relating to the piece's instrumentation and overall form. The instrumentation parameters are the number of tracks, the instrument patch for each track (chosen from the General MIDI set), and the volume and pitch range per instrument. The form-related parameters are the fragment length, the number of fragments in the piece, and the length of the hint.

5. EVALUATION AND ANALYSIS

Exquisite Score was tested by 34 subjects, including professional composers and university students with varying musical backgrounds. Each subject composed at least one fragment, and in total, five pieces were completed, each comprised of eight fragments. In addition, 19 of the subjects completed a survey about their experience.

Based on the survey results, subjects generally enjoyed Exquisite Score. In the open-ended feedback, many subjects explicitly mentioned they found the experience fun. Subjects were delighted to see how the pieces evolved and how their contributions fit in. One subject said "I had a lot of fun composing a thing and listening to it afterwards - it wasn't quite what I expected from the snippet I'd heard." Another subject mentioned they were surprised that their fragment "ended up in a totally different genre" from the rest of the piece. Subjects also enjoyed listening to other completed pieces. One subject noted "It was interesting to see how other people took bits from the parts they'd been able to see to try to make it flow nicely, but it still sounded really

interesting.” Overall the occlusion seems to have worked nicely: enough was hidden that the pieces evolved and explored a breadth of musical ideas, but enough was shared between fragments such that one fragment could transition smoothly into the next.

The surveys also showed that subjects’ experiences varied based on their prior levels of compositional and musical experience. Unsurprisingly, professional composers tended to ask for more power and versatility in the editor, for instance including the ability to change the rhythmic grid, add new instruments, or expand the pitch range for each instrument. On the other hand, subjects who were not familiar with musical composition sometimes found the interface intimidating. One subject offered the suggestion of including an option to limit the notes to certain keys to make composing more approachable. The results indicate that in its current state, Exquisite Score offers a better experience to those with prior musical training. Though the system is still usable by novices, some combination of simplifying the interface and providing lessons or tutorials may make Exquisite Score even more beginner-friendly.

5.1 Qualitative Analysis

The resulting pieces had a large degree of novelty and variation and made for quite a fun and enjoyable listen. Each fragment lasts for about 10 seconds, which seemed just long enough for a composer to start developing an idea. Of course, because of occlusion, the next composer usually could not follow through on the previous musical idea, so in the end there were at least as many musical ideas as fragments. Besides juggling several motifs, pieces also hopped around between different genres and styles. For example, in a piece titled “The Funk,” the third fragment sounds like dance music while the fourth sounds like a children’s song, and later, the sixth sounds markedly abstract and nebulous while the seventh is a simple melodic line with minimal accompaniment.

Despite all the variation, pieces ended up sounding mostly continuous and fragments usually transitioned smoothly from one to the next. One common way composers joined their fragment with the previous one was by repeating the bassline. An example of this from “Piece 1” is shown in figures 3 and 4. Here, the bassline pattern that first appears in the shared region of the fourth fragment is copied and repeated throughout the fifth fragment. The bassline even continues through the beginning of the sixth fragment, though it changes partway through, and of course is lost for the rest of the piece. Still, this is a rare occurrence, since musical material from one fragment usually does not make it past its immediate neighbor.

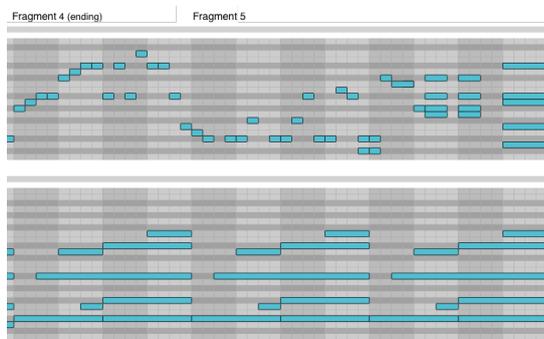


Figure 3: The bassline figure from the end of the fourth fragment is repeated throughout the fifth fragment.

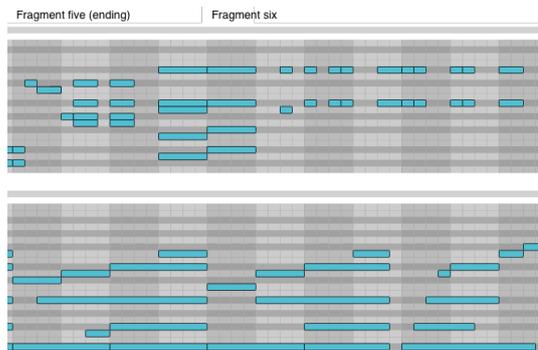


Figure 4: The bassline from the end of the fourth fragment persists all the way until the start of the sixth, where it is later abandoned.

Many composers managed to create continuity through harmony and style. This is especially apparent in “Piece 2,” where fragments two through six were written by professional composers. The harmonies transition flawlessly from fragment to fragment, and the general style and texture stays the same. Although virtually no motivic material is shared between these fragments, they still sound as if they were composed by just one person. The seventh fragment in “Piece 2,” shown in figure 5, is particularly amusing. The harmonic transition from the sixth fragment is seamless, and the seventh fragment even expands upon a rhythmic motive from the sixth fragment, repeating it with diminution to build tension. Halfway through, the composer decides to play a joke and very abruptly transitions to a simple version of Jingle Bells. The entire hint for the composer of the eighth fragment is just the tune of Jingle Bells, so the very successful continuity we get from the first six-and-a-half fragments is thwarted, and the piece ends with a slightly more ornamented version of Jingle Bells.

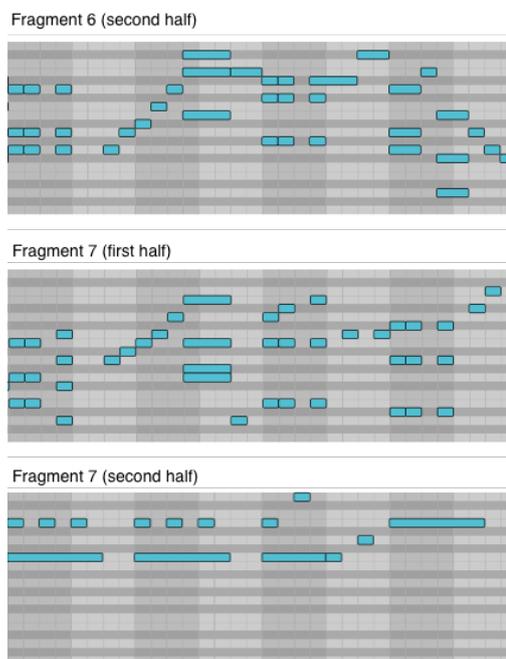


Figure 5: An excerpt from one of the completed pieces with the bassline omitted. Half-way through the seventh fragment, the composer plays a joke and abruptly switches to “Jingle Bells.”

5.2 Quantitative Analysis

In order to quantitatively measure the continuity of a piece, we analyzed the corpus of submitted pieces by measuring the similarity between musical fragments.

5.2.1 Defining a Similarity Metric

The overall strategy for measuring similarity between two fragments is to first convert the fragments into normalized feature vectors and then to take the dot product of those feature vectors to get the similarity score, also known as the cosine similarity [8].

The features we used were inspired by the MIDI feature extractor jSymbolic [6] and included attack density, average note duration, fraction of attacks on offbeats, average pitch, prevalence of minor, major, diminished and augmented triads, pitch class variety, and, for each pitch class, the proportion of all notes with that pitch class.

When analyzing a fragment, we flattened the individual parts, ignoring instrumentation. Instrumentation was ignored because the composers did not actually get to choose this, and it would artificially make fragments within the same piece look more similar to each other. Different parts were flattened because some pieces had only two parts while others had three, though one could imagine a more robust analysis which separated parts based on whether or not they were melody or accompaniment.

Many features needed normalization in order to prevent them from dominating the feature vector. For example, although features like the major triad prevalence cannot be more than 1.0, the average pitch of a fragment might be something like 62 (MIDI for D5). In order to ensure each feature ranged from 0 to 1, for each feature not bounded by 1, we normalized that feature by dividing by the maximum value among all the fragments.

5.2.2 Results

One way to measure continuity is to examine how a piece evolves from its initial fragment. To do this, we took the first fragment of each piece and compared the similarity score between this fragment and each later fragment. One would expect the first fragment to be most similar to the first few fragments and relatively unrelated to the later ones. In Figure 6, we graph the similarity scores from the first fragment to each subsequent fragment for two pieces: “Piece 1” and “Piece 3.” In this case, we only used the proportional pitch class prevalences for the feature vector. For these pieces, the results matches our expectations: fragments closer to the first fragment have higher similarity scores. For this analysis, the results were a lot noisier when taking into account the full set of features for the feature vector.

Another way to measure the continuity in a piece is to measure the similarity between adjacent fragments. For example, if fragment B was composed right after fragment A , we would expect A to be more similar to B than to a random fragment. To measure this, we took each pair of adjacent fragments A and B and calculated a “comparative similarity score” defined as the fraction of fragments C for which $A \cdot B \geq A \cdot C$. A score of 1.0 means that A is more similar to B than to every other fragment, while a score of 0.5 indicates that A is not correlated with B .

The comparative similarity score can be calculated for fragments in the same piece which are two away, three away, four away, and so on. Figure 7 shows that when looking at the average of these comparative similarity scores, fragments which are closer together seem to be more correlated.

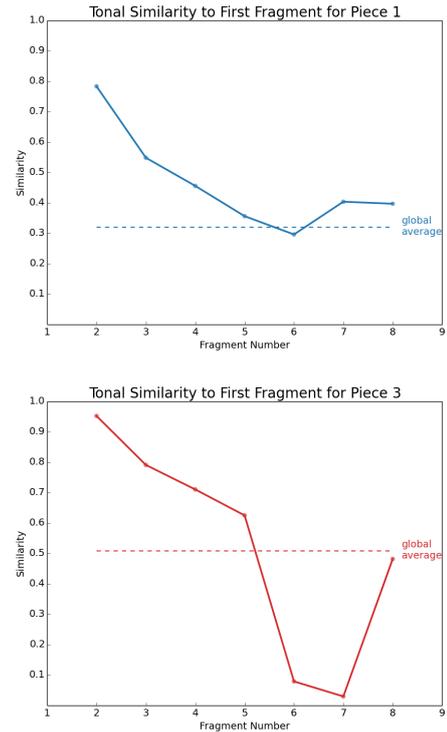


Figure 6: For “Piece 1” and “Piece 3,” the similarity score between the first fragment and each subsequent fragment within the piece. The dashed line marked “global average” represents the average similarity score between the first fragment and every other fragment, even from different pieces. Here, the similarity score only uses the 12-dimensional vector containing the proportional prevalence of each pitch class.

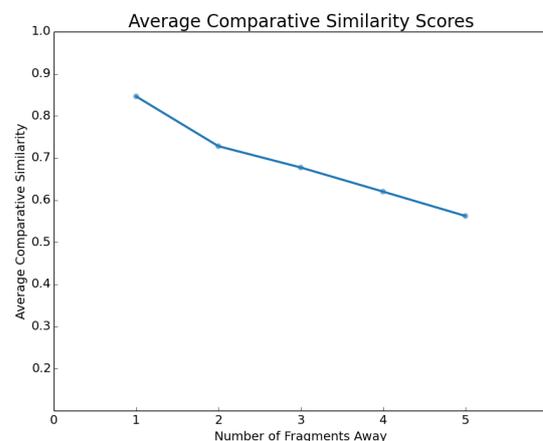


Figure 7: The average comparative similarity scores for fragments which are one away, two away, three away, etc. As expected, fragments which are closer together appear to be more similar.

6. CONCLUSION AND FUTURE WORK

In this paper we presented Exquisite Score, an online system for creating collaborative musical compositions using the paradigm of the parlor game exquisite corpse. Exquisite Score enabled several people with varying musical ability to come together to create short, quirky musical compositions.

In the future, we plan to further explore variations on the exquisite corpse paradigm. One idea we have started to explore is including pieces with automatically repeated sections [5]. For example, one could have a piece where the first composed fragment appears every four fragments. This increases continuity within a piece and also enables the same hint to be given to multiple composers, allowing users to see how different composers react to the same starting material. In addition, if a composer works on a fragment that comes right before the repetition of a previously-composed fragment, the hint can be the beginning of the repeated fragment, rather than the end of the preceding one.

Another way to explore the exquisite corpse paradigm is to allow other types of occlusion. For instance, users might compose for one track at a time, with all but one other track hidden.

Also of interest is testing Exquisite Score in a variety of settings. For example, it would be interesting to see Exquisite Score played as an actual parlor game, with several users in the same room composing a fragment and virtually passing pieces from one composer to the next. It would also be worthwhile to explore Exquisite Score's potential as an educational tool, perhaps presented with a simplified interface or paired with a compositional tutorial.

For analysis, we would like to explore a more robust similarity metric for comparing musical fragments. To actually test the effects of occlusion, it would be informative to compare fragment similarity for pieces with a varying hint size, including pieces with total occlusion (i.e. no hint) and pieces with no occlusion at all.

7. ACKNOWLEDGMENTS

We would like to thank everyone who helped test Exquisite Score for providing feedback and contributing excellent and fun musical snippets. Also, special thanks to Joe Paradiso for guidance and feedback.

8. REFERENCES

- [1] A. Breton. The exquisite corpse, its exaltation. In *Surrealism and Painting*, pages 288–290. Harper and Row, New York, N.Y., first edition, Dec. 1972.
- [2] T. J. Collective. Weird Combinations: The Exquisite Corpse Music Project. <http://thinkjarcollective.com/projects/exquisite-corpse-music-project/>. Accessed: 2017-01-16.
- [3] Folding Story. <http://foldingstory.com/>. Accessed: 2017-01-16.
- [4] G. Forester. Review: Exquisite corpse (zephyr quartet). Accessed: 2017-01-16.
- [5] D. Manesh. Exquisite score - a system for collaborative musical composition. Master's thesis, Massachusetts Institute of Technology, 2017.
- [6] C. McKay. Automatic genre classification of midi recordings. Master's thesis, McGill University, 2004.
- [7] P. Schneider. A note on the exquisite corpse. *Yale French Studies*, (2):85–92, 1948.
- [8] A. Singhal. Modern information retrieval: A brief overview. *IEEE Data Eng. Bull.*, 24(4):35–43, 2001.
- [9] Xavier Barrade. Epic Exquisite Corpse. <http://www.epicexquisitecorpse.com/>. Accessed: 2017-01-16.
- [10] N. Yuill, Y. Rogers, and J. Rick. Pass the ipad: collaborative creating and sharing in family groups. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 941–950. ACM, 2013.