Virtual Cues
Sharing Music Related Dance Practice in an Online Setting

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> "It is in collaboration that the nature of art is revealed." (Steve Lacy)

Introduction

Starting in September 2020, the artistic research project *Social d[ist]ancing: the development of a networked artistic practice out of confinement* set out to explore the potential and limitations of videoconference as a medium for collaboration, while at the same time raising questions about networked artistic practice: In which ways – if any – can virtual rehearsals be thought of as equivalent to co-located (where all participants share the same physical space) ones? What is unique about this mode of collaboration that is relevant for artistic practice? In which ways does the circumstance that the performers are not physically together determine the artistic output? And most crucially, how can the limitations of the medium of videoconference be reframed to add value to our practice?

In order to answer these questions, a multidisciplinary team including music and movement/Eurythmics professor Hanne Pilgrim, composer Adrián Artacho, dance scholar Mariama Diagne and six graduate Eurythmics students from the University of Music and Performing Arts Vienna – Maximilian Resch, Maria Solberger, Benedikt Berner, Dalma Sarnyai, Magdalena Eidenhammer, and Katharina Püschel – embarked on a series of case studies over nearly two years. The project explored computer-assisted ap-

proaches to what we call "music related dance practice"[1] and yielded a wealth of insights and strategies for networked[2] co-creation.

An outgrowth of the project was the development of the *SoDA* software, which allowed us to experiment with different cueing systems and evaluate the potential of "virtual cues" in a networked dance practice. During the six case studies that made up the *Social D[ist]ancing* project – each featuring a different mode of intermedial composition – the distinct characteristics of virtual cues became increasingly the subject of a few practice-based reflections which we believe to be generalisable to the use of virtual cues in any scenario, networked or not. This article tries to summarise these characteristics as well as to contextualise the use of different cueing systems in the performing arts with a special focus on virtual cues and their history.

Virtual Cues

The use of the term "cues" to coordinate performative actions is commonplace in the performing arts, albeit with different connotations depending on the discipline. In the scope of this article, we will start with choreographer William Forsythe's definition of cues as timing signals, "usually practised strategies of communicating timing information in order to start moving together" (Forsythe, cited in Waterhouse et al. 2021: 172). In this sense, cues are instances of non-discursive communication as much as a component itself of a dance performance.

1 Here we refer to the contemporary practice of Eurhythmics, which is a dance and movement practice that deals with the interconnections between music and movement and focuses on the musical components immanent in movement/dance. Different formats of music choreography are used here such as "Plastique animée" (also known as music visualisation, l'interprétation corporelle, etc.) as an outgrowth of Jaques-Dalcroze's method and a common technique in the field of Eurhythmics (Dale 2017: 11).

2 A "networked music performance" is a real-time interaction over a computer network that enables musicians in different locations to perform as if they were in the same room (Lazzaro 2001: 157). Analogously, "networked dance performance" refers broadly to the use of networked technology in a dance performance (Santana 2004: 2). We use the term "networked co-creation" to describe practices of dance improvisation, choreographing and rehearsal where the participants collaborate in real time from different locations over a computer network to jointly create a piece.

Performative cues are commonly non-verbal (e.g., movement, gaze, audible breath[3]), but when they involve speech, they still distinguish themselves from "prompts"[4] and other uses of language during performance in that they are "often said while doing, as opposed to causally before."[5] In its most elemental form, a performer gives a cue, meant for another performer to take it. The timing of a cue can also be negotiated together between several performers, in which case all give and/or take the cue, eliciting a mutual attunement[6] as opposed to a hierarchical one. There are of course no limitations to the amount of performers involved in this give and take – other than practical ones –, or to the nature of the signs[7] used to cue an action, as long as they accomplish this purpose.

This basic cue model is appropriate so long as cues are exchanged directly between performers, and we will call them physical cues. As soon as the causal link between the giver and the receiver of a cue is obscured by some technological device however, we prefer to speak of "virtual cues." For instance, performers could use a closed-circuit camera system to communicate visual cues between each other,[8] or perform an arbitrary action that itself triggers the cueing signal. The latter is the approach that we ended up favouring in our networked dance practice, for a number of practical reasons: it freed performers from looking at the screen at all times, it allowed for rather interesting exercises in transposition (a given movement could be spontaneously used to generate whole sequences of aural cues across the dancers, for example) and it made the cueing process explicit in a way that would allow us to record, revisit and analyse past interactions. It also allowed us to delve into some of the aspects in which technologically mediated cues differ from

3 Waterhouse et al. lists "audible breath, stomps, vocalized short phrases and movement itself" in her analysis of the cues dancers exchange in Forsythe's Duo (Waterhouse et al. 2021: 172)

4 Waterhouse uses the term "prompt" for "when the dancers spoke to each other on stage. Statements intended for one's partner and not the audience" (Waterhouse et al. 2021: 172).

5 Waterhouse et al. 2021: 172.

6 Erin Manning distinguishes between hierarchical (where a dancer consistently leads while another follows) and mutual (where dancers attune to one another) kinds of attunement (Lepecki 2013: 34)

7 The flow of information from the sender to the receiver is comparable to a typical model of communication, whose meaning may only exist within the limits of a given piece.

8 An example of this can be found in Michael Kliën's Duplex/Einem (2002).

physical ones. As we will describe in this article, the mediation of technology is anything but innocuous. The performer's subjective experience of the cue is different in such fundamental ways that we find it useful to consider virtual cues as a different kind of cue altogether. The ways in which virtual cues differ from physical cues are summarised below:

→ Cross-modality

Physical cues can be communicated via one sensory channel (visual, auditory, tactile, etc.) or sensory modality. In any case, the different ways in which the senses function create different forms of reference between performers and their environment. Physical cues can also be perceived through several channels simultaneously (multimodal), as when a cueing gesture is accompanied by touch, or an audible breath, for example. However, the modality through which a dancer perceives a virtual cue (e.g., a cueing sound) might be completely decoupled from the original modality of the original action that triggered the cue (e.g., the pushing of the button of a wearable controller device) and can therefore be cross-modal in a way physical cues cannot. For example, in one of our networked practice sessions performers would use certain body movements to remotely trigger a specific audio file (e.g., a recording of a voicing such as "freeze" or "jump") in another dancer's computer. We used the SoDA application to automatically assign the receiver of a certain cue initiated by a different dancer based on context information, such as their relative positions in the zoom gallery. We used certain movements to trigger whole sequences of cues across participants as well, turning some of our working sessions into an intricate fabric of interconnected *cueing* gestures and *cued* actions. These processes of computer-assisted transposition (in this case from the original cueing movement to a sound cue triggered elsewhere) are examples of what we call "cross-modal cues" (from one sensory modality to another). They are artificial in the sense that they operate under certain rules and parameters which need to be explicitly defined.[9] This inevitably adds additional layers of complexity to the exchange between dancers, but in our experience, it can also help articulate a specific choreographic logic that still feels playful and almost improvised to the participants. We would argue

9 In our project, we would refer to the process of collectively designing the rules as the moment of "composition".

that said rules and parameters can be thought of as material inscriptions of the piece (Magnusson 2009: 169), as a musical score or a video recording except that the choreographic information is embedded in the cueing system, and can only be accessed in interaction with it.

→ Connectivity

The origin of a virtual cue can only be inferred by the receiver, instead of perceived directly, as it would happen with a physical cue. A video-mediated cue could conceivably be broadcasted to all performers, delivered to a random subset of them, or pre-recorded altogether. This emphasis on virtual connectivity is an inherent property of technology-mediated performances[10] that comes at the cost of physical connection. As their interaction is mediated by virtual cues, performers lack each other's presence in the way they would otherwise experience in a shared physical space.

→ Transparency

Though intended for other performers, cues are not necessarily concealed; many – but not all – are perceivable to a public (Waterhouse et al. 2021: 172). When that is the case, cues become embroidered in the fabric of the piece, as much a component of the performance as alignments, breaks, or solos are.[11] When technology-mediated cues are apparent to the audience however (e.g., an audible cue projected through the loudspeakers), the perceived relationship between performers and cue is one of alterity, in contrast to physical cues whose origin can be unambiguously traced down to a specific performer. Sender and receiver[12] of a virtual cue are, by design, placed on different places of a perceptual hierarchy, strongly suggesting a dissymmetry[13] and

10 In his book on Digital Performance, Dixon (2015) outlines a hierarchy of the different modes of interactivity that new media technologies may help to engender, suggesting also the notion of play as fundamental.

11 The components described in the scientific literature include unison, turn-taking, complementary action, concurrent motion, solos, breaks, alignments and cues (Waterhouse et al. 2021: 165).

12 According to the SMCR (Source-Message-Channel-Receiver) model of communication.

13 This hierarchical mode of organisation would seem to exclude more horizontal ones, such as Erin Manning's "leading-as-following" (cited in Lepecki 2013: 34).

a default direction of the communication.[14] Thus, cueing systems need to be carefully designed to blend with the performance, or else they become a nuisance to the audience, a distraction that threatens to reveal the nuts and bolts of the choreography.

→ Attentiveness vs. Flexibility

Virtual cues, perhaps more than physical ones, respond to principles of interruption and switch, a form of quick response that tunes up the nervous system and the capacity to respond fluidly in the moment. This therefore encourages a quality of responsiveness and a readiness to act or inhibit action in the performers (Greenhead/Habron 2015), who feel compelled to action in a particularly stringent manner. The one-directionality of the virtual cues may however bring along a perceived stiffness of the system, which can nonetheless be qualified if, for example, cues are implemented less as binary switches (e.g., "perform action A, now!") and more as invitations to action (e.g., "hereby starts a time window where action A would be fitting").

→ Participatory Community Actions/Audience Engagement

By design, cueing systems are explicit and formalised in a manner that eases the way in for new performers who were not present during the devising of the piece. Even to a participant who would join one of our group rehearsals for the first time, virtual cues appeared clear and unambiguous in a way that, in our experience, reduced the practice time needed to master the piece.[15] Specifically, the use of virtual cues allowed us to "offload" many of the timing decisions onto the system itself, relieving performers from timekeeping tasks. This property can be leveraged to facilitate work with non-professional dancers, as well to explore audience participation in interesting ways. Having a non-hierarchical structure as a premise, our participative experiences with larger online groups turned out to be very engaging and visually interesting in unexpected ways, suggesting a wealth of artistic affordances down this path.

14 Multi-directional cueing systems are nonetheless possible, as in our work with the SoDA software.

15 They might be also less context-dependent than physical cues can sometime be.

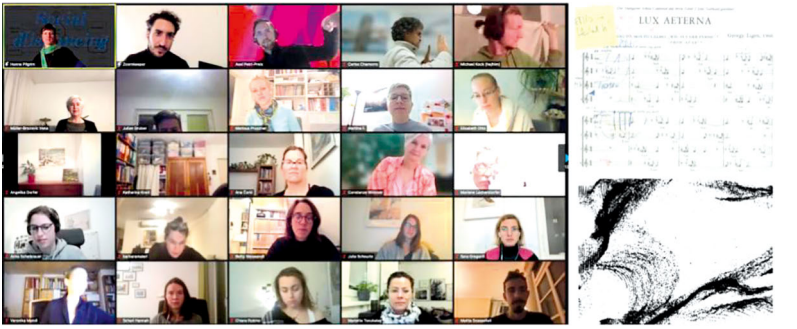

Figure 1: ***Above left*** *is a capture from the interactive community project developed as part of the lecture-performance Rethinking Videoconference, hosted by Conference on Audience and Community Engagement in Classical Music Concert life, at the University of Music and Performing Arts Vienna.* ***Above right*** *is a capture from the first page of Ligeti's Lux Aeterna, with handwritten conducting notes.* ***Below-right*** *is a capture from an interactive visualisation of the participants' movements in real time.*

→ New Approaches to Music Related Choreographic Work

In music related choreographic practices musical works are mostly approached through sensory tangible/perceptible qualities of the music. Specific themes/parameters are extracted from a musical score analysis or levels of perception of the individual performers. Computer-assisted approaches allow for musical works to be accessed through certain structural features and levels of analysis that are not immediately accessible,[16] latent perhaps in hidden layers of the composition. In this way virtual cues – and the technology-mediated systems that generate them – can be seen as epistemic tools (Magnusson 2009: 169) that grant performers access to these hidden layers.

An example of this was our approach to Ligeti's *Lux Aeterna*[17] as the basis for a choreographic work. Upon first hearing, Ligeti's piece presents "an impenetrable texture, something like a very densely woven cobweb" as Bernard

16 As opposed to explicit structures of a musical piece stated, for example, on a score.

17 Lux Aeterna is a piece for a 16-part mixed choir, written by György Ligeti in 1966. The score features a strict polyphonic structure which cannot be heard, or in Ligeti's own words "it remains hidden in a microscopic, underwater world, to us inaudible. I call it micropolyphony" (Bernard 1994: 227).

quoted Ligeti's description from 1983 (Ligeti quoted in Bernard 1994: 227). But what appears to be a continuous band of sound is actually made up of a complex 16-part canon that can only be perceived analytically with the help of the score. Seeking to grasp *Lux Aeterna*'s inner structure in as transparent a way as possible, we decided to focus on the sequences of note onsets across the sixteen voices as the source material for our piece. This led to the transcription of the music onto a visual score[18] which would give each performer precise timing cues about when to start/stop specific body movements.

Brief History of the Technology-mediated Performance

Since the use of personal computers became widespread in the 1980s, many different tools have been developed to assist choreographers in the analysis of existing works and the creation of new ones. Notable examples are Merce Cunningham's work with the *Lifeforms* software (Schiphorst 1993), William Forsythe's *Improvisation Technologies* (Birringer 2002) or Wayne McGregor's *Choreography Language Agent* (CLA) developed by technologist Nick Rothwell (DeLahunta 2016). It is not until the late 1990s that software applications were developed specifically with the goal of guiding dancers during a performance (Calvert et al. 2005). One of such applications is Scott DeLahunta's *Software for dancers* (DeLahunta 2002), which included performance tools alongside the annotation and composition features.

More recent examples of computer-mediated choreography have granted the dancers increased agency over the unfolding of the piece by allowing performers to influence the tempo of pre-recorded music (Guedes 2003) or freely explore interactive sound environments through movement (Peters et al. 2012). It is not uncommon to use live visuals for cueing specific stage actions and delimiting the performance space, in which case they too can be understood as performance tools. A very interesting take on computer-generated choreography can be found in Kate Sicchio's *Hacking Choreography* series in collaboration with Nick Rothwell (Sicchio 2014), which uses body movements as an interface for live coding, hence establishing a bi-directional dialogue between computer and performer.

18 We used a MIDI transcription of the piece and INScore graphic environment to render the parts in real time.

From Metronomes to Smartphones: Aural Cueing

One of the most common examples of virtual cues in theatre production is perhaps to deliver aural instructions via close-circuit radio to performers and technicians. As early as 1855 we find a reference to composer Hector Berlioz's use of electric metronomes to synchronise several sub-conductors,[19] presumably due to the separation between the instrumental groups. This form of technology-mediated conducting commonly known as "click track" technique became ubiquitous with the advent of sound films in the 1920s, and with them, the need for an effective tool for the synchronisation of image and sound appeared.[20] In keeping with the common use of aural cues in theatre[21] and dance[22] to organise time specific actions, our first case study explored the transposition of temporal structure from a recording of John Cage's The Perilous Night23 onto a collaborative movement composition. We did so by segmenting the piece using the salience points in the recording as determined by an automatic morphology analysis algorithm.[24] A computer-generated voice would time the different sections of a fragment from *The Perilous Night* uttering at the beginning of each section the corresponding number. Each aural cue was linked to instances of peer-to-peer interactions (a dialogue of sorts between two specific performers, using only hand movements), collective gestures (agreed upon actions that all eight performers engage in at specific moments), and different synchronised actions across the performers – e.g., Max, Maria and Ben would repeat Hanne's hand movements at different paces while Dalma, Magdalena and Kathi would perform a counterpoint action together. These were composed in smaller groups as part of a collaborative choreography portraying micro-movements and hand gestures, which we called *Perilous Hands* (s. Fig. 2a+b).

19 Berlioz pioneered this system for his concerts in the Palais de l'Industrie at the 1855 World Exposition in Paris, allegedly due to the large distance between the different instrumental groups (Bell 2016: 45).

20 The "click track" technique is sometimes considered to be pioneered by Hollywood film composer Max Steiner in the 1930s (Bell 2016: 45).

21 The use of technical cues (preceded by warnings), committed to the show's "prompt book" is a long established practice in theatre (Tittle 1983: 38).

22 The most conventional kind of aural cue used in dance comes, of course, from the music.

23 Suite for prepared piano in six movements composed by John Cage between 1943 and 1944.

24 In this context, the concept of saliency in aural perception (Giorgio 2014: 16) is interpreted as a proxy for the degree of novelty in the dramaturgy of a musical composition.

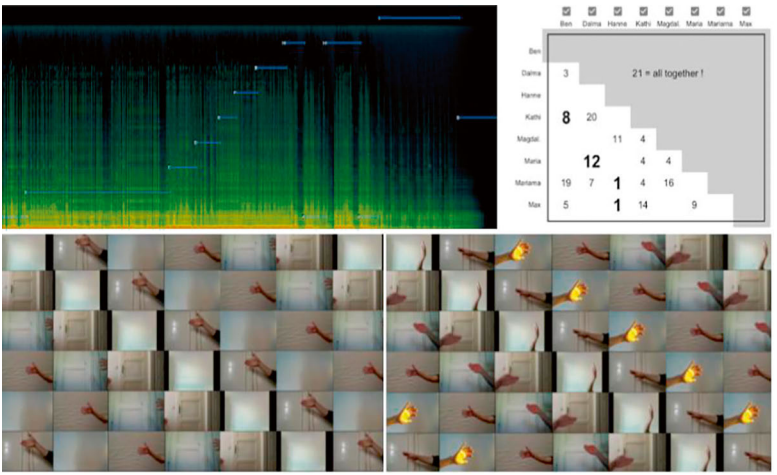

Figure 2a+b: It captures our collaborative hand choreography Perilous hands. *Video recordings and technical details can be found via the QR code on the right.* ***Top-left*** *is a spectrogram from an excerpt of John Cage's* The Perilous Night, *with overlaid sections yielded by an automatic segmentation algorithm based on perceptual salience.* ***Above right*** *are the correspondences in actions across per-formers, with numbers indicating the segment where they belong.*

The Rise of the Onstage Screens: Visual Cueing

The use of a visual medium to indicate specific actions has a rich tradition among musicians, from traditional notation to less conventional graphical scores. This might be one reason why, once technology was mature enough, it was composers who initially championed the use of interactive visual interfaces – also known as "screen scores" (Hope/Vickery 2011) – in their live performances. In opera productions it is nowadays customary to use closed-circuit video to make the conductor's gestures visible from any position on stage. An interesting spin on that basic form of visual cueing can be found in Forsythe's *Eidos:Telos* (1998), where video monitors facing the stage showed video footage in order to help coordinate the actions of the dancers along

the piece.[25] In 2001, Nick Rothwell's *ChoreoGraph* allowed choreographer Michael Klien and composer Volkmar Klien to realise the nonlinear ballet *Nodding Dog* and the piece *Duplex*, in which both dancers and musicians receive visual cues from monitors placed on the edges of the stage (Klien 2008).

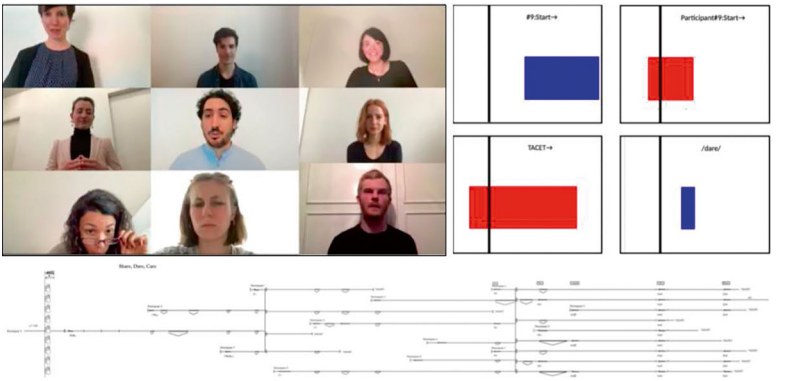

Figure 3a+b: It shows the beginning of the action score of the collaborative video piece Share, Care, Dare *(2021). Video recordings and technical details can be found via the QR code on the right.* ***Top-left*** *is a capture of a moment in the performance.* ***Above right*** *are some examples of the block notation we used to cue the performers: the boxes represent a window of opportunity that starts when the left-moving box crosses the vertical line (turning red) and ends when the totality of the box has crossed to the left side of the line.*

As a starting point for our work within the *Social D[ist]ancing* research project, we experimented with different kinds of computer-mediated visual cues (e.g., computer animated "time blocks" that indicate the onset and length of an action), as well as different modi for transposing cueing infor-

25 According to composer Joel Ryan, though initially intended as an additional multimedia layer of the piece, during the long rehearsal period, dancers came to associate certain parts of the video with specific parts of the choreography. The night of the premiere, the choreographer turned the screens towards the stage, away from the audience, and kept them as a cueing device (Diegert and Artacho 2021: appendix).

mation onto a visual medium. The approach that we ultimately favoured for the piece *Share, Care, Dare* premiered at the 2021 *Society for Artistic Research* (SAR) conference was to render in real time individual screen scores for each performer,[26] that conveyed concise timing cues such as when to synchronise specific actions, when to wait, and when to take the lead.[27]

In a distributed way, we were able to conduct nine – simultaneously – improvised spoken soli[28] which would later become a polyphonic nine-voice composition.

Developing Tools for Networked Music Related Dance Practice: the *SoDA* Environment

Starting our practice from working with more or less conventional – aural and visual – cues, as the *Social D[ist]ancing* project kicked off, the need to explore possibilities beyond the limited affordances of videoconference software became obvious. The *SoDA* environment was hence developed in order to enhance networked dance practice, working in combination with conventional videoconference applications. Designed as a component-based distributed system, *SoDA* allowed us to explore computer-assisted choreography and virtual interaction between human performers, as well as interfacing with third-party software such as *Wekinator, INScore* and *MaxMSP* (Artacho 2021). Running a local instance of *SoDA-network* in each of the performer's laptops, participants in a networked rehearsal were able to receive aural and visual cues in the form of sounds, verbal cues, and visual displays that correlate to specific actions or movements. Cues regarding relative positioning and movement quality (direction, weight, speed and flow as per Laban movement theory) as well as pre-composed sequences or routines are communicated via webcam, microphone input,

26 Our system made use of the interactive score environment INScore (https://inscore.grame.fr/) developed by GRAME. The visual elements were rendered in real time via OSC messages from a local SoDA node instance.

27 The actions and their timing were collectively put together in preparatory sessions.

28 The performers created a solo with the specification of a lecture text that should be addressed to the audience of the SAR conference to improvise freely. They were given visual cues as to when to speak or remain silent and at what moments to insert the signal words "share", "dare", "care" into their impromptu speech.

or shared video playback. Through such cues, the system was shown to foster co-creation in a networked performance space. Working in this way allowed dance practitioners to harness the immediacy and scalability of computer systems for artistic experimentation and allowed us to tap into the potential of Machine Learning in a networked, distributed environment.

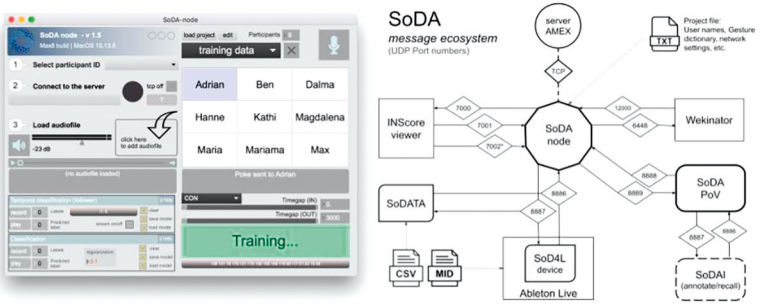

Figure 4a+b: ***Above left*** *is a capture of the main interface within the SoDA environment, the SoDA-node. During our networked practice sessions, each performer ran a node client on their laptop to exchange cues with one another. A description of the system can be found via the QR code right to his text.* ***Above right*** *is a flowchart of the connections between all components within the SoDA environment. While local communication uses OSC messages, communication with other nodes across the internet relies on an external server that also accounts for the latency of each individual node.*

A consequence of the distributedness of our setup, collective reflection became a fundamental part of the co-creation process, both as a means to promote togetherness among performers as well as to reach a shared perspective over the piece.29 We just scratched the surface of what these enhanced cueing techniques can achieve, and we believe that the artistic potential of

29 Reflection on the radical subjectivity of videoconference sometimes transcended rehearsals and became the underlying motive of semi-improvised performances such as the lecture performance »Zoom-Keeping and other bad habits« held online in June 2021.

virtual cues is still largely unexplored. We are also excited about the possibilities available by these newly found collaboration tools and encourage dance practitioners to try them out in novel and creative ways.

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