

INTERACTIVE SCORES: TASKS AND DECISIONS IN IMPROVISATION SYSTEMS AND OPEN WORKS

Per Anders Nilsson

Academy of Music and Drama
University of Gothenburg
per.anders.nilsson@hsm.g
u.se

Palle Dahlstedt

Academy of Music and Drama, and
Dept. of Computer Science & Engineering,
University of Gothenburg and Chalmers
palle.dahlstedt@gu.se

ABSTRACT

This study investigates relationships and interactions between a performer and a score. This view implies a shift in focus, from the score to the act of interpreting and performing, and subsequently to the performer. A significant aesthetic conception is to regard the score as an artifact intended for players to interact with, rather than a means for personal expression per se. The musical context is first and foremost within the experimental music tradition in the post-World War II era. The theoretical framework consists of concepts from, e.g., John Cage and Cornelis Cardew, in addition to influences from the field of interaction design. To elucidate the subject matter, a limited number of musical works are discussed, including both classic pieces and original works. Finally, the paper concludes with some personal reflections on working with interactive scores.

1. INTRODUCTION

The aim of this study is to investigate relations and interactions between a performer and a score, before and during a performance, including explicit and implicit interpretative freedom. The aesthetic and theoretical context is primarily within the experimental music tradition in the post-World War II era, including the concept of an open work. This view implies a shift in focus, from the score to the act of interpreting and performing, and subsequently to the performer. One may approach scores in many ways, e.g., in relation to musical outcomes, as carriers of musical ideas over time and space, as simply a set of instructions, or as autonomous artifacts. Furthermore, in our view, it is not possible to discuss scores without also addressing the concept of a work; these

concepts are entangled. Yet another issue that will be elucidated is the question of how little information a score might contain to count as a score. That is, to give participant players necessary information of how to interpret and perform a musical piece, that may be repeated, with recognizable and preserved identity. It is worth noting, however, that there are many traditionally oriented composers and musicians of today who are not interested and/or comfortable with the mandatory freedom in open works, and therefore are not the object of this text.

Concepts and Notions

A significant aesthetic conception in this study is to regard the score as an artifact intended for players to interact with, rather than as a means for personal expression per se. Likewise, our personal experience as practitioners, composers and musicians in this tradition plays a major role. In this context, a composer is regarded as an interaction designer. Swedish interaction researchers Lars Hallnäs and Johan Redström claim that: “Interaction design is the design of the interaction between users and products”¹. Accordingly, the interaction design perspective shifts the focus from the producer to the user, and in this context from the composer to the performer:

So one central leitmotif here is that interaction design introduces a shift of focus from the things themselves to the acts that define them in use. This raises questions about what it is we design in the interaction design process. What does it mean to shift focus from the things themselves to the acts that define them in use? [1].

Their question may be rephrased: What does it mean to shift focus from the scores themselves to the act of performing them? The products and things mentioned most likely imply technologies such as computers, cars, and domestic appliances. In this study, scores are regarded as products as well, with a focus on relations. That is, with reference to game design studies: “With interaction we mean both the interaction between players playing a game and the interaction between players and the game” [2].

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¹ Interaction Design Foundation <https://www.interaction-design.org/literature/article/what-is-interaction-design>

This concerns the given and allowed interpretative freedom and the constraints afforded by a score, or simply how to interact with a given score. Therefore, interaction with a score happens *before* as well as *during* the performance. This can be described as two modes of music making, namely *design time* and *play time*; concepts that will be used in this text:

Design time, on the one hand, is outside time activity that deals with articulation and application of ideas and knowledge. On the other hand, play time is about real-time activity where interaction with the environment, embodied knowledge, and the present are at the forefront. [3].

This means, for a performer, that analysis and preparation intended for the performance of a score take place at design time, whereas the performance takes place at play time. Subsequently, the appearance of the music does not take place until it is performed, as Hallnäs and Redström assert:

In music the flow of tones in time is material that builds the actual appearance of a piece of music. When composing music, in contrast to ‘real time’ improvisation, we certainly work with this material but only in a sort of abstract manner – the actual compositional traces left are written instructions on how to perform the music, how to build its appearance. To set up these instructions we work with music technology helping us to work with a material that in a certain sense is absent most of the time. This makes it different from wood, paper etc. [4].

This view is shared by musicologist Christopher Small:

Properly understood, then, all art is performance act, which is to say that it is first and foremost activity. It is the act of art, the act of creating, of exhibiting, of performing, of viewing, of dancing, of wearing, of carrying in procession, of eating, of smelling, or of screaming that is important, not the created object. [5].

To conclude: a score contains unique information for how to perform a particular piece of music; musicians interact with the score, but the music only exists when it is played and/or heard in real time. In a later section, a short taxonomy regarding types of score–performer interaction will be proposed and defined.

Score vs Work

A musical work, in this context, is a collection of elements with a set of relations to each other that creates a unique sonic identity when performed. Elements can be many things, such as notes, rhythms, phrases, shapes, grooves, harmonic structures, sonic textures, timbres, as well as behaviors and interaction patterns that emerge. In other words, the given elements appear sequentially and/or simultaneously in an identifiable way in consecutive performances. A score, subsequently, is a set of instructions that are used to give the performers necessary information on how to perform a certain piece of music with preserved identity; it may range from a huge orchestra partiture to simple graphical shapes, as well as verbal or oral instructions. A score, however, is not the music, and according to Small:

A score, of course, is not a musical work. It is not even the representation of it. It is a set of coded instructions that, when properly carried out, will enable performers not only to make sounds in a specific combination, called a musical work, but also to repeat that combination as many times as they desire. Players and listeners learn to recognize that combination as a unity and to give it a name, which may be symphony no 5 in C minor [6].

Moreover, a written score is not even necessary to preserve the identity of a musical work in time and space. Here we are thinking of, e.g., the so-called “head-arrangement” used by American big bands in the 30s, notably Count Basie and Duke Ellington, i.e., pre-agreed and memorized arrangements, which were never written down.

One may say that the concept of a score started with Guido d’Arezzo, (ca 990–1050) when he invented the modern western musical notation system that eventually replaced the neumes that were in use at the time. One reason was to unify the performances of hymns in the Catholic Church, and to facilitate the learning of new material. However, one effect of Guido’s invention was the possibility to create and treat music at design time, e.g., to zoom in and out from details to overall form. Until the beginning of the 20th century, a score most likely primarily contained information of pitch and durations, combined with a set of established indicators of dynamics and articulation, and agreed terms for certain tempi and characters, like *andante* or *allegro*, together prescribing the way to perform a particular piece of music regarding phrasing, tempo, etc. Since this is well known, we will not pursue it further here.

Interaction

One aspect of a score is how much freedom performers are allowed. The short answer is that it depends. It depends, for example, on genre, style, the composer, tradition, and type of work. The range extends from music that demands the highest possible accuracy regarding, e.g., pitches, rhythm, and dynamics, to open-work scores that rely on and even force the player to make up her own decisions. One composer worth mentioning in this context is John Cage (1912–1992). In the chapter *Indeterminacy in Silence* [7], Cage discusses the terms determinate and indeterminate respectively, to distinguish between what is fixed and what is not. He exemplifies with two compositions:

The Klavierstück XI by Karlheinz Stockhausen is an example. *The Art of the Fugue* by Johann Sebastian Bach is an example. In *The Art of the Fugue*, structure, which is the division of the whole in parts; method, which is the note-to-note procedure; and form, which is the expressive content, the morphology of the continuity are all determined. Frequency and duration characteristic of the material are also determined. Timbre and amplitude characteristics of the material, by not being given, are indeterminate. This indeterminacy brings about the possibility of a unique overtone structure and decibel range for each performance of *The Art of the Fugue*. In the case of *Klavierstück XI*, all the characteristics of the material are determined, and so too is the note-to-note procedure, the method. The division of the whole into parts, the structure, is determinate. The sequence of these parts, however, is indeterminate, bringing about the

possibility of a unique form, which is to say a unique morphology of the continuity, a unique expressive content, for each performance. [8].

According to Cage, the Bach player is allowed to “color” the music, while in the Stockhausen example the performer rather has freedom, and are even obliged, to make choices with respect to the morphology of the continuity. More than 200 years separates Bach and Stockhausen, and in the rear-view mirror a trend appears towards more consciousness of the role of the score with respect to performance. Moreover, we cannot know exactly how Bach’s music was performed at his time. Rather, as artist Jeff Koons claims: “The past does not influence me; I influence the past” [9]. As the composer Alvin Lucier asserts about John Cage: “What have Cage’s pieces to do with self-expression? Nothing. They’ve got everything to do with discovery.” [10]. In *The Poetics of the Open Work* from 1959, Italian author Umberto Eco explains the open work by citing the composer Henri Pousseur: “[it] is not so much a musical composition as a field of possibilities, an explicit invitation to exercise choice” [11].

One consequence of the invention of the modern western musical notation was the possibility to make advanced treatments of musical material in the compositional process at design time. In turn, this development did increase the demands placed on the musicians, and the scores became less open for interpretative freedom at the performer’s own discretion. This development accelerated with the 1950’s serialism and its successors, where every musical element became constrained by compositional rules and, accordingly, the musicians became more of “sound-producing machines” whose role was to give sound to the composer’s visions and ideas, rather than self-expression. In serial music the scores contained very complex instructions, which made it difficult to judge whether a performance really did justice to the work. From when he was a music student, Nilsson remembers the Swedish modernist composer Jan W. Morthenson (1940–2019), who at a seminar in the 1980’s at the School of Music in Gothenburg voiced an extreme position: “we don’t need to listen to the music; it is enough to read the score.”

A conceptual idea that has been used in various ways in post-World War II avant-garde and experimental musical practices is to give performers unsolvable or contradictory tasks. John Cage employed the former strategy, inspired by Zen-Buddhist practices such as its short Koan forms, which most often are contradictory in content. Also worth mentioning is the “New Complexity” tradition, notably British composer Brian Ferneyhough who deliberately makes his scores partly unplayable, in order to consistently overstep the bounds of the human possible and consequently mistakes and erroneous playing become an intrinsic part of the performance. Another example is Miles Davis who routinely gave his musicians contradictory instructions. One reason for these strategies is to force performers to think and reflect to make up their own conclusions, and another is to change playing intention, from expressing something to solve a problem. All in all, the role and the function of a score have changed and developed since its inception by Guido d’Arezzo.

Interaction Types in Open Works

In an open work score, the task for the performer is not primarily to sonify the composer’s ideas, but rather to discover inherent possibilities in the score and to make choices. Moreover, an open work offers freedom to the performer but is still constrained to material and procedures provided in the score; the composer-designer purposely leaves certain decisions to the performer to solve. Out of Cage’s concepts of determinate and indeterminate in the examples above, two types of interaction emerge, which may be called *implied interaction*, and *commanded interaction* respectively. *Implied interaction* refers to a traditional interpretation process, for example in performing music of Bach. This means, when interpreting a score determinate in form and structure, a performer must make many decisions about parameters such as phrasing, tempi, dynamics, and timbre. The interpretation of the work takes place at design time; the player interacts with the score. *Commanded interaction* is when the score is indeterminate with respect to form and/or content, and explicitly commands a performer to interact, e.g., to choose the sequence of modules in the Stockhausen example. In addition, subgroups of these types may appear, such as *performers’ interaction*, which can be implied or commanded. *Emergent interaction* is a subgroup of implied interaction, which can be described as when characteristic interaction patterns emerge spontaneously, with no explicit instruction to do so.

APPLICATIONS AND ANALYSIS

In this section a selection of open works is presented and analyzed with respect to the types of interaction described above. Generally, the idea of the open work is attributed to the American composer Earle Brown (1926–2002). Compositions such as *Preliminary Notes* were inspired by the mobile sculptures by Alexander Calder (1898–1976). The shapes of the elements are fixed, but at the same time they are shifting. They show a stable identity, while in permanent variation. In *Preliminary Notes* the performer must choose the sequence of pre-composed parts. This is an example of commanded interaction regarding overall form, whereas the interpretation of individual parts is implied interaction.

One seminal work in this vein is Christian Wolff’s *For 1, 2 or 3 People* from 1963 (Wolff, 1963). Looking back, this composition is a significant milestone in the development of what a score may be. The score contains independent cells that Wolff called *ratio neumes*, which eventually became characteristic of Wolff’s score style, in which each action has a numeric ratio, according to Hicks and Asplund [12].

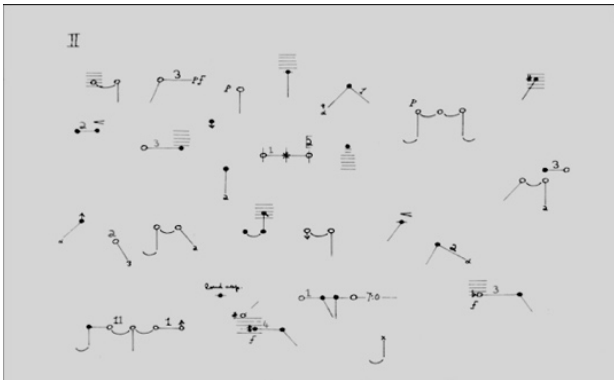


Figure 1: For 1, 2, or 3 People

For performance, the work prescribes a web of commanded interactions between the players, as well as between the players and the score. The first number in the ratio refers to a duration in seconds, whereas the second refers to how many of the given group of pitches (or pitches chosen ad lib by the performer). As Alvin Lucier asserts, one must first learn the vocabulary:

Black notes are variously short, up to about a second; white notes are any length. This may be confusing because in conventional notations black notes are usually short, white notes long. When you see a white note, you must remember that it's not necessarily long and may be determined by the requirements of coordination. Notes with stems as sixteenth notes are very short. A diagonal line toward a note indicates a sound played directly after a preceding sound. You coordinate with sound that came before. A diagonal line going away from a sound indicates that that note must be followed directly by another. [13].

Obviously, the commanded interaction is very complex, and in practice very difficult, or almost impossible, to pursue. If one fails, one must start over, which happens frequently, and therefore the identity of the piece, unintentionally, is rather a series of restarts.

Another example of a work in this spirit is *Treatise* by Cornelius Cardew (1965-67), a score containing 196 pages of abstract graphical elements, such as circles, squares, triangles and lines. At the outset Cardew did not provide any information of how to interpret the score, apart from two note stems at the bottom of each page, which implied traditional notation. Over the years, however, an interpretation tradition has evolved. Most often there are three performers; one plays the so-called lifeline in the middle, one the upper part and one the lower part. Eventually, in 1967 Cardew published *The Treatise Handbook* [14] that presents and discusses his view from experiences of performing the piece. One of the first performers of *Treatise*, together with Cardew, was British pianist John Tilbury, who in a personal conversation in 2013 explained and showed his interpretation, which gave us a clue of Cardew's ideas at the outset. Tilbury simply used the note stems at the bottom to notate what to play, and more than 50 years later he still uses it.

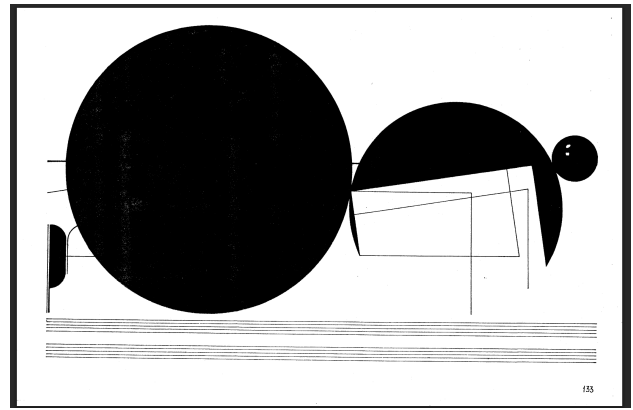


Figure 2: One page of Cornelius Cardew's *Treatise*

More recent performances do not have any use for conventional notation, particularly if performed with non-pitched electronic instruments. In our experience from performing *Treatise*, a great deal of the score-human interaction, however implicit, happens at design time. That is, a kind of negotiation between participating players is necessary, particularly regarding the mapping of graphic shapes to sound and playing behavior. However, what turns out to be essential, in our opinion, is to be consistent in one's interpretation of the different graphic elements. By doing so, the identity is preserved, and it also facilitates the interaction at play time to synchronize the ensemble.

Another piece by Cardew worth mentioning is *The Great Learning* from 1969. This suite of compositions contains seven parts and are based on Confucius book with the same name, which similarly has seven chapters. Each part is different from the others, but they all command interaction by the performers in different ways. Let us briefly look at *Chapter 6*. This part consists of 15 chunks of text, where each chunk starts with text fragments by Confucius in block letters, followed by a playing instruction. Performers should play the sequence of chunks in their own tempo, but be careful with perceived general pauses, and with synchronized events. The first chunks read as follows:

FROM Make or hear an isolated sound and hear out the general pause. Then a set of four sounds, the first one synchronized.

THE EMPEROR A pair of sounds, then a pair of optional sounds. [15].

This piece is first and foremost about commanded interaction, which leads to emergent interaction between the players. Written running instruction is straightforward, and additional performance notes explain sound production, such as optional, isolated and synchronized sounds. The difficulty is to synchronize sounds with another player; else you get stuck and must wait and search. To play this piece is to play a game; the score is played at each performer's individual speed, and therefore will finish at different times, and when finished, the player must leave the stage. At the end there is only one player left: the winner. Therefore, a possible tactic may be to hide the next sound, which makes it difficult for someone to synchronize, and they are forced to wait. Or sometimes two trapped players help each other to synchronize to be able to continue.

INTERACTIVE WORKS

In this section we present two oeuvres: *Chasing Chords* by Per Anders Nilsson and *The Bucket System*, a collaborative piece by Dahlstedt, Nilsson, Tim Perkis and Gino Robair, developed within an artistic research project. The common denominator is that they both command interaction and decision-making by the performers, else nothing will happen.

Chasing Chords

Chasing Chords [16] is a simple musical game that is inspired by first-person shooter video games, implemented in Cycling74 Max/MSP. In essence, it asks a drummer and a piano player to guess and to sync with sounds randomly generated by the software: a sampled bass drum and a piano chord respectively. The given task, however, to play in sync with the randomly generated events, is impossible to solve. The intention to do so, however, demands a certain attention from the participant players. In turn, this activity creates a unique quasi-periodic groove mediated by the software, and randomly generated events, in a mix of live playing and pre-recorded sampled sounds. The emergent groove is, in essence, the sonic identity of the piece, which is preserved between consecutive performances and with different players.

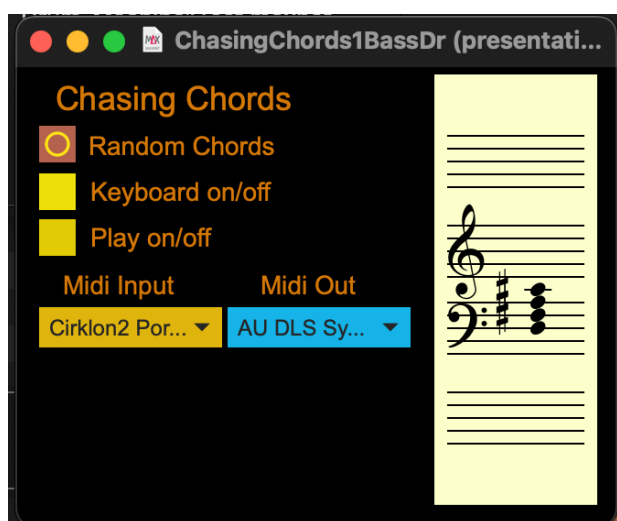


Figure 3: The Chasing Chord interface

This piece is, according to Cage's nomenclature, determinate in structure, and indeterminate in performance. Moreover, there is no need for interpretative work before performance, at design time. Instead, the players just need to understand the task.

The Bucket System family

The Bucket System (Dahlstedt, Nilsson, Perkis, Robair 2015-2025) allows for a new kind of on-stage compositional/improvisation interaction. In essence, it is a signaling system that mediates players' instructions for

playing behavior and/or relations to fellow players. At the outset it is a system for computer-mediated ensemble improvisation, and its credo states that players are composers and performers at the same time. It emerges from a tradition of structured free ensemble improvisation, such as *conduction* and *comprovisation*, and is also influenced by post-World War II experimental, free improvisation music practices, as well as by theatre improvisation techniques. Before playing, participants need to negotiate and define what the four possible signals mean. In this sense the Bucket System is, in line with Cardew's Treatise, an open structure whose content must be defined as part of the interaction with the score at design time. During play, at any moment, any player can submit configurations of signals to a virtual bucket, a storage of potential future configurations of roles for the players. At random times (regulated by some constraints, e.g., minimum and maximum waiting times), a random configuration is "picked up", i.e., selected, so that each player suddenly receives a new signal that (s)he is forced to follow. At its first inception in 2015 [17], implemented using a McMillen *QuNeo* interface, the signals consisted of four led light states: slow and fast blinking light, steady light, and no light. The signals were given on a set of LED buttons that represent a geographical map of the four players, so each player is assigned one state, and each musician can see all four signals. A later version, *Bucket 2*, uses touch screens (as an app on tablets, phones or touchscreen computers) and allows for up to 12 players, using four colors as signals: red, yellow, blue and dark grey.



Figure 4: The Bucket 2 interface

In the Bucket System, an interpretation denotes a set of assigned meanings to the four signals. Here are two examples of interpretations out of the many that have been used with Bucket:

Metaphorical: Red = Busy, Yellow = Simple, Blue = Support².

This interpretation asks the players to focus on their own playing, except for blue, which demands active listening.

² Metaphorical comes from the original Bucket, where the signals consisted of blinking LED lights, where faster blinking it itself might induce more energetic playing.

No other information is given. The musical outcome is a result from the interaction that emerges when participating players fulfill their sequence of given interpretations.

Behavioral: Red = Solo, Yellow = Interact, Blue = Vacillate.

Here the players are forced to listen to the other participants and adjust their playing in accordance with the present task. It is about distribution of roles, and “vacillate” affords a certain degree of freedom, but also introduces ambiguity.

Metaphor and Behavioral are arbitrary names, derived from its basic type of interpretation, to easily discern different signal assignments, or interpretations as we call them. In practice, during a performance, the players may change interpretation, either in a break, or during performance.

Yet another implementation of the Bucket System was developed using color-coded dice. Basically, it is the same concept regarding content, using similar interpretations as presented above. The difference is in the procedures of changing tasks for individual players. In the dice interpretations, any player can at any moment command any other player (or all players) to throw their dice, signaled through hand gestures.

Let us conclude with a recent implementation of ours within the Bucket System family. It is a game board of 55 x 55 cm, made for a performance with four musicians and two dancers. The game board is placed on the stage floor, visible to both the players and the audience. This version contains four basic colors: yellow, red, blue and green, to signal performers' roles, with the addition of black and white as special modifiers representing the dancers. For example, the metaphor interpretation here is given as: Red = Busy, Yellow = Simple, Blue = Extended, Green = Intermittent. Its procedure assigning signals involves physical action by the performers: players are not allowed to change their own interpretation, but are free, and even obliged, to add, remove, or change color for the other players squares and place the dancer's markers. For the two dancers the black and the white cards (symbolizing each dancer) were assigned in such a way that their placement (on top of a musician's field, or across two or more musicians' fields), shows which musician(s) they should interact with, applying interaction patterns from the underlying musicians' color signals. This is a typical example of a partly insolvable task.



Figure 4: Bucket as Floor Game

Comments

The following features are common for all members of the Bucket System family:

- 1) There is no assigned leader or conductor, all participants have a similar role;
- 2) participants must negotiate and agree upon interpretation of the different signals/colors before play;
- 3) participants must follow the current individual signal during play;
- 4) participants must “fill” the bucket/gameboard with new constellations of interpretations, while playing.

In the different versions, procedures of selection of next constellations, as well as how new constellations are introduced differs. This means that the performers, during play, must fulfill two tasks: firstly, to play and interact according to actual color, and secondly to figure out the continuation of the music, with new constellations, else the actual constellation will get stuck, however within the limits of the agreed interpretation.

CONCLUSION

Instead of thinking that a composition, and its score, is a product, we instead envision the score or instruction set as follows: “it is not so much a musical composition as a field of possibilities, an explicit invitation to exercise choice” [18]. As composers, or musical interaction designers, we invite participant players to play with our pieces (or systems), to investigate inherent possibilities in the given work. However, in our opinion, it is naïve to claim that interactive pieces are not shaped by the biases of their designer, about what to expect regarding the interaction at play time and regarding musical outcome. From time to time, participating players will do something unexpected that challenges the intention and expected outcome. As the designer, you may accept and embrace this and think it is interesting and realize that there are hidden possibilities that you were not aware of. But in certain cases, playing and subsequently the outcome becomes boring, when players exhaust intrinsic possibilities too quickly. Or, that the playing takes a direction that goes too far from the original idea, e.g., because players fall back into their own habitual ways of playing. In such cases, one must go back, and at design time re-design the set of rules.

To conclude: in an interaction-based work you invite players to be co-creators within the provided game plan. One must be prepared, and even encourage the players, to try to challenge the work, but still obey the overall constraints, and preserve the intended identity. Most likely, before play-time activity, discussions and negotiations at design time will occur. In our experience, it is difficult to create a score, or game-like instructions, which covers all aspects. The driving force to make interaction work is not to create perfect rule systems, but rather to involve participating players in a creative act by providing creative constraints. It should be fun to play!

REFERENCES

1. Hallnäs, Lars, Redström, Johan 2006, *Interaction Design: Foundations*, p. 22
2. Björk, Lundgren and Holopainen, *Game Design Patterns*. 2003, p.4
3. Nilsson, Per Anders, 2011, *A Field of Possibilities – Designing and Playing with Digital Musical Instruments*, Art Monitor, Univ. of Gothenburg, p. 27
4. Hallnäs, Redström, 2006, *Interaction Design: Foundations*, p. 108-109
5. Small, Christopher, 1998, *Musicking: The meanings of performing and listening*, Univ. Press of New England. p.108
6. Small, 1998, p. 112
7. Cage, John, 1961, *Silence: Lectures and Writings*, Wesleyan University, p.35-40
8. Cage, 1961, *Silence*, p.35
9. Cage, 1961, *Silence*, p.67
10. Lucier, 2012, *Music 109*, Wesleyan University.
11. Henri Pousseur as cited in Eco, Umberto 1959, ‘The Poetics of the Open Work’, in *Audio Culture: Readings in modern music*, 2004, ed. Cox, C., and Warner, D. Continuum, New York, pp. 167–175. p. 168
12. Hicks, M, Asplund, Christian, 2012, *Christian Wolff*, University of Illinois, p.24
13. Lucier, 2012, p.46, 57
14. Cardew, Cornelius, 1967, *Treatise Handbook*, The Gallery Upstairs Press
15. Cardew, Corenlius, 1969, *The Great Learning*, score. Edition Peters
16. Nilsson, Per Anders, Natural Artefacts, 2014, *California Connection*, CD. LJ-Records LJCD-5258
17. Dahlstedt, Palle, Nilsson, Per Anders, Robair, Gino 2015, *The Bucket System*, Proceedings of NIME 2015, Baton Rouge, LA, USA.
18. Pousseur in Eco, 1959, p. 168.