Constrain Yourselves: Exploring End User Development in Support for Musical Creativity

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ABSTRACT
This research explores links between constraint development in creative processes and end user development in environments for creative tasks. A process model describing the development of constraints in creative tasks is presented. To ground the research, support for the user development of musical instruments in a collaborative composition environment is developed, and the use of the system analysed. We find evidence that the development of tangible constraints in the interface has value to users, particularly in focusing collaborative ideation.

Author Keywords
Creativity, Constraint, Collaboration, Music Creation.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Creative practitioners in all domains explore and develop their environments and processes as an essential aspect of their craft. Computers are often essential both in providing the environment and in shaping processes. Support for end user development (EUD) can provide a flexible setting in which to create. Constraints in creative work take many forms, including a desire to act within the bounds of a genre, a physical limitation, or the need for new ideas to fit with existing ones. By developing constraints creators limit the scope of actions they could conceivably take, building the structure necessary to focus work in ill-structured tasks.

Stokes distinguishes between *task* constraints – the choice of materials and processes in the direct process of creation - or *subject* constraints – the chosen focus. In combination these define an overall *goal* constraint [4]. In the domain of musical composition, Pearce and Wiggins identify three types of constraint on the composer: *Internal* constraints are defined by how new ideas will fit with existing ideas in the composition. *External* constraints are limitations on what it is possible to create with the available skills, tools and knowledge. S*tylistic* constraints reflect the intended outcomes in terms of genre and approach [3].

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Environments that are open to manipulation by users could better support creative processes by allowing the development and sharing of constraint structures applied in the interface. Moving control of interface design from the tool designer to the user can also improve support for innovation and personalisation. Collaborators with differing roles may benefit from space for individual preferences in shared platforms, alternatively the shared development of constraints could support negotiation and increase cohesion.

MODELING CONSTRAINT DEVELOPMENT

Integrating the types of constraints defined by Stokes and by Pearce and Wiggins from the perspective of relationships between technology and creativity, we group constraints into the following categories in our model:

Tangible Constraints: Constraints that exist as an enforced property of the physical or virtual environment, having defined qualities and limitations. (e.g. the range of a piano).

Conceptual Constraints: Partially defined constraints existing in the minds of creators. Prevalent concepts may be labelled and communicated (e.g. jazz, cubism), and instances conforming to them can be defined, but without tangible form the boundaries of the constraint are unclear.

Internal Constraints: Constraints formed by the existing ideas creators want to use in the outcome. Further ideas should fit with the constraints imposed by these ideas, or existing ideas modified (e.g. a guitarist may be given a drum beat, constraining the tempo of ideas). Coordinating relationships between ideas is central to composition.

Static Underlying Constraint Structures: Structures used to support the development of constraints (e.g. an EUD tool).

In creative interaction, ideation and evaluation processes are focused by tangible, conceptual and internal constraints. Creators develop conceptual and tangible constraints as a basis for ideation, and evaluate these constraints through the ideas generated. Whilst tangible constraints are automatically enforced, creators must evaluate whether ideas conform to conceptual constraints. Ideas that are retained to be part of the final work form internal constraints on further ideation. Figure 1 represents our domain-general model of constraint development in creative processes, built using a combination of concepts from existing models and observations of creative tasks [1].

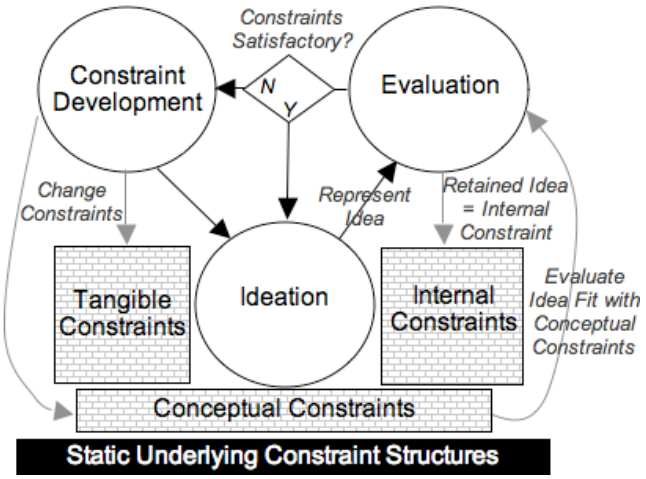

Figure 1: Constraint Development in a Creative Process

PROTOTYPE DESIGN AND OBSERVATIONAL STUDY

Functionality supporting the development of individual musical instruments was developed in an environment for collaborative musical play and composition. This has allowed us to analyse practical issues with the design and use of EUD in a creative collaborative context:

Music Builder consists of three spaces corresponding to elements of a musical creative process. In the *builder space*, users construct screen-based instruments to be played using a tablet computer pen. The underlying constraint structure of the builder is based on essential properties of musical instruments, defined as a means of mapping input gesture to a sonic output [2]. Users develop instruments by defining how interaction with shapes (pressing, dragging etc.) map to the sound produced. The *play space* allows users to play instruments and make recordings that can be combined and manipulated in the *compose space*.

The creation and manipulation of instruments supports the development of tangible constraints on the pitch, voice, volume and length of the output sound and the type of interaction used by each musician. Users can listen to combinations of recordings while they played their instruments to understand the internal constraints on further ideation. In all three spaces, users can sketch freely to the screen, supporting informal idea representations [1]. Music Builder includes template instruments as initial scaffolding. These were important as examples of development, support for manipulation as a basis for exploration as opposed to a blank canvas, and to allow users uninterested in development to play and collaborate with developing users.

The use of the system by six pairs of collaborating musicians in sessions lasting two to three hours has been observed and analysed. Participants were asked to create three compositions after completing a tutorial.

ANALYSIS

The studies provide ground to consider the utility of EUD and how it affects innovation and creative processes. Instruments developed by users often went beyond those we had conceived. Support for instrument development allowed processes of constraint development and idea representation to overlap, so we analysed the purpose and outcomes of three actions commonly observed in response to the emergence of interesting musical ideas:

1. Delete unused notes, restricting the instrument to the set of notes used in the idea.
2. Mark notes on the instrument using the sketch function.
3. Make a recording of the idea.

The first action enforces the notes present in the idea as a tangible constraint, lowering the cognitive load required to play the idea by blocking the play of any extraneous notes. However a possible danger with this may be a tendency towards fixation in a small solution space, as the action limits scope for discovery. The second action represents the idea but does not constrain the musician only to its component notes. The automatic fulfilment of a tangible constraint is lost, but experimentation with further notes is possible. The final action retains only a single instance of the idea as played, however recording importantly supports evaluation without the cognitive load of play [1], and consideration of the internal constraints formed by the idea.

It was observed that collaboration in the development of individual instruments encouraged the discussion and development of shared constraints. In several sessions, a successful approach to composition was to constrain individual instruments to a shared musical scale, improving awareness and stimulating harmonious collaborative play.

CONCLUSIONS

The benefits of EUD in environments for creativity are linked to the need to constrain and structure creative activities at individual and collaborative levels, and to provide flexible support for a wide range of possibilities in designing tools. Both domain-general and domain-specific understandings of constraint can inform the design process of environments for creative tasks. Here we contribute a general model and investigate an implementation in the musical domain. The exploration of interactive mediums for tangible constraint development and internal constraint representation is fertile ground for further research.

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