# Designing for Creative Users: Paired Constraints and Defamiliarization

**Kristin Carlson**
The School for Interactive Arts + Technology
Simon Fraser University
102 Avenue, Surrey, British Columbia, V3T 0A3
Canada
kca59@sfu.ca

**Thecla Schiphorst**
The School for Interactive Arts + Technology
Simon Fraser University
102 Avenue, Surrey, British Columbia, V3T 0A3
Canada
thecla@sfu.ca

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.
*CHI'13*, April 27 – May 2, 2013, Paris, France.
Copyright 2012 ACM 978-1-XXXX-XXXX-X/XX/XX...$10.00.

## Abstract
Defamiliarization is an attentional technique designed to engage a user's decision-making capabilities, enabling new perspectives during otherwise familiar experiences. We connect applications of defamiliarization through a system of Paired-Constraints, a method for restructuring a problem space to guide user decision-making towards more desirable results, in order to support creative user experiences in HCI. Through our analysis of defamiliarization in HCI literature we identify combinations of user agency, system guidance and novelty that can be engaged in design practice for supporting creativity in technological interactions.

## Author Keywords
Defamiliarization, paired constraints, creativity, decision-making, ambiguity, making strange

## ACM Classification Keywords
H5.2. [User Interfaces] Interaction Styles, Theory and Methods, User-centered Design

## General Terms
Human Factors; Design.

## Introduction
The decision-making process of a creative practitioner is often defined as a non-linear process containing an element of novelty or exploration that stretches the

situated experience outside of its normal parameters [8]. However, the novelty generated in a creative experience often includes a period of disorientation that results from actions towards an unknown or unfamiliar goal [20]. Our ability to forget or ignore this disorientation period seems to stem from our perception that an optimal work environment is one that supports user control and agency, providing positive guidance to highlight potentially successful and recognizable decisions within a non-linear state. When designing for user engagement in systems, we seek ways to guide and direct the user towards desirable criteria, empowering them to make successful choices through scaffolding or design alternatives [20]. We do not on the other hand, suggest ways to hold the user back, to confuse or misguide them further. This bias towards accumulating 'better' known experience overlooks the value of disorientation as a precursor to enabling creative, engaging or enchanting user experience [24]. Defamiliarization, or 'making strange', is a pragmatic tactic for making the familiar unfamiliar in order to bring new awareness to known practices [10]. This form of 'disorientation' incites the user to assert their own agency in the scenario [7]. Agency utilizes the users' own reflection, analysis and assessment of the situation to engage in the task at hand.

Constraints are another important aspect of strategic design process that can facilitate the design of defamiliarization experiences. Though constraints can inhibit artistic freedom when imposed externally [1], strategic development of constructive constraints provide direction and guidance to practitioners [33]. Constraints challenge the designer or artist to experiment beyond the immediate, easy or habitual course of action. The use of Paired-Constraints inhibit some decision patterns while provoking others, guiding creative actions in a constructive yet efficient way within non-linear or ill-defined search spaces. Designing for user interaction with paired constraints enables creativity, engagement and enchantment in an interactive process while giving both the designer and the user agency. We are specifically interested in how technology can be designed to inform and support the user's creative processes though Reflection-in-Action to encourage new artistic ideas and methods of composition [25]. The research question driving this investigation is:

*How can paired constraints and defamiliarization be designed for use within technological interaction to provoke innovative decision-making experiences?*

We have performed a survey of literature referencing defamiliarization concepts in HCI and have analyzed them for salient components that guide users towards creative decision-making processes through high user agency, high system guidance and high novelty qualities.

## CONSTRAINTS

Constraints are parameters that guide an executable process. They can be externally imposed such as through culture, deadlines or commission requests. They can be internally imposed unconsciously through one's developed beliefs and habits. They can be consciously yet still internally devised in order to focus action towards specific goals that would not be explored in depth otherwise. The design of constraints directly defines and confines a problem's search space, thereby provoking new and potentially creative explorations [7].

According to Patricia Stokes, a psychologist and artist, the type of constraints utilized in creative-decision making affects the types of solutions generated [26]. The chosen constraint defines the search space, defining the potential solutions available at that time. Stokes suggests that creative constraints have to work in pairs (the first to inhibit habit, the second to induce new creative choice) in order to restructure an existing problem space; routine or habitual results need to be restrained while new and 'creative' results need to be provoked [26]. Creative constraints are often used to explore ideas in new ways and to push artist's choices and actions beyond known answers. Figure 1 is an example that describes the shift from Abstract Expressionism to Pop Art. In this example the use of creative constraint pairs inhibit a routine and established 'abstract expressionist' action while simultaneously provoking new creative choices by guiding awareness to developing another 'pop art' act.

*Paired Constraints for Pop Art*

| Problem Stages | Description |
|---|---|
| Initial state | Current "hot" painting style, Abstract Expressionism |
| Constraint pairs | 1. Preclude emotional impact → Promote intellectual distance (irony) |
| | 2. Preclude improvisation → Promote pre-planning |
| | 3. Preclude abstraction as motif → Promote ordinary, real objects as motifs |
| | 4. Preclude complex forms → Promote simplified forms (hard-edged) |
| | 5. Preclude modulated colors → Promote primary, unmixed hues |
| | 6. Preclude virtuoso brushwork → Promote flat paint application |
| Goal state: | New "cool" painting style, Pop Art |

Figure 1. Paired Constraints for Pop Art Generation [26]

Creativity is often an ill-structured problem, a problem with little or no specified criteria that makes a strategic solution difficult. However, we are able to evaluate the environment, the user and the situation to make informed choices that inherently structure the problem. By exploring these components constraints can be designed to leverage the experience to help facilitate strategic solutions. In general design practice, scaffolding is a frequently used technique to guide users towards desirable decision-making when learning how to use or interact with software. Scaffolding is less apparent in creative artistic practices because of the high reliance on user agency. By only focusing on guiding the user through their experience we forget about the value of the user's agency, and by only focusing on inhibiting actions to explore new possibilities we become frustrated with the process of searching for acceptable possibilities. The resulting reflection, creativity and engagement that can be created for the user in paired-constraint situations enables a structuring of ill-structured problems that can suit a situation rather than a desired result.

## USER DEFAMILIARIZATION IN HCI

Defamiliarization is a device for disorienting users while simultaneously engaging their own agency to re-orient their experience [10]. It can be a component of constraints when a possibility is not accessible, disconnecting the user from their familiar experience and requiring them to problem-solve in an unknown, situated environment. We have reviewed and analyzed 22 papers using defamiliarization, ambiguity, alienation or making strange as methods for avoiding habitual responses in Human Computer Interaction to explore new opportunities and to bring attention to the immediate experience of the user. We began by performing a theme-based analysis focusing on the paper's end goals to explore the use of defamiliarization in a) task completion, b) the enhancement of play, creativity, enchantment and meaning and c) explorations in transfer or re-labeling techniques to

better understand how defamiliarization is designed into user experience. We also identified the primary use of constraints and how they were used to facilitate the user's focus while attaining the end goal (see Table 1). From these results we performed a second analysis by using axial coding to deconstruct the elements of the end goals to find similarities between elements from which to extract a clearer understanding of the connections between end goals.

We identify papers that use defamiliarization in a situation focused on the end goals as 'task completion'. This shifts the user's focus towards the result, with less focus on the immediate experience. Aoki and Woodruff explored methods for controlling user responsiveness in task-based environments such as leasing mobile phone contact information [2]. Halloran et al explored methods of helping museum curators to re-connect their prior knowledge and habits with new possibilities through designing exhibit tours [15]. Noguchi and Coughlan and Johnson both designed constraints to guide creative process [12, 21]. By removing traditionally habitual options in music composition and visual art while provoking users towards more creative options for artistic composition through re-constructing the available search space and scaffolding beginning steps in the process. Poirier and Pringle held a workshop to explore, define and discuss evaluation methods for defamiliarization in design with members of the HCI community who contributed their implementation experiences [23].

Creativity, play and enchantment is explored by using defamiliarization to push users towards disorienting experiences with unique constraints. Benford et al. play with concepts of discomfort and vulnerability in engagement [5]. Corness et al. disoriented viewer's sensations to better understand how audiences perceive performers' actions in a creative context [11]. Gaver et al. explores methods to provoke user interpretation through exploring imagination in unaccustomed roles [14]. Sengers et al. focuses on on-going construction of experience through open-ended interaction with dynamic feedback to develop engaging affective experiences [24]. Constraints can be designed using aesthetic elements that use whole self experiences to provoke perception, play and innovation such as with Bardzell and Bardzell, Biskjaer et al., Bronet and Schumacher, Candy, Johnson-Laird and Peterson et al. [3, 6, 8, 9, 11, 16, 22]. The use of defamiliarization and play might even be useful in creating playful interactions with everyday technologies, such as kitchen appliances [4]. Design for empathy or enchantment can be better understood through experiences of disorientation and user agency to re-engage in the experience [20, 28].

Methods of transferring, re-labeling or re-mapping parameters from one object to another are additional defamiliarization techniques. By shifting the affordances of one medium to another the user's perception of both objects is disoriented, changing the user's perception of the affordances. Djajadiningrat et al. describes a project that identifies both physical and cultural affordances and re-maps them to another medium [13]. Ljungblad and Homquist observe exotic reptiles and re-map relevant qualities to robots to provide insight for potential roles of autonomous robots [18]. Kirsh explores re-mapping between modalities to test the cognitive processes of choreographers and the process of designing and composing movement while Loke inhibits habitual movement generation techniques to


Figure 2. Order for Addressing Analysis Structure

better understand methods for movement design that can be applied to technology interaction [17, 19].

*Theme-Based Analysis*

We compare papers from the HCI community that use concepts of defamiliarization as a component of experience. In our first pass we analyzed these papers for themes of how their use of defamiliarization supports an aspect of paired constraints (design considerations that initiated the experience), how defamiliarization was used to achieve the goals (in process experience) and what the goals of using defamiliarization were (end goal experience). Figure 2 illustrates how we discuss the connection between initiation of experience, the in-process experience and end goals of the experience through literature in Table 1. The 22 chosen papers are grouped by how their use of defamiliarization supports focus on conscious design considerations that inhibit actions, provoke actions or both. Six (6) papers focused on using defamiliarization as a device for inhibiting the user's actions in some way, allowing for open exploration of new search spaces. Nine (9) papers focused on provoking experience, often through using scaffolding strategies to guide users towards strategic decision-making. Seven (7) papers identify decision-making procedures that inhibit certain types of responses while simultaneously guiding others. This shows that the HCI community is participating in all uses of defamiliarization in user experience with a possible focus on provocation. Though papers use a form of paired-constraints in the literature, they often focus on defamiliarization while lacking techniques for consciously designing and applying constraints.

The process for attaining end goals through defamiliarization varied between task-oriented with a narrow focus (5), guided exploration towards the end goals with a medium focus (6), exploration in situ with a very wide focus (10)(without regard for end goals) and a focus on developing greater creativity that is guided towards a creative task with a narrower focus (7). By focusing on end goal completion the user was constrained to the most readily available options to complete the task. Allowing more open exploration towards the end goals still held a focus on completing the task but allowed for creative options simultaneously. Exploration in situ focused on the immediate experience of the user with disregard for focus on the end goals, while developing greater creativity developed a new end goal with a narrow focus on novelty. Each of these process choices affected how the users made decisions and engaged in the end goals.

The end goals of defamiliarization in user experience varied in the below papers. We identified all potential goals in a paper rather than a single option, since most papers had a complex focus on exploring user agency in experience. While the focus for some papers was on creating a new, unfamiliar search space (13), others wanted to create playful environment (6), greater creative options (13), a space for user reflection (8) or just a focus on guiding users to new options through scaffolding (6) or relabeling/mapping/transfer (6). Because defamiliarization creates new, unfamiliar experiences and engages users in the exploration process the decisions made to guide users became important. Users may be left to manage environments in a confused or disoriented state or users may be challenged to find playful or creative solutions. The disorienting environment may provoke user reflection or engage them in and guide them towards unusual options.

| Authors and Paper Title | Initiate User | | Experience Process | | | | Designer End Goals | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inhibit | Provoke | Task-Oriented (Narrow) | Guided Exploration (Medium) | Exploration In Situ (Wide) | Creative-Oriented (Narrow) | Playfulness | Disorientation | Reflection | Scaffolding | Creativity | Re-Labeling |
| Aoki and Woodruff, 'Making Space for Stories' | ■ | | ■ | | | ■ | ■ | | | | | |
| Benford et al, 'Uncomfortable Interactions' | ■ | | | ■ | ■ | | ■ | | | | ■ | |
| Corness et al,, 'Audience Empathy' | ■ | | | | ■ | | ■ | ■ | | | | |
| Loke & Robertson, 'Inventing and Devising Movement' | ■ | | | | | ■ | ■ | | | | ■ | ■ |
| Peterson, et al, 'Aesthetic Interaction' | ■ | | | | ■ | | ■ | ■ | | | ■ | |
| Poirier & Pringle, 'Defamiliarization in Innovation and Usability' | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ |
| Biskjaer, et al, 'Creativity Methods in Interaction Design' | | ■ | | ■ | | | | | | | ■ | |
| Bell, et al, 'Making by Making Strange' | | ■ | | | ■ | | ■ | | | | | |
| Coughlan & Johnson, 'Constraints and End User Development' | | ■ | | ■ | | | | | | ■ | ■ | |
| Gaver, et al, 'Ambiguity Resource in Design' | | ■ | | | ■ | | | | | | ■ | ■ |
| Johnson-Laird, 'Freedom and Constraint' in Creativity' | | ■ | | | | ■ | | ■ | | | ■ | |
| Kirsh, 'Creative Cognition in Choreography' | | ■ | | | | ■ | ■ | | | | ■ | ■ |
| Ljungblad & Holmquist, 'Transfer Scenarios' | | ■ | ■ | | | | | | ■ | | | ■ |
| Sengers, et al, 'Disenchantment of Affect' | | ■ | | | ■ | | | ■ | | ■ | | |
| Wright and McCarthy, 'Empathy and Experience in HCI' | | ■ | | | ■ | | | | ■ | | | |
| Bardzell & Bardzell, 'Intimate Interactions' | ■ | ■ | | ■ | | | | | ■ | | | |
| Bronet and Schumacher, 'Design in Movement' | ■ | ■ | | | ■ | | | ■ | | ■ | ■ | |
| Candy, 'Constraints and Creativity in Digital Arts' | ■ | ■ | | | | ■ | ■ | ■ | ■ | ■ | ■ | |
| Djajadiningrat, et al, 'Interaction Relabeling, Extreme Characters' | ■ | ■ | ■ | | | | ■ | | | | | ■ |
| Halloran et al, 'Unfolding Understandings' | ■ | ■ | | ■ | | | ■ | ■ | | ■ | | |
| McCarthy et al, 'The Experience of Enchantment in HCI ' | ■ | ■ | | | ■ | | ■ | ■ | ■ | | ■ | |
| Noguchi, 'How do Material Constraints Affect Creativity' | ■ | ■ | ■ | | | ■ | | ■ | | ■ | ■ | |

Table 1. Papers that Reference Defamiliarization Concepts Organized by Initiation, End Goals and Process

*Axial Coding*

From the themes identified above we re-analyzed the theme components to extract underlying characteristics and search for new connections between them [27]. To do this we identified components of each end goal theme (for example, Playful: novel, engaging, high user agency, space to explore). Then we compared the components and found similarities between then. From this process we determined that every end goal could be analyzed for degree of novelty, user agency and system guided scenarios. To test these elements we rated each paper on 3 levels: high (H), medium (M) or low (L) novelty, high (H), medium (M) or low (L) agency and high (H), medium (M) or low (L) guidance. For example the paper by Aoki et al. is H novelty, M agency and H guidance. We mapped these ratings to

view them (see Figure 3) and then identified their locations as quadrants for similar components (see Figure 4). In these figures we have removed the Novelty rating because every system included in the review had a high novelty rating. By looking at the location of different papers in the figure and the elements that placed them in that location, we can discern between four quadrants. These quadrants can represent topics of the reviewed literature and we can understand the components through the ratings (see Figure 4). For example, the topic of Disorientation has low user agency, low system guidance yet high novelty.

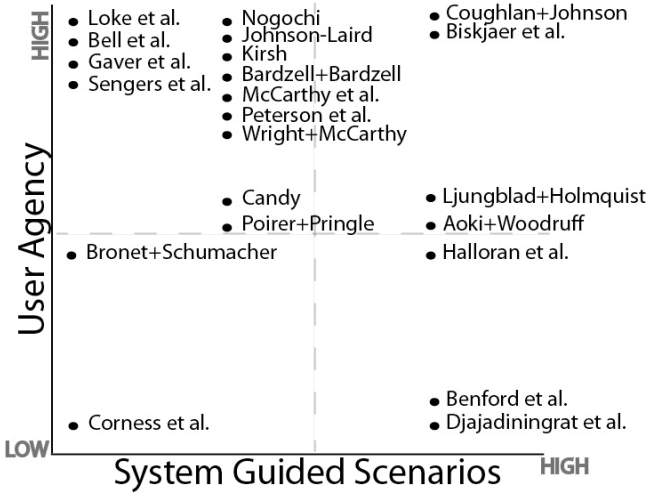


Figure 3. Axial Coding Layout (Removing Novelty Rating)

This creates an unfamiliar environment in which the user has minimal ability to affect, which could be a situation where the user's typical actions for that situation are inhibited and hence they are unable to move forward on their own. The process of exploration focuses on in-the-moment experience.

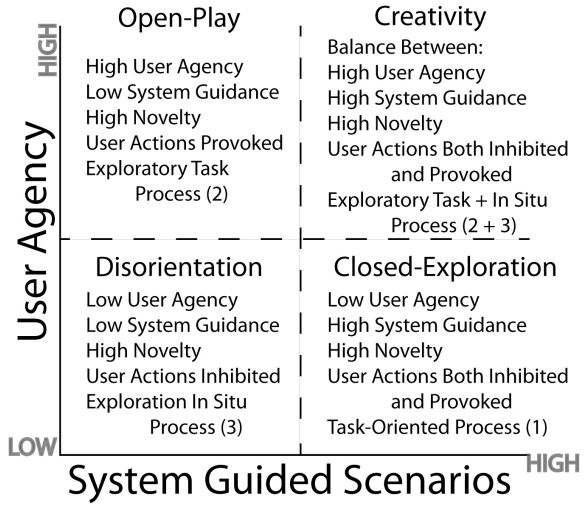


Figure 4. Axial Coding Extraction of Components

Closed-Exploration also has low user agency but high system guidance and high novelty. In this way the user's typical actions are inhibited, but there is guidance towards new actions that gives the user a space to move away from and towards. This process of exploration is more task-based with a clear objective and purpose. The topic of Open-Play has high user agency, low system guidance and high novelty. The user's actions are provoked through their own engagement, though often without any outside guidance to challenge their engagement. This process is more exploratory towards a task in that the user is exploring novel ways to continually engage themselves.

Creativity is very close to Play in that it has high user agency, high novelty and high system guidance. While these components may sound more restrictive than play, the ability to inhibit typical user actions while guiding them towards new, novel actions while the user stays in control and engaged can create a very fruitful environment but providing very new options that the user can choose between. This process is a mix of exploring options in situ as well as having goals to work towards so that there is iterative development.

*System Type Deconstruction Examples*
In order to better understand how these axial coding components relate back to the papers, we analyze one paper in the categories of Disorientation, Open-Play, Closed-Exploration and Creativity. We explore how defamiliarization was used and contributed to the concept of paired-constraints, in search of a reverse-view on the decision-making processes.

In the Disorientation quadrant Corness et al. describe a performance-research project to disorient the audience's typical method of sensing a dance performance behind them by separating their visual, auditory and kinesthetic senses through a mediated environment [13]. Within the environment the user is unable to control their typical perceptual process of the situation, resulting in low user agency. The mediated environment also does not provide any guidance to the user, though it is a highly novel scenario. The combination of these elements resulted in a highly disorienting experience for the audience member while providing insight on how audiences construct a relationship to a performer through their experience.

In the Open-Play quadrant, Gaver et al. describe three options for designing for ambiguity: enhancing, creating and provoking [14]. Enhancing Ambiguity uses imprecise representations to emphasize uncertainty. This includes over-interpreting data to encourage speculation (but draw attention to possible truths rather than non-truths). It may expose inconsistencies to create a space of interpretation and cast doubts on sources to provoke independent assessment. Creating Ambiguity develops unusual contexts to inhibit user preconceptions. Options include adding novel functions to breach existing genres or blocking expected functionality to comment on familiar products. Provoking Ambiguity offers unfamiliar roles to encourage the user's imagination. This includes pointing out things without explaining why. Users are provoked to explore novel and unfamiliar situations with a goal in place, but no clear direction to achieve it. These options rely on high user agency to make sense of the low system guidance. Users in this situation must explore options in situ, working towards an unclear or undefined task.

In the Closed-Exploration quadrant, Djajadiningrat et al. uses a variety of examples as 're-labeling' to select a novel, meaning-laden object or character to overlay a functional tool [13]. For example, one project identifies the affordances of a pistol and re-maps them to a calendar program, enabling a new playful manner of engaging with everyday scheduling. This process inhibits the user's traditional expectations and affordances of the calendar function while provoking new novel experiences through the pistol affordances. This paper is an excellent example of creative design decisions by using concrete and meaning-laden objects to create new affordances when layered on old

interaction options. While re-labeling does not allow for the open-endedness that other methods of defamiliarization do, it re-contextualizes the possible options which requires the user to re-consider the decisions at hand. This experience could be quite disorienting to an unprepared user (when the expected affordances are not there). However the functionality of the calendar does not change which limits the extent of disorientation (and also shifts the focus of interaction quality from function to aesthetics). This work supports user engagement and quality of experience in interaction, which is highly important in creative process. There is low user agency because the user does not have to create the scenario in which to use the tool, but are engaged in a highly novel situation interacting with a highly designed system that guides their experience through the meaning-laden choices.

In the Creativity quadrant, Coughlan and Johnson describe a system for collaboratively designing computational instruments and composing music through designing paired-constraints [12]. This study tracked the development of instruments and identified the importance of iterative design between tangible and conceptual ideals. This system of actively exploring constraints found a balance between inhibiting the user's familiar musical options while provoking new ones. There was high user agency, high system guidance (through the collaborative constraint-design effort) and high novelty in the situation. Users needed to explore the available options in situ, but also had clear artistic goals to reach for.

## Conclusion

In this paper we identify salient scenarios that discern user creativity in technological interaction from concepts of open-play, closed-exploration and disorientation. These differentiated scenarios of user experience are important to define in order to enable further sophistication in qualities of interaction design that support user creativity. Components of user agency, system guidance and novelty were developed from our review of digital interaction literature that explore concepts of defamiliarization and paired-constraints for experience design. While our literature review indicates that some form of paired-constraints have been applied to interaction design, the focus is often on defamiliarization 'at large', lacking techniques for consciously designing and applying constraints. The description of scenarios can support definition of user experiences to design paired-constraints and defamiliarization instances to support the desired scenario. Future work includes the exploration of constraint design and its affects in application to user creativity supported by technological interaction

## References

[1] Amabile, T. M., Hennessey, B. A., & Grossman, B. S. (1986). Social influences on creativity: The effects of contracted-for reward. Journal of Personality and Social Psychology, 50(1), 14–23.

[2] Aoki, P. M., & Woodruff, A. (2005). Making space for stories: ambiguity in the design of personal communication systems. CHI '05 (pp. 181–190). ACM.

[3] Bardzell, J., & Bardzell, S. (2008). FEATURE: Intimate interactions: online representation and software of the self. Interactions, 15(5), 11–15.

[4] Bell, G., Blythe, M., & Sengers, P. (2005). Making by making strange: Defamiliarization and the design of domestic technologies. ACM Trans. Computer Human Interaction, 12(2), 149–173.

[5] Benford, S., Greenhalgh, C., Giannachi, G., Walker, B., Marshall, J., & Rodden, T. (2012). Uncomfortable interactions. Proc. CHI '12 (pp. 2005–2014). ACM.

[6] Biskjaer, M. M., Dalsgaard, P., & Halskov, K. (2010). Creativity methods in interaction design. Proc. DESIRE '10 (pp. 12–21).

[7] Boden, M. A. (2003). The Creative Mind: Myths and Mechanisms. Routledge.

[8] Bronet, F., & Schumacher, J. (1999). Design in Movement: The Prospects of Interdisciplinary Design. Journal of Architectural Education, 53(2), 97–109.

[9] Candy, L. (2007). Constraints and Creativity in the Digital Arts. Leonardo, 40(4), 366–367.

[10] Crawford, L.(1984). Viktor Shklovskij: Différance in Defamiliarization. Comparative Literature, 36(3), pp. 209–219.

[11] Corness, G., Carlson, K., & Schiphorst, T. (2011). Audience Empathy: a Phenomenological Method for Mediated Performance. Proc. of the 8th Conference on Creativity and Cognition, Atlanta, Georgia, USA.

[12] Coughlan, T., & Johnson, P. (2008). An Exploration of Constraints and End User Development in Environments for Creative Tasks. International Journal of Human-Computer Interaction, 24(5), 444–459.

[13] Djajadiningrat, J., Gaver, W., & Fres, J. (2000). Interaction relabelling and extreme characters: methods for exploring aesthetic interactions. Proc. Designing Interactive Systems, (pp. 66–71). ACM.

[14] Gaver, W., Beaver, J., & Benford, S. (2003). Ambiguity as a resource for design. CHI '03 (pp. 233–240). ACM.

[15] Halloran, J., Hornecker, E., Fitzpatrick, G., Weal, M., Millard, D., Michaelides, D., Cruickshank, D., et al. (2006). Unfolding understandings: co-designing UbiComp In Situ, over time. Proc. Designing Interactive Systems, DIS '06 (pp. 109–118). ACM.

[16] Johnson-Laird, P. (1988). Freedom and Constraint in Creativity. In Sternberg, R. J. The Nature of creativity: contemporary psychological perspectives. CUP Archive.

[17] Kirsh, D. (2011). Creative Cognition in Choreography. International Conference on Computational Creativity (ICCC), ACM Press.

[18] Ljungblad, S., & Holmquist, L. E. (2007). Transfer scenarios: grounding innovation with marginal practices. CHI '07 (pp. 737–746). ACM.

[19] Loke, L., & Robertson, T. (2008). Inventing and devising movement in the design of movement-based interactive systems. OZCHI '08 (pp. 81–88). ACM.

[20] McCarthy, J., Wright, P., Wallace, J., & Dearden, A. (2006). The experience of enchantment in human computer interaction. Personal Ubiquitous Computing, 10(6), 369–378.

[21] Noguchi, H. (1999). How do material constraints affect design creativity? Proc. Creativity & Cognition, (pp. 82–87). ACM.

[22] Petersen, M., Iversen, O., Krogh, P., & Ludvigsen, M. (2004). Aesthetic interaction: a pragmatist's aesthetics of interactive systems. Proc. Designing interactive systems, DIS '04 (pp. 269–276). ACM.

[23] Poirier, C., Pringle, C. (2012) Defamiliarization in Innovation and Usability. CHI '12 Workshop.

[24] Sengers, P., Boehner, K., Mateas, M., & Gay, G. (2008). The disenchantment of affect. Personal Ubiquitous Computing, 12(5), 347–358.

[25] Schon, D. A. (2000). Reflective Practioner: How Professionals Think in Action. New York: BasicBooks.

[26] Stokes, P. D. (2006). Creativity from Constraints: The Psychology of Breakthrough. New York: Springer.

[27] Strauss, A. C., & Corbin, J. M. (1990). Basics of Qualitative Research: Grounded Theory Procedures and Techniques. SAGE Publications, Inc.

[28] Wright, P., & McCarthy, J. (2008). Empathy and experience in HCI. Proc. CHI '08 (pp. 637–646). ACM.