An Enactment-Based Approach to Creativity Support

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ABSTRACT

Despite the great amount of work addressing the issue of embodiment with regards to creativity support technologies for children, there is a paucity of research that presents theoretical bases that are able to explain in depth the process of how the generally positive effects on creativity obtained from user studies take place. In this paper, we draw from our experiences conducting studies with children aged 8 to 10 and from the theories of Lev Vygotsky to present a model of the mediated creative process. We further advance that an enactment-based approach to creativity support is beneficial, and describe two studies that advance understanding of the design of enactment-based technology to nurture creativity in children.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: User-centered design

General Terms

Design, Human Factors

Keywords

Creativity, Imagination, Embodiment, Children, Enactment, Vygotsky, Storytelling, Mediation

1. INTRODUCTION

The field of child-computer interaction has in recent years seen both a growing concern about the issue of creativity and an increasing apparent adoption of the embodiment perspective. However, little research that addresses the two issues simultaneously present concrete understanding of underlying mechanisms or conceptual models of how they relate to each other and to other factors. In this paper, we first provide a very brief overview of the types of perspectives adopted on embodiment in the literature on interaction design for children. We then present a model of the creative process that arises from our interpretation of the theories of Lev Vygotsky and from insights emerging from our studies with children in the context of digital creative storytelling.

2. EMBODIED APPROACHES

Embodiment theory suggests that bodily action and environmental affordances play an important role in the development of children’s higher level thinking [2]. Over the years, the embodied perspective has gained enormous traction in the HCI literature addressing children. One of the first key articles [2] in the inaugural International Journal of Child-Computer Interaction provides a review of embodied cognition theories as they relate to research in child-computer interaction. In the proceedings of the Interaction Design and Children 2012 conference alone, we find eight papers that explicitly mention the use of embodiment theories in some form to design, evaluate or interpret research artifacts and findings. Many of the other papers in the proceedings adopt perspectives that reflect embodiment without making explicit reference to the concept. Embodied perspectives in interaction design for children have included the need for systems to have in-situ capabilities, the use of physical activity and movement for interaction, the use of the actual body as interface, the use of physical/tangible objects, and the benefits of physical computing for augmenting artifacts.

Despite the popularity of embodiment theories, we find few works that address how exactly the proposed technology is mediating the child’s creative process. In a similar vein, Antle’s article [2] highlights that the increase in applications of embodiment lenses to research in the community has unfortunately not been driven or informed by understandings of children’s embodied abilities and needs. Among IDC 2012 papers for instance, only one elaborated a theoretical framework for embodiment. Charoenying, Gaysinsky and Ryokai [5] present the notion of Papert’s body syntonicity to address computer-supported learning, as the basis for a model of how a child’s ‘enacted’ experiences in the real world can reinforce learnt ‘schemes’.

3. A MODEL OF MEDIATED CREATIVITY
We present a model of the creative process that operationalizes several aspects of Vygotsky’s theories of creativity and concept formation. The purpose of this model is to motivate the development of technology-based tools to support storytelling for children, especially from the 3rd–4th grades.

### 3.1 Storytelling as a Creative Process

In his theory on the formation of concepts, Vygotsky makes a distinction between *complexes* and *concepts* ([23] pp. 96-209). The former are characterized by surface level organizations such as grouping by similarity and membership in a collection. The latter is marked by one’s logical reconstruction of the constituent atomized units of thought to form an understanding. The complex is fragile and breaks down easily, while the latter is flexible and can be effectively wielded for further learning and thinking. A particularly interesting kind of complex is the *pseudoconcept* that Vygotsky describes as resembling a real concept because it takes the form in which it was encountered in the first place. Hence, the recipient may be able to regurgitate the *pseudoconcept* as though she has a grasp of it, only to have it evaporate the moment she tries to apply it in a different context. For Vygotsky, the formation of true concepts requires that the *pseudoconcept* be ‘destroyed’ and ‘reconstructed’ anew by the conceptualizer ([23] pp. 96-145), [12, 15].

Here, Vygotsky builds a bridge from creativity and imagination to the entire enterprise of human thinking and learning. To learn is to create anew a concept for oneself. "If human activity were limited to reproduction of the old, a person would, in essence, be attending only to the past and would be able to adapt to the future only to the extent that it reproduces the past. The creative activity of an individual does this, essentially; it attends to the future, creating it, and changing the view of the present. . . . This creative activity, based on the combinatory ability of our brain [is called] imagination or fantasy" [20, 22].

We apply this fundamental Vygotskian theory to understand the active process of a child’s hearing and telling of a story. Figure 1 illustrates our conceptualization of the creative process of story telling and uptake. First, Vygotsky, as well as others such as Pelaprat and Cole [16] distinguishes between *creativity* and *imagination*, and proposes that the first is based on the second. Imagination becomes creativity when it enters the social and cultural world in some perceivable form: if the output of an activity is “perceived as new, the products of imagination become creative when they enter the cultural world of interaction.” ([16], p. 414). This important distinction is shown in our conceptual figure.

Second, the left side of the figure shows the raw material from which a child constructs a story concept. The raw material can be of two forms: (i) a *stimulus* that may be any perceivable element in the environment, or (ii) elements from prior *experiences* retrieved from memory. For example, when a child hears a story, the presentation of the story is the main stimulus. To properly understand the story for herself, she decomposes the story elements into *idea fragments*. She *recombines* these fragments with others from her prior experience and knowledge into her new experience of the story for a re-expression or retelling. In a sense, the child is forming her own concept of the story much in the same way a screenwriter reconceptualizes a book for telling-in-film. Similarly, when she constructs a new story, the child has available to her the idea fragments from her experience, and depending on context, she may also receive stimulus from her immediate environment and any designed support from technologies she may be using.

The process of recombination is integral to many mechanisms that others have also advanced for creativity. Finke et al. [11] list the process of ‘conceptual association and recombination’ as the two important properties of creative cognition. Boden [3] as well refers to ‘combinatorial creativity’, i.e., utilizing rules in a conceptual search space in new ways “to come up with new combinations”. Fauconnier and Turner’s [10] concept of ‘conceptual blending’ holds the same idea of combining domains.

This takes us to the rightmost stage of Figure 1 where the story is expressed (whether in a story retelling or the telling of a new story). Here the process transitions from imagination to creative output as it is actualized in the world of social interaction [1, 16]. This stage of expression is not required. Maruskin and Thrash [13] show the significant role that inspiration and motivation have to play for one to actualize ideas. We emphasize that Figure 1 is a logical model that does not imply any strict temporal order. Some of the stages may occur simultaneously, and the stages may iterate. This is illustrated particularly and most importantly by the dotted arrow labeled *feedback* where the creative expression itself provides new material to further fuel the recombination process as it becomes part of the perceivable environment of the child. Vygotsky conceives of this mediation of thinking through perception as an ‘outside-in’ process ([21] pp. 92-104). External representations that humans appropriate to mediate thinking may take the form of a sound (speaking a word helps us to think of its meaning), a gesture, or a block to represent an idea. This ‘outside-in’ strategy of thinking is critical in childhood, but is employed to mediate thinking through life.

### 3.2 Mediating the Creative Process

We have thus far described the basic processes in our model. HCI research in creativity support focuses on how to support, in effect positively mediating, one or more of the processes, namely idea fragment construction, recombination and expression. The arrow labeled *Enactment* in Figure 1 represents the embodied process to mediate creativity in the child. We propose that embodiment works through the concept of enactment or enactive representation, that we conceive as the *process by which action, constructed through motoric behavior, participates in the organization of thought*. We do not mean by this only the acting out of narrative content by overt physical action. Humans are able to bring covert sensorimotor simulation into enactive thought [19], in essence enacting abstractly in mind.

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**Figure 1:** A conceptual model of the creative process
Furthermore, even speaking and the production of verbal utterances involve embodied imagery expressed in prosody and gesture [14, 18]. According to Bruner [4], enactment is involved in all active experience and production of narratives. For the child however, externalized enactment is particularly critical. Our research focuses on children in the 3rd–4th grade. During this period of development especially, the child is early in the process of developing the inner world of abstract imagination ([21] pp. 52–57, [17]).

The value of enactment as an approach to supporting children’s creativity is at least threefold. First, its accessible nature motivates the child to engage in creative expression. Second, it facilitates the process of expression of the child engaged in it. And third, through the ‘outside-in’ strategy we described before (the loop-back arrow) and through its function of being a lived-in experience, enactment positively affects the generation of idea fragments and recombination stage. Enactment for the child therefore may produce a richer creative process. The question then becomes how technology may be employed to support externalized enactment at different stages of Figure 1.

4. ENACTMENT-BASED CREATIVITY

We conducted two major studies that flesh out how the enactment-based approach can inform the design of creativity support technologies. Both involve children aged from 8 to 10 as participants. The first study shows that the use of multimedia in interfaces for story creation motivates children to harness enactment to stimulate and express imagination. The second study shows that perceptual and manipulative affordances of physical, tangible objects change children’s level of imagination during enactment.

4.1 Study I

In Study I [9], we investigated how children using different available interfaces to create storytelling differ in their creative process. In groups of three or four, ten children from an afterschool program were given the task of completing a story with a given beginning using in one condition, a stop-motion animation software, and in the other, digital text in the form of Powerpoint slides with a book template (see Figure 2). Apart from a training session on how to use the software, the children were given no other instructions. All the groups of participants underwent both conditions. The children were asked to retell their story individually to a researcher immediately after the story creation task. The conversations among the children in each group during the story creation sessions, as well as the post-study retellings and interviews were audio recorded.

Using a method of discourse analysis called the reference chain analysis, we analyzed the transcribed in-session conversations to derive stages and strategies used during creation in each condition. The story retellings of the children were coded into ‘narrative digests’ that list out all the idea units in the retelling and compared with the ‘digest’ of the actual stories they created. The created stories were also evaluated by three elementary school teachers using Ameal’s consensual assessment technique [1]. A core finding of the study was that the children using the animation interface made use of enactment in the form of character vocalizations and bodily demonstrations to evolve the story. The main avenues of enactment as being vocal and motoric at this stage of the child’s development is not surprising, given that the child is early in the process of developing the inner world of abstract imagination [21] (pp. 52-57), [17]. Moreover, their unit of story development using enactment was at a micro-level, focusing on a character, a prop or a scenery item at a time but elaborating upon it in greater depth than in the condition of digital text story construction. We term this behavioral phenomenon of the children that was motivated by a multimedia creation interface micro-enactment [6].

4.2 Study II

Study II [8] explored how the physicality of tangible objects affect children’s level of in-situ imagination during storytelling. We constructed three versions of three artifacts, namely a toy frying pan, a toy pickaxe and a toy lantern. The three versions (or types) of each object differed in terms of level of ambiguity in their designs (see Figure 3). The first type possessed culturally-specific affordances that are visually and manipulatively similar to the real-life referent of the object (hereafter referred to as the cultural object). The second type was designed to have generic affordances that are somewhat manipulatively similar to the real-life referent of the object (the physical object). The third type was a simple stick with little guided affordances (arbitrary object). Eleven children from an elementary school took part in the study. In random pairs, the children listened to a story that we constructed to have three acts, one act for each of the three object types. At three points within each act, the story was paused and each child was asked to enact separately the scene right before the pause using one version of the object. For example, at enactment point A in Act 1 the child is asked to enact cook-
ing mushrooms using the cultural frying pan. At enactment point B in the same act, she enacts digging up rocks with the cultural pickaxe. At point C, she enacts shoeing bats away with the cultural lantern. Act 2 will then deal with the physical objects and Act 3 with the arbitrary objects. The order of object types used across acts was randomized for each child. After each story act, the child was interviewed about her enactments, asked to retell the story and to draw the scene from one of her enactments. All enactments and interviews were audio and video recorded.

We assessed how well the child imagines during enactment in terms of richness, typicality and consistency by using MAIA, a method to assess in-situ imagination by micro-analyzing the enactment videos, interview transcripts and scene drawings, as described in [7]. Our analysis yielded a significant Object × Object Type × Gender interaction effect. The results suggest that there are strong gender differences in the type of object affordances that support children’s imagination. We found consistent patterns for both the pickaxe and the lantern objects whereby for males, imagination scores were significantly higher using the arbitrary objects. For females, although the differences among the object types did not cross significance level, trends show that imagination was better supported by the physical objects. The frying pan object generated deviations from the established pattern for each gender causing the cultural (for females) and the physical (for males) objects to overtake the other object types. We hypothesized that the deviations can be explained by the fact that the frying pan is a domestic appliance that is heavily loaded with cultural meaning.

5. CONCLUSION

Our studies are but the start of a larger exploration that aims at building an empirically-grounded base for designing technologies for children that nurture the creative process end-to-end. We presented a model of mediation in the creative process that describes how creativity support technology designed from an embodiment perspective may be effective for children. We advanced that embodied systems function through the lived-in experience of enactment to stimulate idea fragments used in the process of recombination, and to motivate and facilitate expression. The core of our research is an exploratory foray into how technology, including virtual or physical interfaces, may nurture the creativity of children in the age group of 8 to 10. We found that multimedia interfaces seem to encourage the use of micro-enactment, and that generic or arbitrary physical affordances of tangibles, depending on gender, may be better suited to support broader imagination in the child. We focus on the domain of creative storytelling, but with a wider view, our model of the mediated creative process and proposed enactment-based approach may be seen as applicable to many other domains as well. As per Bruner’s [4] concept of ‘narrative intelligence’, human beings are essentially storytellers, and make sense of life and all experiences through narratives.

6. REFERENCES


