# Computer Support for Children's Collaborative Fantasy Play and Storytelling

**Kimiko Ryokai and Justine Cassell**

*Media Laboratory*
*Massachusetts Institute of Technology*

**Abstract**

Collaborative fantasy play and storytelling serve an important role in preschool children's development. Making up characters and telling stories are activities through which children make sense of and test their hypotheses about the world. While computers are increasingly present to support young children's collaboration in school tasks, there is a lack of computational systems to support children's voice in this kind of important collaborative activity.

StoryMat is a system that supports children's collaborative fantasy play and storytelling. With StoryMat, however, collaboration can take place among co-present peers, or between a child and a previous user, mediated by the StoryMat. StoryMat records and recalls children's own narrating voices and the movements they make with their toys on the mat. Stories from the past are conjured up on the mat as a narrating moving shadow of the toy, when they are triggered by the present stories that are similar. By hearing peer stories in response to their own story, children's stories and the experience of telling them seem to become richer. This paper addresses the importance of supporting children's collaboration in fantasy play and storytelling and suggests a new way for technology to play an integral part in that activity.

**Keywords** - peer collaboration, storytelling, fantasy play

## INTRODUCTION

Computer Supported Collaborative Learning is often defined as a collaboration between a teacher and a learner mediated by a computer, or two children solving problems together using a computer. However, collaboration also occurs spontaneously among children as they co-construct fantasy worlds and tell stories about them, in the process improving their language and narrative skills, and their ability to work with other children, and computers can play important roles in this kind of collaboration as well. In this paper, we look at a particular kind of collaboration in children's play – that is fantasy storytelling play. Fantasy storytelling play is important in children's development and collaboration among peers plays a key role in the success of the activity. We discuss the role that one computationally-enhanced play mat plays in young children's collaborative fantasy storytelling play.

## Fantasy Play

In children's spontaneous play, their language and actions are both the process and the product of their fantasy play. For example, a child who is holding a piece of block tells her playmate, "Pretend this was a train, OK?" Children demonstrate in this language a sense of possibility – the concept of "what might be" (Singer & Singer, 1990).

Such imaginative exercise is important in children's development. Fantasy play allows children to explore different possibilities in their life without the risk of failure and frustration from unexpected events. Pretense gives children a unique opportunity to explore their own emotional arousal (Fein, 1987), and also an opportunity to experiment with possible interactions and relationships among humans (Leslie, 1987). As such, fantasy play plays an important role in children's emotional and social development.

Fantasy play also fosters children's cognitive and language skills. In fantasy play, children practice their ability to represent objects, actions, and feelings with something that stands for them. Such ability is paralleled by a corresponding ability to represent in language (Nicolich, 1977). By fostering the development of children's symbolic imagination and providing a field for its exercise, fantasy play and narrative activity prepare the way for the development of abstract thinking and higher mental processes (Nicolopolou, 1996).

## Young Children's Play: Developmental Perspective

Children's play patterns change as they get older. Children start out by engaging in a "solo" play style and gradually learn to engage in more social play.

At age 2, children's play is solitary. That is, children play alone with toys regardless of their proximity to other children. A child may be playing with a toy car right next to a child who is playing with a toy truck. But neither of them attempts to get close to the other. They seclude themselves from the presence of others and their interest is only in their interaction with the object (Parten,1932; Peller, 1955). Children in this stage also speak predominately in the first person during fantasy play. For example, a child may say, "What's that?" or "Go away!" in his play, but he does not introduce the quoted speech.

At age 3, children are predominantly focused on "parallel" play or what Peller (1955) calls "mirroring" play. Children who engage in parallel play still do not show any attempt to influence the other's play with their own. But the child plays with similar toys in the same play style as other children. We may see a child who is playing in a very similar way to a child who is playing right next to him. "Chu-ga chu-ga." One child plays with his train toy. And another one says the same thing, "Chu-ga chu-ga," with his toy. Yet there is no interaction between them.

By age 4, children engage in more social play. Their play becomes more "associative" and "cooperative." They are concerned with common activity and able to have conversation with a common goal. They are also able to engage in the higher level of activity as they are able to play with others in the "shared-imagination" world (Damon, 1983). They coordinate their actions and interpretation of the world in a cooperative manner. By age four, children also become increasingly competent at speaking from a perspective that is different from their own. Auwarter (1986), in his experiment with children age between 3 and 9, found that the ability to take a character role identity in a story increased as children became older. Auwarter also found that children's ability to produce the neutral perspective (narrator's perspective) increased as the children got even older. While younger children are able to narrate from the character's point of view as in "This tastes really good!," older children were able to also narrate from the neutral observer, the narrator's point of view, as in, "So, he ate some delicious apples."

Therefore, as they develop, children are more likely to interact cooperatively, and able to engage in make-believe activities and share the world with others using more sophisticated language forms. However, make-believe play is at its peak when a child is between the age 4 and 7 (Vygotsky, 1967). By age 8, a child begins to reason more like an adult. A child seeks out more logical and realistic scenarios rather than imaginary made-up scenarios (Miller, 1979).

While preschool children aged between 4 and 7 are able to construct make-believe roles or situations, they are also able to engage in such activity with others in a cooperative manner (Damon, 1983). Therefore, that period of one's childhood seems to be devoted to preparing or practicing imaginative skills, and also to doing so in the social context. In parallel, children during this age are acquiring the ability to present the content of their fantasies to others, through the use of the narrative voice. Thus, whereas younger children may simply roar, older children become able to say "and then the dragon roared 'I will eat you all up.'"

**Peer Collaboration in Fantasy Play**

Children are better at fantasy play in collaboration with peers than with parents, as peer play demonstrates more negotiation and is more improvisationally creative (Whiting & Whiting, 1975). Fein & Fryer (1995) found no evidence that mothers contribute to the quality or sophistication of peer play. In contrast, in children's play, peers' stories and imaginary creations serve as a new suggestions for children to enact and tell their story creatively within the dramatic frame (Baker-Sennett, Matusov, & Rogoff, 1992). It is the "collective" routines among peers that take children's fantasy play even further (Corsaro, 1992).

Fantasy play among peers also offers a space where children can practice speaking from different perspectives, such as an imaginary character or a third person narrator. With age, children learn to take different perspectives and they also become competent at mixing the roles to achieve more complex uses of language (Auwarter, 1986). Fantasy play among peers allows children to listen to and become influenced by different uses of language. Therefore, peer collaboration in fantasy play serves an important function in children's exploration and practice of language.

In sum, in fantasy play children practice and develop many essential social, cognitive and linguistic skills, and can then apply what they learn in play sequences to the everyday cognitive and social demands of life. Peer interaction and collaboration help to foster the activity. Some children, however, do not have access to the peer context that can scaffold their fantasy play. Hospitalized or otherwise isolated children suffer from exactly this lack of peers in their exploration of the world. While computer support for young children's collaborative learning is often focused on their school tasks such as learning math and writing the letters of alphabet, there seems to be a need for systems that support young children's collaborative fantasy play.

**StoryMat**

StoryMat is a system designed to support children's collaborative storytelling in the context of their fantasy play. StoryMat is a soft play mat that provides an under-determined play space for children to tell their own stories, and yet it is an "active" play mat in that it supports children's storytelling play by recording and recalling their stories. When children tell their stories with a toy on StoryMat, their narrating voices and the associated movements of the toys are recorded. The recorded story is then compared with other stories told by children who have visited the mat previously. One of the past stories that shares a similar pattern (specifically, the length of the story, the pattern of the path the toy took, and the identity of the toy) with the present story is recalled on the mat, as a moving shadow of the toy with its narrator's voice. This in turn provides a space where a child may continue the themes of the story she heard by telling her own new story. The child may tell her subsequent story by coming up with a creative solution to the story she just heard. Or she may continue to tell what she was telling but incorporating some story elements from the story she just heard. In this sense, StoryMat is a kind of imaginary playmate, but who also mediates natural collaboration between a child and her peer group.

**Figure 1**: StoryMat invites children to tell their stories collaboratively in an under-determined play world.

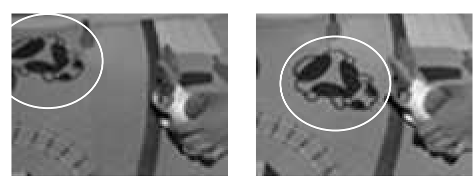


**Figure 2**: Telling a story with the stuffed bunny triggers a previously told story to be played back on the mat as an animation.

Generally, the stories children tell are not saved for some special occasion or just for adults to hear. Instead, they slip unobtrusively into the flow of children's everyday play (Miller & Sperry, 1988). Yet, if there were a space where such stories were stored for the tellers or their peers to hear and for them to explore further, in much the style of peer collaboration they are excellent at, the experience of storytelling might become richer. StoryMat was designed to capture children's everyday stories to support more connections and exchanges of stories among children. By recording and recalling children's own stories, StoryMat offers more opportunities for children to listen to and interpret each others' stories even in the absence of physical playmates. As a result, a child who plays on the mat by herself could tell her stories collaboratively with stories that were told by other children on the mat, just as she might in playing with her real friend. And a child who plays on the mat with friends will have more stories to work with in telling his stories, and a model of collaborative storytelling to depend on. In both cases, collaboration among peers is exploited to foster creative storytelling on StoryMat.

StoryMat, with its soft and tangible interface that allows more natural manipulation of digital information (Ishii & Ullmer, 1997), not only creates an emotionally engaging environment for storytelling, but also invites more collaboration and interaction among peers. StoryMat uses the voice and the movements children produce as input and output. Free from the confines of typing and the general desktop arrangement, children on StoryMat move around and narrate freely with their toys. The voices of the children recalled and heard on the mat also contribute to creating an environment where peer collaboration is encouraged.

In addition to providing a larger-than-themselves interface, this particular kind of quilt serves as a unique interface for collaborative storytelling. Objects sewn on the mat are story evoking: paths going in different directions, trees, houses, and fields of contrasting colors. These objects serve as "story starters" for children, yet they are under-determined enough to be transformed into any objects children imagine them to be. For example, a house can be imagined by one child to be a candy shop and another child to be her own home. A blue field can be a magic spring or a field filled with blue flowers. Children on StoryMat see and hear other children's transformations of the appliqués on the mat creations and become inspired to tell their own stories creatively.

## Technical Implementation

The StoryMat itself is a soft cloth quilt with appliquéd figures on it. Software divides the mat into 192 (16x12) areas, without any need for attached wires or grids. An ultrasonic transmitter embedded in the small stuffed animal allows wireless tracking of the animal's movement on the mat. Squeezing the stuffed animal triggers the computer to start recording the child's narrating voice and the two dimensional coordinates of the stuffed animal. When the child lets the stuffed animal go, the coordinates and the voice are combined into a movie file and saved in the computer to be played at the appropriate locations of the mat. When new input is subsequently encountered at the same place on the mat, the movie file is then automatically triggered and played back via a projector mounted above the mat, and heard through a pair of speakers next to it. The animation of the stuffed animal is projected onto the mat and travels the course of the recorded path, complemented by the child's recorded voice. When there are multiple sessions stored at the same place on the mat as the new session, the one with most similar size and pattern (the length of the story session, pattern of the path the toy took, and the identity of the toy) as the new session is chosen to be played back. The idea is to mediate a collaboration between a child and the peer by connecting the present stories with the past stories, but also to have the computer play a role of a playmate by responding to the child's story with a peer story that is similar.

The stories on StoryMat are also designed to be manipulatable objects of collaboration. During the course of a playback, when the user squeezes the stuffed animal and begins to tell a new ending for the played-back story, a new animation is created of child #1's beginning and child #2's ending, and this new animation is stored in the library of possible stories to be played back on the mat. Thus, layers of children's stories accumulate in the library alongside original one-child stories.

**StoryMat User Study**

Our belief is that the StoryMat system acts as a kind of imaginary playmate or peer, standing in for absent children when a child is playing alone on the mat, and mediating communication between two children playing on the mat when children play together. In this way, we believe that the StoryMat encourages creative exploration of language and narrative in young children. In order to investigate these claims, we investigated how playing on StoryMat impacts the experience of children who are playing alone and playing together with a playmate, and we compared children who are playing on the active StoryMat and children who are playing on a passive quilt. That is, groups of children who played alone and children who played with a playmate on StoryMat were compared with groups of children playing alone and groups of children playing with a playmate on a passive mat. The identical quilt without the recording and recalling function of stories is what we call the passive mat.

We recruited 36 children between the age of 5 to 8 for the study. Children were randomly assigned into one of two groups: 1) StoryMat group, who played on StoryMat and 2) a control group, who played on the passive mat. In each group, 6 children played alone and 12 children played with another playmate, resulting in 6 dyads and 6 singles in each group.

The children played on StoryMat or the passive mat for 15 minutes. The first 10 minutes of discourse were collected from all the child participants. All the 36 children's speech, a total of 24 10-minute sessions (12 singles and 12 dyads sessions) were transcribed.

We analyzed the transcripts in two ways, to examine the two claims expressed above. First we looked at whether StoryMat provides a place for collaborative storytelling, and how collaboration was expressed among dyads and with solitary children. We analyzed the transcripts by examining the number of story elements from other children's stories incorporated by the children in different groups. Second, we looked at whether more or less developmentally advanced types of fantasy storytelling play were fostered by children using StoryMat in the different conditions. We analyzed the transcripts by investigating how children used different identity roles in their fantasy play.

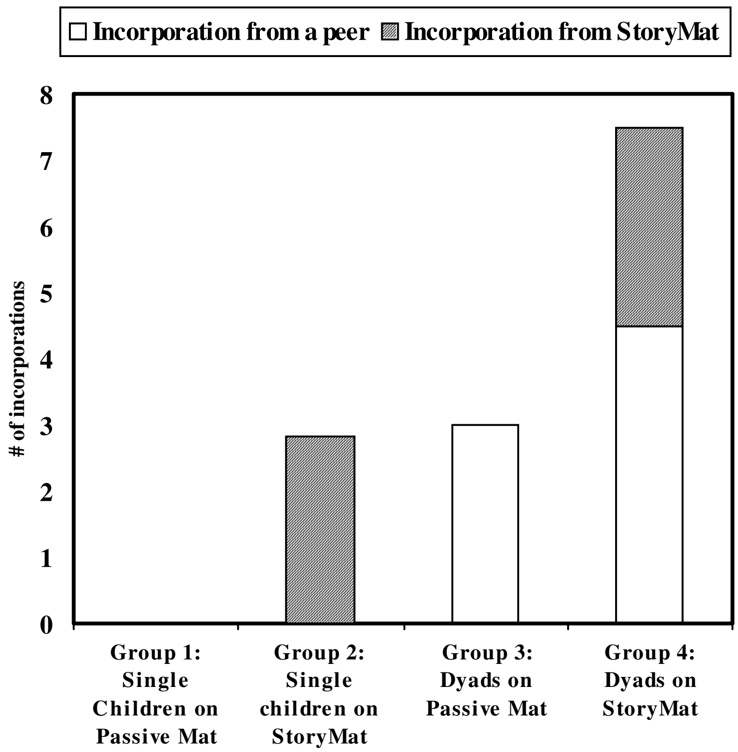
## (1) Incorporations

In fantasy play, children include others' make-believe games into their own by transforming objects, acts, or themes that follow a sequence or order (Singer & Singer, 1990). In order to investigate collaborative storytelling on StoryMat, we looked at incorporations of language style and story elements. That is, incorporations of a particular style of saying a word or a phrase, and incorporations of particular fantasy objects. The following is a discourse segment of a child who played in a dyad on StoryMat, which illustrates such an incorporation.

> Girl (8-year-old)
>
> [note: the words in italics indicate a peer story provided by StoryMat]
>
> *Let's see what this yellow house is. It doesn't look like a garage. click click click [child makes sounds]. No answer. Let's try this one. Click click click. There might be a note inside like our houses. Let's go look. No nothing. Wait, here's something! It says 'this is a* ***mysterious music pad****. Go on it and have some fun.*
>
> Oh, boy! A **mysterious music palette**! That's so much fun! Come on! Look, it's a piano! All I have to do is say something, and it turns on!

In this example, the child hears a StoryMat story with the unusual story element of a 'mysterious music pad'. Immediately afterwards, she incorporated that element into her own story, and continued the story in that vein.

By incorporation we mean either a story theme from a StoryMat story or a clear linguistic register from a StoryMat story that are subsequently used by the current child playing on the mat. The number of incorporated language style and story elements per session was compared across the groups. We were interested here in a 4-way comparison among the groups, as shown in the following graph:




**Graph 1**: Children's incorporations of elements from other children and from StoryMat.

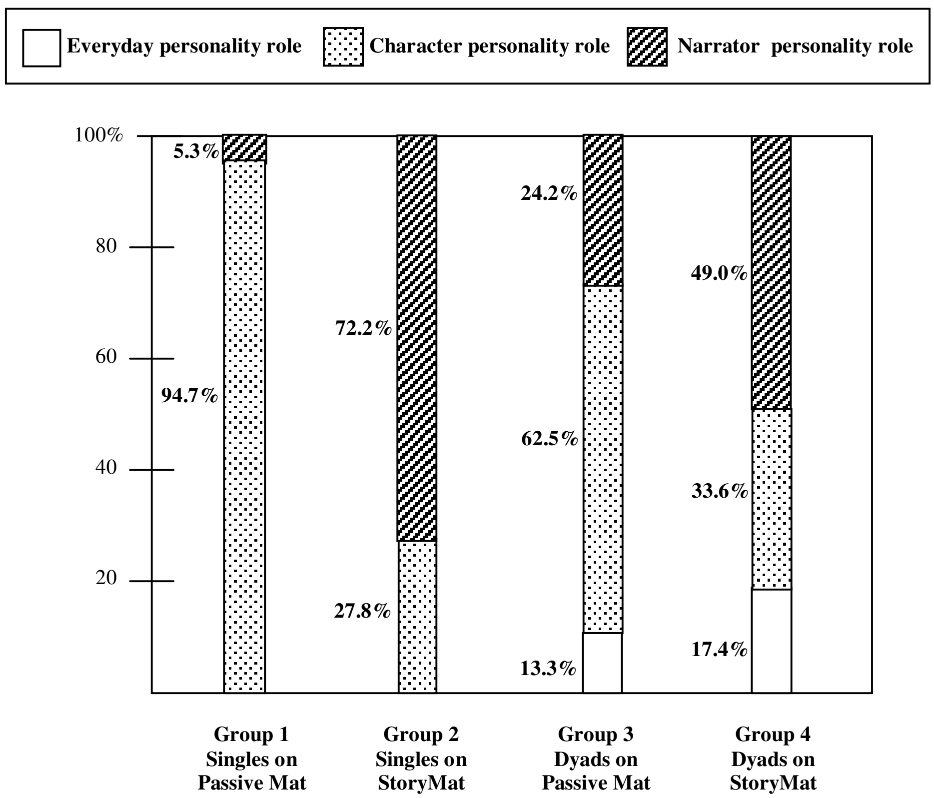
The dyads on StoryMat had more incorporations than any other group. Detailed analysis of the results showed that the dyads on StoryMat incorporated elements **both** from their co-temporal, co-spatial peer and StoryMat. This result is interesting as it provides an evidence for a child being able to collaborate with StoryMat stories at the same time as with a physical playmate. The single children on StoryMat also incorporated elements from StoryMat stories as much as a child did from a peer on the passive mat. This result also provides evidence for a child being able to collaborate with StoryMat stories in much the same way as children collaborate with other children.

The result showed that both the dyads and the singles on StoryMat incorporated elements from stories provided by StoryMat. By incorporating others' story elements into their own stories within their dynamic story frame (Singer & Singer, 1990), the children on StoryMat told stories in much the way they might with a real life peer. StoryMat was able to play a role of a playmate by responding to the children's story with a peer story that was similar.

**(2) Speaker Identity**

It is clear from the above result that StoryMat supports collaborative activity, in children playing alone and playing together. What is the nature of this activity? Are children actually telling stories in the way they might with flesh-and-blood playmates? In order to investigate this question, we looked at one very robust measure of ‘narrativity’ – the ability to shift back and forth between the roles of character, narrator, and everyday person. This aspect of narrativity is particularly interesting as it is just being acquired in the pre-school to early-schooling age range that we examined in our study.

Thus, the average percentages of different roles taken by a child in telling a story were compared across the groups. The following graph shows the results:




**Graph 2**: Use of narrative roles by single children and dyads on the passive mat and StoryMat.

The results show that the single children on the passive mat mainly took the character role. The very rare use of the narrator role among children in this group reflects the fact that the children did not introduce quotes of a character (i.e. “Then he said, ‘Oh, no!’”), but rather only acted as characters (i.e. “Oh, no!”). The exclusive use of character voice characterizes children’s pretend play rather than fantasy storytelling, and is a comparatively younger form of play (Auwarter, 1986). Children are *enacting* the different roles in their fantasy situation, but not *narrating* them.

The single children on StoryMat took the narrator’s role most of the time, but also took the character role fairly often. These results indicate that single children on StoryMat were engaging in storytelling rather than pure fantasy play. When a character’s words are introduced with verbs of saying (said, yelled, told), the story becomes understandable by others and becomes more self-sufficient (Scarlett & Wolf, 1979). The single children on StoryMat both acted out as a character and told stories about the character. But they seemed to successfully mix the two roles to tell stories, rather than engaging solely in pretend play.

The dyads on the passive mat took three different roles, everyday, character, and narrator. In the everyday personality role, they had a conversation with their peers as a way of scaffolding an unfolding story (e.g. "Let's do a school story – you be the principal!"). They used this role extremely rarely, however. The dyads on the passive mat mainly used the character role, and occasionally the narrator role. The fact that they used the character role more than the narrator role indicates that the dyads on the passive mat were more engaged in pretend play than storytelling. This contrasts with both the singles and the dyads on StoryMat.

The dyads on StoryMat also took three different roles. They had a conversation with their peer as an everyday person, used a character role, and used a narrator role. As mentioned earlier, an interesting contrast between the dyads on the passive mat and the dyads on StoryMat is the use of the narrator role. The fact that they used the narrator role more than other roles indicates that they were narrating and were able to mix other roles. The notable difference between the two dyad groups is that StoryMat dyads narrated most of the time while those on the passive mat spoke as characters most of the time. The balanced mixture of roles displayed by the dyads on the StoryMat is the most characteristic of mature storytelling.

The results suggest that StoryMat provides a place where children are encouraged to narrate rather than to engage in pretend play. As explained by Scarlett and Wolf (1979), storytelling with the help of a narrating voice allows others to understand the intention of the author. The audience has to be able to construe what is happening within the story. By connecting children's present stories with the past stories, StoryMat seems to create an environment where a child is encouraged to engage in this kind of mature audience-focused storytelling.

**Discussion**

The proceeding analyses of the children's storytelling process show that the single children on StoryMat told stories by taking a narrator's role but also used a character role to act out some of their imaginary characters. This contrasted with the single children on the passive mat who predominately took a character role. By using the character role in conjunction with a narrator role, the single children on StoryMat created a world of stories that is more self-sufficient (Scarlett & Wolf, 1979). The single children on StoryMat were also able to switch between different roles to introduce more complex narrative utterances (Auwarter, 1986).

A similar contrast was observed between the dyads on StoryMat and the dyads on the passive mat. The dyads on StoryMat mainly used a narrator's role but in conjunction with a character role, whereas the dyads on the passive mat predominately used a character role. These results suggest that StoryMat fosters developmentally advanced storytelling.

It was also shown that the dyads on StoryMat produced the high number of incorporations. That is because the dyads on StoryMat had two collaborators, a peer and StoryMat stories. The dyads on StoryMat incorporated elements both from their peer and StoryMat stories. But, importantly, single children playing on the StoryMat incorporated as many elements from the stories that the mat told as two children playing on a passive mat incorporated from each other's stories. These results provide evidence for StoryMat offering a place for collaborative storytelling for children with or without a co-temporal co-spatial playmate. For children who play alone, StoryMat plays an imaginary playmate by offering peer stories. For children who play together with a playmate, stories offered by StoryMat serve objects of their collaboration in addition to the ones offered by a physical playmate.

## CONCLUSIONS

This paper presented the design framework and some results from a user study of the StoryMat system. By offering peer stories, StoryMat seems to provide a place where children are able to practice and foster their storytelling skills. By offering peer stories, StoryMat also seems to offer a place for a child to experience collaborative storytelling regardless of the absence of a co-temporal and co-spatial playmate. The children on StoryMat listened to peer stories offered by StoryMat in much like the way they do with the stories offered by real life peers. In fantasy play, collaboration among peers is important and technology can step in as a key member of the peer group, like an imaginary playmate with an active imagination.

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## Authors' Address

*Kimiko Ryokai & Justine Cassell*
*MIT Media Laboratory*
*E15-320R*
*20 Ames Street*
*Cambridge MA, 02139 USA*
*[kimiko, justine]@media.mit.edu*