Toyteller: Toy-Playing with Character Symbols for AI-Powered Visual Storytelling

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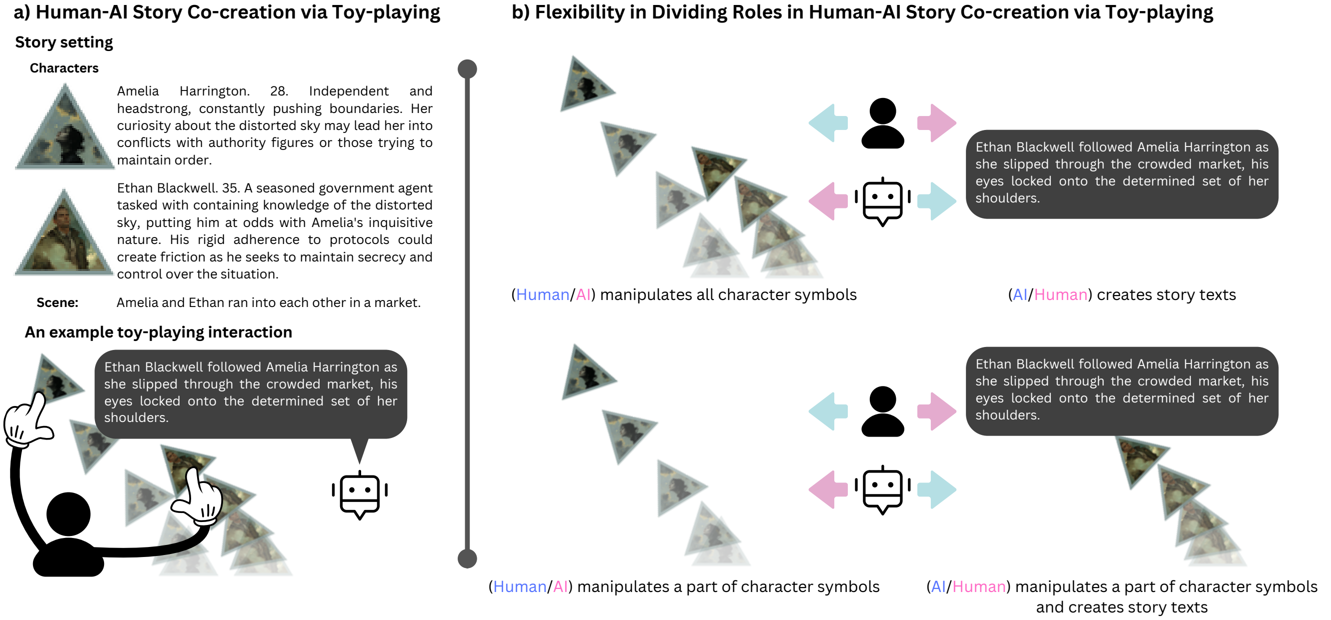
a) Human-AI Story Co-creation via Toy-playing
Story setting
Characters
Scene:
An example toy-playing interaction
b) Flexibility in Dividing Roles in Human-AI Story Co-creation via Toy-playing
(Human/AI) manipulates all character symbols
(AI/Human) creates story texts
(Human/AI) manipulates a part of character symbols
(AI/Human) manipulates a part of character symbols and creates story texts

Amelia Harrington. 28. Independent and headstrong, constantly pushing boundaries. Her curiosity about the distorted sky may lead her into conflicts with authority figures or those trying to maintain order.

Ethan Blackwell. 35. A seasoned government agent tasked with containing knowledge of the distorted sky, putting him at odds with Amelia's inquisitive nature. His rigid adherence to protocols could create friction as he seeks to maintain secrecy and control over the situation.

Amelia and Ethan ran into each other in a market.

Ethan Blackwell followed Amelia Harrington as she slipped through the crowded market, his eyes locked onto the determined set of her shoulders.

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Figure 1: Interactions in Toyteller. a) Toyteller enables visual storytelling with AI through *toy-playing* interaction with character symbols that accompany story texts. These character symbols can become both 1) a means to express the user's intention about the story unfolding and 2) a generation target that will be a part of the final visual story. For example, given a story setting defined as open-ended text, the user can physically manipulate symbols representing two of the story's characters, and Toyteller can generate a story sentence that aligns with the user-provided character motions. b) Toyteller allows users flexibility in deciding which part of the output artifact (symbol motions, story texts) is created by the user or by the AI.

ABSTRACT

We introduce Toyteller, an AI-powered storytelling system that allows users to generate a mix of story texts and visuals by directly manipulating character symbols like they are playing with toys. Anthropomorphized motions of character symbols can convey rich and nuanced social interactions between characters; Toyteller leverages these motions as (1) a means for users to steer story text generation and (2) an output format for generated visual accompaniment to user-provided story texts and user-controlled character motions. We enabled motion-steered story text generation and text-steered motion generation by mapping symbol motions and story texts onto a shared semantic vector space so that motion generation models and large language models can use it as a translational layer. We hope this demonstration sheds light on extending the range of modalities supported by generative human-AI co-creation systems.

CCS CONCEPTS

• **Human-centered computing → Interactive systems and tools**; **Interaction techniques**; • **Computing methodologies → Natural language generation**.

KEYWORDS

visual storytelling, toy-playing, generative AI

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1 INTRODUCTION

Generative AI technologies, such as large language models (LLMs) [3, 11], have been shown to enable many new forms of AI-supported storytelling [4, 9, 14]. Many AI-powered storytelling applications, however, still rely heavily on natural language as the primary means of steering story generation—even though stories are often expressed through modalities beyond natural language [7]. In the context of human-human story co-creation, for example, children often casually create stories while they play with toys in their hands [1, 6, 13]. Existing AI systems do not effectively support these kinds of collaborative multimodal storytelling: even the most advanced AI models yet (1) exhibit limited understanding of sequential multimodal inputs [2, 15]; (2) suffer from latency that limits interactive use [10]; and/or (3) assume complex multimodal inputs (e.g., comic strips [8]) that are difficult for users to casually manipulate.

In this work, we introduce Toyteller, an AI-powered visual storytelling system that adopts the movement of character symbols as both an output modality and a steering input. Specifically, in Toyteller, the user can collaborate with AI to create the story of two characters along with their corresponding motions in symbols (Figure 1). The user manipulates the motion of one or two characters or writes down the story text, and AI fills in the rest of the content that is not filled in by the user (i.e., motion or texts). Toyteller leverages the symbolic movements of characters inspired by Heider and Simmel's experiments [5], as these anthropomorphized motions can express rich and nuanced semantics of social interactions with simple manipulation of symbolic objects. We achieve motion-to-text and text-to-motion generation by having a translational layer that maps motion inputs onto the frozen semantic vector space for texts, so that we can condition large language models and motion generation models with motions and texts, respectively. Through this demonstration, we hope to inspire the UIST community to consider more diverse interaction modalities for human-AI co-creation.

2 TOYTELLER: INTERACTION

In this section, we first motivate the use of toy-playing interaction in human-AI co-creation of visual stories and then explain interactions in Toyteller's interface.

2.1 AI-powered Storytelling via Toy-playing

With toy-playing interaction for human-AI story co-creation, we leverage humans' ability to perceive social interactions between characters even from simple movements of symbolic shapes. Heider and Simmel's experiment is one prominent example (Figure 2), where they found that people can anthropomorphize motions of triangles and a circle, considering these shapes as characters and their motions as social interactions happening between these characters [5]. The range of social interactions that can be expressed with these symbolic motions is wide—for instance, Roemmele et al. [12] categorized possible interactions between two characters into 31 classes. In fact, even motions of the same category are able to express nuanced differences through varying dynamics, such as the magnitude or velocity of movement. For example, for the motion of "hit," the velocity of a hitting character would indicate how hard the character hit the other one.

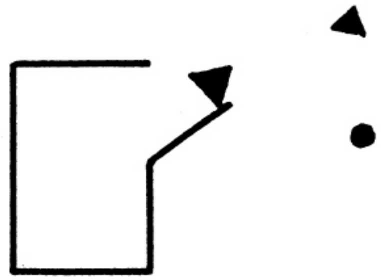


Figure 2: Heider and Simmel's experiment.

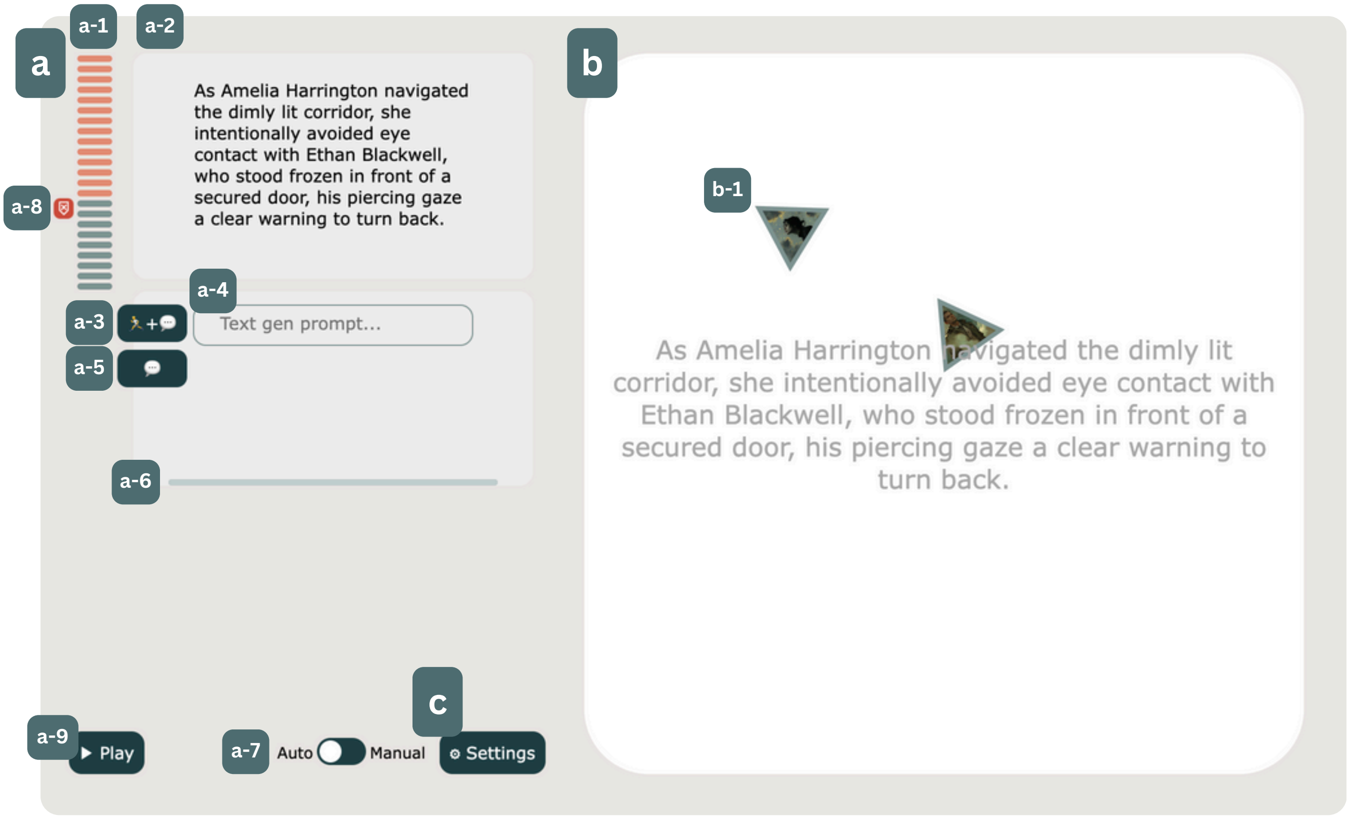
In the context of human-AI story co-creation, the movement of shapes has the benefit that it can serve both as 1) a means to steer AI generation and 2) a target of co-creation with AI. That is, as steering input, the user's manipulation of character symbols can serve as a means to condition the AI's generation of story text. This steering input offers complementary benefits to other input forms (e.g., natural language prompts), allowing users to express nuanced intentions about story events via the relatively simple interaction of gestural object manipulation. Meanwhile, movements of character symbols can also serve as part of a story artifact, as a visual complement to the story text. Hence, in human-AI co-creation contexts, these movements can be a target of AI generation—for instance, the AI can generate character motions from user-provided story text or as a reaction to the user's manipulation of other character symbols. As these character motions can serve as both input and output, the user can flexibly decide which parts they would like to contribute to visual stories, and the AI can fill in the remaining parts based on whatever input the user supplies (Figure 1b).

This *toy-playing* interaction—humans and AI manipulating visual character symbols while telling accompanying stories—can have many application scenarios. In this paper, we introduce one specific application, Toyteller, which is designed to demonstrate toy-playing interaction in a 2D screen interface.

2.2 Interface

We designed Toyteller to demonstrate toy-playing-based human-AI story co-creation in a specific setting of two characters interacting with each other. While there can be more complex story settings with more characters and props, we consider dyadic settings as users can still express a wide variety of stories with them. Moreover, Toyteller focuses on the generation of story prose text. Toyteller is designed for touchscreen and mouse-pointer user interfaces, which permit the user to manipulate at most two character symbols simultaneously.

At a high level, Toyteller consists of three parts: 1) a setting page, allowing users to configure characters and story background; 2) a story timeline, showing a sequence of passages of story text; and 3) a playground, where a single passage of story text is complemented by user-manipulatable character symbols.



As Amelia Harrington navigated the dimly lit corridor, she intentionally avoided eye contact with Ethan Blackwell, who stood frozen in front of a secured door, his piercing gaze a clear warning to turn back.

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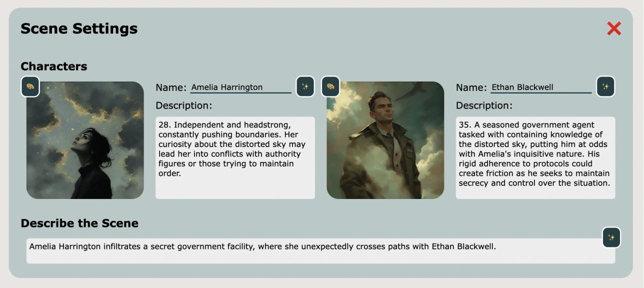
Figure 3: The Toyteller interface consists of a timeline module (a), playground (b), and a button to enter the setting page (c). The user can use the progress bar (a-1) to navigate recorded motion frames, which align with story textboxes (a-2). The user can manipulate character symbols (b-1) to record character motions. The user can ask Toyteller to generate both character motions and story texts (a-3) while giving a high-level direction as a natural language prompt (a-4). The user can also initiate the generation of story text only (a-5) and adjust the size of the last textbox (a-6). By default, Toyteller automatically reacts to the user's input, but the user can turn this off (a-7). The user can delete frames and textboxes after a selected frame with a button (a-8). After recording frames and texts, the user can play them back (a-9).



Scene Settings

Characters

Name: Amelia Harrington

Description:

28. Independent and headstrong, constantly pushing boundaries. Her curiosity about the distorted sky may lead her into conflicts with authority figures or those trying to maintain order.

Name: Ethan Blackwell

Description:

35. A seasoned government agent tasked with containing knowledge of the distorted sky, putting him at odds with Amelia's inquisitive nature. His rigid adherence to protocols could create friction as he seeks to maintain secrecy and control over the situation.

Describe the Scene

Amelia Harrington infiltrates a secret government facility, where she unexpectedly crosses paths with Ethan Blackwell.

Figure 4: Interface for setting story scene. The paint and sparkle buttons allow users to use AI to generate the setting's content images and texts, respectively.

2.2.1 Setting. Before unfolding the story with toy-playing interactions, the user needs to set up the story setting by opening a setting page with the button in Figure 3c. Specifically, the user can set 1) two characters' names, 2) specific descriptions about them, 3) their profile images, and 4) a high-level description of the scene (Figure 4). Information except profile images will be used to generate story texts, while images will be overlaid on the character symbol to indicate which symbol corresponds to which character. While users can manually type in or upload these entries, Toyteller also provides the option of generating texts and images with large language models and text-to-image models, with the sparkle and paint buttons, respectively.

2.2.2 Story Timeline and Playground. Once the user has configured the story setting, they can start unfolding the story using the story timeline (Figure 3a) and the playground (Figure 3b). The story timeline includes the progress bar that shows the recorded frames (Figure 3a-1) along with the story textboxes that correspond to certain parts of the progress bar (Figure 3a-2). The playground has two triangular character symbols, which are manipulatable by both the user and AI models (Figure 3b-1).

Motion → Text. As mentioned in Section 2.1, Toyteller allows flexible human-AI co-creation of visual story. The first approach

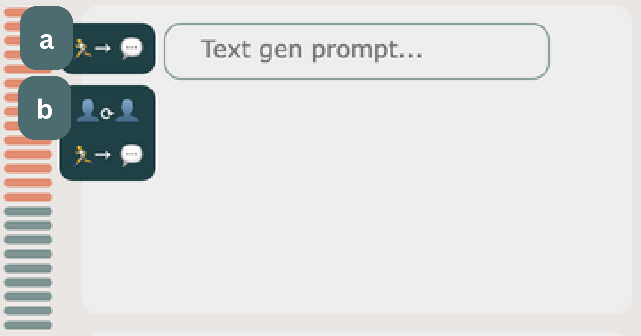
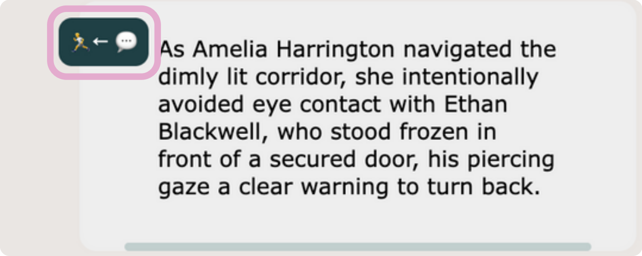


Figure 5: The user can manually initiate motion-to-text generation with a) and b). b) allows users to generate a sentence by swapping the "active" character of the event recognized by the system.

to interacting with Toyteller involves the user and AI defining character motion first, then adding story sentences that align with this character motion. When contributing character motion, the user can decide to move one or two character symbols, and the AI will concurrently generate motion for uncontrolled character symbols. Alternatively, the user can invoke AI to generate motion for both characters (Figure 3a-3). As the user or AI manipulates symbols, Toyteller records motion frames and accumulates them on the timeline. When the timeline reaches the end of the last textbox and the user is controlling one of the symbols, the size of the last textbox grows to match its end to the end of the timeline. As the user stops manipulating the symbols, Toyteller starts generating a story sentence that aligns with the provided motions. When AI generates both character motions, Toyteller starts generating the story sentence as the end of the timeline reaches the end of the last textbox. Note that for the text generation, the user can prime the high-level direction with a natural language prompt (e.g., "Write the ending of the story," Figure 3a-4).

While the above interactions assume that Toyteller reacts to the user's input automatically (e.g., as the user moves one character, AI moves the other character automatically), there might be cases in which the user wants to decide the moment for AI generation. In such cases, the user can toggle the switch in Figure 3a-7. As the user is in manual mode, if the user provides character motions first, they can manually generate story texts with buttons in Figure 5. Note that the button in Figure 5b allows the users to swap who is active or passive in the event, as there are cases where AI fails to recognize the active character in the event correctly.

Text ⟶ Motion. The second approach to interacting with Toyteller involves the user or AI contributing passages of story text first, then creating character motions. Here, the user can decide to write a story sentence by themselves or use AI to generate it (Figure 3a-5). Again, when generating text with AI, the user can steer text generation via a natural language prompt. Then, the user can move some or all of the character symbols to align them with the provided sentence, and AI will generate the motion of characters uncontrolled by the user. The user can also make the system generate all characters' motions with the button in Figure 6. When the user



As Amelia Harrington navigated the dimly lit corridor, she intentionally avoided eye contact with Ethan Blackwell, who stood frozen in front of a secured door, his piercing gaze a clear warning to turn back.

Figure 6: When text is provided before character motions, with the button highlighted in pink, the user can make AI generate those motions.

wants to adjust the size of the textbox so that fewer or more frames can correspond to it, they can use the handle in Figure 3a-6.

Revision. As the user accumulates a series of motions and story sentences, they can revise them. For motions, the user can first move to the start of the frames they want to edit and manipulate the character symbols to override previously recorded character motions. For sentences, the user can manually edit them in the text box. If they want to regenerate the story sentence, they can first delete the existing sentence and use buttons in Figure 5. The user can also delete created frames and sentences. Specifically, they can delete content after a specific frame by moving to the frame in the timeline and then clicking the delete button (Figure 3a-8). As the user is done with editing the content, they can play the recorded frames along with the aligned story sentences by clicking `Play` button (Figure 3a-9).

3 CONCLUSION

In this demonstration, we present Toyteller, which facilitates human-AI visual storytelling via toy-playing interactions. As people can easily anthropomorphize the motion of character symbols, toy-playing interactions can serve as not only a good means to express intent about character-character interactions but also a form of story content in their own right. We hope that Toyteller will inspire the UIST community to expand the range of interaction modalities supported in human-AI co-creation.

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