Why Did Hamlet Delay His Revenge?

Finding answers to such questions by computer simulations.

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In his introduction to the Hamlet play, D. Bevington made the following observation: “Ever since the nineteenth century it has been fashionable to discover reasons for Hamlet's delaying his revenge” (Bantam Books edition of The Complete Works of William Shakespeare, published in 1988, volume 3).

Can the reasons for Hamlet's delay really be discovered? But to say “discovered” implies some certainty, whereas it seems that we can only speculate without end about such questions for which, like all the “what if” questions in college literature classes, no real answer is possible. After all, are not the answers to all such questions just in the minds of authors, who like the author of Hamlet may be long since departed? Nevertheless, educated persons have persisted in asking such questions as they try to plumb the mind of a writer and imagine alternative paths a story could have taken. I will argue that such questions are not only meaningful, but also potentially answerable with a mathematical precision, given specific assumptions.
about human nature and the way an individual makes choices, i.e., a person’s “action selection”.

This is becoming possible with recent advances in behavior simulations, using “synthetic characters”. Synthetic characters are creatures that may be embodied on a computer monitor, if they have any body at all; otherwise, they are similar to robots. Their behavior is not a story written by a fiction writer; rather, the creatures make their own decisions. They can do this because they have computer brains. Underlying their movements and expressions in their virtual world are sensory-perceptual, motivational, behavior and motor control systems organized in a software program.

To use such work as it now stands (with only non-verbal interactions) to answer questions like the one on Hamlet posed at the beginning of this article, we have to assume that human actions are much less a consequence of verbal reasoning and intellectual persuasion than they are the outcome of underlying drives and affective states, i.e., the motivation systems of the brain, shaped by inheritance and by personal histories. In my recent work with behavior simulations at the Massachusetts Institute of Technology, I have developed the architecture of the software brain of screen creatures to include an affect system modeled after the functions of the real brain's so-called limbic forebrain, known to underlie emotional feelings and motivations and to be crucial for learning abilities. I did this work with two advisors at M.I.T., Prof. G. Schneider, a neuroscientist in the Department of Brain & Cognitive Sciences, and Prof. B. Blumberg of the Media Lab.

Before I can discuss the Hamlet question, I must try to define what we mean by a “story”, and then describe, with examples from my work at M.I.T., how the running of a computer program can generate a story.
A story is composed of a number of components, which include believable characters, events and environments. Each of these components is specified, in turn, by its sub-components. Thus, a character can be defined in terms of personality and motivations and by how these internal properties influence the choices involved in the generation of actions. A story is laid out along a time axis, weaving the components of character and situation and environment together so that the various components present within one story space make sense. This process of weaving results in establishment of narrative structures and contexts.

Given this view of “a story,” there is no right or wrong story line, i.e., no single way of weaving a given set of story components together, as long as the resulting structure makes sense. In fact, the number of possible outcomes, i.e., the number of stories that can hold the given story components together in a sensible way, is virtually infinite.

With this perspective in mind, we can envision a new way of generating a story. Instead of the author's laying out the contextual structure first and then fitting in the characters' expressions of motivation and their behavioral actions and reactions, he or she can begin by specifying a certain portion of the total set of story components he or she has in mind. Then, if these components are placed in a specific environment, it becomes possible for the author to harvest contextual developments over time. With modern computer technology, this vision of story generation is becoming possible. Its implementation can make it possible for everyone who has access to the proper communication channel to retrieve the set of story components, and then to use them to develop a story.

Such opportunities for generating a story are becoming possible with recent advances in behavior simulations, using “synthetic
characters", as mentioned near the beginning of this article. Synthetic characters are artificial creatures that could be characters of the story. A synthetic character need not be expressed on the screen, and in fact other story components, such as the music or the camera, or other components that comprise a story, can also be synthetic characters. Each of the expressed (embodied) story components is presented as a virtual entity on the computer monitor. The synthetic characters can be controlled by a program that makes them ready to interact with the "writer", i.e., the user of the program, who can influence the components of the story through real time interactions. As a synthetic character receives inputs from the user and perceives the actions and reactions of other characters within the same story space, it joins the ensemble of synthetic characters that constitutes the story components, and together they develop a story by themselves.

An early example of such implementations was dubbed "(void*): A cast of characters", developed by the Synthetic Characters Group at the MIT Media Laboratory. (See figure 1.) The main characters that can communicate with the user are three alien looking creatures with distinctive personalities. There are two additional characters, unembodied, the camera and music creatures. The user can observe behavior and the emotional expressions indicating motivational changes in the three main characters and react so as to weave a story harmoniously. Interactions between characters and the user happen via an interface inspired by Charlie Chaplin's famous film Gold Rush: a person can pick up and move the forks sticking into a pair of buns. When this happens, the person now "possesses" one of the three characters. When she moves the buns and forks in a certain way, the user makes the character's legs move, or more accurately, this makes the character "feel a nearly irresistible urge" to move its legs in a certain manner. The character controlled by possession not only
dances in a way that mimics the movement of the interface, but it also develops a certain attitude toward dancing, possession and interaction itself, and it learns good and bad characteristics of various types of dance. The development of certain emotional attitudes of the characters toward other story components itself becomes a story.

Figure 1. (Void*): A cast of characters implements a diner setting. (Right side) There are three distinctive characters sitting at the counter. (Left side) A human participant may come in and possess one of the three characters using a wireless interface mimicking the buns-and-forks from Charlie Chaplin's well-known movie Gold Rush. From then on, she can force the characters to dance in a certain way by wiggling the interface in the way she wishes the legs of the possessed character to move. Characters respond to this possession and forced dancing differently, based on each character's personality, past experience and motivation.

This emergence of a story that is consistent over time is possible because characters themselves are consistent and coherent—"stay in character". To be perceived as a consistent being, a character's perceptual, motivational, behavioral actions and reactions, and the way the internal components are expressed should be consistent with each other. A character that is hungry is more likely to find an apple hidden behind a chair than a character who is not hungry. The hungry character is much more likely to grab and eat the apple rather than flee from it, and will most probably eat in a happy way rather than in a hesitating manner. A software framework called the
“creature kernel”, which mimics the structure of a biological brain, provides the means whereby a coherent character is built.

A creature kernel is composed of four main components or systems: these are the perception, motivation, behavior and motor systems. Each system contains a hierarchical network of nodes. For example, the behavior system includes a node called “approach” which could be activated by a connection from the perception system — “sight of apple” — combined with an active connection from the motivation system — “hunger”. Approach can trigger the behavior node “walk”, which inhibits nodes at the same level like “run” and “crawl”. If the animation graphics are available, the activation of “walk” activates lower level nodes like “lift left leg”, etc. Learning occurs by changes in the network of connections. Thus, “sight of apple” could come to trigger avoidance rather than approach if approaching the apple resulted in something bad happening too many times.

Now let us go back to the question about Hamlet proposed at the beginning of this article. The well known play is a contextual structure built up by the writer named William Shakespeare using story components such as the characters named Hamlet, Claudia and Gertrude with human-level appearances and intelligences, and other environmental components such as castle, England, et cetera. Hamlet delayed his revenge on his uncle because his personality, given the circumstances, did not allow immediate decision making; his past education and experience happened in the particular way that, interacting with his inborn characteristics, gave him sufficient motivation to decide and proceed in one way or the other. The reactions of other components and characters were organized in a way that influenced his selection of his actions in one way versus another. A very different story could have emerged with alterations in
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any of the story components at the earlier stages of the story development.

With the implementation of virtual characters that are modifiable and have the ability to interact, and provision of opportunities for users to interact with the characters, a totally different story may emerge out of the same set of story components.

Figure 2. Nine scenes of Hamlet which, in the simulations, human participants had control over. Being a form of story components, even though these are not at the level of details of action, through real-time interactions each participant could experience the evolving of a coherent story that is consistent over time.
We explored this possibility by providing story components from Shakespeare's *Hamlet* (see Figure 2) and allowing some interactive influences on these components by participants. Stories emerged as a result of the interactions, and in some of these stories Hamlet took his revenge rather quickly, in others he delayed for a long time, and in still others he decided not to pursue revenge at all. Each story made sense and was understandable to the user who observed the interacting characters and the emergence of the story.

Of course, with actions governed only by the internally and externally triggered drives and affective states and without the eloquent speech of the characters in the marvelous writings of the Bard, this approach overlooks a great source of joy. A story is simply viewed as an abstraction of behavioral and motivational responses and actions of the starring characters, and the structure of the main story outline is the major entity to be observed. As the software and the accessory hardware evolve to include linguistic expression and style together with detailed graphical portrayals, more of the joy of literature and theater will become possible with such computer-generated stories.

The above description has presented a new way of generating interactive stories, written not by a human "simulator" — i.e., by an author of fiction — but by computer simulations based on synthetic characters with specific settings of experience and personality, in specific virtual environments. By this means, speculative questions about literary fiction will become answerable as never before, or at least the debate will shift to definitions of the underlying motivational structure of the major characters, and how such structures arose and how fixed or plastic they may be.

You may still object to any claim that valid answers to "what if..." questions about literature can be derived from computer simulations,
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especially any claim that such answers can be mathematically precise. For example, you may want to say, “The writer of a story, Shakespeare in this case, need not follow human nature. At his whim, he could make the story go against normal drives and affects.” I would suggest two answers to such objections and questions. First, I would reply, “Yes, but in such a case the writing is not good — not true to life. I would suggest that in such a case the human simulator's [writer's] program [in his brain] is behaving erratically and needs fixing! Great literature is not whimsical like this, in my view.” Second, the simulation program generates a story “with mathematical precision” but in terms of probabilities, and the program includes some random variables. Hence, a given story line detail is never fully predictable, and different results can be obtained with successive simulations using the same initial parameter settings. But with multiple runs of a simulation, I observe that the progression of a computer-generated story is not chaotic at all, and it is quite possible to find answers—actually, multiple possible answers—to why Hamlet delayed his revenge for such a long time.

With the deterministic nature of the computer's operations, the answers to questions like the one in the title to this article can be more satisfying than those obtained by students arguing about the question in a literature class, or by literary critics. Without the computer simulation facility, each person brings his own preconceptions and experiences to the argument, and many of these are left unspecified. With the computer, we are forced to define all the relevant variables and rules of operation, including not only various personality characteristics but also rates of learning, rates of forgetting, degrees of plasticity in various parameters, and so forth. Then one could experiment with various possibilities for why Hamlet delayed his revenge for so long. For example, you could specify the
amount of time Hamlet spends having fun playing with his uncle, or with his friends, during childhood, and then, leaving all other parameters unchanged, determine the effects of the one variable on the later outcome of the play. In running the program, I observed that if Hamlet developed a very positive attitude towards playing with friends, and spent more time playing with them, he was more likely to neglect going to Gertrude's wedding party. If he did go to the wedding party, it had a significant impact on the build-up of a desire to take revenge against Claudius.

Although one can always question whether all relevant parameters and rules have been included, at least with the simulation program the answers will be reliable within bounds that can be laid out for all to see. The outcomes are not tainted by unspecified assumptions of the human interpreter. What you see is what you get, and with something as complex as the Hamlet story, "what you get" cannot be determined without the help of simulations (absent Shakespeare himself): the complexity or sheer number of the interactions is simply too great to keep track of. A person has to simplify things too much, whereas the computer does not. It can keep track of multiple thousands or even millions of interactions and tell us what patterns of behavior emerge from the initial conditions and behavioral rules that we can specify and write into the software.

Whatever the answers we obtain may be, we could always question whether all the relevant drives and senses and behavioral abilities have been included—i.e., are the characters and their environment complex enough? Do they match sufficiently what Shakespeare had in his mind? A crucial assumption I make in this work is that the main story line depends on only a few dominant drives: thus, Hamlet's dominant drives, except early in the play, are desire to take revenge and desire to live peacefully. Other drives, it is assumed, are
also ongoing, like hunger, thirst, drives governing sleep and waking, motor restlessness, etc., but these are sidelines to the main story line and do not affect it in any significant way, and hence can be ignored in the simulations.

Perhaps the most relevant addition we cannot now provide is language ability and function. Besides the communication functions it added to human interactions, it came to play an internal integrative role once dominated by the affect system of the brain as in my synthetic characters. By this I mean that the verbal system of the brain is interconnected with many other parts: different sensory modalities, the motivational systems, and the behavior and motor systems. Does this mean that for internal communication and integration, the word replaced the feelings? Certainly not. That is not how the brain has evolved. Rather, evolution has added a new layer of integration on top of the old, and the older affect system not only remains, but it has itself evolved. Verbal abilities of this nature eventually will be added to the software brains of synthetic characters.

Does this all mean that we will eventually be able to simulate fully a human being? No doubt, synthetic characters will evolve into creatures that are more and more convincing. Could the simulation programs eventually be used to predict reliably a person's behavior? This will probably always remain moot. If I were simulating your behavior, you could always choose not to follow a prediction about your own choices if you knew what the prediction was! But we are getting far from the Hamlet simulations. Too far? Well, dear reader, let me remind you, "It's only a story!"
Sources


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