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Psychologically Plausible Methods for Character Behavior Design

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38.1 Introduction

If you have ever worked with 3D game character artists, you'll have heard them talk obsessively about silhouette and how a character reads. They do this because they understand that for video games especially, there is the issue of viewpoint. As players move around a world in 3D, they can change their viewpoint with respect to the character considerably, changing distance and angle. Artists want their work to be understood by players, so they try and maximize that understanding by taking care to make a "readable" character. A readable character is one that can be viewed from different directions and at different distances and still remain recognizable.

As behavior designers, we have very similar issues to deal with; we have to make our behaviors "readable" by players in different situations and have our players recognize and understand the behavior. The aim of this chapter is to encourage you to think about this aspect of your behavior design and to ground you in a sample of the psychological aspects that come into play from the player's perspective. Using a number of studies performed by groups of undergraduate game design students as examples, the intention is to raise awareness rather than to be academically rigorous. As psychology is a very complex field,

it is recommended that these studies not be taken at face value, but instead should be used to consider how psychology might inform the development of character behavior, by adding methods of evaluation and ways of thinking about player understanding.

38.2 Perception and Abstractions

When working on character behaviors, one of the principal tools at our disposal is the use of animation and movement. By the use of movement, we can convey to the player different behavioral meanings based on the nature of the movement, but how do players actually perceive movement?

In the 1970s, psychologist Gunnar Johansson ran a series of studies involving point-light animations [Johansson 73]. He took a number of his students and dressed them completely in black clothing. He then attached small reflective markers to various joints and got the students to act out particular motions while filming them such that only the markers were visible. The resulting films bear a striking resemblance to modern motion-capture data; an example of his work can be viewed online [Maas 11].

Johansson was interested in our perception of motion. What he found was that from these relatively sparse data, his test subjects were able to describe what types of objects were involved and in some circumstances what gender the subject was. He varied the angles of the motions and otherwise manipulated the viewpoints in order to study where perception broke down. Interestingly, when he tested occluding some of the markers, the participants were able to perceive the motion until a relatively high percentage of the markers were obscured. Similarly, he altered the orientation and found that perception broke down only in fairly extreme circumstances (e.g., when the subject was turned upside down).

What this perception study showed is that humans (and presumably other animals) have a capability to take relatively sparse or abstract motions and parse them into familiar mental models of motion. We can think of this process as *shape fitting*, taking motion, and mapping it to known patterns of movement and then attributing that movement to some previously learned behavior.

It seems likely that this capability is actually a very useful one in terms of neuroevolution; for instance, it might be used to spot a prey animal from a distance by its movement pattern or for selecting a weaker prey animal from a herd.

So what does this all have to do with character AI? The basic premise proposed here is that when we create behavior, we should take care that the motion the behavior exhibits matches motions that can then be shape fitted by players into mental models that allow them to associate the motion of the character with learned patterns.

Just to highlight this point, consider a character behavior in the abstract for a moment. If we want to portray an aggressive character, what styles of movement would we most likely select to show that aggression? One suggestion would be that short, fast movements would be better for showing aggression than long, slow movements. Why would this be the case? One possibility is that we have evolved a capability to detect sharp fast movements as aggressive in response to the types of movements we might have seen from predator animals. For example, think of a cat trying to attack a mouse; how does the movement change as the cat approaches? Think of the explosive force used for when the cat "pounces" on the mouse.

This sharp fast movement happens in other animals too. Fish, insects, and snakes all exhibit striking motions. Most 3D animators know this instinctively, but this notion of movement speed was actually outlined much earlier in traditional stop-motion animation as the principle of force described well in *The Illusion of Life* [Thomas 81] and essentially deals with the biomechanical effort involved in specific motions. The act of stalking in the cat movement might be seen as aggressive by a viewer who had previously seen the cat hunting. From the perspective of the prey, however, the slower movement is less threatening, which suggests that viewpoint has a large impact on the way movement is perceived and is informed by the previous experience of the viewer.

Another interesting aspect to come out of Johansson's work is the fact that some motions suggest particular feelings or relationships. In one study, the motions of two point lights were arranged such that a synchronized circular motion was used, as shown in Figure 38.1. Where the point lights gained close proximity and mirrored the motion of each other, this was perceived by viewers as having affinity between the points. Similarly, points that moved in contrary motions were perceived to have animosity.

In order to cement this notion of perception of motion in the abstract, let us present another study that will also ease us into another aspect of psychology.

In 1944, Fritz Heider and Marianne Simmel presented a paper called *An Experimental Study of Apparent Behavior* [Heider 44]. In it, they describe a study where they presented viewers with a film showing a number of abstract shapes (lines, circles, triangles) with corresponding motions filmed using stop-motion animation. They asked the participants to explain what they saw in the film. In almost all of the cases, the participants explained the film in terms of what the "characters" were doing. They described the scene with explanations such as the following: "A man has planned to meet a girl and the girl comes along

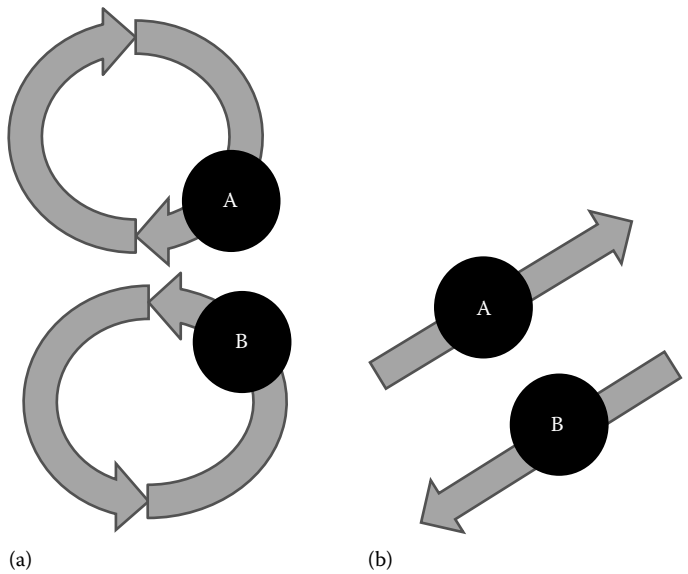

Figure 38.1

An example of complementary (a) and contrary (b) motions used in the study.

with another man. The first man tells the second to go; the second tells the first, and he shakes his head. Then the two men have a fight, and the girl starts to go into the room to get out of the way and hesitates and finally goes in," clearly showing that they had generated an internal narrative to explain what they saw. Indeed it is hard not to see the same footage [Smith-Welch 08] and offer a similar explanation.

The fact that viewers of a film are able to take abstract shapes with motion and construct an internal narrative should really drive home the point that we need to consider the qualities of motion inherent in behavior when we are trying to design characters. Once again, this points to the ability to map relatively abstract movements to known behavioral patterns. As character designers, this should give us some ideas on how to shape the understanding of a character's behavior from a player's perspective. Altering the qualities of movement and the viewpoint they are seen from could allow us to alter how a character is perceived to our advantage, much like an author setting up a reader's mental view of a character before getting them to perform an action.

38.3 Developmental Psychology and the Teleological Stance

The process by which we are able to translate movements into mental models and the specifics of that process is an ongoing area of research. The term "shape fitting" relates it to the processes used in computer vision, but this is merely a shorthand description for a complex set of processes. It is quite useful to review this aspect within the literature on developmental psychology. A useful starting point is the *Blackwell Handbook of Childhood Cognitive Development* [Goshwani 10]. In particular, the chapter by Gergely [Gergely 10] describes an early infant process that allows inference about actions through a naive theory of rational action, basically a process of mapping movements to intended actions that is referred to as the teleological stance. As infants grow, they develop more capabilities in terms of the ability to read a given motion and infer its intention, so developers of games for infants should probably consider the stages of development their target audience has reached.

This ability to read the intentions of others uses gaze direction as a key component. Children follow the gaze direction of their parents in order to learn what is important for them to be aware of [Goshwani 10]. Over time, they develop the capacity to model the knowledge of others, using gaze as a significant aspect of that model. For example, as a child grows, they begin to understand that another person might have knowledge of a particular object or they might not. They learn that if the other person has actually seen the object (i.e., directed their gaze toward it), then they know about the object. Thus, they learn that the stronger the gaze, the more important the object.

This aspect of gaze direction is important for us as behavior designers because it is one of the primary tools we can use to direct the player toward the correct reading of behavioral intent. The player can read the behavior quite differently if they see that the character is not aware of an interacting object; in other words, if we direct the gaze of the character away from an object, we can alter how the player reads any corresponding interaction with it.

Consider Figure 38.2 as an example. In the leftmost pair, we have no way of determining the gaze direction. If you focus on that pair exclusively, you are unlikely to ascribe any intention to the objects. In the middle pair, the gaze is pointing inward; this is likely to indicate antagonism or aggression, unless we have previously seen context in which the pair had displayed positive affect, in which case we might view them as being in a friendly

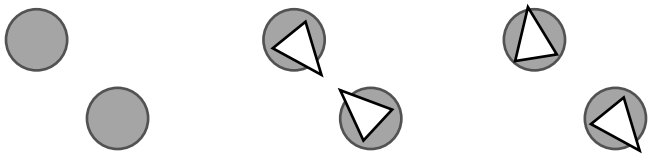

Figure 38.2

A simple example of how perceived gaze direction can influence our reading of a situation.

chat or a conspiratorial congress. The final pair we might well view as being unaware of each other, unless we had seen previous context that suggested they knew each other, might then change the reading of the pair to one of a social rebuff. However, if you interpret the "characters" in the figure, you should be aware that the only condition that is changing is the perceived gaze direction of each pair. This effect is happening even within a very abstract scene but can be particularly strong when seen in motion.

38.4 Attribution Theory

The work by Heider, Simmel, and others eventually led to the field of psychology known as attribution theory [Kelley 67]. For behavior design, this concept of *attribution* is an important one. The basic idea is to consider how we attribute the intention of an action. We commonly think of actions as internal (i.e., the character intended to do it) or external (it was done to the character or caused by other factors). As behavior designers, we should be able to influence a player's view of the behavior such that they ascribe the action as being intentional by the character or unintentionally happening to the character. For instance, we might hint at the incompetence of a character, which leads the player to likely ascribe positive actions as being external; in other words, if something good happens, it happens by chance and not skill.

An interesting aspect of the Heider/Simmel study was that the narrative given to explain the scene changed when the scene was presented in reverse; each viewer was presented with both a "forward" normal viewing of the film and a "reverse" viewing, in which the film was played backward. In many areas, the narrative broke down because the context of the motions was changed. For instance, the larger triangle in the forward presentation is seen as dominant or bullying through the remaining narrative due to an early segment where it performs a fast motion toward the smaller triangle and pushes it a short distance; however, in the reverse presentation, the first aggressive "push" movement is not seen, and thus the narrative of dominance is changed. This implies that in order for a viewer to correctly attribute a behavior, that behavior must be seen within a context that is temporally plausible; in other words, the order in which we present behavioral movements is important. It can be useful to recreate this aspect of the study with your own section of a film, playing the film in the reverse and thinking about how the behaviors are affected. Are some behaviors still understandable? Do you read the motivations of characters differently? What is causing that effect?

We can consider a simple illustration of this effect. Think of a cat trying to catch a mouse; imagine the cat slowly creeping up behind the mouse, keeping close to the ground, slowly moving up, and then suddenly moving with rapid force during a "pounce" behavior.

Now consider the behavior with the order of actions reversed. Instead of a creep-then-pounce, think how a pounce-then-creep would look.

The concept of attribution of behavior is an interesting one, in that it poses questions about awareness and intent. If we are constantly evaluating the motions of others in a bid to understand their intention in terms of our own beliefs about them, then perhaps we can start to manipulate that evaluation in order to achieve a desired effect. One of the key aspects we need to think about is the attribution of intent. Does a behavior we want to portray show intention for the character or not? For example, imagine two characters and a ball. Character A throws the ball at character B; only character B is facing away from A and is not aware of the ball, so consequently B gets hit on the head. In this simple scene, we can actually influence different readings of the inference of the viewer.

Consider the case where we have previously shown character A throwing balls at other characters. In this case, it is likely a viewer would ascribe the ball-throwing behavior as an intentional act. The viewer will have learned that character A throws balls and thus would see the ball-throwing action as fitting in with what they know about A's likelihood to intentionally throw a ball at another character.

Now imagine the same scene, but instead we have previously seen character B being hit by several other characters throwing balls. In this case, we are more likely to attribute the behavior to be a lack of awareness by B than any particular malice by character A.

The fact that a simple ball-throwing behavior could be understood differently depending on our understanding of the attributed qualities of the participants is an important point to note in any character behavior design. We can begin to manipulate a player's reading of a given character by reinforcing their mental attribution processes if we can set up scenes in a manner that takes into account the teleological stance of the behavior and reinforces a given view of the character.

38.5 Problem of Characters as Tokens

Before we get on to discussing the practical application of these psychological principles in terms of behavior design, it is worth noting an issue that most character designers face. A number of years ago at the University of Bolton, we ran an (unpublished) undergraduate study into the methods that players use to select companion characters in games. In this particular study, the test involved choosing companion characters for further gameplay from a roster of characters, which were presented in different ways. The characters themselves were portrayed using different clothing and gender options, with the aim of the study being to understand more about the effect of the communication mode (text, cinematic) on the choice. One of the more surprising results from the study came from the qualitative interviews conducted with participants after they had made the character choice. Although this was not the aim of the study, we found that most players chose characters not based on their narrative delivery method, but instead on a measure of perceived usefulness in the game. In essence, they had ignored the "character" of the choice and had instead chosen based on the utility value. This was not a choice that was based on evidence (no statistics were provided for comparing the characters) but rather on a simple perceived value, that is, "they looked like they would be good in a fight."

The fact that players understand that characters in games are also part of the game mechanics suggests an underlying problem in terms of making more believable characters,

in that for all our best efforts, we may never be able to break that relationship in the player's mind. It might well be that games with more focus on the story and setting of the game could convince players to choose characters for their narrative value; however, it is worth considering what aspects of a character players are likely to base their choices on at the design stage. Is the player presented with information on the character that will explicitly state their utility? How can we identify players who make choices based on other aspects of character and perhaps alter our offering of choices based on that identification?

38.6 Practical Application of Psychology in Character Behavior Design

In another study, an undergraduate group was interested in how the perception of a character shaped a player's view of their own performance. They conducted an experiment in which test subjects played an online game against a series of three "bots" where each bot was represented with a different narrative designed to relate to easy, medium, and hard opponent difficulty levels. What the test subjects were not aware of was that each of the three "bots" was actually being controlled by a human player, who was deliberately playing to a script that essentially reduced the combat to the same level of difficulty for each play session. What the study found was that the players were more likely to score their own performance highly if they managed to win against the "hard" enemy. Similarly, they sought to attribute a loss to the difficulty level of the opponent. This study essentially showed that players can be influenced to feel differently about their own performance depending on the narrative context of their actions. If the context is one where the player feels they are likely to lose, then they ascribe a loss to the game, whereas if they win they are more likely to ascribe the win to their own mastery or skill, no matter of the actual difficulty involved in the action.

In practical terms, this means we can start to encourage players to feel more skillful by presenting them with challenges described as hard, but which are biased toward them winning. This can be as subtle as describing enemies in a manner that inflates their ability with respect to other agents, for example, calling an agent a major instead of a soldier. We can also influence a player's perception by making sure they see a character fail at a task; from that point, it is more likely they will perceive that character as more likely to fail other tasks.

Similarly, we can influence a player's perception of character interactions within a group by carefully manipulating their motions. Considering the case where a player is controlling a group of role-playing characters, we can make two characters within that group appear more friendly toward each other by simply biasing their movements to be more complementary (i.e., often aligned in the same direction, being in close proximity). We can increase the perception of animosity by making sure that the characters avoid close proximity and bias their movements such that they never mirror each other.

38.7 Conclusion

When designing the behaviors of characters in a game, it can be too easy to focus on the individual behavior and lose sight of the overall readability of the character. If we want to create characters that players understand and believe in, we must embrace the aspects of psychology that inform how a player perceives them.

In this chapter, we have tried to offer some simple psychological theories that you can investigate and use to your advantage when considering your initial character designs. Hopefully, this chapter has convinced you that many of the psychological tools you can use to affect players' perceptions function at a high level of abstraction and can often be implemented with very minimal development cost.

Psychology itself is an ongoing area of research and we are only just beginning to investigate the psychology involved in games. From a practical point of view, many of the psychological effects described in this chapter are quite subtle or do not apply universally to all player types. Even with these caveats, it is well worth the time for a designer to familiarize themselves with psychology and its measurement as part of the design toolset. We have seen many of our students gain design roles within the game industry due in large part to their experience working on an aspect of game psychology that is under researched, offering a unique experience and perspective that many employers seem to find valuable.

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