

A Model of Interpersonal Attitude and Posture Generation*

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Abstract. We present a model of interpersonal attitude used for generating expressive postures for computer animated characters. Our model consists of two principle dimensions, affiliation and status. It takes into account the relationships between the attitudes of two characters and allows for a large degree of variation between characters, both in how they react to other characters' behaviour and in the ways in which they express attitude.

Human bodies are highly expressive, a casual observation of a group of people will reveal a large variety of postures. Some people stand straight, while others are slumped or hunched over; some people have very asymmetric postures; heads can be held at many different angles, and arms can adopt a huge variety of postures each with a different meaning; hands on hips or in pockets; arms crossed; scratching the head or neck, or fiddling with clothing. Computer animated character often lack this variety of expression and can seem stiff and robotic, however, posture has been relatively little studied in the field of expressive virtual characters. It is a useful cue as it is very clearly visible and can be displayed well on even fairly graphically simple characters. Posture is particularly associated with expressing relationships between people or their attitude to each other, for example a close posture displays a liking while drawing up to full height displays a dominant attitude. Attitude is also an area of expressive behaviour that has been less studied than say, emotion. As such we have chosen to base our model of gesture generation primarily on attitude rather than emotion or other factors.

1 Related Work

Various researchers have worked on relationships between animated characters. Prendiger and Ishizuka[7] and Rist and Schmitt[8] have studied the evolution of

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relationships between characters but, again, have not studied the non-verbal expression aspects. Cassell and Bickmore[4] have investigated models relationships between characters and users. Closer to our work, Hayes-Roth and van Gent[5] have used status, one of our dimensions of attitude, to guide improvisational scenes between characters.

Research on posture generation has been limited relative to research on generating other modalities of non-verbal communication such as facial expression or gesture. Cassell, Nakano, Bickmore, Sidner and Rich[3] have investigated shifts of postures and their relationship to speech, but not the meaning of the postures themselves. As such their work is complimentary to ours. Bécheiraz and Thalmann[2] use a one-dimensional model of attitude, analogous to our affiliation, to animate the postures of characters. Their model differs from ours in that it involves choosing one of a set of discrete postures rather than continuously blending postures. This means that it is less able to display varying degrees of attitude or combinations of different attitudes.

2 The Psychology of Interpersonal Attitude

We have based our model of interpersonal attitude on the work of Argyle[1] and Mehrabian[6]. Though there is an enormous variety in the way that people can relate to each other Argyle identifies two fundamental dimensions that can account for a majority of non-verbal behaviour, affiliation and status. Affiliation can be broadly characterised as liking or wanting a close relationship. It is associated with close postures, either physically close such as leaning forward or other close interaction such as a direct orientation. Low affiliation or dislike is shown by more distant postures, including postures that present some sort of barrier to interaction, such as crossed arms. Status is the social superiority (dominance) or inferiority (submission) of one person relative to another. It also covers aggressive postures and postures designed to appease an aggressive individual. Status is expressed in two main ways, space and relaxation. A high status can be expressed by making the body larger (rising to full height, wide stance of the legs) while low status is expressed with postures that occupy less space (lowering head, being hunched over). People of a high status are also often more relaxed, being in control of the situation, (leaning, sitting and asymmetric postures) while lower status people can be more nervous or alert (fidgeting, e.g. head scratching). The meaning of the two types of expression are not fully understood but Argyle[1] suggests that space filling is more associated with establishing status or aggressive situations while relaxation is more associated with an established hierarchy.

Attitude and its expression can depend both on the general disposition of the person and their relationship to the other person, for example status depends on whether they are generally confident for status and whether they feel superior to the person they are with. The expression of attitude can also vary between people both in style and degree.

The relationship between the attitude behaviour of two people can take two forms, compensation and reciprocation. Argyle presents a model in which people have a comfortable level of affiliation with another person and will attempt to maintain it by compensating for the behaviour of the other, for example, if the other person adopts a closer posture they will adopt a more distant one. Similar behaviour can be observed with status, people reacting to dominant postures with submission. Conversely there are times where more affiliation generates liking and is therefore reciprocated, or where dominance is viewed as a challenge and so met with another dominant posture. Argyle suggests that reciprocation of affiliation occurs in early stages of a relationship. Status compensation tend to occur in an established hierarchy, and challenges occur outside of a hierarchy.

3 Implementation

This section presents a model of interpersonal behaviour that is used to generate expressive postures for pairs of interactive animated characters. The model integrates information about a character’s personality and mood, as well as information about the behaviour and posture of the other character. Firstly a value for each of the two attitude dimensions is generated and then this is used to generate a posture for the character. An overview of the process is shown in figure 1. As described below this process is controlled by a number of weights that are able to vary the character’s behaviour thus producing different behaviour for different characters. Values for these weights are saved in a character profile that is loaded to produce behaviour appropriate to a particular character.

The first stage in the process is to generate a value for each of the dimensions of attitude. As described above these depend both on the character itself and the behaviour of the other character. The character’s own reactions can be controlled directly by the user. A number of sliders are presented to the user with parameters that map onto the two dimensions. They take two forms, parameters representing the personality of the character, for example “friendliness” maps on to affiliation, and parameters representing the character’s evaluation of the other character, for example “liking of other”. These parameters are combined with variables corresponding to the posture types of the other character (see below) to produce a final value for the attitude. For example, affiliation depends on how close or distant the other person is being, and possibly other factors such as how relaxed the other character is. Thus the equation for affiliation is:

$$\text{affiliation} = \sum w_{\text{self}_i} \text{sliderValue}_i + \sum w_{\text{other}_i} \text{postureType}_i$$

Where w_{self_i} is a weighting over the parameters representing the characters own reactions and w_{other_i} is a weighting over the other characters posture types. These weights not only control the relative importance of the various posture types but their sign controls whether the character displays reciprocation or compensation. There is an equivalent equation for status.

The attitude values are used to generate a new posture. Firstly they are mapped onto a posture type, which represents a description of a posture in

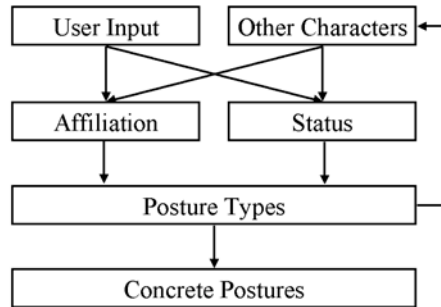


Fig. 1. The posture generation process.

terms of its behavioural meaning, as discussed in section 2. The postures types are: close (high affiliation), distant (low affiliation), space filling (high status), shrinking (low status), relaxation (high status) and nervousness (low status). As attitudes can be expressed in different ways, or to a greater and lesser degree the mapping from attitude to posture type is controlled by a weighting for each posture type that is part of a characters profile. As well as being used to generate concrete postures the posture type values are also passed to the other character to use as described above. The values of the posture values are clamped to be between 0 and 1 to prevent extreme postures.

Each posture type can be represented in a number of different ways, for example space filling can involve raising to full height or putting hands on hips while closeness can be expressed as leaning forward or making a more direct orientation (or some combination). Actual postures are calculated as weighted sums over a set of basic postures each of which depends on a posture type. The basic postures were designed based on the description in Argyle[1] and Mehrabian[6] combined with informal observations of people in social situations. The weights of each basic posture is the product of the value of its posture type and its own weight relative to the posture type. The weights of the basic postures are varied every so often so that the character changes its posture without changing its meaning, thus producing a realistic variation of posture over time. Each basic posture is represented as an orientation for each joint of the character and final posture is calculated as a weight sums of these orientations. Figure 2 shows example output postures.

4 Conclusion

We have explored the use of interpersonal attitude for the generation of body language and in particular posture. Our initial results are encouraging and in particular attitude seems to account for a wide range of human postures Figure 2 shows some examples of postures generated for interacting characters.

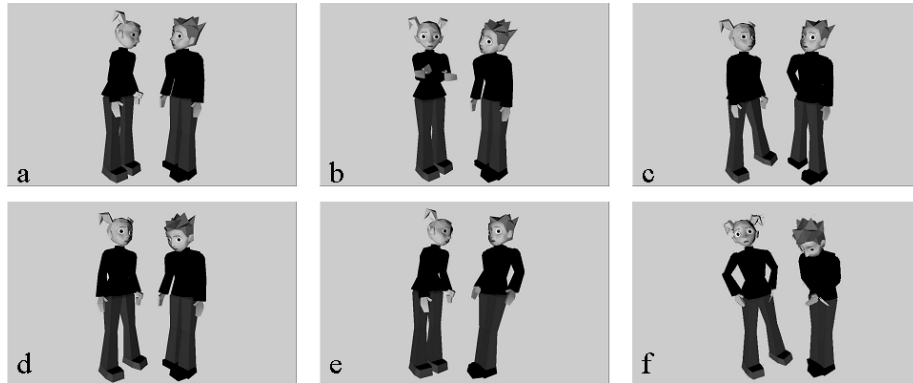


Fig. 2. Examples of postures generated displaying various attitudes. (a) affiliation reciprocated by both parties, displaying close posture with a direct orientation and a forward lean. (b) the male character has high affiliation and the female low affiliation, turning away with a distant crossed arm posture. (c) both characters are dominant, the female has a space filling, straight posture with raise head, while the male also has a space filling posture with a hand on his hips. (d) The male character responds submissively to the dominant female character, his head is lowered and his body is hunched over. (e) The female character responds with positive affiliation to the male character's confident, relaxed, leaning posture. (f) A combined posture: the female character shows both low affiliation and high status and the male character low affiliation and low status.

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