

A Model of Personality and Emotional Traits

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Abstract. How do we construct credible personalities? The current SAL (Sensitive Artificial Listeners) characters were constructed intuitively and can be unconvincing. In addressing these issues, this paper considers a theory of personality and associated emotional traits, and discusses how behaviours associated with personality types in people may be adapted to develop characteristics of virtual agents. Our objective is to ensure that behavioural perceptions of a virtual agent credibly reflect the agent's 'actual' personality as prescribed.

Keywords: Personality traits, Eysenck, emotional traits, virtual agents.

1 Introduction

This paper proposes that the way in which personality dimensions affect various attributes of animated characters should reflect similar processes in the humans upon which they are modelled. Our work is part of the EU project SEMAINE, which aims to provide a multimodal system of conversational agents, or Sensitive Artificial Listeners (SAL). These virtual agents are designed to sustain realistic interaction with human users, despite having limited verbal skills.

We first present different theories of personality. Then in later sections, we explain how we kept a computationally appropriate level of complexity to model personality in virtual agents and how personality affects behaviours. Section 4 describes a model to build agents with different behaviour propensities. The four SAL characters are presented in the next section. We end this paper by introducing the SAL architecture where we detail how personality acts not only on the behaviour characteristic of the virtual agent but also on its communicative styles, in particular when being a listener.

1.1 Trait Models of Personality

Trait models of personality assume that traits influence behaviour, and that they are fundamental properties of an individual. The five-factor model [1] is a modern lexical

approach, and posits five main personality dimensions – extraversion, neuroticism, openness to experience, agreeableness and conscientiousness.

In comparison, Eysenck [2] developed a model based on traits which he believed were heritable and had a probable biological foundation. Likely personality traits were identified from clinical and experimental literature, and the three main traits which met these criteria were extraversion-introversion, neuroticism-emotional stability, and psychoticism.

There is evidence of some form of theoretical integration between the two models. Eysenck's traits of extraversion and neuroticism are virtually identical to the similarly named dimensions of the 'Big Five', and psychoticism seems to correspond to agreeableness and conscientiousness combined – suggesting these traits may be components of psychoticism [3].

Extraversion and neuroticism have also been associated with the basic assumptions of Gray's [4] two-dimensional model of impulsivity and anxiety. Gray proposed that people differ in sensitivity of their Behavioural Approach System (BAS, responsible for impulsivity) or Behavioural Inhibition System (BIS, responsible for anxiety).

1.1.1 Biological Underpinnings of Eysenck's Three-Factor Model

Eysenck attempted to provide causal explanations based on individual differences in nervous system functioning. His biological theory suggests that as extraverts are less cortically aroused than introverts, they should need more external stimulation and be more comfortable under arousing conditions.

Highly neurotic individuals are predicted to show more autonomic nervous activity in stressful situations. Alternatively, M.W. Eysenck's Hypervigilance Theory argues that as 'highly anxious' people constantly look out for signs of threat, they will use many rapid eye movements, and attend selectively to threat-relevant stimuli [5].

Psychoticism is less well understood, however Eysenck suggested psychoticism is linked to male hormones (e.g. testosterone) which influence impulsivity.

1.2 Trait Emotionality

Neuroticism is primarily an emotional disposition – 'negative emotionality', or the propensity to experience negative emotions. Similarly, extraversion 'predisposes an individual towards positive emotion' [6]. These reliable and stable individual differences in the propensity to experience global positive and negative affect confirm the notion of trait emotionality [7], and also warrant consideration when defining characteristics of conversational agents.

2 Complexity/Adequacy

There is a continued debate in the literature as to which of the two main personality models is more theoretically appropriate. What *we* must consider is which dimensions best reflect the various attributes of a virtual agent. The diversity created by the trait models provides a comprehensive framework, however modelling personality as a reflection of complex multivariate solutions might be difficult if virtual agents need more easily controlled parameters [8].

Confining interpersonal behaviour to fewer dimensions would allow for more effective management, and Eysenck's three-dimensional model would arguably serve as an acceptable foundation. Its core dimensions of extraversion and neuroticism are undisputed and central to all major trait theories. Psychoticism is useful as it seems to reflect agreeableness and conscientiousness. Further benefits in adopting Eysenck's model are that its biological underpinnings could to some extent direct and justify specific response patterns of behaviour in developing characters of virtual agents.

3 Building Personality

Our objective is to provide a sound theoretical basis to generate behavioural characteristics which will allow an observer to infer a personality. Personality predicts specific behaviours. Individual personality types are deduced from the answers to questions about behaviours. We need to do the opposite, and generate consistent sets of behavioural attributes (an agent's visual cues etc) from a personality.

In doing so, it should be remembered that extraversion is not just linked with positive affect, but associated with a general level of activation and behavioural approach [9]; neuroticism similarly is related to behaviour avoidance. Both dimensions thus reflect differences in behaviour, affect and cognition [7].

4 Representing and Modelling Distinctive Characters

To model behaviour tendencies of virtual agents, we use the approach developed by [10] where an agent is defined by a *baseline* that captures the global behaviour tendency of the agent. The baseline is defined as a set of numeric parameters: the agent's modality preference and the agent's behaviour expressivity. The modality preference refers to the agent's degree of preference in using each available modality (face, head, gaze, gesture and torso) to communicate while the behaviour expressivity is represented by a set of 6 parameters that influence the quality of the agent's movements as was proposed by [11]: the frequency (OAC parameter), speed (TMP parameter), spatial volume (SPC parameter), energy (POW parameter), fluidity (FLD parameter), and repetitiveness (REP parameter) of the non-verbal signals produced by the agent. These expressivity parameters are defined for each modality: one set of parameters for the head movements, another set for the facial expressions, and so on.

5 Definition of Characters

These are the principles. The challenge now is to map the connections and consider how we translate these stable traits into personality-dependent actions. We should thus be aware of the links between impressions of personality and verbal/nonverbal behaviour, i.e. which behaviours actually effect a viewer's perception of personality. The five major categories typically used to classify nonverbal behaviour are facial expressions, eye and visual behaviour (e.g. gaze), kinesics, paralanguage, and proxemics.

5.1 Defining Representative Behaviour of SAL Characters

The design of the characters draws on the above. The application consists of a system of Sensitive Artificial Listeners (SAL), designed to sustain an interaction with a human user via generation of nonverbal behaviour in real time. SAL characters represent four psychologically different affective/personality types, which try to draw the user into their own emotional state. Poppy is outgoing (extraverted) and optimistic; Spike is angry and argumentative; Prudence is pragmatic and practical; and Obadiah is gloomy and depressed. Figure 1 portrays the 4 SAL facial models.



Fig. 1. The 4 SAL agents: Poppy, Spike, Prudence and Obadiah

Although the literature describing behaviours associated with particular human personalities is not couched in the same terms used to describe the agents, we can begin to use the human research to help us specify the design parameters for our characters. The definition of the 4 characters is work in progress. Let us concentrate on the behaviour characteristics of Poppy. The facial expressions of extraverts tend to be ‘friendly’, and the literature suggests that individuals are perceived as more sociable when smiling than with a neutral face [12]. We might further expect Poppy’s facial appearance to be attractive (see Fig. 1). This relates to the ‘what is beautiful is good’ stereotype - positive personality attributions tend to be projected on to those possessing attractive faces [13]. Faces high in symmetry have similarly received significantly higher ratings of attractiveness, and facial symmetry is associated with personality attributes such as sociability, liveliness, and happiness [14].

Drawing on Eysenck’s theory of extraversion and arousal, Poppy would be characterized as having high levels of general activation. For example, extraverts tend to demonstrate more body movements, and display greater levels of facial activity [15]. Studies have also shown that extraversion is associated with greater levels of gesturing, more frequent head nods, and general speed of movement [12]. During conversation, extraverts tend to position themselves closer to others, and direct facial posture and eye contact is more likely to be maintained [16].

Regarding language and paralanguage, extraverts tend to talk more loudly and more repetitively, with fewer pauses, shorter silences, and less hesitations [17]. Extraverts initiate more interactions, using more positive emotion words and informal style [18].

6 SAL Architecture

Our system analyses user's movements and voice to determine the agent's behaviour while listening to the user. The agent can perform non verbal signals (called *backchannels* [19]) to show how it is reacting to the user's speech, if it is listening, understanding, agreeing and so on. The system is divided into three modules [20]: the *agent definition*, the *backchannel planner* and the *backchannel realizer*.

Agent definition. The agent definition module contains the information that characterises a SAL agent: the baseline and the agent's *mental state*, which describes what the agent thinks about the user's speech.

In our system, we define the mental state as a set of communicative functions the agent wishes to transmit during an interaction. We consider twelve communicative functions, a subset chosen from the taxonomy proposed by Allwood et al. and Poggi [19, 21]. Each communicative function is associated with a set of behavioural signals that must be performed to convey the given function. The listener functions should vary during the interaction, since they depend on several factors like the content of the speaker's speech, the listener's own beliefs, the relationship between the two parties and so on. However, at present, for sake of simplicity, we link the agent's mental state to the emotional characteristics that differentiate the four SAL agents. For example, Spike, who is angry and argumentative, conveys negative communicative functions, in particular dislike, disagreement and lack of interest.

Backchannel Planner. The backchannel planner module decides when and how the agent must provide a backchannel signal. To determine when a backchannel is triggered, this module analyses the user's verbal and non verbal behaviour; researches have shown that backchannels are often emitted according to the speaker's behaviour [22, 23]. Then, the backchannel planner calculates all the possible signals and chooses the most appropriate one through an algorithm of action selection [24].

Backchannels can be potentially conflicting at the signal level. In this case, only one of these backchannels can be displayed and a backchannel selection is necessary to choose the most appropriate one relative to the context of the interaction. For example, personality has an influence on the backchannel selection by modulating the number of displayed backchannels (e.g. Poppy shows a lot of backchannels while Obadiah much less).

Backchannel realizer. The backchannel realizer instantiates the backchannel output from the action selection module into a set of signals. This step considers also the agent's definition: the baseline and the agent's mental state. For each communicative function the agent intends to transmit, the backchannel realizer determines the corresponding non verbal behaviours from the backchannel lexicon [25, 26] taking into account the agent's modality preference and its expressivity parameters. Finally, the resulting animation is played on a graphic window where the virtual agent is shown.

7 Conclusion

In this paper we have presented a model of personality and emotional traits for virtual agents. We have applied this model to SAL agents. The model we have adopted from

the different theories of personality is the Eysenck's model. Four distinctive agents have been designed with a given personality each. For each of them, personality affects the agent's global behaviour quality as well as their backchannel productions (frequency and type of signals).

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