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# Perception of psychopathy and the Uncanny Valley in virtual characters

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ABSTRACT

Virtual characters with a realistic, human-like appearance are increasingly being used in video games and animation. However, increased realism does not necessarily imply increased acceptance and factors such as aberrant facial expression may evoke the Uncanny Valley phenomenon. In humans, personality traits such as anger, callousness, coldness, dominance, being unconcerned, and untrustworthiness are associated with psychopathy; a visual facial marker of this condition being a lack of visible response in the eye region to emotive situations. As such, the present study investigated if inadequate upper facial animation in human-like virtual characters evoked the uncanny due to a perception of psychopathic traits within a character. The results revealed that virtual characters that showed a lack of a startle response to a scream sound were regarded as most uncanny and perceptions of personality traits associated with psychopathy were a strong predictor of reported uncanniness but, that other negative personality traits not associated with psychopathy were not. The study presents possible psychological drivers of uncanniness to inform designers why a lack of detail in a character's upper face when portraying a startle response may evoke perception of specific negative personality traits in a character, to help control the uncanny in character design.



## 1. Introduction

Recent empirical investigation into the Uncanny Valley in synthetic agents has helped elucidate factors which may exaggerate the uncanny. Tinwell, Grimshaw, and Williams (2011a) revealed that some facial expressions of emotion are more prone to perception of uncanniness than others. Specifically, viewers are especially sensitive to uncanniness in realistic, human-like, male characters presenting the emotions fear and surprise when the uncanny is exaggerated by eliminating movement (and therefore emotional expressivity) in the character's *upper face* including the eyelids, eyebrows and forehead (Tinwell, Grimshaw, Williams, & Abdel Nabi, 2011b).

While the study by Tinwell et al. (2011a, 2011b) successfully investigated how aspects of a character's appearance may be manipulated to reduce the uncanny for empathetic characters (or to enhance the uncanny for antipathetic characters intended to be frightening), the possible psychological processes driving the uncanny response were not empirically examined. The present study sought to replicate Tinwell et al.'s findings for male characters and tested whether it generalized to female characters too. It then moved onto investigate some of the psychological processes that may drive the uncanny response by exploring if inadequate upper facial animation (i.e., lack of upper facial emotional expressivity) leads to the perception of a particular type of negative personality traits in virtual characters, psychopathy, and whether it is this which elicits an uncanny response in viewers. The findings from this study may be used to inform character designers in video games and animation and elucidate how, and importantly *why*, a lack of detail in the upper face region in particular contexts may evoke perception of specific negative personality traits in a character. Furthermore, it may help towards building a conceptual framework of the uncanny in virtual characters to help us better understand which factors contribute to the uncanny, and how it may be controlled in character design.

### 1.1. The Uncanny Valley

The concept of the uncanny was first proposed in psychological writings of the early twentieth century as a way to explain why some objects may appear strange or eerie to a viewer. For example, the psychologist Jentsch (1906) suggested that life-like wax-work dolls and automata are often regarded as frightening because the viewer cannot distinguish if the object is real or unreal and that this indecision constitutes "uncanniness". In 1919, Freud offered an alternative perspective by theorizing that the uncanny occurred when objects or situations evoke a sinister revelation of that which

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is normally concealed from human experience and should, for psychological health and ego stability purposes, remain out of conscious awareness.

Given that Jentsch's examples of uncanny objects included automata, it is understandable that in more recent times human experience of uncanniness in response to robots has been investigated. In a seminal study, the roboticist Marashiro Mori (2012) explored human reaction to human-like robots and drafted a graph to demonstrate the relationship between experience of the uncanny and increasing human-likeness in a robot's appearance (see Fig. 1). Mori originally used the Japanese neologism *Shinwa-kan* as a measure of perceived uncanniness that has since been translated in English as one's "affinity" towards to a given object (see MacDorman & Kageki, 2012; also, Bartneck, Kanda, Ishiguro, & Hagita, 2009; Ho & MacDorman, 2010).

As Fig. 1 shows, unlike robots with a traditionally mechanical appearance, the level of affinity towards human-like robots drops sharply at a point where the robot appears close to, but not quite, authentically human-like. The incongruence between a robot's behavior and their human-like, physical appearance caused a negative affective response in the viewer, thus creating a valley shaped dip in the otherwise linear relationship between perceived affinity and human-likeness (see Fig. 1). Furthermore, the effect of object movement would amplify the uncanny effect for the viewer. Rather than just one particular factor such as facial expression (Tinwell et al., 2011a, 2011b), it has been suggested that multiple factors may contribute to uncanniness, especially so with animated characters (Hanson, 2006; Pollick, 2010). For example, a perception of jerky or unnatural movement (MacDorman, Coram, Ho, & Patel, 2010) may exaggerate the uncanny as might perception of a lack of synchronization of lip movement with speech (Tinwell, Grimshaw, & Williams, 2010). This line of investigation follows the work of previous authors who have put forward a range of explanations as to why we experience the uncanny including whether it may be an instinctive reaction to a perception of potential danger.

### 1.2. Explanations of the Uncanny Valley

In an attempt to understand and explain the Uncanny Valley, in his original paper Mori (2012) reflected on issues related to its function:

> Why were we equipped with this eerie sensation? Is it essential for human beings? I have not yet considered these questions deeply, but I have no doubt it is an integral part of our instinct for self-preservation. (Note: The sense of eeriness is probably a form of instinct that protects us from proximal, rather than distal, sources of danger. Proximal sources of danger include corpses, members of different species, and other entities we can closely approach. Distal sources of danger include windstorms and floods.) (Mori, 2012, p. 3).

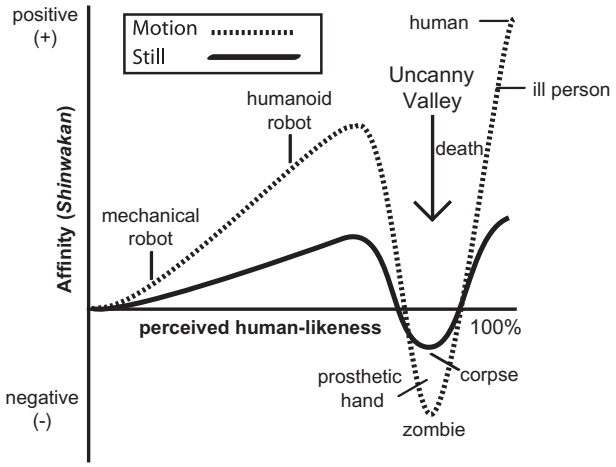


**Fig. 1.** Mori's plot of perceived familiarity against human-likeness depicting the Uncanny Valley (taken from a translation by MacDorman and Kageki of Mori's "The Uncanny Valley").

Mori (2012) postulated that experience of the uncanny in almost, fully human-like characters may serve as a reminder of one's own death and the resulting feelings of dread, a supposition prompted by the fact that corpses and human-like robots possess a physical human appearance but show no behavioral fidelity. Building on Mori's (2012) explanation that the Uncanny Valley may be in response to a proximate threat of danger, Kang (2009) later theorized that the uncanny was caused when a man-made object, such as a robot, is regarded as a threat to the viewer; something that intends to, or has the potential to cause harm. If the human is unquestionably of higher stature and in control, then there is little or no threat. In this way, characters such as "Pinocchio" or "Shrek" may be regarded as cute and comical. However, we may judge ourselves as having less (or no) control over other man-made objects such as powerful androids or highly human-like virtual characters which *may* be more dominant and, thus, a greater threat.

Lewkowicz and Ghazanfar (2012) suggested that perception of the uncanny is not innate but a developmental phenomenon that relies on early perceptual experience of typical human facial expression; hence, the psychological substrates of uncanniness may be related to the adequate development of the skills required for adaptive interpersonal and social functioning.

### 1.3. Uncanny facial expression of emotion in virtual characters

More recently, due to advances in digital technology for simulating realism, viewers have reported similar uncanny experiences in response to realistic, human-like virtual characters featured in animations and video games (see e.g. Brenton, Gillies, Ballin, & Chatting, 2005; Doerr, 2007; Geller, 2008; Green, MacDorman, Ho, & Vasudevan, 2008; Ho & MacDorman, 2010; Hoggins, 2010; MacDorman, Green, Ho, & Koch, 2009; Rose, 2011; Tinwell et al., 2011a, 2011b). Video game designers (working in genres such as action games and role-playing games) perceive an increased aesthetic realism as highly desirable as this may allow viewers to better appreciate the emotional state of characters, leading to a heightened state of engagement with that character and immersion in the game (Doerr, 2007; Hoggins, 2010; Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Järvinen, 2008). However, criticism has been leveled at this approach based on the inability of such characters to reliably, clearly communicate their emotional state to the viewer (Crigger, 2010; Doerr, 2007; Rose, 2011), possibly due to the technological challenges of achieving this.

For scenes involving full motion video (FMV) in video games, such as pre-recorded trailers and cut scenes, motion capture techniques are combined with post-production editing in 3D software to create a character's facial expression. This process allows for the recording of high fidelity facial expression of emotion from a human that is then modeled to a 3D character. Designers may then use a key-framing technique to edit individual frames of existing motion capture data to attempt to make the character's facial expression as realistic and accurate as possible and appropriate to the given context of the game. However, this process cannot be used for footage generated in real-time and, instead, automated and/or procedural generation techniques are used to generate a character's facial expression. These automated techniques may