

論文 / 著書情報
Article / Book Information

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Title(English)	The Exploration of Uncanny Valley and Influence of Robot ' s Nonverbal Behaviours Toward Likability in Human-robot Interaction
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論文要旨

THESIS SUMMARY

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申請学位 (専攻分野) 博士
: Doctor of (Philosophy)
Academic Degree Requested

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

“Human-like robot that guarantees the highest likability from human is the optimal goal.” This goal has been a winning trophy for researchers, especially in social robot research field. One of the barriers that obstructs the current studies from achieving this goal is Uncanny Valley effect. Many studies have been endeavouring to find approaches to avoid and overcome the Uncanny Valley whilst achieving the highest likability. However, the focus on the influences of robot’s appearance leaves a big missing part: the influence of robot’s nonverbal behaviour. This impedes the complete exploration of Uncanny Valley. This study then aims to explore the Uncanny Valley and its existence from a viewpoint of robot’s nonverbal behaviour. The optimal goal of this thesis is to gain more understanding on Uncanny Valley from a viewpoint of robot’s nonverbal behaviour as a step closer to achieve the highest likability from humans.

In Chapter 2, we firstly started our investigation in human-human interaction aiming to assert the importance of nonverbal behaviour in the interaction by investigating the relationship between human’s internal state and interactional behaviour, in this case, the relationship between prior knowledge and nonverbal interactional behaviors in face-to-face interaction. We observed mutual gaze convergence and head nodding synchrony as the representations of nonverbal interactional behaviours and as the indicators of communication effectiveness. We conducted an experiment on lecture task between lecturer and students with/without prior knowledge. The result shows that the interaction with prior knowledge establishes significantly higher mutual gaze convergence and head nodding synchrony compared to the interaction with no prior knowledge. The findings reveal that prior knowledge facilitates mutual gaze convergence and head nodding synchrony with different temporal range and the relationship between human’s internal state and their nonverbal interactional behaviour is found. The findings in Chapter 2 demonstrate that nonverbal behaviour plays a very important role in human-human interaction, which emphasizes the importance of nonverbal behaviours and that nonverbal behaviour is worth consideration for robot’s nonverbal behaviour design to enhance human’s likability in human-robot interaction.

In Chapter 3, we continued our investigation in human-robot interaction aiming to investigate the influence of robot’s nonverbal behaviour toward human’s likability. The research question is what specific means (gaze or head nodding behaviour) and strategy (backchanneling or turn-taking) of robot’s nonverbal behaviour influences and enhances likability in human with specific personality (introvert and extravert). Our findings reveal that robot’s head nodding behaviour, especially with backchanneling strategy, has positive influence toward the introvert participants and it is reflected and results in substantial head nodding synchrony

during the interaction. In contrary, robot's gaze behaviour, especially with turn-taking strategy, has positive influence toward the extravert participants and it is reflected and leads to significant mutual gaze convergence during the interaction. The study in Chapter 3 provides an evidence showing that there is a relationship between robot's nonverbal behaviour and human's likability. This chapter affirms and emphasizes the influence of robot's nonverbal behaviour toward human's likability.

In Chapter 4, we further expanded the investigation with more variety of robot's nonverbal behaviour combinations in order to explore the Uncanny Valley from a viewpoint of robot's nonverbal behaviour. We asked the participants to rate human-likeness and affinity of robot's nonverbal behaviours ranged from 0 (no nonverbal behaviour) to 3 (gaze, head nodding, and gestures) combinations. The result shows a biphasic relationship between human-likeness and affinity of robot's nonverbal behaviours. Also, the point where the affinity rating significantly dropped down is detected. This reveals a curve resembling the Uncanny Valley. The result indicates that though the robot with head nodding behaviour is perceived as more human-like compared to the robot with no nonverbal behaviour, it gains the least rating on affinity. With gestures, the robot is highly evaluated in both human-likeness and affinity. The study in Chapter 4 provides an evidence indicating the existence of Uncanny Valley from a viewpoint of robot's nonverbal behaviour.

This thesis presents an exploration of Uncanny Valley from a viewpoint of robot's nonverbal behaviour. Our findings provide an evidence indicating the existence of Uncanny Valley from a viewpoint of robot's nonverbal behaviour. This study can be considered as the 1st finding of Uncanny Valley from a viewpoint of robot's nonverbal behaviour. We found that the Uncanny Valley detected in robot's nonverbal behaviour is context-dependent. In giving a talk context, robot's head nodding behaviour with no gestures might present context-behaviour mismatch, which violates humans' expectation and lead to double bind situation. As a result, when the robot expresses only head nodding behaviour with no gestures, it is prone to fall into the Uncanny Valley. On the other hand, robot's gestures can fulfill human's expectation and familiarity on gestures-speech relationship. When the robot expresses gestures, it is highly evaluated and gains the higher likability from humans. This study suggests that one possible strategy to overcome the Uncanny Valley from a viewpoint of robot's nonverbal behaviour, especially in giving a talk context is gestures. Gestures should be considered as a fundamental element of robot's nonverbal behaviour and other nonverbal behaviours such as gaze and head nodding behaviours should be adaptive regard to the target groups. Last but not least, this thesis emphasizes the influence of robot's nonverbal behaviours toward likability in human-robot interaction. To overcome the Uncanny Valley effect, robot's nonverbal behaviour should not be overlooked.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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