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This compilation thesis contributes to a deeper understanding of perceived safety in human-robot interaction (HRI) with a particular focus on social robots. The current understanding of safety in HRI is mostly limited to physical safety, whereas perceived safety has often been neglected and underestimated. However, safe HRI requires a conceptualization of safety that goes beyond physical safety covering also perceived safety of the users. Within this context, this thesis provides a comprehensive analysis of perceived safety in HRI with social robots, considering a diverse set of human-related and robot-related factors.

Two particular challenges for providing perceived safety in HRI are 1) understanding and evaluating human safety perception through direct and indirect measures, and 2) utilizing the measured level of perceived safety for adapting the robot behaviors. The primary contribution of this dissertation is in addressing the first challenge. The thesis investigates perceived safety in HRI by alternating between conducting user studies, literature review, and testing the findings from the literature within user studies.

In this thesis, six main factors influencing perceived safety in HRI are lifted: the context of robot use, the user's comfort, experience and familiarity with robots, trust, sense of control over the interaction, and transparent and predictable robot behaviors. These factors could provide a common understanding of perceived safety and bridge the theoretical gap in the literature. Moreover, this thesis proposes an experimental paradigm to observe and quantify perceived safety using objective and subjective measures. This contributes to bridging the methodological gap in the literature.

The six factors are reviewed in HRI literature, and the robot features that affect these factors are organized in a taxonomy. Although this taxonomy focuses on social robots, the identified characteristics are relevant to other types of robots and autonomous systems. In addition to the taxonomy, the thesis provides a set of guidelines for providing perceived safety in social HRI. As a secondary contribution, the thesis presents an overview of reinforcement learning applications in social robotics as a suitable learning mechanism for adapting the robots' behaviors to mitigate psychological harm.

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