Chapter 7
Cognitive and Neural Mechanisms Involved in Interactions Between Touch and Emotion

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ABSTRACT

Touch has been described as the most fundamental means of contact with the world and the most primitive modality among all sensory systems. In the past, the study of emotional communication has focused almost exclusively on facial and vocal channels but has ignored the channel for the sense of touch. However, the latest studies have documented that the sense of touch can convey at least six emotions, and its accuracy rate is comparable to that of facial expressions and vocal communication. Moreover, there is also mounting evidence indicating that the modality of touch encompasses two dimensions, which provide not only its well-recognized discriminative input from glabrous skin to sensory cortex but also an affective input from hairy skin to the insular cortex because a type of low-threshold mechanosensitive receptor that innervates hairy skin has been shown to convey emotions via C fibers. In light of recent advances in our research, this chapter aims to illustrate the cognitive and neural mechanisms that underlie interactions between touch and emotion.

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INTRODUCTION

Recently, research has indicated that the sense of touch can convey at least six emotions and that its accuracy rate is comparable to that of facial expressions and vocal communications. Here, I summarize the current state of knowledge on the elaborate mechanisms that facilitate the formation of communication via touch. First, I describe behavioral results related to touch-communicated emotions. Next, I show that in agreement with physiological evidence, there is a class of low-threshold mechanosensitive C fibers that innervate hairy skin and that these neurons represent the neurobiological substrate for affective touch. Then, I present evidence that touch communicates distinct emotions and that this process requires several neural mechanisms, some of which are concerned to emotional processing and others that are involve in a specialized tactile perception system. Finally, I highlight factors that I believe are related to the neural bases of interactions between touch and emotion.

BACKGROUND

With the rapid aging of our population, human-robot emotional interactions are becoming a topical issue related to the process of helping the elderly and sick and performing medical rehabilitation as well as social services (Figure 1). However, humans would rather choose a more emotional animal than a cold machine companion. The emotional interactions between robots and humans that occur via the sense of touch seem to be an impenetrable barrier not only in the field of brain science but also in the field of humanoid robots. Recently, a growing amount of evidence has indicated that the sense of touch has another dimension and that it provides not only its well-recognized discriminative input to the brain but also an affective input (McGlone, Wessberg, & Olausson, 2014). This result will hopefully promote the development of methods to integrate the senses and new research in the brain sciences, provide theoretical and technological support for research into emotional interactions between human beings and robots, and drive the brain sciences and other industries related to advanced robots to thrive in the world.

Figure 1. (a) The aging population of China, including the increasing proportion of elderly people. (b) Humanoid robots can communicate emotions to people via face, voice, and touch modalities.