Mapping from Facial Expression to Internal State based on Intuitive Parenting

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In this paper, we propose a developmental model in which the facial expression of a caregiver is associated with the internal state of the robot through intuitive parenting [Papousek and Papousek, 1987]. Intuitive parenting is the usual parents' behavior in which they often mimic and emphasize their facial expression of certain emotional state presumed from their children's facial expression. This behavior is thought to help children to develop their sympathetic ability [Gergely and Watson, 1999].

Fig. 1 shows our proposed system. Our virtual robot acquires various kinds of the sensor information from the human caregiver, touch sensors (keyboards), sounds, and camera images. Such sensor information changes the internal state of the robot, which consists of two kinds of variables, independent to each other, corresponding to the arousal-sleep axis and the pleasure-displeasure axis [Russell, 1980]. These internal variables change based on the simple relaxation dynamics equations. This internal state is represented in these two dimensional space. This space is associated with the representational space of facial expression of others through the intuitive parenting communication.

most the same as the Russell's two dimensional emotional model. Fig. 2 (b) shows the time course of the internal state variables and facial expression during the communication with the caregiver after learning. The robot changes its internal state depending on the caregiver's facial expression and successfully follows it.

(a)   (b)

Figure 2: Experimental results: (a) Facial expressions associated with internal state, (b) Sympathetic communication after learning
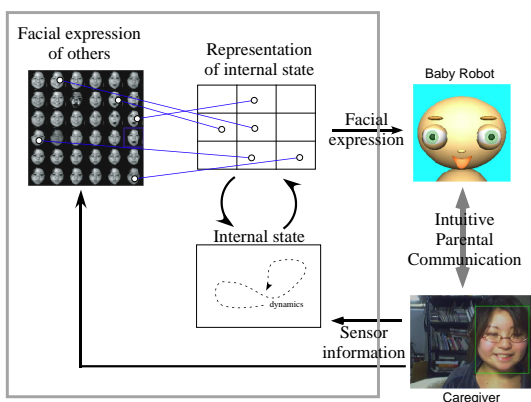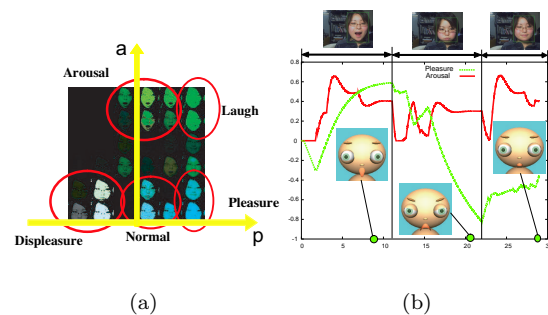

Figure 1: Associating the others' visual facial expressions with internal states

Fig. 2 (a) shows the corresponding facial expressions on the representational space of the internal state. The caregiver's faces are associated with the internal state, and the distribution is al-

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