2017 26th IEEE International Symposium on
Robot and Human Interactive Communication (RO-MAN)
Lisbon, Portugal, Aug 28 - Sept 1, 2017.

Encoding Cultures in Robot Emotion Representation

Thi Le Quyen Dang, Nguyen Tan Viet Tuyen, Sungmoon Jeong, and Nak Young Chong

Abstract— **Cultural differences may influence interactions between humans with different social norms and cultural traits, incurring different emotional and behavioral responses. The same applies to human-robot interaction (HRI). We believe that controlling robot emotions based on the cultural context can help robots adapt to humans from culturally diverse backgrounds. Such culturally aligned robots are expected to be easily accepted by humans as part of daily life. In this paper, we aim at investigating the role of culture in representing robot emotions which are injected by humans during its early stage of development and subject to change through their own experience thereafter. Several public data sets of pictures labeled with affective ratings by Indian, American, and European subjects are presented to social humanoid Pepper robots. The result shows that robots can learn to behave socially in alignment with an individual's cultural background. Moreover, we have demonstrated that robots under the effect of different cultures can generate different behavioral responses to the same stimuli, which is considered one of the most important issues in socially assitive robotics.**

I. INTRODUCTION

Socially assistive robots are increasingly being used in nursing homes as a companion for providing elderly and/or autistic people with mental health services. Over the decades, artificial emotions have been explored and modeled to promote interactions between humans and robots [1], [2]. Artificial emotions help robots drive cognitive mechanisms for selecting appropriate actions in response to environmental stimuli. Furthermore, emotionally responsive robots also help humans understand how robots are affected by stimuli and the way they react to those stimuli. Therefore, trust (or predictability) can be built between humans and robots during social interactions for mental healthcare applications.

There are several approaches, inspired by human infants, that aim at imitating human emotions and expressions to model robot emotions [3]–[5]. In previous works, robots play a passive role as a learner to mimic human emotions and expressions directly through human-robot interaction (HRI). Cognitive memory architectures were also applied to enable robots to form affective appraisals for acquiring knowledge and generating emotions. However, a limited number of robot emotions were considered. Indeed, robots can not use the knowledge acquired to generate diverse personal emotions which may allow them to make their personality stand out. Furthermore, the influence of culture in representing robot emotions were not investigated, which may prohibit robots from gaining the attention of a variety of cultural groups.

Different cultures let humans share different experiences through controlling emotion generation and cognition processes [6]. This cultural influence makes humans interpret emotional expressions and experienced emotions in a different way [7], [8]. Therefore, people from different cultural backgrounds expect different responses from robots during HRI. As an example, Egyptians show more interest when having Arabic greetings than Japanese greetings when interacting with robots, even though they understand Japanese language and culture [9]. It should be noted that cultural context may play an important role to enable robots to gain increased attention from people in long term interactions [10]. We believe that the cultural context is an important prerequisite contributing to the proper methods of controlling robot emotions in a culturally diverse environment.

In this paper, we aim to investigate the role of cultural context in representing robot emotions which may enable robots to understand people's cultures. Thus, robots can generate culturally aligned emotions and promote engagement with people in HRI. In our previous work [11], the robot emotion was created by the interacting effects of the human guide and robot personal experiences. This model has shown that different experiences acquired from the human guide can enable robots to generate different emotions responding to visual stimuli. Therefore, in this paper, we explore the influence of human cultures given through HRI toward representing culturally aligned emotions for socially assistive robots. For further understanding of the robot's emotions through physical body movement, we use Pepper humanoid robots [12] and generate a set of behaviors driven by the proposed personal emotion representation method.

The paper is organized as follow. Section II discusses the basic ideas underlying our proposed model and presents the method of exploring cultural context in representing robot emotions. Section III describes our implementation process and analyzes the results of our experiments. Section IV concludes our work.

II. ROBOT EMOTION FOR CULTURAL ALIGNMENT

In this section, we discuss the proposed model for representing robot emotions in a culturally responsive way. All factors that influence the robot emotion are investigated and modeled, allowing robots to acquire knowledge and generate emotions continuously during HRI. With the influencing factors, we further investigate the effect of cultural context in modeling robot emotions toward aligning with different cultural backgrounds. We also design simple behaviors of

*This work was supported by the EU-Japan coordinated R&D project on Culture Aware Robots and Environmental Sensor Systems for Elderly Support commissioned by the Ministry of Internal Affairs and Communications of Japan and EC Horizon 2020.

The authors are with the School of Information Science, Japan Advanced Institute of Science and Technology, Ishikawa, Japan {quyen.dang, ngtvtuyen, jeongsm, nakyoung}@jaist.ac.jp

978-1-5386-3518-6/17/$31.00 ©2017 IEEE

Pepper humanoid robots, which enables them to express their emotional states during HRI.

A. *Personalized Emotion via Retrieval of Memories [11]*

The proposed emotion representation is based on the role of internal and external emotional cues incorporating the human guide and the robot's own experience. The human guide helps robots interpret the environment and shape their emotions, which is expected to be favorably accepted by humans. Different previous experiences can influence the formation of robot emotion, leading to the robot personality development. In order to enable robots to acquire knowledge and gain emotional experiences continuously during HRI, a long-term memory was designed based on a developmental memory architecture. In this work, robots are able to extract certain properties of objects from visual stimuli such as scale-invariant feature transform (SIFT) key points and color features. These properties are used to form affective appraisals of objects to recall past experiences including engaged emotions. Using recalled emotions and human guides, robots are able to control their personal emotions in response to the environmental stimuli. An overview of the proposed model is shown in Fig. 1.

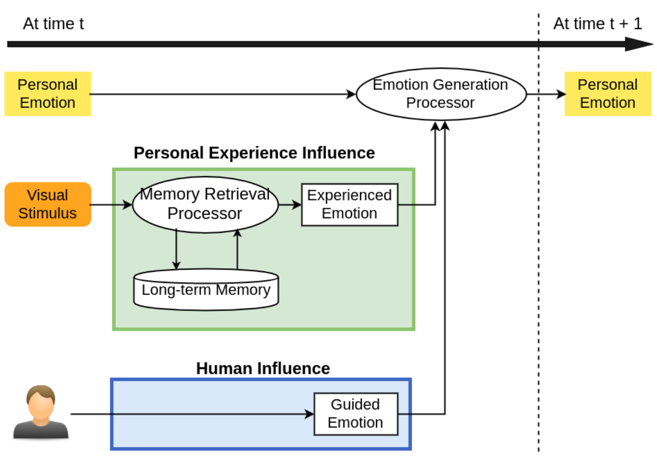


Fig. 1. Robot emotion representation with human guides and experiences

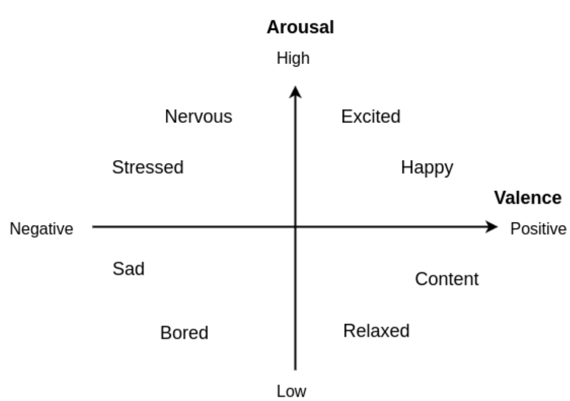


Fig. 2. 2-dimensional emotional model [13]

Two orthogonal dimensions of emotion have often been used for emotion representation [13] using the valence (negative/positive) and arousal (high/low) values as shown in Fig. 2. Happy and content are positive emotions which have different arousal levels. Valence and arousal are considered very important which enhance memory performance and human tendency to share emotions and/or relevant information with others [14], [15]. Our previous work investigated the roles of two main factors affecting the formation of robot emotions: guided emotions injected and shared by people the robot has interacted with and experienced emotions recalled through the retrieval of long-term memories. We investigated the effects of valence and arousal in the guided and experienced emotions integrated into the robot personal emotion that changes as time goes by.

At a certain time, the robot emotion is influenced by three factors: the guided emotion, the experienced emotion, and the emotion of the robot at the previous time step. The proposed model explained the contribution of each component to the formation of emotions using the following update mechanism:

$$C_{PE_{t+1}} = \lambda_1 C_{GE_t} + \lambda_2 C_{EE_t} + (1 - \lambda_1 - \lambda_2) C_{PE_t}, \quad (1)$$

where $C_{PE_{t+1}}$ represents the current emotion of the robot. C_{GE_t}, C_{EE_t}, and C_{PE_t} describe the guided emotion, the experienced emotion, and the robot emotion at the previous time step, respectively. λ_1 and λ_2 are percentage weights for C_{GE_t} and C_{EE_t}, respectively, based on their relative importance. Since the valence and arousal values act independently of each other, we determine the parameter μ such that it has the least influence on each component when calculating λ_1 and λ_2 given by,

$$\lambda_1 = \frac{|C_{GE_t} - \mu|}{|C_{GE_t} - \mu| + |C_{EE_t} - \mu| + |C_{PE_t} - \mu|}, \quad (2)$$

$$\lambda_2 = \frac{|C_{EE_t} - \mu|}{|C_{GE_t} - \mu| + |C_{EE_t} - \mu| + |C_{PE_t} - \mu|}. \quad (3)$$

After each update, a new experience including the emotion generated at the current time step is consolidated in the robot long-term memory for future recall. The proposed model enabled robots to be taught by humans to acquire knowledge and generate emotions continuously. While doing this process, robots may develop their emotions in association with the instructor's personality traits. When being affected by the same stimuli and directed by the same human guide, different robots may acquire knowledge differently from each other. Thus, robots may generate different emotions responding to the same stimuli.

B. *Exploring Cultural Context in Emotion Representation*

During social interactions among humans, internal states including emotions regulated by different cultures can lead to an enhancement to positive social relationships or an increase in discord [16]. Cultures provide guidelines to help humans interpret and anticipate emotional expressions of others. Diverse cultures influence the ways humans evaluate and express emotions differently [17], [18]. Humans have the ability to understand different cultures to regulate their

TABLE I

EMOTIONAL AND BEHAVIORAL RESPONSE BASED ON REFERENCE RANGE (α, β, AND γ) IN VALENCE (V) AND AROUSAL (A).

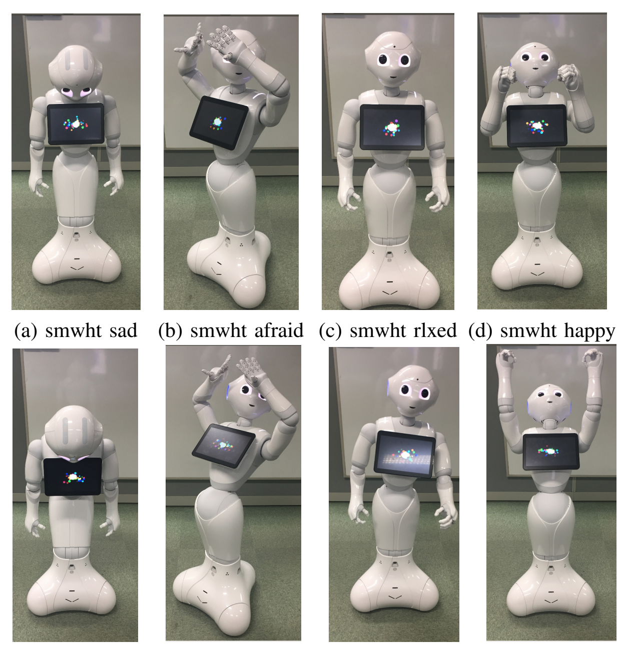
	Low Arousal ($A < \alpha$)	**mid-Low Arousal** ($\alpha < A < \beta$)	**mid-High Arousal** ($\beta < A < \gamma$)	**High Arousal** ($\gamma < A$)
Low Valence ($V < \alpha$)	Sad, Slow	Sad, Medium	Afraid, Medium	Afraid, Fast
mid-Low Valence ($\alpha < V < \beta$)	Somewhat Sad, Slow	Somewhat Sad, Medium	Somewhat Afraid, Medium	Somewhat Afraid, Fast
mid-High Valence ($\beta < V < \gamma$)	Somewhat Relaxed, Slow	Somewhat Relaxed, Medium	Somewhat Happy, Medium	Somewhat Happy, Fast
High Valence ($\gamma < V$)	Relaxed, Slow	Relaxed, Medium	Happy, Medium	Happy, Fast

own emotions and select appropriate behaviors, thereby establishing amicable relationships with others. Thus, along the lines, we explore the role of culture in controlling the robot's emotions and body expressions that would facilitate HRI. Specifically, we aim at providing robots with a capability of generating culturally aligned emotions and behaviors, which is an important direction in increasing the acceptability of socially assistive robots toward diverse nursing care applications.

In the proposed model [11], humans can influence the robot's personal emotions, which showed the possibilities of controlling the robot's emotions by the cultural traits of human subjects. We divide the influence of cultures on robot emotions into two types: cultural formation and cultural adaptation. For the first type, robot emotions can show distinctive features of a certain culture. In order to allow robots to acquire the capability to show such culture specific features from scratch, robots are initialized with no long-term memory and neutral non-arousing emotional states. Besides, robots are only allowed to interact with humans from a specific cultural group. During interactions with humans, robots begin to develop personal emotions based on human guided emotions and acquired knowledge. According to the mechanism presented in (1), high intensity level of human guided emotions has great influence on the robot's personal emotions. Since humans show their cultural background through a combination of multiple modalities, robots can reflect human cultures through the acquired knowledge and personal emotions generated by the update mechanism. While interacting with humans from a specifc culture, the robot immerses itself in that culture and accordingly develops its emotion in alignment with that culture. For the second type of robot emotion genation, robots can adapt their emotions to the culture which might be different from the original culture in which it has been immersed. When being affected by humans from other cultural groups, the robot's past experiences are recalled to gain interpretation about the environment and drive emotions responding to ambiguous objects therein. In addition, the human guide under different cultural backgrounds would also have an impact on robot emotions. Thus, robots will be able to control their personal emotions to have adaptive emotions and consolidate new experiences with the context of cultures surrounding them.

C. Emotional Behavior Generation

In order to enable our robots to express their personal emotions, we design a set of simple emotional behaviors [19], [20]. These behaviors were evaluated based on experiments with children and adults. We use these behaviors to represent emotions of Pepper robots [12]. With a cute face, the emotional behaviors of Pepper can easily grab people's attention and entice people to get into communication with them. A total of sixteen emotional and behavioral responses are defined based on the values of valence and arousal. We use the parameters α, β, and γ as the reference range to map the values of valence and arousal in a range into the corresponding emotional body expression label and movement speed as shown in Table I. More specifically, the valence values are mapped into the emotional body expression labels, while the arousal values are used to select one of three speed levels of body movement. The emotional body expressions of Pepper are shown in Fig. 3. We have confirmed that our robots can generate emotional and behavioral responses to environmental stimuli reflecting their emotinal states. These emotion behaviors are considered to be socially acceptable in a wide range of situations.



(a) smwht sad (b) smwht afraid (c) smwht rlxed (d) smwht happy

(e) sad (f) afraid (g) relaxed (h) happy

Fig. 3. Body expressions for emotional labels.

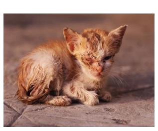
III. EXPERIMENTS

Experimental details are provided in this section which include the input data set for visual stimulus, experimental protocol, and scenario. We also describe and analyze the results obtained from the experiments.

A. Input Data Set

The input data set is selected from International Affective Pictures Systems (IAPS) [21] and Nencki Affective Picture Systems (NAPS) [22]. These data sets contain natural colorful images in multiple categories such as human bodies, animals, or landscapes. Each image is associated with a pair of valence-arousal values with a mean and standard deviation. In our experiments, we specifically use the NAPS data set with ratings performed by the European subjects (of which sixty percent are Polish), and the IAPS data set with ratings by subjects from the American [21] and Indian [23] cultural groups, respectively. Although there are various ethinic and cultural groups in Europe, the culture of Europe as a whole can be considered to be similar and to have significant differentiation to American and Indian cultures.

Our proposed emotion model aims at incorporating cultural differences into the process of emotion generation. To simplify complicated image processing technical details and enable robots to acquire knowledge based on affective object appraisals [11], we use a single object image from the data sets with a simple background. Although two data sets contain more than 2,000 images in multiple categories, there are more or less a dozen images that contain a single object with a simple background in each class (*e.g.*, 15 in the cat class). Due to a limited number of available images rated by multiple cultural groups, only one image is chosen from the IAPS data set. This image contains the ratings of valence and arousal performed by the Indian and American cultural groups. The selected image and the corresponding ratings are shown in Fig. 4. The valence and arousal values change on a continuous scale from 1 to 9. The point (5, 1) in the valence-arousal plane represents the neutral non-arousing emotional state. Moreover, from the NAPS data set, we select seven images of different breeds of cats which contain the European ratings of valence and arousal. The ratings were similarly measured on a continuous scale with the same range as the IAPS data set as shown in Fig. 5.



	Valence	Arousal
Indian [23]	2.60	6.88
American [21]	2.44	4.75

Fig. 4. Selected IAPS image with Indian and American ratings.

(a) V: 7.43, A: 4.04 (b) V: 5.69, A: 5.12 (c) V: 5.23, A: 5.76 (d) V: 6.96, A: 3.91

(e) V: 2.68, A: 6.75 (f) V: 7.41, A: 4.29 (g) V: 4.85, A: 5.01

Fig. 5. Selected NAPS images with European ratings.

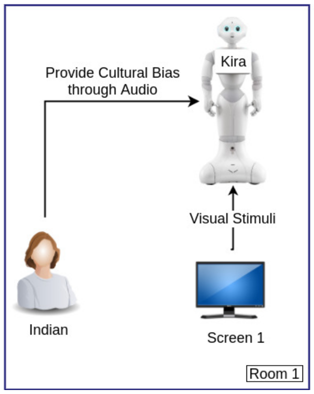
B. Interaction Procedure and Scenario

In order to investigate the validity of our proposed representation model of robot emotions that differ across cultures, we design an evaluation scenario using two identical social humanoid robots: *Kira* and *Mia* as illustrated in Fig. 6. These robots are initialized with no long-term memory and neutral non-arousing emotional states. Interactions between humans from different cultural backgrounds and the robots are divided into two phases: 1) acquiring culturally biased knowledge and experiences with a visual stimulus from two different cultural groups and 2) responding to the incoming stimuli based on the knowledge the robots have acquired. In the first phase, both *Kira* and *Mia* observe the selected IAPS image on the screen in separate rooms. It is assumed that an Indian subject interacts with *Kira*, while an American subject interacts with *Mia*. Two robots receive the human-guided emotions with a pair of valence-arousal values through the speech recognition system for each visual stimulus. After that, we keep the robots from interacting with human subjects to restore the robots to the same initial emotional state, before beginning the second phase. In the second phase, a set of selected NAPS images are presented to *Kira* and *Mia* as per the following sequence: Fig. 5(a), 5(d), 5(b), 5(c), 5(e), 5(f), and 5(g). It is also assumed that an European subject provides the two robots with culturally biased emotions in the same way.

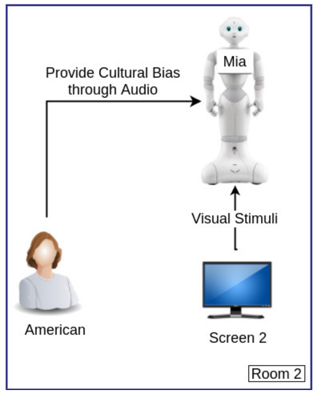
Two identical robots react to a sequence of incoming visual stimuli. When observing a visual stimulus, two robots can gain visual features of the stimulus through global extraction and local extraction. On the one hand, they perform global extraction to detect such information as object location and background context. Extracted information can be used for forming an episode to represent the stimulus in their memory. On the other hand, two robots do local extraction from detected objects. Specifically, object image features such as color and key point features are extracted. These features are used to form affective appraisals for recalling their past experiences. Using the recalled experiences and human guided emotions, two robots update their personal emotions to select a culturally aligned behavior responding to the given stimulus. In addition, two robots acquire a new experience based on the generated emotion and obtained information from global and local features for future accesses. In the current procedure, no forgetting mechanism and mood effects are considered according to the assumptions made in [11]. The system has been implemented using Choregraphe GUI and NAOqi 2.3.4 APIs.

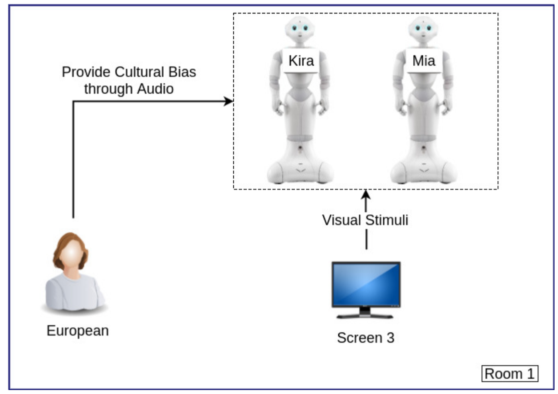
C. Results

The personal emotions of *Kira* and *Mia* were recorded every time when a visual stimulus was provided as shown in Fig. 7, where the blue rectangles denote the valence and arousal values of *Kira*, while the red diamonds denote those of *Mia*, respectively. In the first HRI phase, although two robots observed the same given image, *Kira* was influenced by Indian culture, while *Mia* was influenced by American culture. Their cultural bias could influence their personal



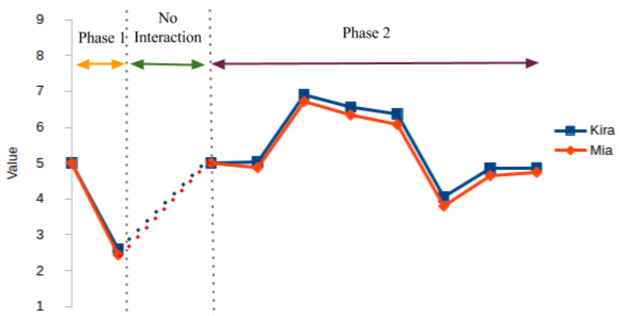
(a) Phase 1: Learning to control emotions aligned with a culture



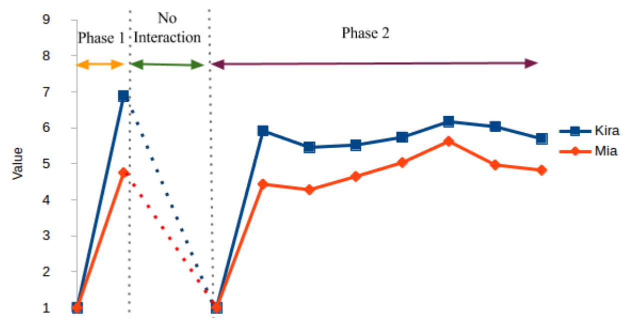


(b) Phase 2: Controlling emotions adapting to a new culture

Fig. 6. Experimental setup and procedure. At each process of interaction, a human teacher provides a robot with a pair of valence and arousal values corresponding to a given image in the data set rated by a specific cultural group.

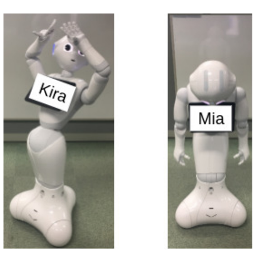


(a) Valence component

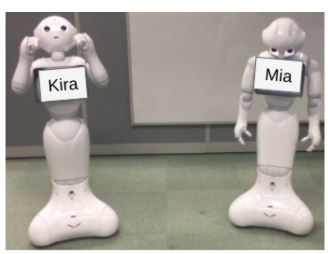


(b) Arousal component

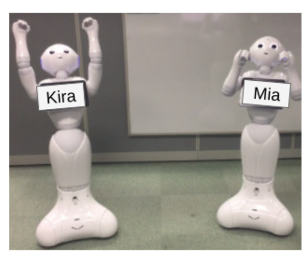
Fig. 7. Personalized robot emotions in the two phase experiments. In Phase 1, two robots, initialized with the same emotional state and no long-term memory, are given the visual stimulus and its corresponding rating shown in Fig. 4. After that, there is no interaction between humans and robots to let the robot's emotional states reach neutral-non arousing. In Phase 2, two robots are given 7 NAPS images as per the sequence of Figs. 5(a), 5(d), 5(b), 5(c), 5(e), 5(f), and 5(g)



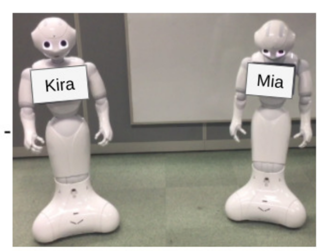
(a)



(b)



(c)



(d)

Fig. 8. Emotional body expressions of two robots under the effect of different cultures: (a) expression of Kira and Mia in response to Fig. 4 in Phase 1 for learning to control emotions aligned with Indian culture and American culture respectively. (b)-(d) expressions of two robots in response to Fig. 5 (a), (c), and (g), respectively, in Phase 2 for controlling emotions adapting to European culture.

emotions when exosed to European culture in the second phase. Thus, we disabled further interactions and let their emotions reach to the same initial emotional state. In the second phase, two robots were given seven images and influenced by European culture. Robot personal emotions were updated based on the mechanism presented in (1). The parameter μ in (2) and (3) was set to 5 and 1 for valence and arousal, respectively.

Then, the two robot's personal emotions were mapped into the previously designed behaviors, enabling them to express their emotional states through body movement. For mapping emotions into behaviors, we set parameters α, β, and γ in Table I to 3.9, 5, and 6.1, respectively, because of the limited number of experimental input stimuli. Snapshots of selected behaviors driven by personal emotions of two robots are shown in Fig. 8.

D. Discussion

In the first phase of experiments, *Kira* and *Mia* did not have any prior knowledge and stayed in a neutral non-arousing emotional state. They easily accepted guided emotions from human subjects which are considered culturally biased. *Kira* learned to generate emotions in alignment with Indian culture. *Mia* could generate emotions which reflect

American culture. Two robots acquired different emotional experiences even though they were exposed to the same stimuli. Since *Kira* was immersed in Indian culture with a high arousal level, *Kira* expressed its afraid emotion with fast body movements when observing the IAPS visual stimulus. *Mia* was immersed in American culture with a lower arousal level. Thus, *Mia* expressed its sad emotion with slow movements in response to the stimulus. When there were no interactions between the robots and human subjects, two robots' personal emotions were restored to the neutral non-arousing emotional state. Therefore, their personal emotions were the same at the beginning of the second phase.

The robots received the same European guided emotions and the same NAPS stimuli in the second phase of experiments. However, their personal emotions in response to the incoming stimuli appeared to be different, especially for arousal components. This may be caused by the fact that they were immersed in different cultures in the first phase. In the second phase, each robot used its previous experiences to interpret and respond to new stimuli. They may generate different emotions despite of being influenced by the same culture. Therefore, their emotional behaviors were not alike. *Kira* showed more positive behaviors and faster movements than *Mia*. *Kira*'s behaviors changed from somewhat happy through happy to somewhat relaxed, while *Mia*'s behaviors change from somewhat sad through somewhat happy to somewhat sad. Our results showed that cultures have a strong influence on the generation of robot emotions. The current results are encouranging in the sense that robots can behave in alignment with a certain culture and adapt themselves to different cultures.

IV. Conclusion

In this paper, we have investigated how the culture can be incorporated into the proposed robot emotion representation model and how the emotion can be expressed physically through body movement. Two identical social humanoid robots were taught by humans to create emotions in alignment with a specific culture. The robot's personal knowledge under the effect of different cultures is an integral part to generate the robot behavior that reflects its cultural traits. Therefore, robots should be able to create and express different emotions in response to the same stimuli. Employing the proposed emotion model which embodies the interacting effects of the human guides and robot experiences, robots can adapt themselves to a new cultural environment. Furthermore, we proposed sixteen emotional body expressions using Pepper robots. The proposed behaviors enable Pepper robots to represent their emotional states represented in various ways through a combination of valence and arousal values. We will further extend the proposed approach by incorporating the effect of robots' exposure to combined auditory and visual stimuli. In the near future, we will investigate the acceptance of the proposed model by elderly subjects with cognitive decline in a nursing home.

References

[1] D. Li, P. P. Rau, and Y. Li, "A survey of socially interactive robots," *Robotics and autonomous systems*, vol. 42, no. 3, pp. 143–166, 2003.

[2] H. Li, J.-J. Cabibihan, and Y. K. Tan, "Towards an effective design of social robots," *International Journal of Social Robotics*, vol. 3, no. 4, pp. 333–335, 2011.

[3] A. L. Thomaz, M. Berlin, and C. Breazeal, "An embodied computational model of social referencing," in *Proc. IEEE Int'l Workshop on Robot and Human Interactive Communication*, pp. 591–598, 2005.

[4] S. S. Ge, C. Wang, and C. C. Hang, "Facial expression imitation in human robot interaction," in *Proc. IEEE Int'l Symposium on Robot and Human Interactive Communication*, pp. 213–218, 2008.

[5] A. Lim and H. G. Okuno, "Developing robot emotions through interaction with caregivers," in *Handbook of Research on Synthesizing Human Emotion in Intelligent Systems and Robotics*. IGI Global, pp. 316–337, 2015.

[6] H. R. Markus and S. Kitayama, "Culture and the self: Implications for cognition, emotion, and motivation," *Psychological review*, vol. 98, no. 2, p. 224, 1991.

[7] M. G. Calvo and L. Nummenmaa, "Perceptual and affective mechanisms in facial expression recognition: An integrative review," *Cognition and Emotion*, vol. 30, no. 6, pp. 1081–1106, 2016.

[8] P. Liu, S. Rigoulot, and M. D. Pell, "Culture modulates the brain response to human expressions of emotion: electrophysiological evidence," *Neuropsychologia*, vol. 67, pp. 1–13, 2015.

[9] M. Trovato, Gabriele Fand Zecca, S. Sessa, L. Jamone, J. Ham, K. Hashimoto, and A. Takanishi, "Towards culture-specific robot customisation: a study on greeting interaction with egyptians," in *Proc. IEEE Int'l Symposium on Robot and Human Interactive Communication*, pp. 447–452, 2013.

[10] D. Li, P. P. Rau, and Y. Li, "A cross-cultural study: Effect of robot appearance and task," *International Journal of Social Robotics*, vol. 2, no. 2, pp. 175–186, 2010.

[11] T. L. Q. Dang, S. Jeong, and N. Y. Chong, "Personalized robot emotion representation through retrieval of memories," in *Proc. IEEE Int'l Conference on Control, Automation and Robotics*, pp. 65–70, 2017.

[12] (2016) Pepper humanoid robot. [Online]. Available: https://www.ald.softbankrobotics.com/en/cool-robots/pepper

[13] J. Posner, J. A. Russell, and B. S. Peterson, "The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology," *Development and psychopathology*, vol. 17, no. 03, pp. 715–734, 2005.

[14] E. A. Kensinger, "Remembering emotional experiences: The contribution of valence and arousal," *Reviews in the Neurosciences*, vol. 15, no. 4, pp. 241–252, 2004.

[15] B. Rimé, "Emotion elicits the social sharing of emotion: Theory and empirical review," *Emotion Review*, vol. 1, no. 1, pp. 60–85, 2009.

[16] J. J. Gross, "Emotion regulation: Affective, cognitive, and social consequences," *Psychophysiology*, vol. 39, no. 3, pp. 281–291, 2002.

[17] J. L. Tsai, J. Y. Louie, E. E. Chen, and Y. Uchida, "Learning what feelings to desire: Socialization of ideal affect through children's storybooks," *Personality and Social Psychology Bulletin*, vol. 33, no. 1, pp. 17–30, 2007.

[18] J. Leu, J. Wang, and K. Koo, "Are positive emotions just as positive across cultures?" *Emotion*, vol. 11, no. 4, p. 994, 2011.

[19] A. Beck, L. Cañamero, A. Hiolle, L. Damiano, P. Cosi, F. Tesser, and G. Sommavilla, "Interpretation of emotional body language displayed by a humanoid robot: a case study with children," *International Journal of Social Robotics*, vol. 5, no. 3, pp. 325–334, 2013.

[20] M. Häring, N. Bee, and E. André, "Creation and evaluation of emotion expression with body movement, sound and eye color for humanoid robots," in *Proc. IEEE Int'l Symposium on Robot and Human Interactive Communication*, pp. 204–209, 2011.

[21] P. J. Lang, M. M. Bradley, and B. N. Cuthbert, "International affective picture system: Affective ratings of pictures and instruction manual," University of Florida, Gainesville, FL, Tech. Rep. A-8, 2008.

[22] A. Marchewka, Ł. Żurawski, K. Jednoróg, and A. Grabowska, "The nencki affective picture system (naps): Introduction to a novel, standardized, wide-range, high-quality, realistic picture database," *Behavior research methods*, vol. 46, no. 2, pp. 596–610, 2014.

[23] M. Lohani, R. Gupta, and N. Srinivasan, "Cross-cultural evaluation of the international affective picture system on an indian sample," *Psychological Studies*, vol. 58, no. 3, pp. 233–241, 2013.