Toward Emotion Regulation via Physical Interaction

Alwin de Rooij
City University London
Northampton Square, London, EC1V 0HB, UK
alwinderooij@city.ac.uk

ABSTRACT

Emotions can be regulated to fit a task in order to enhance task performance. Motor expressions can help regulate emotion. This paper briefly reports ongoing work on the design of physical interactions based on motor expressions that can help regulate emotion to fit a task. We argue that to be effective, such interactions must be made meaningful in relation to ongoing appraisal processes, and that such interactions can help regulate emotion via congruence, suppression, or incompatibility. We present previous work on the validation of these arguments within the context of supporting idea generation, and develop a roadmap for research that aims to translate these results to the design of physical interactions under device constraints. The research will enable designers of interactive technology to develop physical interactions that help regulate emotion with the aim to help people get the most out of their own capabilities.

Author Keywords

Affective Computing, Embodied Interaction, Emotion Elicitation, Emotion Regulation, Motor Expression.

ACM Classification Keywords

H.5.2 Information interfaces and presentation: User interfaces - Theory and methods, and J.4 Social and behavioral sciences: Psychology.

INTRODUCTION

Emotion enhances task performance when the adaptive responses promoted by appraisal processes, i.e. the processes that cause emotion [10], fit the performance requirements of a task [2]. For instance, the cognitive flexibility associated with appraising an event as goal-conducive fits well with the performance requirements for idea generation, which typically benefits from generating many and diverse ideas [2]. As such, emotions can be utilized to design technologies that enhance task performance. How to best do this is still an open question.

IUI'14 Companion, Feb 24-27, 2014, Haifa, Israel.
ACM 978-1-4503-2729-9/14/02.
http://dx.doi.org/10.1145/2559184.2559186

One approach is to utilize motor expressions of emotion to regulate an emotional response. Psychology shows that motor expressions (gestures, postures, and facial expressions) help regulate appraisal processes [9]. This has been explored within the context of intelligent interaction via 1) anthropomorphic agents that utilize people´s tendency to mimic others´ motor expressions, and 2) the design of physical interactions we have with a technology on the basis of motor expressions [6, 7, 8, 11]. This research focuses on the latter.

The few attempts made to design physical interactions on the basis of motor expressions either report very early stage results [6, 7], or show only partial support for motor expressions as a way to regulate emotion [8, 11]. For instance, interactive furniture designed to support movie experience only influenced positive emotions for positive movie scenes, but not negative emotions [8]. The gist of these projects is that it is challenging to translate the results from psychology to an interactive technology. This translation is the aim of the research presented in this paper.

To this end we review research from psychology to learn about the role of motor expression in emotion regulation. We then discuss previous work that validates our theoretical findings within the context of idea generation, and develop a roadmap for research that aims to translate these results to the design of physical interactions under device constraints. Our aim is to enable the design of novel technologies that regulate emotion to help people get the most out of their own capabilities.

FROM EXPRESSIONS TO EMOTION REGULATION

Psychology shows that there is a reciprocal relationship between emotion-relevant appraisal processes and motor expressions [9, 10]. Appraisal processes typically cause other emotion-relevant processes, and promote specific motor expression responses. Motor expressions in turn help regulate the nature and intensity of the appraisal process, guiding the emergence of an emotional response.

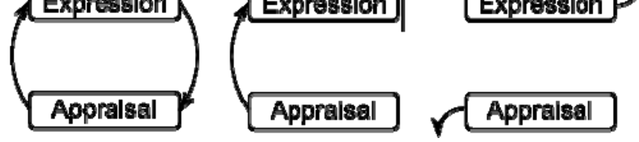

Figure 1. a. Congruence, b. suppression, c. incompatibility - three ways in which motor expressions can regulate emotion.

The structure of the appraisal-expression relationship reveals three ways in which motor expressions regulate appraisal processes (Figure 1). First, pairing an appraisal and a *congruent* motor expression regulates the intensity of that appraisal [9], e.g. smiling intensifies appraisals of pleasantness. Second, *suppression* of the appraisal process occurs when the expressive muscles associated with an appraisal are restrained [9]. Third, *incompatibility* between an appraisal and an associated motor expression introduces a feeling of unusualness and a focus on finding a sense of stability, independent of the type of appraisal-expression pairing [5]. These regulatory properties show how motor expressions can regulate emotion.

Motor expressions only help regulate emotion when they can be made meaningful within the context in which the expression occurs [4, 9]. For instance, smiling increases the intensity of pleasantness, but only when something is already appraised as pleasant [9]. This might complicate application. However, many tasks predictably evoke appraisals. For instance, solving difficult problems typically evokes frustration, whereas open-ended idea generation typically evokes pleasantness [1]. Such regularities can be used to pair motor expressions with expected appraisals of a task to regulate the emerging emotion to fit that same task.

FROM EXPRESSIONS TO TASK PERFORMANCE

In principle, a designer can choose a motor expression and an approach to regulate emotion to fit a task (Table 1). For instance, to increase the goal-conduciveness associated with an idea generation task, we can design physical interactions based on the motor expressions associated with goal-conduciveness, using calm movements and decreasing muscle tension.

Appraisal		Adaptive response	Arm expression
Needs	Pleasant	Incorporative thought	Flexing the arm
	Unpleasant	Exclusive thought	Extending the arm Incr. muscle tension
Goals	Conducive	Flexibility	Calm movements Decr. muscle tension
	Obstructive	Narrowness	Instrumental action High muscle tension
Power	High power	High ability beliefs	Agonistic movements Balanced muscle tens.
	Low power	Low ability beliefs	Slow, few, movements Low muscle tension

Table 1. Examples of appraisal processes, associated adaptive responses, and associated arm expressions (after [2, 10]).

As mentioned earlier, a match between the adaptive responses associated with an appraisal process and the performance requirements for a task enhances task performance [2]. For instance, creative idea generation is typically helped by the generation of many and diverse ideas. The cognitive flexibility associated with goal-conduciveness supports this aspect of creative idea generation. Incompatibility promotes an adaptive response of its own, i.e. broadened thinking, because incompatibility promotes a overall reduction of bias [5]. This is also helpful in idea generation. Therefore, physical interactions designed based on motor expressions can regulate emotion to fit the performance requirements of a task, enhancing task performance (cf. Table 1). See [2] for an extensive discussion on this subject.

FROM EXPRESSIONS TO PHYSICAL INTERACTIONS

The design of physical interactions on the basis of motor expressions can be facilitated by the development of new interactive technologies that sufficiently support the use of motor expressions. For instance, myography can be used to sense most relevant properties of an arm gesture, which can in turn be used to ensure that the relevant features of the arm gesture are used as a physical interaction. It is however unknown whether the influence of motor expressions on emotion regulation can translate to the limitations posed by different devices. We identify two major issues below, and in the following section propose directions for future work.

Device constraints can impose limitations on the way motor expressions can be translated to a physical interaction. This can possibly be overcome by scaling the properties of an expression to fit the interactive technology. For instance, performing an arm expression on a 10” tablet device limits the proprioceptive features of the expression, but it may facilitate kinesthetic or muscle force features associated with the expression. If only some aspects of an expression can be sufficiently used, it may still have regulatory properties. Expressions could also influence regulation via a more conceptual link [4]. For instance, arm extensions might regulate unpleasantness. However, at a conceptual level arm extension is about pushing or keeping something away from you. A gesture that just moves to the right can therefore also be constructed as pushing something unpleasant away given the right circumstances. This could in some cases provide another route to integrate motor expressions under device constraints.

PREVIOUS, CURRENT, AND FUTURE WORK

The research done to date is within the application domain of creativity support tools.

A first experimental study (n=32) was designed to assess the viability of emotion regulation via congruence, suppression, and incompatibility to enhance performance on an idea generation task [3]. We tested two hypotheses: 1) posing motor expressions that are typically elicited by pleasantness (smiling, arm flexion) should increase performance on the idea generation task because those motor expressions can be made meaningful as part of the pleasantness of unobstructed thought (congruence) [1], whereas suppression (frowning, arm extension) of these motor expressions decreases performance (suppression), and 2) introducing incompatibility between the emotional nature of the problem situation (having to deal with either a pleasant or unpleasant problem) and the motor expression also enhances creativity through the overall reduction in biased thought associated with incompatibility. The results confirmed our theoretical conjectures. An incompatibility with the appraisal of the problem situation, and the posed motor expressions increased the amount of ideas ($F(1, 25) = 7.60$, $p < 0.05$, $\eta_p^2 = 0.23$) and the originality of the participants' ideas ($F(1, 24) = 7.08$, $p < 0.05$, $\eta_p^2 = 0.23$). Motor expressions associated with pleasantness increased the enjoyment of the idea generation task itself ($F(1, 25) = 4.34$, $p < 0.05$, $\eta_p^2 = 0.15$), which mediated an effect of motor expressions on increased originality ($Z = -1.77$, $p < 0.05$). This shows that motor expression congruence, suppression and incompatibility can be viable ways to regulate emotion with the goal to enhance idea generation.

To translate these results to the design of physical interactions we developed a technology that forms a minimal limitation to the use of arm expressions to interact with an idea generation tool. Acoustic myography is combined with a Kinect sensor to learn the proprioceptive, kinesthetic, and muscle force features of arm expressions associated with (un)pleasantness. These arm expressions are used to control a dictaphone to record ideas as part of an idea generation task. We hypothesize that the recording of ideas can be made meaningful within the context of idea generation because the goal of the idea generation task is extended to recording ideas, as opposed to only generating them. If so, we can expect increased idea generation performance for arm expressions associated with pleasantness. This study is currently running.

Future work focuses on the translation of our previous results to the design of physical interactions under device constraints. We plan to test whether we can scale motor expressions associated with (un)pleasantness to commonly used devices such as 10" tablets. We want to investigate two questions. First, do arm expressions of (un)pleasantness regulate emotion when only parts of the expression can be utilized? This can be investigated by trying to integrate as many aspects of the proprioceptive, kinesthetic and muscle force characteristics associated with motor expressions of (un)pleasantness as possible into the physical movements used to interact with the device. Second, can a conceptual approach to defining motor expressions, where physical interactions are designed to imply (un)pleasantness, be used to regulate emotion? This can be investigated by assessing the regulatory effects of different physical interactions that imply pushing something away from you, or pulling something toward you in the more general sense. Both hypotheses can facilitate a route to integrating motor expressions' capability to regulate emotion in the physical interactions we use to interact with everyday devices.

In summary, the presented research and proposed future work will help designers of interactive technology to develop physical interactions designed on the basis of motor expressions that can help regulate emotion, and via emotion, enhance task performance, with the aim to help people get the most out of their own capabilities.

REFERENCES

1. Akbari Chermahini, S. and Hommel, B. Creative mood swings: Divergent and convergent thinking affect mood in opposite ways. *Psychological Research 76*, (2012) 634-640.
2. De Rooij, A. and Jones, S. Mood and creativity: An appraisal tendency perspective. *Proc. Creativity & Cognition 2013*, ACM Press (2013), 362-365.
3. De Rooij, A. and Jones, S. Motor expressions as creativity support: Exploring the potential for physical interaction. *Proc. BCS HCI 2013*, ACM Press (2013).
4. Eder, A.B. and Rothermund, K. When do motor behaviors (mis)match affective stimuli? An evaluative coding view of approach and avoidance actions. *Journal of Experimental Psychology: General 137*, 2 (2008), 262-281.
5. Huang, L. and Galinsky, A.D. Mind-body dissonance: Conflict between the senses expands the mind's horizons. *Social Psychological and Personality Science 2*, 4 (2011), 351-359.
6. Isbister, K., Karlesky, M., Frye, J. and Rao, R. Scoop! A movement-based math game designed to reduce math anxiety. *Proc. CHI 2012*, ACM Press (2012), 1075-1078.
7. Isbister, K., Schwekendiek, U., and Frye, J. Wriggle: An exploration of social and emotional effects of movement. *Proc. CHI 2011*, ACM Press (2011), 1885-1890.
8. Kok, R. and Broekens, J. Physical emotion induction and its use in entertainment: Lessons learned. *1st IFIP Entertainment Computing Symposium*, Springer.
9. Reimann, M., et al. Embodiment in judgment and choice. *Journal of Neuroscience, Psychology, and Economics 5*, 2 (2012), 104-123.
10. Scherer, K.R. The dynamic architecture of emotion: Evidence for the component process model. *Cognition & Emotion 23*, 7 (2009), 1307-1351.
11. Zariffa J., Hitzig, S.L., and Popovic, M.R. Neuromodulation of emotion using functional electrical stimulation applied to facial muscles. *Neuromodulation*, pre-print (2013).