Basic Emotion Measurement: Advances in Basic Emotion Theory

Yiwei Sha[1,a,*]

[1]Ocean Academy, China University of Geosciences, Wuhan, Hubei, China
a. 296283348@qq.com
*corresponding author

Abstract: Emotions are both subjective feelings and objective physiological responses. Traditional psychology uses questionnaires to conduct research, which has great limitations. This article review some developments of the basic emotion measurement within a new theory about body maps. With a unique topographical self-report method, people could better understand the relationship between body sensations maps and different emotions. This article reviews several studies and compares them with other relevant emotion measurement studies to identify further possibilities and future research directions. Moreover, this paper will cut in from the method and process results of the experiment, and strive to obtain more accurate data for future. This new approach may provide new way of thinking. Meanwhile, the application of emotional bodily maps to various fields, such as artificial intelligence and experimental reference.

Keywords: Basic Emotion Theory, Somatosensation, Emotional expression, Emotion measurement

1. Introduction

Central to Basic Emotion Theory is the assumption that emotions enable the individual to respond adaptively to evolutionary significant threats and opportunities in the environment, such as the cry of offspring, a threat from an adversary, or a potentially available sexual partner[1].Darwin initially hypothesized that a range of emotional expressions is universal across the human germline, probably because emotions are an innate components of human evolution. There is a lot of evidence that the recognition of these seven expressions is universal in the world- happiness, surprise, anger, disgust, sadness and contempt. When a specific emotion is aroused, the brain controls the corresponding facial muscles to make specific expressions. At the same time, the autonomic nervous system(ANS) prepares the body for emotional responses through the activity of the sympathetic and parasympathetic systems. That means emotions are often felt in physical and somatosensory feedback and are thought to trigger conscious emotional experiences. Research and testing of basic emotions are essential for the development of psychology.

To learn more about this new research method and find improvements, this paper refer to 3 experiments, which using a topographical self-report method to reveal maps of bodily sensations. This article uses a review approach to analyze the relevant experiments, and total the body's response to emotion.

It hopes that these maps can describe the subjective emotions well and be applied in many fields of psychology.

2. Experiments

In these three experiments, the participants were children, major depressive disorder, native speakers of Swedish and Finnish. Scientists used similar emotion-inducing methods to get participants to experience one of the specific basic emotions. At the same time, they asked the participants to reported bodily sensation associated with the basic emotion and a neutral state. Also when they were viewing each stimulus, participants need to color the active bodily regions they felt to be increased or decreased. Finally, using one-out linear discriminant analysis (LDA) classified the neutral state and the basic emotions and determined statistically the accuracy of the results.

2.1. The First Experiment

The experiment is based on a computer, topographical method to show the relationship between basic emotion and bodily sensation[2].

2.1.1. Experimental Design

Nummenmaa et al. separate 36-302 participants into five groups [2]. In group one, the emotion words were arranged in random order. Participants were asked to identify the body regions they were becoming activated or deactivated. In this group, they were divided into two control groups, West European and East Asian, with different language and culture. The emotions words and instructions were translated into another language and back-translated to original language while ensuring the semantic consistency.

In group two, by reading short stories including short emotional and nonemotional episodes, there were five vignettes to induce each basic emotion and the neutral emotional state. It's important for these vignettes in random order and none of them described an practical emotion. That is to say that there were no direct clue about the emotion or sensation in these story. Meanwhile, consistent with the basic emotion engagement, the responses in such brain activation and autonomic nervous system and somatosensory were highly correlation.

In group 3, through 10-second short movies, participants experienced with the discrete emotional state. There were some limitation that it's hard to elicit anger and surprise with the movie stimuli. Similarly, these movies were in random and no sound.

In group 4, Nummenmaa, L., et used pictures of basic facial expressions to stimulate the basic feelings of participants. Each pictures were two male and female from the Karolinska set [2].

In group 5, participants were stimulate from body somatosensory maps from group 1.

2.1.2. Experimental Process

Fig.1 The tool participants used to record the activation and deactivation data. The body were abstract and 2D to reduce the difficulty of the task. Using statistical analysis combined with these activation and deactivation maps. These data were stored as integers and be represented by 50,364 data points.
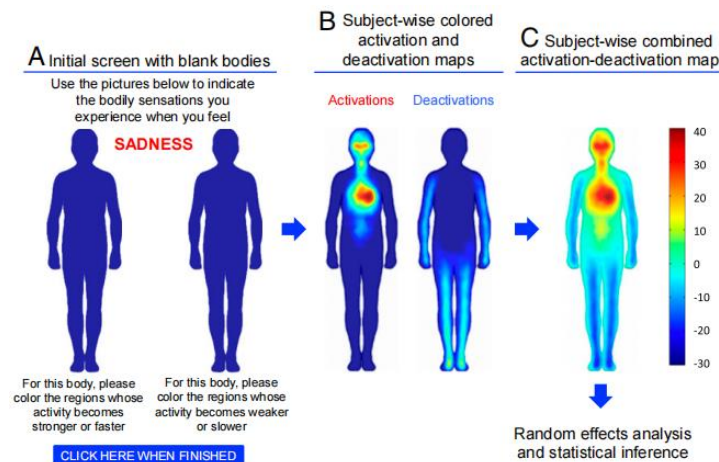
Figure 1: The embody tool. Participants colored the initially blank body regions.

In a word, the participants were shown some emotional words, stories, movies, or facial expressions. Meanwhile, they were asked to work with two silhouettes to color the active bodily regions when they viewed each stimulus and felt to be increased or decreased (Fig.1). When scientists observed them, it should be noted that it's important to construct bodily somatovisceral states' representations by refer to embodied emotion models. In particular, the scientists in group 4 tested a hypothesis. Without asking participants to color the region whose activity in themselves, they were told to color the blank bodies with six basic facial emotions. After the tests for each group were recorded, their accuracy was confirmed by statistical separable bodily somatosensory maps. Finally, spanning the bodily somatosensory maps, they constructed a similarity matrix of group 1-4 with six basic emotions plus the neutral state. In this experiment, it's quite necessary to calculate the LDA accuracy and whether the bodily somatosensory maps were concordant across the emotion evoking method. In general, LDA could be applied to the dataset and show accuracy for similarity between the individual groups and classification. At last, they analyzed the relevant data and draw some conclusions.
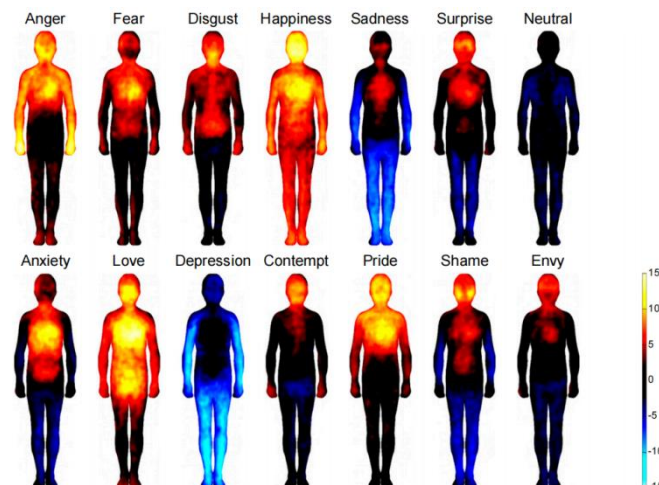

Figure 2: Bodily topography of basic (Upper) and nonbasic (Lower) emotions associated with words.

2.2. The Second Experiment

In the second experiment, there were a total of 331 participants, which made up for 48 preschool, 68 second grade, 91 forth grade, 42 eighth grade, and 46 high-school children and adolescents and all of them were came from University of Tampere[3].

In this experiment, the participants induced each emotion only by reading emotion words, and the children under 6 years were asked to listen to these words. All the words were in their original language, Finnish. Similarly, participants were asked to achieve this procedure repeatedly to make the word in random orders. The author of this experiment wanted to find that basic emotions are discrete over the lifespan. It also check the accuracy of the linear discriminant analysis (LDA) and compute the score between group's bodily somatosensory maps and adult's bodily somatosensory maps for each basic emotion.

The result of experiment 2 reveal that there is a rudimentary differentiation in emotion and bodily sensation at preschool age. At the same time, during the period of adolescence, interoceptive representation show increasingly discrete with different emotions. This parallel development was speculated to be related to the use of emotional words to describe different events. This also show a development of awareness influence their relationship between bodily sensation and emotion, and it can shape the perception children's perceive the environment.

2.3. The Third Experiment

In the third experiment, there were totally 90 participants, 30 healthy control and 30 individuals experiencing depressive disorder without medication and 30 individuals experiencing depressive disorder with medication[4]. Similarly, they were asked to color the areas of the bodily regions they felt increasingly or decreasingly during each emotion. Then, Nummenmaa, L. and H. Saarimaki analyzed the body somatosensory maps and calculated the pattern and reveal separable activation pictures for all. In a word, healthy control seems more activation than the group used medication, and the group without medication showed most strong deactivation for all the emotion in three groups. That is to say, the basic emotion was related with the bodily sensation especially in depressive disorder and it seems that medication play a important role in the feeling of deactivation.The results of the experiment may serve as a reference for the treatment of depression in the future.

2.4. Contrast

All three experiments used a topographical self-report method to reveal maps of bodily sensations. In terms of the design process of the three experiments, the characteristics of the first participant are not the same. This is specific to the age group of the participants, the population they represent, and the background information collected. In the course of the experiment, traditional emotion induction methods are generally used, and the results of the experiment are determined by the participants' subjectivity. All the result reveal distinct body somatosensory maps were related with each basic emotions. In short, the last two experiments are the specific application and demonstration of the first experiment.

2.5. Summarize

In general, scientists used similar emotion-inducing methods to get participants to experience one of the specific basic emotions. The participants were shown some emotional words, stories, movies, or facial expressions. Again, these ways of inducing emotion are in random order and had some certain restrictions. Participant were all asked to reported bodily sensation associated with the basic

emotion and a neutral state. Then, participants need to color the active bodily regions they felt to be increased or decreased. Finally, using one-out linear discriminant analysis (LDA) classified the neutral state and the basic emotions and determined statistically the accuracy of the results. All three experiments wanted to know the relationship between basic emotions and body sensation. These results support the model's speculation that somatosensory and embodying play a key role in emotional processes. Elucidating the relationship between subjective bodily sensations and human emotion may make to better understand emotional disturbances, which are accompanied an alternative affective process, ANS activity, and somatosensory. The result reveal a type of topographical changes of emotion-triggered and this may could give a new biomarker for emotional disturbance[5].

3.   Further Experimental Procedure

Basic emotion is an evolutionary adaptation of individuals to the apparent threats and opportunities in the environment. On this basis, emotions are actually one of the driving forces for changing people' present and future behavior. Emotions can stimulate people to respond to the environment and have complex behavioral patterns. That is to say, individuals adjust their behaviors and physiological responses through emotions, which plays an important role in the study of psychology. These basic emotions, usually expressed in happiness, surprise, anger, disgust, sadness and contempt, have very unique subjective feelings and cultural universality, and may have discrete functional neurological characteristics to a certain extent. Basic emotions are of great significance for the study of individual physiological and psychological characteristics. Traditional psychology conducts psychological research in the form of questionnaires or some relatively subjective judgment methods. This has a certain reference, but just like mathematical physics, a relatively objective and true standard is also necessary. This makes the author want to further refine similar experiments[6].

Generally speaking, the 7 basic emotions are studied as a whole. But whether it is reasonable to judge the physiological characteristics of basic emotions, as these characteristics are not on the same level. In other words, it's possible to use a topographical self-report method to judge individual's happiness, and also use like electroencephalogram to decide one's anger. For the results of this experiment, it is not entirely correct to judge the physiological characteristics of emotions by only a single method. While it is important to test for statistical separation, the specificity of each underlying basic emotion needs to be considered. So it is necessary to summarize and compare relevant research on basic emotions[7].

3.1. Method 1: Emotion-induced methods

Methods of inducing emotion are classified into five types in psychology today: visual stimuli, music, autobiographical recall, situational procedures, and imagery[8].

3.1.1. Objective Limitation

Static images can evoke certain emotions and auditory input can play the same role. Autobiographical recall can be used not only as a method of evoking basic emotions, but also as a way to evoke feelings from the original event.

Autobiographical recall is more complicated than the first two and is not suitable for experiments with large samples.

At the same time, imagery, including reading vignettes, is a novel way to stimulate basic emotions. These methods are not the only ways to arouse emotions.

However, the aforementioned methods are relatively efficient and practical in psychological research. In the three experiments mentioned above, these methods of emotional stimulation were applied[9].

3.1.2. Subjective Limitation

These emotion-evoked methods are practically limited by current technological developments.

According to related experiments, 30%-50% of participants in experiments that stimulate basic emotions will be affected by the characteristics of needs. Some situational intentions and static pictures are only required to evoke specific emotions. But in reality, these methods also evoke other emotions in the participants. That is, the mapping of emotions to bodily sensations may not be characteristic of a single emotion during the experiment. The effect of emotion induction on participants is difficult to measure. Similar to the level of each basic emotion. For example, a stranger soiling your floor and a stranger hitting you, participants felt the basic emotion of anger, but there was a big difference between the two. Comparing the levels of different emotions is a huge problem. Therefore, in the process of emotion induction, the purpose and concept of emotion induction should be s vague as possible[10].

3.2. Method 2: Participant selection

In addition to improvements in emotion-induced methods, participant selection has long plagued psychological research. The sample sizes in the three experiments were not sufficient for specific participants. A common problem in psychology is the difference in human culture, language, and way of thinking. The usual solution is a sufficiently large sample and a statistically correct detection. The relatively under sampled samples of these experiments may lead to their results not being generalizable. Everyone's different experiences are not necessarily the same for the emotional level and state caused by experiencing emotional stimulation. As is usually the case, different people have different emotions about evening dishes[11].

At the same time, emotion is an internal state and was transient and volatile. These three experiments are subjectively perceived by individuals and color the active areas. Especially in the process of conducting psychological experiments, the reliability of participants' subjective emotions is still unknown. That is to say, this body maps of emotions is needed a more objective approach. Using some instruments or methods to measure the basic feelings of individuals like high-resolution, non-invasive method may resemble an EEG. Of course, just like the questionnaire method, in the case of being too subjective, it will also have the advantage of facilitating a large number of samples.

4. Conclusion

This article compares three topological research methods used to investigate the relationship between basic interests and bodily sensations. The basic principle of each method is roughly the same, but there are some differences in the experimental process. After a series of research and analysis, areas for improvement were found and relevant suggestions were made. Although there are still many areas for improvement, such as the process of emotion induction or the selection of participants, there is a strong reference to this method. This paper studies from the theoretical method, but it is relatively lacking from the practical aspects. After in-depth participation in relevant experiments, more practical and effective improvement methods can be proposed. We need to further generalize and summarize, and apply to more fields, such as combining the latest artificial intelligence technology - machine visual techniques to provide new insights into fundamental

emotion theory research research ideas. We have reason to believe that this technology will develop further in the future.

Reference

[1] Keltner, D., Sauter, D., Tracy, J., & Cowen, A. (2019). Emotional expression: Advances in basic emotion theory. Journal of nonverbal behavior, 43(2), 133-160.

[2] Nummenmaa, L., Glerean, E., Hari, R., & Hietanen, J. K. (2014). Bodily maps of emotions. Proceedings of the National Academy of Sciences, 111(2), 646-651.

[3] Hietanen, J. K., Glerean, E., Hari, R., & Nummenmaa, L. (2016). Bodily maps of emotions across child development. Developmental Science, 19(6), 1111-1118.

[4] Nummenmaa, L., & Saarimäki, H. (2019). Emotions as discrete patterns of systemic activity. Neuroscience letters, 693, 3-8.

[5] Nummenmaa, L., Hari, R., Hietanen, J. K., & Glerean, E. (2018). Maps of subjective feelings. Proceedings of the National Academy of Sciences, 115(37), 9198-9203.

[6] Lyons, N., Strasser, A., Beitz, B., Teismann, T., Ostermann, T., Anderle, L., & Michalak, J. (2021). Bodily maps of emotion in major depressive disorder. Cognitive Therapy and Research, 45(3), 508-516.

[7] García-Magariño, I., Chittaro, L., & Plaza, I. (2018). Bodily sensation maps: Exploring a new direction for detecting emotions from user self-reported data. International Journal of Human-Computer Studies, 113, 32-47..

[8] Hassan, M. M., Alam, M. G. R., Uddin, M. Z., Huda, S., Almogren, A., & Fortino, G. (2019). Human emotion recognition using deep belief network architecture. Information Fusion, 51, 10-18.

[9] Rainville, P., Bechara, A., Naqvi, N., & Damasio, A. R. (2006). Basic emotions are associated with distinct patterns of cardiorespiratory activity. International journal of psychophysiology, 61(1), 5-18.

[10] Hartmann, M., Lenggenhager, B., & Stocker, K. (2022). Happiness feels light and sadness feels heavy: introducing valence-related bodily sensation maps of emotions. Psychological research, 1-25.

[11] aarimäki, H., Gotsopoulos, A., Jääskeläinen, I. P., Lampinen, J., Vuilleumier, P., Hari, R., ... & Nummenmaa, L. (2016). Discrete neural signatures of basic emotions. Cerebral cortex, 26(6), 2563-2573.