ポスター
# ポスター9
# 医療データ解析・評価
2017年11月22日(水) 13:30 〜 14:30 L会場（ポスター会場1） (12F ホワイエ)

[3-L-3-PP9-1] サーモグラフィによる意思表現が不自由な患者における情緒変化の把握：「ゆめ水族園」体験時の情緒評価

丁 憙勇[1], 木戸 倫子[1], 長尾 弘子[2], 三原 明穂[1], 本郷 千草[2], 星田 徹[2], 大野 ゆう子[1] （1.大阪大学, 2.国立病院機構 奈良医療センター）

背景：「ゆめ水族園」とは，プロジェクタから海の生物のダイナミックな動きを音響効果とともに部屋に映写し，水族館に接する機会の少ない人たちに，豊かな感覚体験を届ける活動であり，保健医療機関でも導入されている．このようなイベントの体験において，意思表現が不自由な患者の情緒変化は，観察者による観察評価（表情や行動等の主観的評価）が主であった．しかし，その変化がポジティブな感情（楽しみや喜びなど）であるか，ネガティブな感情（ストレスや悲しみなど）であるかを区別することは非常に困難であり，その対象者を長期間ケアしている医療者・保育者のみが或る程度，推測することが限界であった．本研究では，感情表現が不自由な患者を対象に「ゆめ水族園」体験時に感情に変化が現れるか，現れた場合，その感情はポジティブかネガティブか識別可能な非侵襲非接触測定方法の提案を目的とした．
方法：成人の筋ジストロフィー患者4名と重症心身障害児・者4名を対象として「ゆめ水族園」開始前と体験時の顔表面温度分布の時系列変化をサーモグラフィで計測し，顔表面温度分布の変化を分析した．同時に心電図，心拍変動（ HRV）の計測，付添の看護師・保育士による観察評価も行い，サーモグラフィによる温度変化との関係を分析した．
結果と考察：開始前に比べて体験時には全例において顔表面温度の分布に変化がみられ，特に唇と頬周辺にその差が明確であることが分かった． HRV変動も明らかであり，自律神経系に「ゆめ水族園」の刺激が影響を与えたことが確認できた．サーモグラフィによる情緒評価は，専門家の観察評価とも矛盾がなかった．今回提案した方法は普段行っている療育活動の際にも応用可能であり，患者の感情に合わせた活動プログラムを検討することが可能であると考えられる．

サーモグラフィによる意思表現が不自由な患者・障害者における情緒変化の把握：「ゆめ水族園」体験時の情緒評価

丁　憙勇[*1]、三原　明穂[*1]、木戸　倫子[*1]、長尾　弘子[*2]、本郷　千草[*2]、星田　徹[*2]、大野　ゆう子[*1]
*1 大阪大学大学院医学系研究科、*2 国立病院機構　奈良医療センター

Thermal Imaging-Based Evaluation of Autonomic Nervous System in YUME Aquarium

Hieyong Jeong[*1], Akiho Mihara[*1], Michiko Kido[*1], Hiroko Nagao[*2], Chigusa Hongo[*2], Tooru Hoshida[*2], Yuko Ohno[*1]
*1 Graduate School of Medicine, Osaka University, *2 National Hospital Organization Nara Medical Center

Multi sensory environments (MSEs) are designed with two goals in mind: to promote intellectual activity and to encourage relaxation. Although MSEs offer patients with cognitive impairments and other challenging conditions the opportunity to enjoy and control a variety of sensory experiences, most of the caregivers wonder whether patients participate in this activity with great interest or not. Thus, the purpose of the present study was to confirm the effect of MSEs on facial temperature distribution (FTD) in emotion through thermal imaging-based evaluation. The experiment was to measure the FTD while patients enjoyed the MSE activity. The confirmation of effect was performed by the analysis of the FTD which was the non-contact and non-invasive measurement. As a result, it was found that the FTD for the patient showed different tendencies under the condition of before and after stimuli. Namely, it seemed that the range of over the 2% FT was related to the sympathetic nerve activity, and the range of over 30% FT was related to the parasympathetic nerve activity.

Keywords: Autonomic nervous system, Multi sensory environment, Thermal imaging-based evaluation.

1. Introduction

Multi sensory environments (MSEs) are designed with two goals in mind: to promote intellectual activity and to encourage relaxation. MSEs offer patients with cognitive impairments and other challenging conditions the opportunity to enjoy and control a variety of sensory experiences. Multi sensory stimulation provides opportunities for bridging barriers, which limitations of movement, vision, hearing, cognitive ability, constrained space, behavioral difficulties, perception issues, pain, and other problems create obstacles to patients enjoyment of life. This relaxing and explorative experience is provided under the guidance of a caregiver at the clinical site. Figure 1 shows an overview of YUME aquarium which is one kind of MSEs. Handicapped patients have a chance to experience the virtual aquarium as if they are in an aquarium while seeing many kinds of fishes, penguins, and so on. This activity is provided as a social service activity of EPSON company, however, one problem is that most of the social voluntary workers and caregivers wonder whether patients enjoy their activities or not. Here, we are interested in how to recognize whether most of the patients participate in the activity with a great interest or not.

Recently functional infrared thermal imaging has been considered an upcoming, promising methodology in the emotional arena. Driven by sympathetic nerves, observations of affective nature derive from muscular activity subcutaneous blood flow as well as perspiration patterns in specific facial parts. Therefore, the purpose of the present study was to confirm the effect of MSE on facial temperature distribution (FTD) in emotion through thermal imaging-based evaluation.

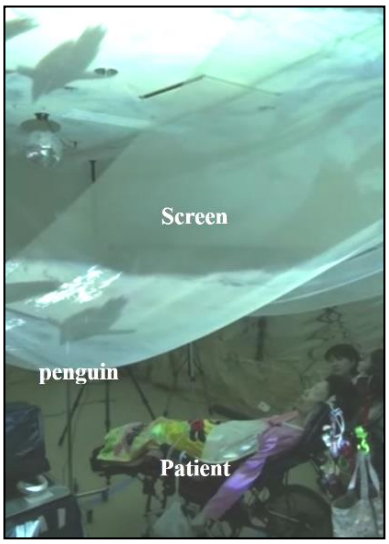

Figure 1. An overview of YUME aquarium.

2. Methods

One patient with muscular dystrophy (MD) participated in these experiments which were to measure the FTD. MD is a group of muscle diseases that result in increasing weakening and breakdown of skeletal muscles over time, but the mental condition is similar to that of general persons.

At first, there was not any stimulation during the 3 min because of the comparison of results without any stimuli, and then the patient enjoyed the YUME aquarium during 15 min. The thermal imager for the non-contact type

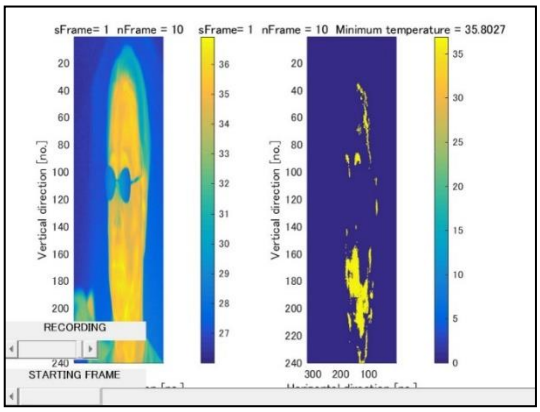

Figure 2. Results of all ranges of facial temperature distribution (FTD) (left) and the range of over the top 2% FTD (right).

measured the FTD during all of the experiment (18 min). The analysis was performed by the sum of FTD per frame. Activities of sympathetic and para sympathetic nerves were confirmed by the differential of facial temperature.

3. Results

Figure 2 shows results of all ranges of FTD (left) and the range of over the top 2% FTD (right). The setting of temperature limitation enables us to filter most of the noise and to inform the relationship between the FTD and ANS activity. According to the range of FTD, the distribution for the included rate of low temperature is different. Figure 3 shows results of Fast Fourier Transform (FFT) for the range of over the top 2% FTD (a) and the range of over the top 30% FTD (b). The horizontal axis represents the frequency, and the vertical axis represents the amplitude. The blue plot indicates the results before stimuli during 3 min, and the orange plot indicates the results after stimuli during 15 min. For the range of over the top 2% FTD, both results of FFT showed the main activity of sympathetic nerve. However, for the range of over the 30% FTD, results of FFT after stimuli indicated the parasympathetic nerve, although results of FFT before stimuli indicated the sympathetic nerve. The difference between results before and after stimuli came from the included ratio of low temperature.

As a result, all of the experimental results show a possibility of the relationship between the FTD and the ANS activity.

4. Discussion and Conclusion

Thermal infrared imaging has been proposed as a potential system for the computational assessment of human ANS activity and psychophysiological states in a contactless and noninvasive way. Through bio heat modeling of facial thermal imagery, several vital signs can be extracted, including localized blood perfusion, cardiac pulse, breath rate, and sudomotor response, since all these parameters impact the cutaneous temperature.

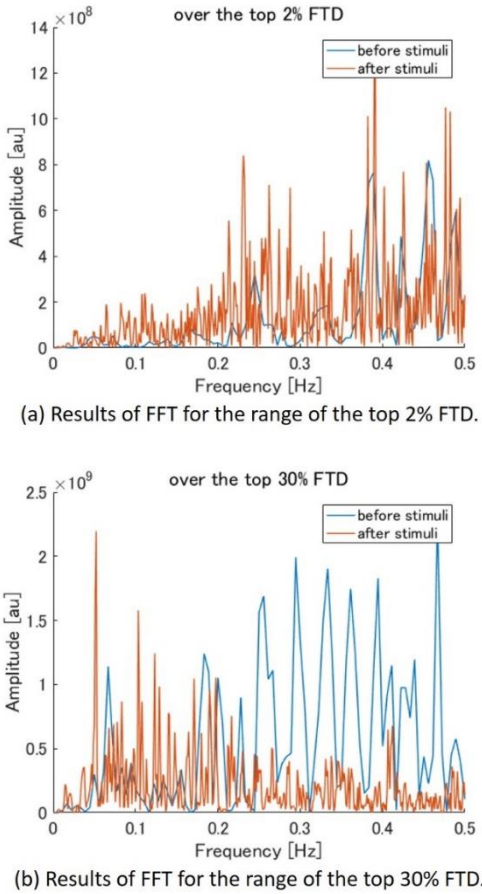

Figure 3. Results of FFT for the range of the top 2% facial temperature distribution (FTD) (a) and the range of over the top 30% FTD (b).

The obtained physiological information could then be used to draw inferences about a variety of psychophysiological or affective states, as proved by the increasing number of psychophysiological studies using thermal infrared imaging. This paper can conclude therefore a hypothesis of the principal achievements of thermal infrared imaging in computational physiology with regard to its capability of monitoring psychophysiological activity.

Acknowledgment

The research and writing of this article were made possible by funding from the Hirose International Scholarship Foundation and the supporting from National Hospital Organization Nara Medical Center and EPSON Co., Ltd.

References

1) Ioannou, S, Gallese, V, Merla, A. Thermal infrared imaging in psychophysiology: Potentialities and limits, Psychophysiology 2014, 51: 951-963.
2) Kreibig, S. Autonomic nervous system activity in emotion: A review, Biological Psychology 2010, 84: 394-421.