Analysis of Psychological Stress Factors and Facial Parts Effect on Intentional Facial Expressions

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Abstract—**This paper presents a gender-specific stress model to analyze the psychological stress factors on intentional facial expressions. We have focused on the relationship between facial expression intensity and Stress Response Scale (SRS-18). In this paper, we extract three facial expressions (i.e., happiness, anger, and sadness) from the basic six facial expressions defined by Ekman, and then represent a graphical model of the relationship between these three facial expressions and the psychological stress factors (i.e., "depression and anxiety", "displeasure and anger", and "lassitude"). In the experiment, we created an original facial expression dataset consisting of three facial expressions and a psychological stress dataset by SRS-18 obtained from 10 subjects during 7-20 weeks at one week interval. As the results of probabilistic reasoning based on the observed values of each facial expression, such trends were obtained as follows. BNs shows trends of different stress factor between men and women in relations of expression levels and psychological stress. Stress models appeared on happiness faces of "lassitude" factor in men, the anger faces of "displeasure and anger" were affected with stress factors in women.**

Keywords-Bayesian networks；Expression levels；SRS-18；Intentional facial expressions.

I. INTRODUCTION

Modern society is full of stress. Numerous people live their lives with a variety of stressors. Stress is a biological reaction that develops when we confront a psychological or spiritual stressor [1]. Reactive processes of people interacting with the environment signify individual cognitive processes involved in biological reactions and physiological processes. There are three indexes of biological bodies, psychology, and action that demand the consideration of individual processes when subjected to stress. Usually, the human brain effectually responds to maintain mental and physical balance. However, excessive stress can trigger mental illness such as depression [1]. Because it can be difficult to conceal stress, faces are often called a window by which one can discern information of various types such as the modality of a person's mind, and health condition. Especially, facial expressions can show aspects of internal psychology, reflective emotions such as delight, anger, sorrow, pleasure, and the existence of stress. Close friends and family members communicate while interpreting stress from conditions and changes of facial expressions.

For this study, we specifically examine intentional facial expressions. Moreover, we set the upper part, lower part, and whole parts of the face as regions of interest (ROI) to address static and dynamic diversity, as defined by Akamatsu [2]. We quantify the relation between facial expressions and psychological stress by employing Bayesian networks (BNs), which can describe stochastic relations of events as a graphic structure. In our evaluation experiment, we create stress models by gender, and then analyze stress factors and stress elements in facial expressions of various types: happiness, anger, and sadness.

II. RELATED STUDIES

Existing methods for measuring stress are divisible into two types: a contacted type and a noncontact type. By using the findings that stress can affect amylase secretion in saliva, methods for quantifying stress have been proposed and many products are marketed based on the findings [3] [16]. In association with the autonomic nervous activity and stress, many analytical studies of the heart rate variability have been performed. At present, various devices have been developed and are used in research and clinical practice [4] [17]. There are many reports on the correlation between stress and neural activity of the cerebrum, In particular, Electroencephalography (EEG) is one of the indicators that have been studied for many years, researches using EEG have been performed on the context of the psychological state, such as attention and concentration, stress and anxiety [5] [18]. As a new functional brain analysis method, Near-infrared spectroscopy (NIRS) for measuring the cerebral blood volume changes locally non-invasively is also attracting attention as a stress measuring method, which indicates that the activity of the prefrontal cortex is changed significantly [19]. However, the objective comparison related to identify the most suitable approach for stress measurements is very complex, because each researcher has a different story, e.g., the type of stressor used in their experiments is different for each approach. In addition, these methods of contact type are susceptible to contact interface generally.

Stress measurement checking using a questionnaire form is a noncontact popular measurement method. The Profile of Mood States (POMS) [6] is an inventory that is recognized worldwide, although its results cannot generally be compared because the target attributes differ. POMS consist of 65 items. The brief version of POMS consists of 30 items [7]. POMS becomes extremely burdensome if we take images of facial expressions together. Suzuki et al. developed the Stress Response Scale-18 (SRS-18) [8], which is useful for a wide range of subject ages. SRS-18 comprises 18 items. SRS-18 measures psychological stress encountered over a short time. Moreover, SRS-18 shows highly discriminative capability in high stress and low stress groups. Numerous question items are available on SRS-18 related to an event that a normal person encounters daily while most existing stress evaluations are aimed at the assessment of clinical conditions. We regard SRS-18 as an optimal and helpful inventory to be used to assess facial expressions because of the measurement of physical and mental reactions and smaller number of question items.

III. Relations Of Psychological Stress And Facial Expressions

A suitable amount of stress improves activation and leads to work efficiency. However, excessive stress produces psychosomatic abnormalities because of humans' limited adaptive capability. How one feels stress effects is reported to vary delicately in similar environments because of individual differences from conditions and tolerance of stress [9].

Therefore, it is necessary to measure a state of stress in individuals. Furthermore, we must take steps to improve a bad stress state soon after it occurs [1]**.** Therefore, we must become able to grasp a person's emotional state considering corresponding relations to biology, psychology, and action for stressors of various kinds. The relations between the changing expression intensity and psychological stress with facial expressions can be verified from their psychological and behavioral aspects. We can assess expressions of individual facial expressions using Facial Expression Spatial Charts (FESCs) [10]. Our experiment results suggest the influence of psychological stress on facial expressions. For this study, we create a model of stress elements for individuals of both genders using BNs. Then, we graphically analyze the interdependence between psychological stress and facial expressions. For this study, we designate a parameter of expression intensity that quantitatively expresses facial expressions.

IV. Datasets

For this study, we constructed a dataset to assess facial expression changes. We measured the psychological stress of a subject showing facial expression changes by using SRS-18 and comparing the results to the facial expressions.

A. *Facial Expressions Images*

We set the term during which we measured facial expressions to construct individual models of stress elements. We constructed an original and long-term dataset for the specific facial expressions of one subject. For the experiment, we created original facial expression datasets from 10 subjects, with each dataset including images with three facial expressions: happiness, anger, and sadness obtained at one-week intervals during 7-20 weeks. The subjects were five women (Subjects A, B, C, and D were 19; Subject E was 21) and five men (Subjects F and J were 19; Subjects G, H, and I were 22), all of whom were university students. The order of facial expressions in a single measurement is in the order of happiness, anger, sadness. When taking images of each facial expression, the same expression is repeated 3 times on the basis of neutral facial expressions during the image-taking time of 20 seconds. We previously instructed subjects to express an emotion 3 times during the image-taking time. One set of data consisted of 200 frames with the sampling rate of 10 frames per second.

We set the Region of Interest (ROI) to 90 x 80 pixels, including the eyebrows, which all contribute to the impression of a whole face as facial feature components. We set the ROI of the upper part to 40 x 80 pixels including the eyebrows, which contribute to the impression of upper facial parts as facial feature components. We set the ROI of the lower part to 50 x 80 pixels including the mouth, which contributes to the impression of lower facial parts as facial feature components.

B. Target Facial Expressions

We set three facial expressions of object facial expressions because the facial expressions are acquired over a long term for our study. We sought to reduce the load on subjects. We selected happiness, anger, and sadness from six basic facial expressions by Ekman [11]. He pointed out that Japanese people show disgust by smiling to conceal their true emotions. Therefore, we consider that it is difficult for subjects participating in this study to express disgust. The emotion of fear is a rare feeling in daily life. In the opinion of subjects, it was often stated that they are not aware of how they appear when feeling fear. Therefore, we do not record fear among the facial expressions. Surprise can readily occur along with fear, happiness, solace, anger, and despair [11]. Therefore, we do not include surprise among the recorded facial expressions because it invariably translates into complex facial expressions.

Our target facial expressions are therefore happiness, anger, and sadness, which include the geometry of each quadrant of Russell's circumplex model [12].

C. Stress Measurement

Psychological stress reactions are anxiety, anger, lassitude and difficulty in concentrating, which are encountered on a daily basis when one is affected by stressors. Our measurement contents are three robust stress factors: "depression and anxiety", "displeasure and anger", and "lassitude". Subjects respond on the check sheet along a four-response method for 18 items, answering with responses from "Completely different" to "It's correct". Each answer receives a score of 0-3. High point totals signify a higher degree of stress. Moreover, stress levels are represented by consultation value Level 1 (i.e., weak), Level 2 (i.e., normal), Level 3 (i.e., slightly strong), and Level 4 (i.e., strong). For this paper, we define the reported values as stress levels. For this experiment, we measured stress values using the SRS-18 and took facial expressions of 10 subjects. To avoid influencing the facial expressions, we reported no scores to subjects. Moreover, subjects wrote their responses to SRS-18 before recording facial expressions.

D. Extraction of Facial Expressive Intensity

Figure 1 shows a flow chart of our proposed method. Features are emphasized using Gabor wavelet filters as the preprocessing of input images. We reduce noise and constrict the amount of information using time-series images decorated with Gabor wavelets and processing coarse graining. We extract the topological variation of facial expressions and normalize constriction to the time direction using coarse graining data. Therefore, we classify images into patterns of facial expression categories depending on Self-Organizing Maps (SOMs) [13]. Moreover, we reclassify facial expressions images using SOMs and Fuzzy Adaptive Resonance Theory (ART) [14] of adaptive learning algorithm with stability and plasticity. SOMs set a mapping space by categorization of some items relative to others. However, Fuzzy ART can categorize same standards because it categorizes definite granularity using vigilance parameters. We rearrange the reclassification of categories based on neutral facial expressions. We consider that the categories show the influence of facial expressions.

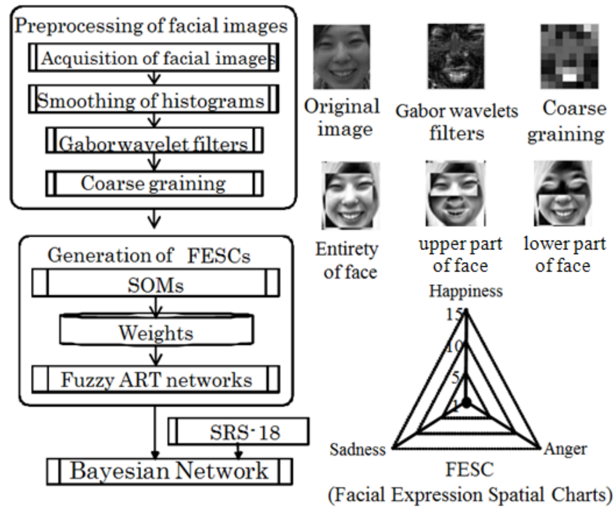

Figure 1. Procedure of the proposed method

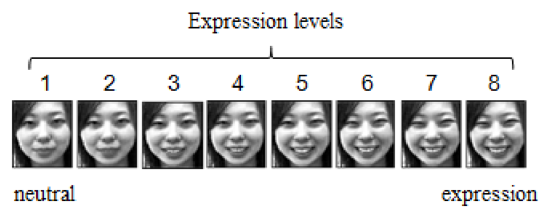

Figure 2. Expressive intensity

Figure 2 shows the expression intensity, which quantifies the strength of expression. SOMs of unsupervised learning are eminently useful for clustering and visualization. We classified facial expression patterns using SOMs to extract the facial expression topology. Fuzzy ART is an unsupervised learning neural network of incremental learning that can learn new patterns while maintaining past memories. Therefore, we regard ART as the optimal method for pattern learning of individual facial expressions. For our method, we reclassify facial expression images using Fuzzy ART in classification using SOMs. The pattern classification using SOMs categorize in set mapping space. Therefore, classification results are relative. However, we consider reclassification of constant granularity using Fuzzy ART as an extractive method to infer the individual expression intensity.

V. MODEL OF STRESS ELEMENTS

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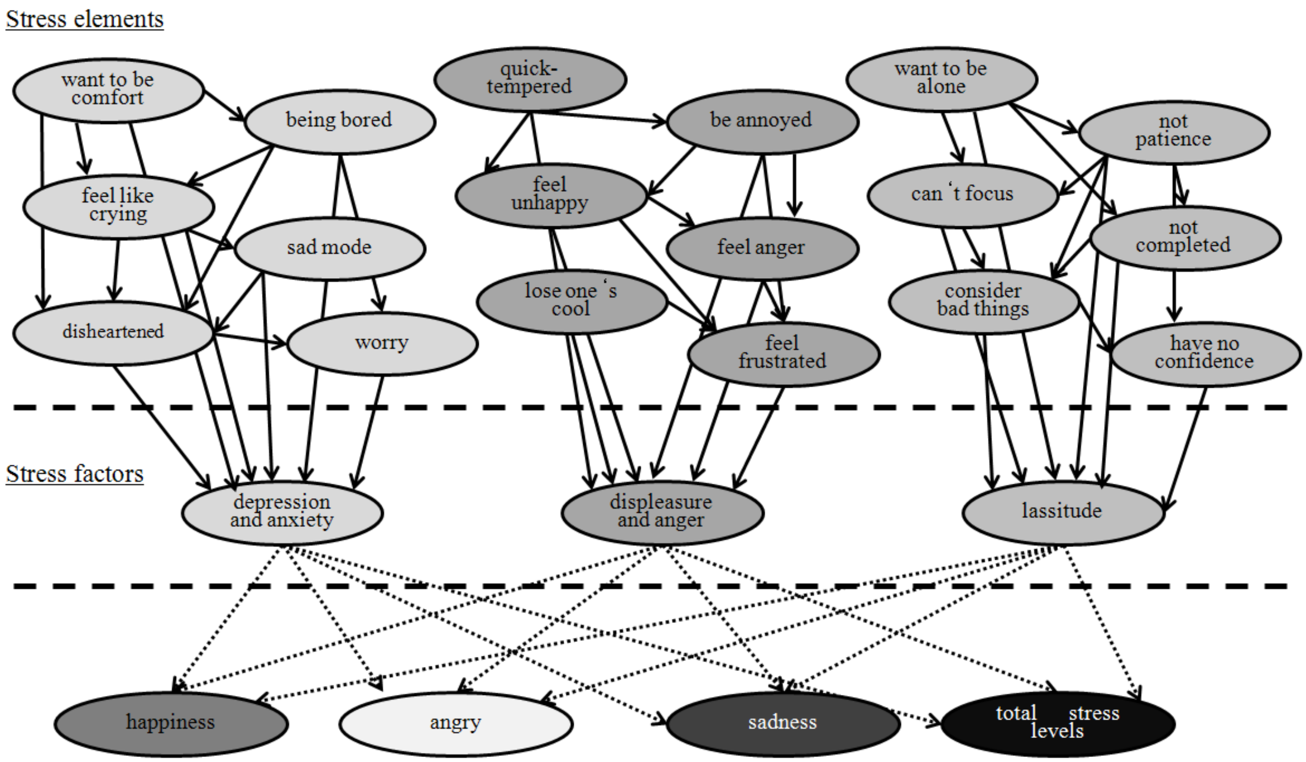

Figure 3. Stress elements model of male

A Bayesian network is a state-of-the-art knowledge representation scheme dealing with probabilistic knowledge [15]. Its nodes and arcs connect together forming a directed acyclic graph. Each node can be viewed as a domain variable that can take a set of discrete values or continuous value. An arc represents a probabilistic dependency between the parent node and the child node. We illustrate the graphical-modeling approach using a real-world case study, such as modeling and inferring human psychological stress by integrating information from intentional facial expressions and four grades, three stress factors, 18 stress attributions of SRS-18. A probabilistic psychological stress model based on the BNs is the best option to deal with the relationship between facial expressions and human psychological stress. We created a model of stress elements using BNs based on stress factors, stress elements, and facial expression intensities.

A. Definition of Variable Nodes

The stress model used in our experiment comprises 25 nodes. A stress element model was constructed from 18 stress elements, 3 stress factors, 3 facial expression intensities, and one total stress level. "depression and anxiety", "displeasure and anger", and "lassitude" of stress factor accommodate parent nodes for the six stress elements. The stress factors are parent nodes to the total stress level nodes, which are the child nodes. We set relations manually between the parent and child of facial expression intensities and stress factors. We set stress factors and expression intensity respectively as parent and child nodes based on preconditions for psychological stress influence to facial expressions. Furthermore, we set directed links for stress elements six nodes to each stress factor based on a precondition that stress elements trigger stress factors.

The 18 nodes of stress elements are assigned 0-3 points with four items: "Strongly No", "Yes a little", "Yes", and "Definitely Yes". All stress factor nodes have four grades: Level 1(i.e., weak), Level 2(i.e., normal), Level 3(i.e., slightly high), and Level 4(i.e., high).

VI. Analysis of Stress Element Model

For the analysis described in this section, we built two models given constraints on different nodes of stress factors to obtain a single simple model for which effects of stress are noticeable. Using the selected model, we attempt to analyze the type of facial expressions that are easily influenced by stress. Then, we shall analyze the stress factors and stress elements supporting them. To study differences in stress susceptibility by gender, we compare the results of analysis of stress elements in men and women.

A. Model Construction

As a preliminary experiment, we constructed models of stress elements under two constraints: "with constraints, where each factor is independent"; and "without constraints, allowing relations among elements". As it might be inferred from the contents of the preliminary experiment, no need exists to define an exact correlation between stress elements

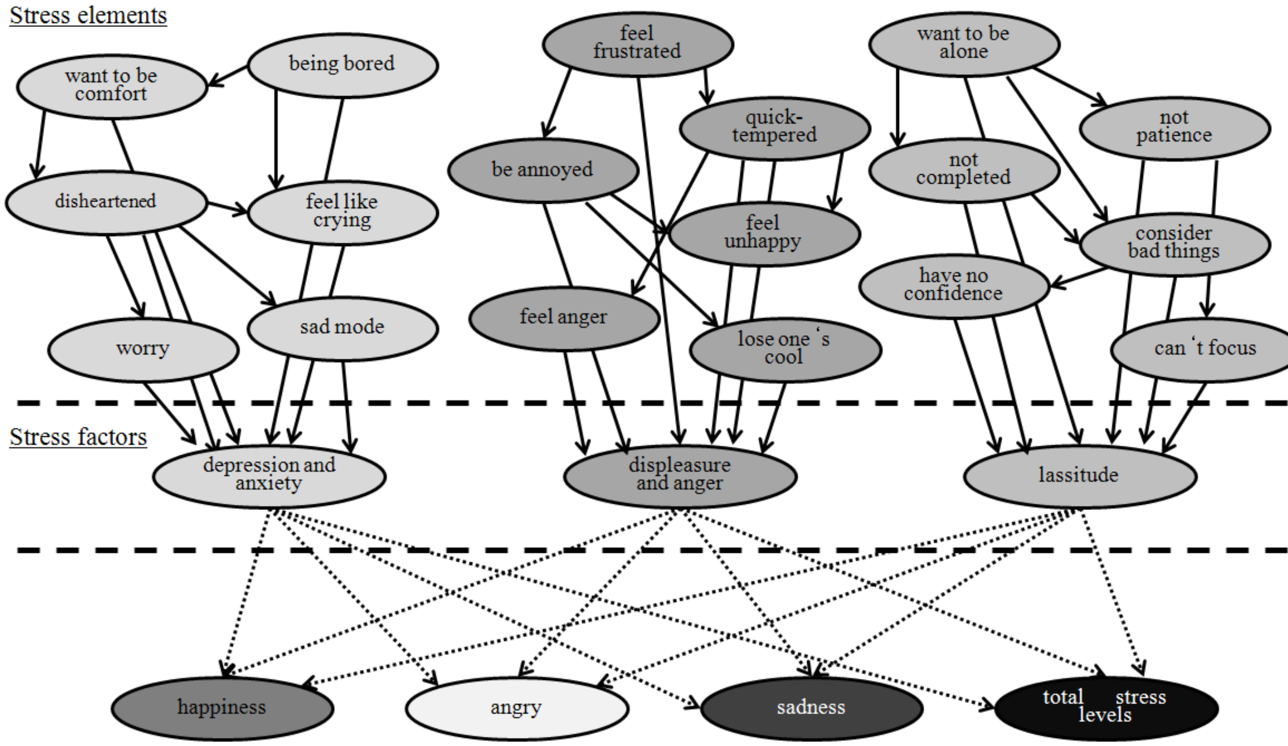

Figure 4. Stress elements model of female

because a tendency is apparent by which the probability distributions of the stress levels and expressive intensities are similar, irrespective of the presence or absence of constraints. However, the probability distribution of the model without constraints is an important characteristic for the analysis of stress elements. It is regarded as more effective when performing probabilistic inference.

Therefore, for the following experiments, we use the stress element model without constraints, allowing their relation among elements.

B. *Analytical Procedures*

The stress element models of men and women are presented in figure 3 and figure 4. Each node in stress factors, such as "depression and anxiety", "displeasure and anger", and "lassitude", has directed links of six items of stress elements as parent nodes. The directed links signify that nodes connected with them are optimized for better inferential accuracy. Therefore, a strong mutual relation exists between nodes that are connected by directed links.

The analytical procedures of stress factors that affect the facial expressions are described in the following based on the stress element models. As the flow of the entire analysis, by giving evidence to the degree of stress response, and by comparing the probability distribution of the expressive intensities "happiness", "anger" and "sadness", we strive to identify facial expressions that are sensitive to stress.

Additionally, we verify any stress elements in terms of whether they affect the expressive intensities of the facial expression.

First, we calculate the expressive intensities of three facial expressions by giving evidence to the stress response degree as "weak". Conducting stochastic reasoning based on the probability distribution of each expressive intensity, the most sensitive stress is likely to appear in any facial expression was determined. Next, we assessed the degree of stress responses of "slightly strong" and "normal" using the same procedures. We specifically examine the probability distribution of expressive intensities in three facial expressions. Furthermore, even for stress elements corresponding to each stress factor, using the same procedures as stochastic reasoning, we identify the stress factors and elements that affect expressive intensities in facial expressions.

C. *Male Model*

Figure 5 presents a probability distribution of the expressive intensities corresponding to each stress response degree in the male model. Giving evidence to the stress response degree as "weak", the probability value was also larger because the expressive intensity increases. For the case in which the stress response degree is "normal" compared to "weak", the probability value is greater when the expressive intensity is small. Moreover, in the case of "slightly strong", probability values tend to be large in all

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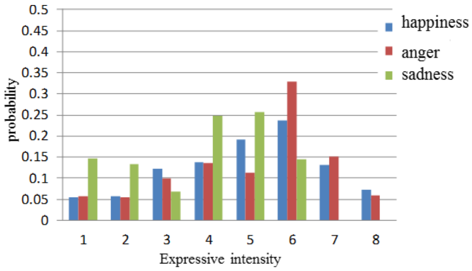
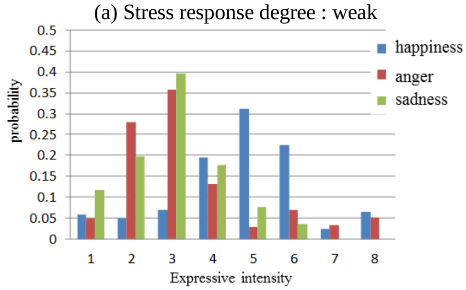
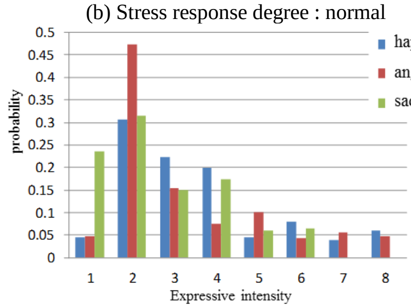


(a) Stress response degree : weak

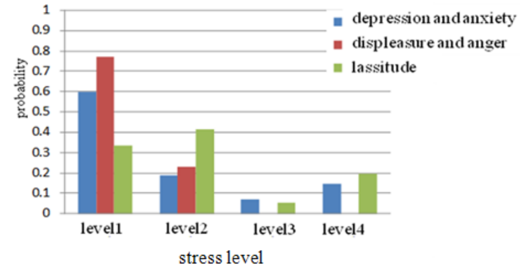


(b) Stress response degree : normal

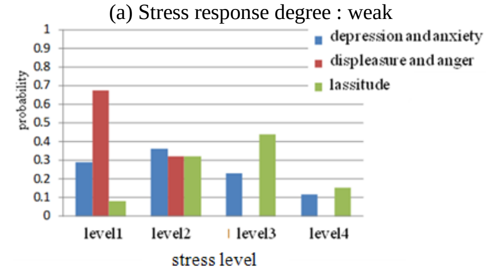


(c) Stress response degree : slightly strong

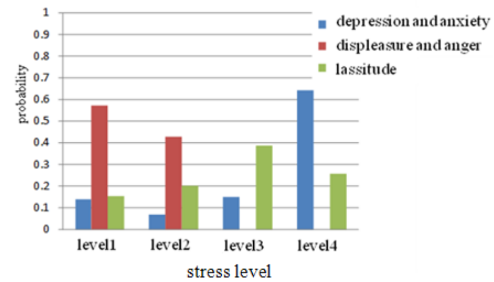
Figure 5. Probability distribution of the expressive intensities corresponding to each stress response degree in male model



(a) Stress response degree : weak



(b) Stress response degree : normal



(c) Stress response degree : slightly strong

Figure 6. Probability distribution of the stress levels with emphasis on the facial expression of "happiness"

three facial expressions, when expressive intensities are small. The results are shown as described above: when the confirmed. Estimating the expressive intensity corresponding to stress response degree is particularly difficult for facial expressions of "anger" and "sadness" because it is small in the state of "normal" stress.

Therefore, we will strive to conduct analyses particularly addressing the "happiness" facial expression, for which the probability value of expressive intensity is changing related to the stress response degree. To analyze the stress factors and stress elements that support them on the "happiness" facial expression, by giving evidence sequentially from "Level 1" to "Level 4" for total stress levels, we identify the stress factors affecting facial expressions from their probability distributions of expressive intensities. Furthermore, we examine the link structure of the stress elements related to the stress factor that has been identified.

Figure 6 depicts a probability distribution of the stress level in each stress factor. As the stress response degree becomes higher, the level of the stress factor "depression and anxiety" indicates a high value. This phenomenon appears most significantly on the estimated value of the probability distribution. However, for the stress factors of "lassitude" and "depression and anxiety", characteristic changes are not observed in the estimated value of the probability distributions at respective stress levels.

Therefore, in the male model, we consider that the factor of "depression and anxiety" affects the facial expressions of "happiness" as a stress factor. Then, as targeting the six stress elements characterizing the factors of "depression and anxiety", we attempt to identify the stress factors for supporting the relevant factor. We set evidence for the stress response degrees of "normal", "weak", and "slightly strong". Figure 7 shows the probability distribution of stress elements for each stress level. For "normal" and "weak" as stress response degrees, the highest probability value of "strongly no" denying the stress elements was identified, other probability values were less than 0.3. For "slightly strong" as a stress response degree, stress elements of "sad mood", "crying", and "disheartened" showed high probability values together for support of the cause of "definitely yes".

D. *Female Model*

Using the same procedure as that used for the men, we analyzed the relations between stress factors, stress elements, and expressive intensities of three facial expressions for women. In the female model, a marked change was

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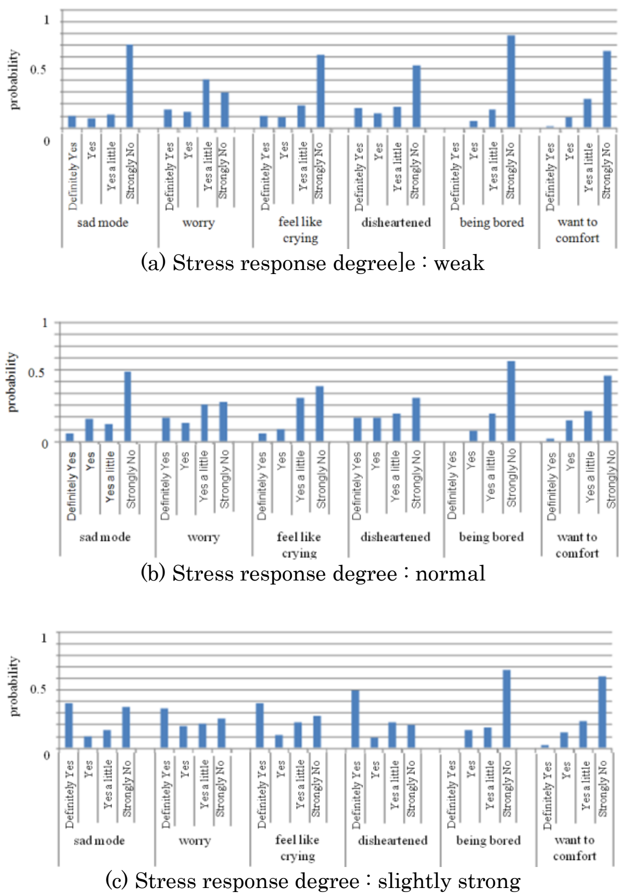
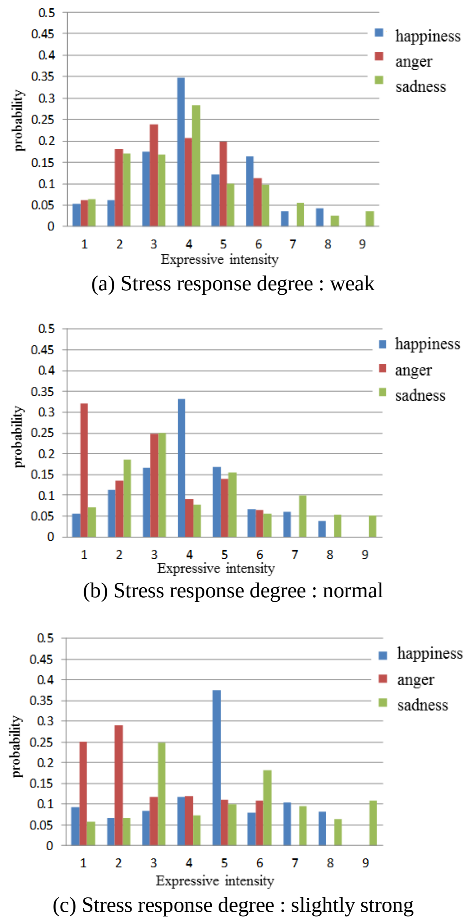


(a) Stress response degree]e : weak

(b) Stress response degree : normal

(c) Stress response degree : slightly strong

Figure 7. Probability distributions of the stress elements characterizing the factors of "depression and anxiety" in male model



(a) Stress response degree : weak

(b) Stress response degree : normal

(c) Stress response degree : slightly strong

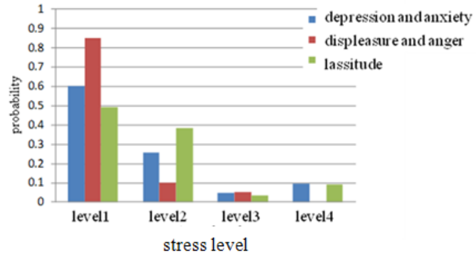
Figure 8. Probability distribution of expressive intensities corresponding to each stress response degree in female model

recognized in the probability distribution of expressive intensity of "sadness", as presented in figure 8.

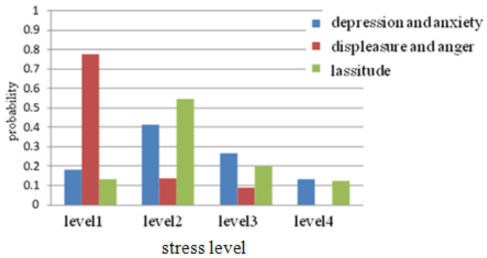
Figure 9 presents a probability distribution of stress levels with emphasis on the facial expression of "sadness" in each stress factor. As it might be understood from the contents of figure 9, particularly addressing the probability distribute-on of the factors of "lassitude" and "depression and anxiety", a considerable change is apparent with the difference of stress response degree, i.e., "weak", "normal", and "slightly strong". The probability distributions of the stress elements characterizing the factor of "depression and anxiety" are presented in figure 10. As a stress element giving influence to the factor of "depression and anxiety", the influence of "disheartened" exists to a slight degree. However, no distinctive element to support the factor of "lassitude" is found anywhere because the probability distribution shows a similar tendency to that of the change of the degree of stress response.

Based on the experimentally obtained results presented above, we conduct an examination from the perspective of stress factors and stress elements giving influence to them, specifically examining the relation between psychological stress and three facial expressions for men and women. Some facial expressions appear easily, but others are difficult to assess in psychological stress. In the male model, facial expressions of "happiness" show marked changes attributable to differences in the stress-response degree, but characteristics of the probability distribution of expressive intensities are similar in facial expressions of "sadness" and "anger". Expressive intensities become slight with the increase of stress response degree as an overall trend. In the female model, a change was observed in the characteristics of the probability distribution of expressive intensities, only the facial expression of "sadness", by setting evidence to the stress response degree as "slightly strong".

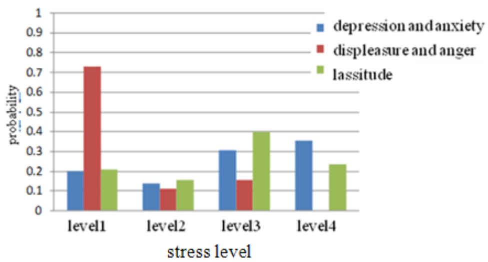
Therefore, we inferred that the influence of psychological stress appears easily, respectively, in the expression of "happiness" for men, and in the expression of "sadness" for women. In addition, the factor of "depression and anxiety" as a stress factor influences the facial expressions of "happiness". Then, as stress elements which support it, three items exist for men: "sad mood", "feel like crying", and "disheartened". Although significant changes were observed in the probability distribution of the factors of "lassitude" and "depression and anxiety", the female model did not



(a) Stress response degree : weak

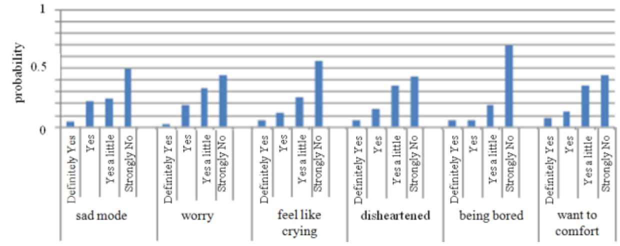


(b) Stress response degree : normal

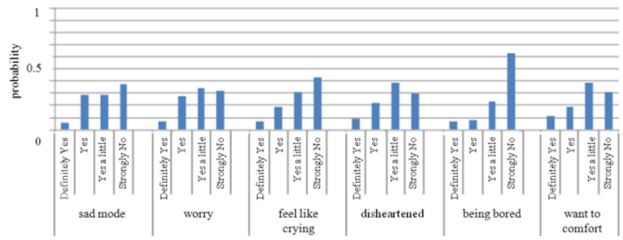


(c) Stress response degree : slightly strong

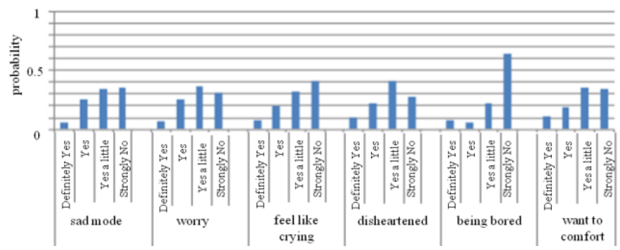
Figure 9. Probability distribution of stress levels with emphasis on the facial expression of "sadness"



(a) Stress response degree : weak



(b) Stress response degree : normal



(c) Stress response degree : slightly strong

Figure 10. Probability distributions of the stress elements characterizing the factors of "depression and anxiety" in female model

engender specific stress elements to support those stress factors.

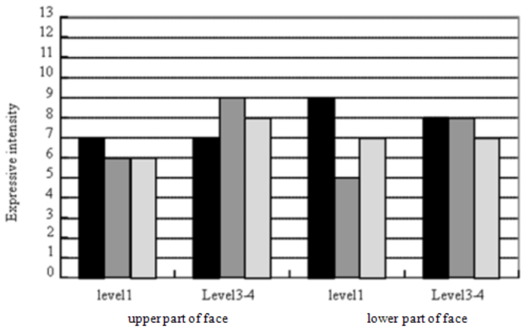
VII. STRESS FACTORS AND EFFECT OF FACE REGION

In this section, we first classify the state (slightly high) of levels 3–4 and the state (weak) of level 1 for which each stress factor holds the state of "Level 4" from "Level 1". Next, by probabilistic reasoning of giving evidence in these two states, we strive to identify the face region (upper face, lower face) in which psychological stress effects readily appear. For this experiment, we use the model of stress elements for the entire subject, i.e., the 10 university student subjects comprise 5 men and 5 women.

A. *Factor of 'depression and anxiety'*

Figure 11 shows expressive intensities of parts of the face, where we set evidence to the state (slightly high) of levels 3–4 and the state (weak) of level 1, assessing the factor of "anxiety-depression". Estimation results of stress levels and expressive intensities are presented in figure 11(a). The relation between types of facial expression and the differences of expressive intensity are presented in figure 11(b). These two figures are summaries for the respective face regions. The vertical axes in the figures respectively show the expressive intensity and the difference of expressive intensity. It is noteworthy that the difference of expressive intensity shows the absolute value of the difference between the expressive intensities levels "3-4" and "level 1" in respective states.

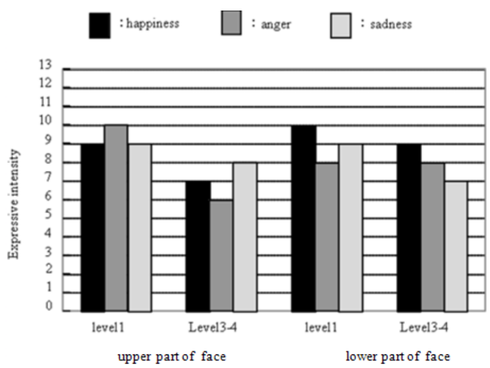
Specifically, assessing the differences of expressive intensity in "happiness", "anger", and "sadness", the respective values of the upper face are 0, 3, and 2. In contrast, the respective values of the lower face are 1, 3, and 0. In the case in which the stress factor of "anxiety-depression" acts significantly, large values have been identified for the upper and the lower face at expressing "anger". Therefore, the influence of "anxiety-depression" readily appears at expressing 'anger'. In addition, we infer that the influence affects the entire face region. These analytical results are consistent with the contents of the previous study described in 18), i.e., the emotional states of mind stimulated "anger" and "depression" are similar.



(a) Estimation of stress levels

(b) Difference of expressive intensity each face part

Figure 11. Expressive intensities of parts of the face



(a) Estimation of stress levels

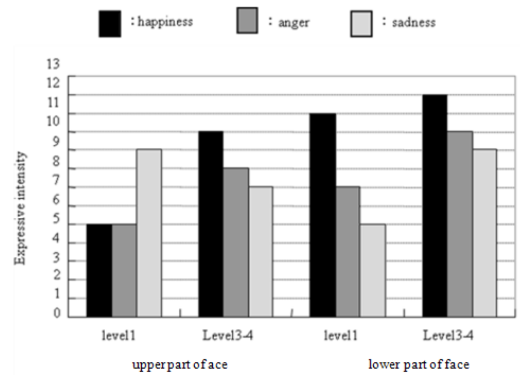
(b) Difference of expressive intensity each face part

Figure 12. Expressive intensities of each face region based on the stress factors of "displeasure and anger"

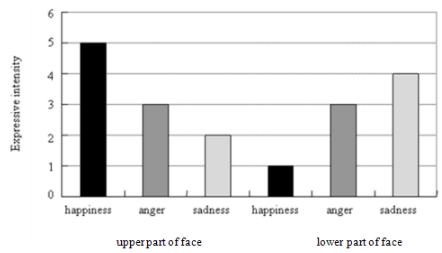
B. *Factor of 'displeasure and anger'*

Figure 12 represents the expressive intensities of each face region based on the stress factors of "displeasure and anger", as presented in the preceding section. Specifically examining the differences in expressive intensity in "happiness", "anger", and "sadness", the respective values of the upper face were 2, 1, and 4. In contrast, the respective values of the lower face are 0, 1, and 2. Accordingly, we consider that the following analysis is reasonable, i.e., the influence of "displeasure and anger" readily appears at the upper face of expressing "anger".

In addition, because we are conducting the operation of "glared" to intimidate an opponent expressing "anger", this analytical result matches a case study in which changes occur during that process, such as "eyebrows down" or "upper eyelid is raised". Consequently, the effect readily appears strongly in the upper face of the facial expression "anger", in the case in which the stress factor of "displeasure and anger" is readily apparent.



(a) Estimation of stress levels



(b) Difference of expressive intensity each face part

Figure 13. Expressive intensities of respective face regions based on the stress factor of "lassitude"

C. *Factor of 'lassitude'*

Figure 13 exhibits expressive intensities of respective face regions based on the stress factor of "lassitude". Specifically examining the differences of expressive intensity in "happiness", "anger", and "sadness", the respective values of the upper face are 5, 3, and 2. In contrast, the respective values of the lower face are 1, 3, and 4. Accordingly, we regard the following analysis as reasonable: the influence of "lassitude" readily appears at the upper face expressing "happiness", and the lower face expressing "sadness".

In general, changes in facial expressions are poor during the state of "lassitude". Therefore, a tendency to fall "expressionless" might be confirmed. However, results indicate that the influence appears strongly on the lower face for the expression of "sadness" and the upper face of the expression ‘happiness’ in this analysis. For this study, we adopted an experimental protocol in which all subjects intentionally express three facial expressions of "happiness", "sadness", and "anger", even when they are in the state of "lassitude". Therefore, these reasoning results reflect the characteristics of datasets based on the experimental protocol. Although the factor of "lassitude" contributes significantly, we have found out that the effect readily appears at the lower face of the expression "sadness" and the upper face of the expression ‘happiness’ on intentional facial expressions.

VIII. CONCLUSION AND FUTURE WORK

This study, which analyzed stress factors and elements of psychological stress on intentional facial expressions using BNs, was conducted to identify the types of facial expressions and facial parts which readily manifest the influence of psychological stress. In our evaluation experiment, we conducted stochastic reasoning to build stress elements models for all subjects, men and women, providing evidence to the stress response degree and stress factors.

Results revealed the following points.

1) The factor of "anxiety-depression" affects the facial expression of "happiness" in men.
2) The factors of "anxiety-depression" and "lassitude" affect the facial expressions of "sadness" in women.
3) The influences of "depression and anxiety" readily appear when expressing "anger", and affect the entire face.
4) The influence of "displeasure and anger" readily appears at the upper face when expressing "anger".
5) The influence of "lassitude" readily appears strongly in the lower face of the expression of "sadness", with the upper face of the expression of "happiness".

We will estimate models of stress elements longitudinal and transversal data to increase the number of subjects and the photography period. Furthermore, we will improve our method to address both intentional facial expressions and natural expressions that will be exposed unconsciously.

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