# Feature of Autonomic Nerve Activity while People Evaluate Geometric Patterns

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# Feature of autonomic nerve activity while people evaluate geometric patterns

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## ABSTRACT

Visual art produces a variety of affective states. It is involved one's personarity what the person feels by art products. Moreover, the process of the feeling is unconscious. Especially, visual art works in 2D has some physical properties such as texture, color, composition, and pattern of figures. To explore the human process of the feeling toward art, we focused on pattern of figures in this study. Previous research on 'pattern goodness' has used the method of subjective evaluation. The change of the uncounscious state is not be measured using those methods. These previous studies on 'pattern goodness' also have some issues as following. They has been used dot patterns as stimuli which participants can focus on the figure but not the ground. These stimuli are composed from less than 10 black dots. Thus, The first aim of this study is determination to obtain the feature of autonomic nerve activity while people evaluate geometrics patterns, to obtain the objective result. The second aim is to reveal what kinds of physical elements of patterns affect people's feelings of goodness. In this investigation, we especially focused on fractal dimension, and SD of Dnn(Distance to the nearest neighbuor) as an index of the subjective randamness. The experiments were carried out by measuring participants' heart rate and skin conductance level while they evaluate stimuli of patterns formed by lined up black and white circles. The participants were exposed various patterns of the stimuli through a PC monitor. They controlled a slider machine to change the presenting pattern stimulation. They stopped the slider operation at selected an image as the best. The results implied which type of patterns produces positive emotions to the participants. These results reveal which kind of patterns of figure can perception of art of humans.

## 1. INTRODUCTION

In psychology, there are a large number of studies dealing with "pattern goodness", which have tried to investigate the kinds of pattern compositions that make people feel good. In 1963, Garner & Clement used simple patterns which consist of black dots on a 3×3 matrix as stimuli in their experiments to evaluate people's perception of patterns. Subsequent research on "pattern goodness" has mostly used the same or similar simple patterns as stimuli (e.g. Kodama & Miura, 2010). Thus, the question has remained to determine how complex patterns may be perceived and can be applied for real design in society. Consequently, in this experiment we used complex 2D geometrical patterns composed of black and white to study people's physiological responses.

In addition, previous studies on "pattern goodness" mainly have used subjective evaluation to measure people's feelings such as semantic deferential method or method of magnitude estimation. On the other hands, some recent researchs have used objective evaluation to investigate people's feelings by measuring their physiological activity. Thus, we measured

people's physiological activity, which reflects people's feelings to get quantitative results. In this experiment, we focused on heart rate and skin conductance level since previous research found that there is a relationship between human's feelings and skin conductance (Shutoh et al., 2013). Moreover, according to Lang et al.,(1993), skin conductance responses is considered to reflect levels of arousal rather than emotional valence. Thus, skin conductance level is one of the affective indexes that can reflect people's feelings. The first aim of this study was to determine the feature of autonomic activity which reflect people's feelings of goodness when they evaluate geometric patterns. Besides, the second purpose is to determine the kinds of complex pattern compositions that make people feel the goodness.

## 2. METHOD

In the experiment, participants were presented with stimuli through a monitor. They could freely control a slider of a machine which control the exposing pictures from right to left to change presented images, until they selected an image as the best. During the presentation of images, their feelings were measured by recording their heart rate and skin conductance. After that, they were required to answer a questionnaire about the impression of image they chose and the degree of their confidence.

### 2.1 Participants

17 participants took part in this experiment whose nationality is Japan, and they are university students (age; M = 24.18, SD = 2.72). They were required to have normal or corrected eyesight to see information on a monitor. All of the participants provided written informed consent and got an explanation about that they could stop the experiments whenever they want and take a rest if they get tired. This study was approved by the ethical committee at University of Tsukuba.

### 2.2 Experimental Procedure

Participants sat relaxed on a chair which was 150cm away from the monitor and adjusted a height of chair to see a centre of the monitor vertically and horizontally. This monitor were 42 inch full hi-vision (61㎝x 98㎝). They were able to alter the 39 number of stimuli by adjusting a slider of the experimental machine. Stimuli were switched to change one after another over moving a slider.

### 2.3 Physiological and behavioural measurement

We took physiological measurements; heart rate and skin conductance while participants evaluate stimuli. PowerLab and LabChart (ADInstruments) were used to record heart rate, skin conductance, and the electrical signal concerting with a movement of a slider of experimental equipment. This movement of a slider was recorded as a behavioral measurement of participants.

### 2.3 Stimuli

Stimuli consisted of black circles on a white background. On G group stimuli (G1˜G20), black circles were positioned on the imaginary grid. On the other hand, NG group stimuli (NG1˜NG19), black circles did not follow the grid. We calculated fractal dimension using Flactal3of fractal analysis system (Institute of Livestock and Grassland Science, NARO), and SD of Dnn (Distance to the nearest neighbour) as an index of the subjective randomness.

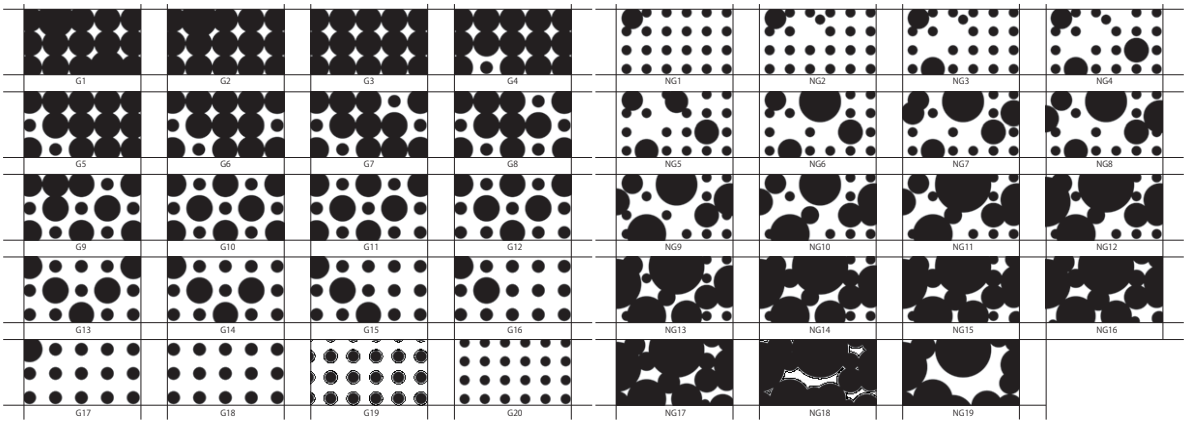


Figure 1: 39 number of stimuli (height: 1080 pixel, weight :1920 pixel).

## 3. RESULTS AND DISCUSSION

### 3.1 Which image they chose the best

Fig.2 shows that number G10 was the most chosen as the best among 39 kinds of stimuli. This result supported that Gestalt psychology mentioned that "good figures" tend to have simplicity, which also consist of regularity or symmetry. However, 7 participants chose NG group stimuli which circles did not follow the imaginary grid. It might be another reason which we may not explain that simple pattern does not always good.


*Figure 2: The image they selected as the best (N=17) 【Y-axis shows how many participants chose an image, X-axis shows the number of stimuli. Blue color means people who have an experience to learn art or design, but green one means people who don't】.*

### 3.2 Physiological responses when participants stopped manipulating a slider

9 participants from 17 participants, their data got trouble by electrostatic energy. Thus, their physiological data could not be used for analysis. Thus, 8 participants' data were used for analysis. When participants stopped manipulating the slider, skin conductance level were increased after about 6.3 second (Figure 3). It is well known that SCL and SCR have a feature

which tends to increase against stress of stimuli. This result implied SCL are tended to increase when people evaluated stimuli as the best.

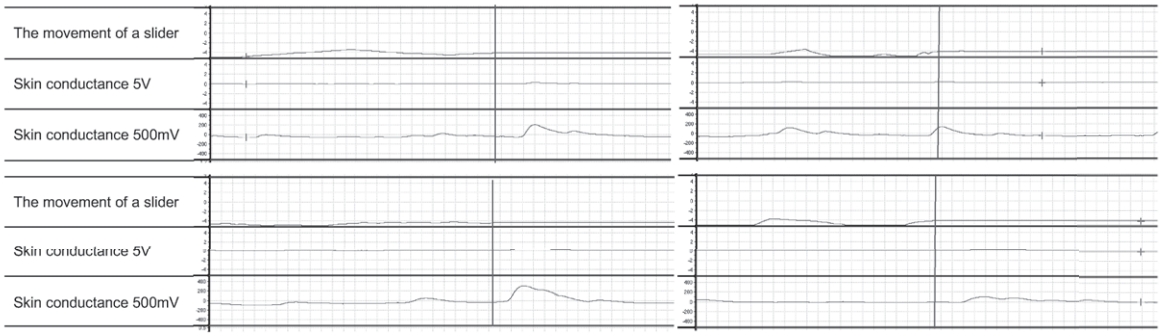


Figure 3: Examples of skin conductance response when they stopped manipulating【Red vertical line shows at the moment they stopped】

## 4. CONCLUSIONS

The advantage of this experiment of method is recording for objective evaluation real time data. Moreover, participants can intuitively evaluate stimuli without language expression. However, we need an additional experiment to make it clear what the meaning of physiological data. We only asked participants to choose an image as the best, thus, we need to compare the data which they choose an image as the worst or neutral. Consequently, the present study has quite a bit of room for improvement, but implied that the type of patterns that produce positive emotions can help them understand how patterns affect people's perception of art.

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