# Kansei evaluation analysis toward constructing human-machine interface based on Gaze Catching System for real life

Chiu-Yi Lee, Toshimasa Yamanaka

*juyilee@kansei.tsukuba.ac.jp*
*tyam@geijutsu.tsukuba.ac.jp*

Abstract: In this paper, an interface was developed which used in a virtual space model to test that if the human-machine interface based on the Gaze Catching System can apply to human life. This interface was constructed by an indoor room image containing 3 changing light spots. The 3 changing light spots would change their color from red to green by the times user looking at it, but in different participants groups the changing response time are different. This research was targeted to clarify what kind of impression that people have when having a gaze interaction in an indoor room space, and also how the response time influences participants' impressions of the interaction system. The psychological methods, the semantic differential method (SD), and statistical analysis was employed in this research. From the results of the experiment, response time was not seen to have effect on gaze interaction, while Awareness of gaze interaction would bring more humanlike impression.

***Key words: Kansei evaluation, eye- tracking, gaze-tracking, interaction, response time***

## 1. Introduction

Recently, new technology has been studied and developed, and our life is deeply involved with machines. Concerning on the situation that we're getting more rely on machines, the relationship between human and machine is not just limited to that people order machines one sided, but a new relationship is necessary to be constructed.

Thinking of human-human communication, “eye contact” is a characteristic communication that people have. People have eye contact pretty often. However, only human or animals would be able to take reaction to others’ gaze. What if machines have reaction to people’s gaze? And how does it affect the interaction between human and machine? The question of this research is arisen from these experiences of human gaze. In this research we targeted on profiling the human gaze movement to construct a new kind of “gaze interaction” between human and machine.

Eye-gaze tracking has a potential to greatly influence the way that we interact with machines as a new form of human-machine interface.[1] Recent advances in electronics and computing technology have made possible non-contact and real-time video based eye-gaze tracking systems. To be acceptable to the general population, eye-gaze tracking systems should be non-contact, non-restrictive, sufficiently accurate for the user's range of tasks, easy to set up and simple to use. This non-contact eye-gaze tracking system must be a powerful tool to construct the new human-machine interface system.

In this research, a Gaze Catching System was developed, and by adding the new interfaces to the system, we

aimed to clarify which factors are needed for the kansei evaluation of gaze interaction. SD method [2] was used for the evaluation. we evaluated the Gaze Catching System using a virtual room. T-test and ANOVA were applied in this experiment to tell if response time or awareness has effect on the kansei evaluation of gaze interaction. This presenting study is considered to be an out of ordinary research in the studies of gaze interaction.

## 2. Gaze Catching System

This Gaze Catching System contains two parts, the gaze tracking part and the interface part. The gaze tracking part is devised based on the open source code "TrackEye : Real-Time Tracking Of Human Eyes Using a Webcam", which is written by Zafer Savas, and licensed under The Code Project Open License (CPOL)[3, 4]. This source code is able to detect the position of eyes and pupils with simple devices, and we use this function to construct gaze detection.

For the expectation to apply the gaze interaction system to real life space, we constructed a virtual space as the interface part. To make a virtual space, we introduced Elumens Vision Station into our experiment (see Figure.1). The Vision Station is able to transform 2-D computer graphics into 3-D sensory encounters that can provide a more immersive and realistic experience by providing peripheral images to its user.

Figure.1 Elumens Vision Station

In this experiment, we use an indoor room image as the background of the interface, and 3 changing light spots were added on the electrical objects in the room. These 3 changing light spots would change its color from red to green with people's gaze (see Figure.2).The electrical projects were chosen to put on the changing light spots because they are machines we often use in our life, and also electrical projects often have lights as their switch signals. The colors of the light spots, red and green, are also chosen from the common colors of switch signals. We'd want to simulate the situation that when people look at the electrical project it will react specifically on the position where people look, but since the limit of accuracy of the tracking gaze program, we set up the sense areas (as the blue dotted line showed in Figure.2) as the substitutes of electrical objects, and the light spots were at the center of the area.

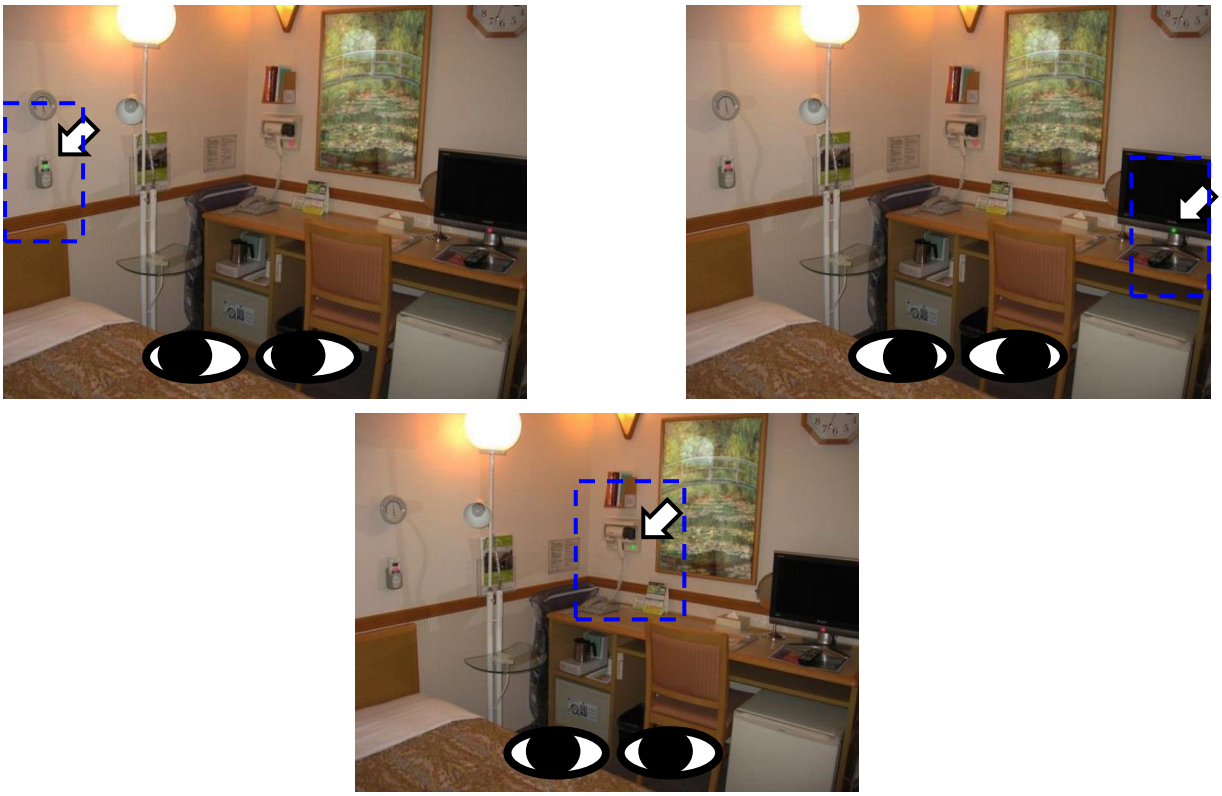

Figure.2 The changing light spots would change color when detecting gaze.

## 3. Experiment

### 3.1 Response time of gaze interaction

The system response time is a very important factor in the interaction with machine. There were many previous studies doing the research about the response time of computers [5] [6], and how it effects on people. However, the response time of gaze interaction is not studied much.

In this experiment, we found a previous research about the response time of computer and people as consultation. In the study of graphic response from light pen, it shows that where the lines are drawn with deliberation by the users, a delay of up to 0.1 second seems to be acceptable [5]. And in other study of the effects of Internet delays on users, it shows that the delay time before the task appeared is considered to be short as about 0.4 seconds [6]. So according to previous studies, we set the response times in this experiment as 100ms, 300ms, and 600ms. The participants are also separated to 3 groups corresponding to the 3 sets of response time. We're going to find out the effect of response time on gaze interaction.

### 3.2 Participants

The participants in our experiment were 30 students of University of Tsukuba. They are ranged in age from 20 to 30 years old. All participants are Japanese including 18 males and 12 females, and they are separated to 3 groups as below.

a) Group 100 ms : 7 men, 3 women

b) Group 300 ms : 6 men, 4 women

c) Group 600 ms : 5 men, 5 women

### 3.3 Condition

Participants were asked to sit in front of the Elumens Vision Station to watch the interactive stimuli about 3 minutes. While they were watching, the gaze tracking began to work, and the red light spot on the interface would change to green color when participants looked at the area.

At the end of the experiment, the participant was asked to answer questionnaires for ratings the experience of gaze interaction by the SD (Semantic Differential) method. The questionnaire consisted of 20 adjective pairs shown in Table 1 in order to analyze the impressions of each participant. Also the questionnaire is appended a question to ask if the participants were aware of the gaze interaction.

## 4. Results

### 4.1 Results of Questionnaires

Table 1 shows the results of the ratings. The adjective pairs in the table are translated from Japanese words used in the questionnaires. The mean values and the standard deviation values are the result of the 30 participants separating to 3 groups (100ms, 300ms, 600ms). The ratings are based on the 1-to-5 scales, where 1 means fitted positive adjectives very well (adjectives in the leftmost-column in the Table 1).

Table 1 Evaluated adjective pairs and the results

| Adjective Pairs | Mean | | | S.D. | | |
|---|---|---|---|---|---|---|
| | 100ms | 300ms | 600ms | 100ms | 300ms | 600ms |
| Kind — Cruel | 2.1 | 1.9 | 2.6 | 1.10 | 0.74 | 1.07 |
| Favorable — Unfavorable | 2 | 2.7 | 2.7 | 0.67 | 0.82 | 0.95 |
| Friendly — Unfriendly | 2.5 | 3.1 | 2.9 | 1.35 | 0.99 | 0.99 |
| Safe — Dangerous | 2 | 1.5 | 1.9 | 1.05 | 0.71 | 0.99 |
| Pretty — Ugly | 2.7 | 2.9 | 3 | 0.67 | 0.57 | 0.47 |
| Distinct — Vague | 2.9 | 3.2 | 3.1 | 1.20 | 1.23 | 1.10 |
| Accessible — Inaccessible | 2.4 | 2.7 | 2.7 | 0.84 | 0.95 | 0.82 |
| Altruistic — Selfish | 2.5 | 3 | 2.6 | 0.71 | 0.67 | 0.52 |
| Humanlike — Mechanical | 2.9 | 3.5 | 3.2 | 1.10 | 0.97 | 0.92 |
| Full — Empty | 3 | 3.5 | 3.1 | 0.82 | 0.97 | 0.74 |
| Interesting — Boring | 2 | 2.5 | 2.1 | 1.05 | 1.27 | 0.99 |
| Happy — Unhappy | 2.4 | 2.8 | 3 | 0.84 | 0.79 | 0.67 |
| Likable — Dislikable | 2.4 | 2.8 | 2.7 | 0.97 | 1.23 | 0.82 |
| Exciting — Dull | 1.9 | 2.3 | 1.7 | 0.99 | 1.34 | 0.67 |
| Good — Bad | 2.3 | 2.4 | 2.2 | 0.67 | 1.07 | 0.63 |
| Complex — Simple | 3.2 | 3.5 | 3.3 | 0.92 | 1.08 | 0.82 |
| Rapid — Slow | 3 | 3 | 2.6 | 0.94 | 0.82 | 0.97 |
| Active — Passive | 3 | 3.2 | 3.1 | 0.67 | 0.92 | 0.57 |
| Showy — Quiet | 3.6 | 3.9 | 3.6 | 0.70 | 0.74 | 0.52 |
| Sharp — Blunt | 3.1 | 2.9 | 2.7 | 0.74 | 0.57 | 0.82 |

### 4.2 Gender effect analysis

In this section, we're doing an analysis of gender effect. There might be many factors that cause gender differences in the evaluation, including the different preferences for the background indoor room image or the environment of the experiment. Table 2 shows the result of the analysis.

An Independent-samples t-test was conducted to compare the scores of adjective pairs for males and females. There were statistically significant differences at the $p < .05$ level in the scores of two adjective pairs, "Happy - Unhappy" and "Complex - Simple". The significant difference in the scores of "Happy - Unhappy" for male (M = 2.50, SD = 0.86) and female (M = 3.08, SD = 0.51), t (28) = -2.109, p = 0.044 (two-tailed). The significant difference in the scores of "Complex - Simple" for male (M = 3.06, SD = 0.94) and female (M = 3.75, SD = 0.75), t (28) = -2.142, p = 0.041 (two-tailed).

According to results above, most of the adjective pairs are not affected by gender, except the adjective pairs, "Happy - Unhappy" and "Complex - Simple". In this research, we don't want to consider the effect caused by gender on gaze interaction. Thus we will exclude the two adjective pairs in the following analysis.

Table 2 The result of independent-samples t-test for males and females

| | **Group Statistics** | | | | **Independent Samples Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | |
| Adjective Pairs | Sex | N | Mean | Std. Deviation | Equal variances assumed | F | Sig. | t | df | Sig. (2-tailed) |
| Kind – Cruel | male | 18 | 2.1111 | 1.07861 | true | 1.031 | .319 | -.592 | 28 | .559 |
| | female | 12 | 2.3333 | .88763 | False | | | -.616 | 26.623 | .543 |
| Favorable – Unfavorable | male | 18 | 2.4444 | .92178 | True | .477 | .496 | -.170 | 28 | .866 |
| | female | 12 | 2.5000 | .79772 | False | | | -.175 | 25.979 | .862 |
| Friendly – Unfriendly | male | 18 | 2.7222 | 1.17851 | true | 1.460 | .237 | -.661 | 28 | .514 |
| | female | 12 | 3.0000 | 1.04447 | False | | | -.678 | 25.644 | .504 |
| Safe – Dangerous | male | 18 | 1.8333 | .98518 | True | 1.157 | .291 | .238 | 28 | .814 |
| | female | 12 | 1.7500 | .86603 | False | | | .244 | 25.761 | .809 |
| Pretty – Ugly | male | 18 | 2.7778 | .64676 | True | 6.337 | .018 | -1.045 | 28 | .305 |
| | female | 12 | 3.0000 | .42640 | False | | | -1.134 | 28.000 | .266 |
| Distinct – Vague | male | 18 | 2.9444 | 1.21133 | True | .031 | .863 | -.711 | 28 | .483 |
| | female | 12 | 3.2500 | 1.05529 | False | | | -.732 | 25.888 | .471 |
| Accessible – Inaccessible | male | 18 | 2.3889 | .84984 | True | .253 | .619 | -1.710 | 28 | .098 |
| | female | 12 | 2.9167 | .79296 | False | | | -1.735 | 24.863 | .095 |
| Altruistic – Selfish | male | 18 | 2.6667 | .68599 | True | .168 | .685 | -.338 | 28 | .738 |
| | female | 12 | 2.7500 | .62158 | False | | | -.345 | 25.316 | .733 |
| Humanlike – Mechanical | male | 18 | 3.4444 | 1.04162 | True | .555 | .462 | 1.698 | 28 | .101 |
| | female | 12 | 2.8333 | .83485 | False | | | 1.776 | 26.919 | .087 |
| Full – Empty | male | 18 | 3.3889 | .91644 | True | 2.365 | .135 | 1.530 | 28 | .137 |
| | female | 12 | 2.9167 | .66856 | False | | | 1.630 | 27.697 | .114 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Interesting – Boring | male | 18 | 2.1667 | 1.24853 | True | 1.962 | .172 | -.201 | 28 | .842 |
| | female | 12 | 2.2500 | .86603 | False | | | -.216 | 27.919 | .831 |
| **Happy – Unhappy** | male | 18 | 2.5000 | .85749 | True | 7.132 | .012 | -2.109 | 28 | .044 |
| | female | 12 | 3.0833 | .51493 | False | | | -2.325 | 27.796 | .028 |
| Likable – Dislikable | male | 18 | 2.5000 | 1.09813 | True | 1.909 | .178 | -.892 | 28 | .380 |
| | female | 12 | 2.8333 | .83485 | False | | | -.943 | 27.412 | .354 |
| Exciting – Dull | male | 18 | 1.9444 | 1.21133 | True | 1.523 | .227 | -.142 | 28 | .888 |
| | female | 12 | 2.0000 | .73855 | False | | | -.156 | 27.858 | .877 |
| Good – Bad | male | 18 | 2.2778 | .89479 | True | .123 | .729 | -.185 | 28 | .855 |
| | female | 12 | 2.3333 | .65134 | False | | | -.197 | 27.710 | .846 |
| **Complex – Simple** | male | 18 | 3.0556 | .93760 | True | 1.025 | .320 | -2.142 | 28 | .041 |
| | female | 12 | 3.7500 | .75378 | False | | | -2.239 | 26.886 | .034 |
| Rapid – Slow | male | 18 | 2.7778 | .87820 | True | .058 | .812 | -.656 | 28 | .517 |
| | female | 12 | 3.0000 | .95346 | False | | | -.645 | 22.338 | .525 |
| Active – Passive | male | 18 | 3.0556 | .80237 | True | .353 | .557 | -.413 | 28 | .683 |
| | female | 12 | 3.1667 | .57735 | False | | | -.441 | 27.772 | .663 |
| Showy – Quiet | male | 18 | 3.8333 | .70711 | True | .211 | .649 | 1.396 | 28 | .174 |
| | female | 12 | 3.5000 | .52223 | False | | | 1.483 | 27.622 | .149 |
| Sharp – Blunt | male | 18 | 3.0556 | .63914 | True | 2.407 | .132 | 1.497 | 28 | .146 |
| | female | 12 | 2.6667 | .77850 | False | | | 1.437 | 20.437 | .166 |

### 4.3 One-way Between-groups Analysis of Variance for Response Time

A one-way between-groups analysis of variance was conducted to explore the impact of response time on the evaluation of gaze interaction. Participants were divided into three groups according to which kind of response time they had experienced (Group 100ms; Group 300ms; Group 600ms). The result of this analysis was showed in Table 3.

According to Table 3, there was no significant difference in the score of any adjective pair for three groups. Thus in the experiment, we can't determine if the response time has effect on the evaluation of gaze interaction.

Table 3 ANOVA for Response Time

| ANOVA | | | | | | |
|---|---|---|---|---|---|---|
| | | Sum of Squares | df | Mean Square | F | Sig. |
| Kind – Cruel | Between Groups | 2.600 | 2 | 1.300 | 1.340 | .279 |
| | Within Groups | 26.200 | 27 | .970 | | |
| | Total | 28.800 | 29 | | | |
| Favorable – Unfavorable | Between Groups | 3.267 | 2 | 1.633 | 2.423 | .108 |
| | Within Groups | 18.200 | 27 | .674 | | |
| | Total | 21.467 | 29 | | | |
| Friendly – Unfriendly | Between Groups | 1.867 | 2 | .933 | .735 | .489 |
| | Within Groups | 34.300 | 27 | 1.270 | | |
| | Total | 36.167 | 29 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Safe – Dangerous | Between Groups | 1.400 | 2 | .700 | .808 | .456 |
| | Within Groups | 23.400 | 27 | .867 | | |
| | Total | 24.800 | 29 | | | |
| Pretty – Ugly | Between Groups | .467 | 2 | .233 | .700 | .505 |
| | Within Groups | 9.000 | 27 | .333 | | |
| | Total | 9.467 | 29 | | | |
| Distinct – Vague | Between Groups | .467 | 2 | .233 | .168 | .846 |
| | Within Groups | 37.400 | 27 | 1.385 | | |
| | Total | 37.867 | 29 | | | |
| Accessible – Inaccessible | Between Groups | .600 | 2 | .300 | .393 | .679 |
| | Within Groups | 20.600 | 27 | .763 | | |
| | Total | 21.200 | 29 | | | |
| Altruistic – Selfish | Between Groups | 1.400 | 2 | .700 | 1.734 | .196 |
| | Within Groups | 10.900 | 27 | .404 | | |
| | Total | 12.300 | 29 | | | |
| Humanlike – Mechanical | Between Groups | 1.800 | 2 | .900 | .900 | .418 |
| | Within Groups | 27.000 | 27 | 1.000 | | |
| | Total | 28.800 | 29 | | | |
| Full – Empty | Between Groups | 1.400 | 2 | .700 | .974 | .390 |
| | Within Groups | 19.400 | 27 | .719 | | |
| | Total | 20.800 | 29 | | | |
| Interesting – Boring | Between Groups | 1.400 | 2 | .700 | .566 | .574 |
| | Within Groups | 33.400 | 27 | 1.237 | | |
| | Total | 34.800 | 29 | | | |
| Likable – Dislikable | Between Groups | .867 | 2 | .433 | .416 | .664 |
| | Within Groups | 28.100 | 27 | 1.041 | | |
| | Total | 28.967 | 29 | | | |
| Exciting – Dull | Between Groups | 1.867 | 2 | .933 | .866 | .432 |
| | Within Groups | 29.100 | 27 | 1.078 | | |
| | Total | 30.967 | 29 | | | |
| Good – Bad | Between Groups | .200 | 2 | .100 | .149 | .862 |
| | Within Groups | 18.100 | 27 | .670 | | |
| | Total | 18.300 | 29 | | | |
| Rapid – Slow | Between Groups | 1.067 | 2 | .533 | .643 | .534 |
| | Within Groups | 22.400 | 27 | .830 | | |
| | Total | 23.467 | 29 | | | |
| Active – Passive | Between Groups | .200 | 2 | .100 | .186 | .831 |
| | Within Groups | 14.500 | 27 | .537 | | |
| | Total | 14.700 | 29 | | | |
| Showy – Quiet | Between Groups | .600 | 2 | .300 | .692 | .509 |
| | Within Groups | 11.700 | 27 | .433 | | |
| | Total | 12.300 | 29 | | | |
| Sharp – Blunt | Between Groups | .800 | 2 | .400 | .777 | .470 |
| | Within Groups | 13.900 | 27 | .515 | | |
| | Total | 14.700 | 29 | | | |

### 4.4 Analysis for Awareness of Gaze Interaction

In the questionnaire of this experiment, except the evaluation part using SD method, I also appended one more question to ask if the participants were aware of the gaze interaction. In 30 participants, there were 4 participants who answered “Clearly Aware”, 7 “Vaguely Aware”, and 19 “Not Aware at all”. The detail of the awareness condition in each group is showed in Table 4. In this section, we’re going to analyze how the awareness affects the evaluation of gaze interaction.

Table 4 The distribution of awareness

| | Clearly Aware (people) | Vaguely Aware (people) | Not Aware at all (people) |
|---|---|---|---|
| Group 100ms | 3 | 0 | 7 |
| Group 300ms | 0 | 4 | 6 |
| Group 600ms | 1 | 3 | 6 |

A one-way between-groups analysis of variance was conducted to explore the impact of response time (100ms, 300ms, and 600ms) on the awareness of gaze interaction. The result of this analysis was showed in Table 5. According to Table 5, we can see there was no significant difference in the awareness for three groups. Thus in this experiment, we cannot determine if the response time has effect on the awareness of gaze interaction.

Table 5 ANOVA for response time on the awareness of gaze interaction

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | .200 | 2 | .100 | .176 | .839 |
| Within Groups | 15.300 | 27 | .567 | | |
| Total | 15.500 | 29 | | | |

Then we analyzed the relationship between awareness and evaluation of gaze interaction. In older to clear the condition of awareness and unawareness, we exclude the evaluation from the participants who answered “Vaguely Aware”. The result of this analysis is showed in Table 6.

An Independent-samples t-test was conducted to compare the scores of adjective pairs for awareness and unawareness. There was statistically significant difference at the $p < .05$ level in the scores of adjective pair, “Humanlike – Mechanical”, for awareness ($M = 2.25$, $SD = 0.96$) and female ($M = 3.5$, $SD = 0.92$), $t(20) = -2.435$, $p = 0.024$ (two-tailed).

Table 6 The result of independent-samples t-test for awareness and unawareness

| | **Group Statistics** | | | | **Independent Samples Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Aware | N | Mean | Std. Deviation | Equal variances assumed | Levene's Test for Equality of Variances | | t-test for Equality of Means | | |
| | | | | | | F | Sig. | t | df | Sig. (2-tailed) |
| Kind – Cruel | yes | 4 | 2.2500 | .95743 | true | .106 | .748 | .338 | 20 | .739 |
| | no | 18 | 2.0556 | 1.05564 | False | | | .360 | 4.778 | .734 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Favorable – Unfavorable | yes | 4 | 2.0000 | .81650 | True | .725 | .405 | -.946 | 20 | .355 |
| | no | 18 | 2.4444 | .85559 | False | | | -.976 | 4.594 | .378 |
| Friendly – Unfriendly | yes | 4 | 2.5000 | 1.00000 | true | .551 | .466 | -.410 | 20 | .686 |
| | no | 18 | 2.7778 | 1.26284 | False | | | -.477 | 5.384 | .652 |
| Safe – Dangerous | yes | 4 | 1.5000 | .57735 | True | 2.343 | .142 | -.582 | 20 | .567 |
| | no | 18 | 1.8333 | 1.09813 | False | | | -.860 | 8.763 | .413 |
| Pretty – Ugly | yes | 4 | 3.2500 | .50000 | True | .110 | .743 | 1.578 | 20 | .130 |
| | no | 18 | 2.7778 | .54832 | False | | | 1.678 | 4.758 | .157 |
| Distinct – Vague | yes | 4 | 2.2500 | .95743 | True | .669 | .423 | -1.304 | 20 | .207 |
| | no | 18 | 3.1111 | 1.23140 | False | | | -1.538 | 5.480 | .180 |
| Accessible – Inaccessible | yes | 4 | 2.0000 | .81650 | True | .952 | .341 | -1.479 | 20 | .155 |
| | no | 18 | 2.7222 | .89479 | False | | | -1.572 | 4.755 | .180 |
| Altruistic – Selfish | yes | 4 | 2.2500 | .95743 | True | 2.940 | .102 | -1.523 | 20 | .143 |
| | no | 18 | 2.7778 | .54832 | False | | | -1.064 | 3.450 | .356 |
| Humanlike – Mechanical | yes | 4 | 2.2500 | .95743 | True | .012 | .913 | -2.435 | 20 | .024 |
| | no | 18 | 3.5000 | .92355 | False | | | -2.377 | 4.336 | .071 |
| Full – Empty | yes | 4 | 2.7500 | .50000 | True | 1.908 | .182 | -1.333 | 20 | .197 |
| | no | 18 | 3.3889 | .91644 | False | | | -1.934 | 8.332 | .088 |
| Interesting – Boring | yes | 4 | 1.7500 | .95743 | True | .394 | .537 | -1.298 | 20 | .209 |
| | no | 18 | 2.5556 | 1.14903 | False | | | -1.465 | 5.135 | .201 |
| Likable – Dislikable | yes | 4 | 2.2500 | .50000 | True | .724 | .405 | -1.076 | 20 | .295 |
| | no | 18 | 2.8333 | 1.04319 | False | | | -1.664 | 9.965 | .127 |
| Exciting – Dull | yes | 4 | 1.7500 | .95743 | True | .045 | .834 | -.567 | 20 | .577 |
| | no | 18 | 2.1111 | 1.18266 | False | | | -.652 | 5.272 | .542 |
| Good – Bad | yes | 4 | 2.0000 | .81650 | True | .331 | .572 | -1.062 | 20 | .301 |
| | no | 18 | 2.5000 | .85749 | False | | | -1.098 | 4.602 | .326 |
| Rapid – Slow | yes | 4 | 2.5000 | 1.00000 | True | .067 | .798 | -.981 | 20 | .338 |
| | no | 18 | 3.0000 | .90749 | False | | | -.919 | 4.174 | .408 |
| Active – Passive | yes | 4 | 3.0000 | 0.00000 | True | 4.722 | .042 | -.416 | 20 | .682 |
| | no | 18 | 3.1667 | .78591 | False | | | -.900 | 17.000 | .381 |
| Showy – Quiet | yes | 4 | 3.5000 | .57735 | True | .286 | .599 | -.707 | 20 | .488 |
| | no | 18 | 3.7778 | .73208 | False | | | -.826 | 5.405 | .444 |
| Sharp – Blunt | yes | 4 | 3.5000 | .57735 | True | .112 | .742 | 1.595 | 20 | .126 |
| | no | 18 | 2.9444 | .63914 | False | | | 1.706 | 4.794 | .151 |

## 5. Discussion

Based on the results, we have few points to discuss:

◆ Response Time VS. Evaluation of Gaze Interaction VS. Awareness

According to the result of one-way between-groups analysis of variance for response time, there was no significant difference in the score of any adjective pair for three different response time groups. In assumption, we supposed that the gaze interaction with short response time would have better evaluation than the long one. However, it cannot be verified in this experiment. One of the reason caused the result is considered to be the unawareness to gaze interaction. More than half of participants do not aware the gaze tracking during interaction. And from the result of analysis for awareness of gaze interaction, it does not show the better ability to be aware in short response time. Therefore, the participants might not notice the delay of response. And since the delay of response is not noticed, the evaluation of gaze interaction would not show differences from different response time.

◆ The difference between the evaluation of awareness and unawareness

From Table 6, we have known that there was statistically significant difference in adjective pair, "Humanlike – Mechanical", for awareness and unawareness. And also the evaluation of awareness has small mean score that means when gaze interaction being noticed the gaze interaction has more humanlike impression. This is a reasonable result since the idea of gaze interaction with machine is from the characteristic "eye contact" of people, and if participants did not notice the gaze interaction, the gaze interaction they have are unconscious thus they have less humanlike impression. In this experiment, I did not use humanoid design, however, having the interact-ability with human characteristic does give people the impression of humanlike.

◆ Effect of using the developed interface to participants' impression

At the end of this experiment, many participants were surprised when they were told that the video they watched was actually not a video but a gaze interaction interface. We wanted to make the participants have more natural experience of gaze interaction by concealing gaze interaction in the prior explanation of experiment. However, participants did not have experience of interacting with machine by gaze, it was hard for them to associate this experiment to gaze interaction.

From the results of this experiment, the availability of applying this human-machine interface based on the Gaze Catching System is not clearly verified. Since the most unawareness, the evaluations from participants are not all in a conscious interacting situation. But we want to use this developed system to construct a two-way interaction between human and machine, the current interface is not able to reach the target. It needs to improve the design of the interface based on the Gaze Catching System.

◆ Problems of developed interface

The low accuracy of the gaze tracking program might be one of the reasons of the unawareness. The TrackEye program has the advantage that it only needs simple equipment which makes it easy to be used. The source code of Trackeye is open that allow other users to add another function they want base on the eye-tracking system. But accompany with the advantage, the disadvantage of low accuracy is unavoidable. Improve the arrangement of experiment and the accuracy of program would be the lesson before next research.

## 6. Conclusion

From the experiment results, the most unawareness of participants made the availability of applying the human-machine interface based on the Gaze Catching System is not clearly verified. To use the developed system to construct a two-way interaction between human and machine, it needs to improve the design of the interface.

However, the efficiency of the interfaces was examined by subjective kansei evaluation methods. The factor of response time was not seen to have effect on gaze interaction, while Awareness of gaze interaction would bring more humanlike impression. This research was considered to be the indispensable basic research for constructing a new human-machine interface based on the Gaze Catching System in the future.

## 7. Reference


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