

Study of the implementability of tactile feedback while operating touch panel device

-From two directions of efficacy & feasibility-

Kyoto Institute of Technology
Jien wakasugi
Masayoshi Kubo

Table of Contents

Background of study · Previous study

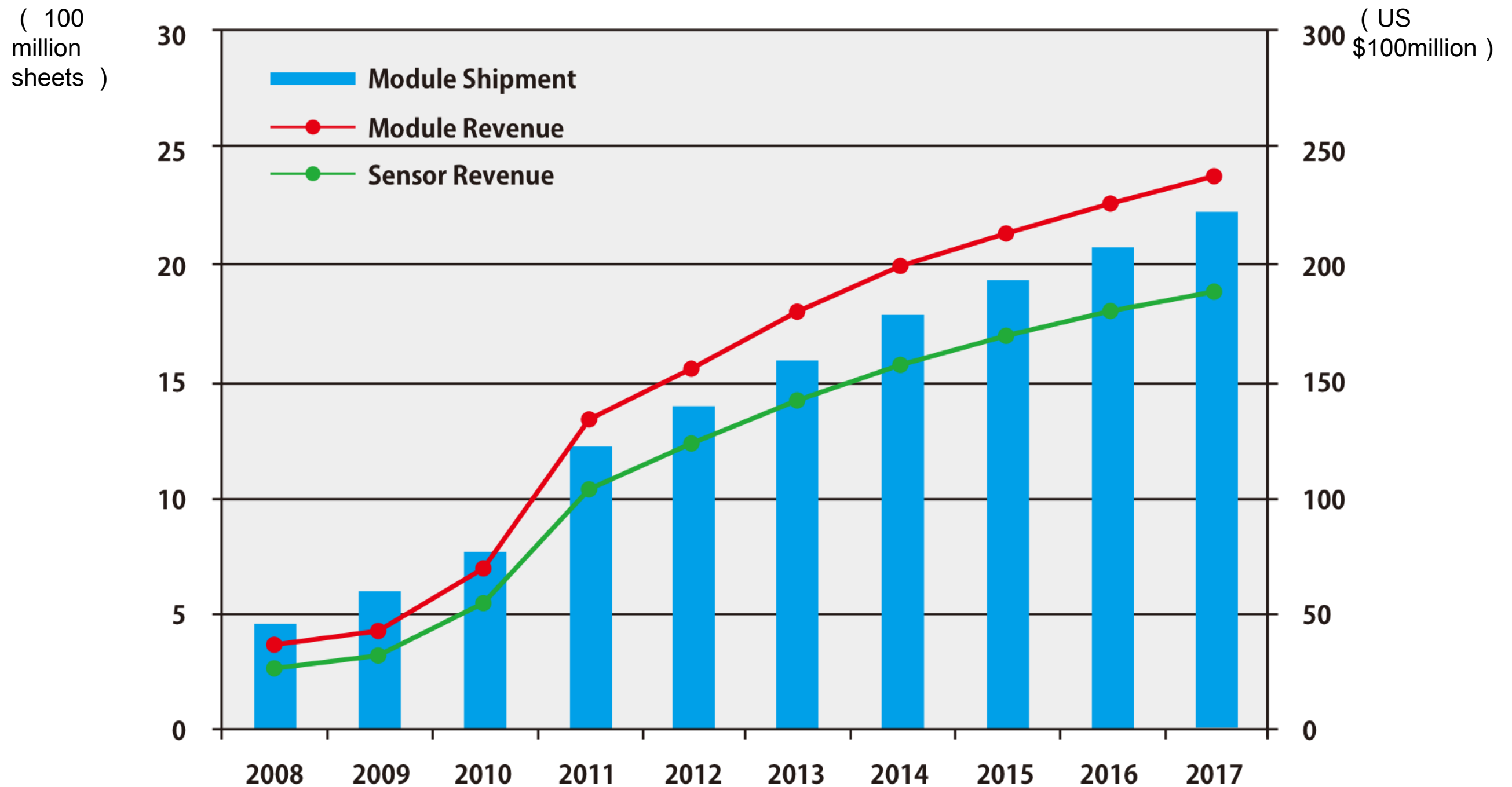
Research method

Research analysis

Discussion · Conclusion

1. Back ground of study

Penetration and Generalization of Touch Panel



1. Back ground of study

Penetration and Generalization of Touch Panel

A user interface without a physical clue

In the HCI field, the importance of feedback is suggested.

Haptic feedback does not have many patterns,
and opportunities to use are limited.

1. Back ground of study

About tactile (vibration) feedback

In case of electrostatic capacity type, it detects change of electrostatic capacitance

Give users a simulated experience of "touched" by vibration



Applicable to various physical environments such as sitting and walking

1. Back ground of study

About tactile (vibration) feedback

The current haptic feedback

The range of **monotonous** pattern expression is small.

It was **similar** in different situations and gestures

2. Previous study

The influence of various vibration feedback on smartphone on user's impression

Collect user-defined vibration patterns
Impression evaluation of vibration pattern

- The vibration pattern consists of 4 elements.
- **The intensity of vibration** gives a cheerful impression or an unpleasant impression.
- Vibration displacement which is flat and strong vibration gives a heavy impression.

2. Previous study

Text communication system with force sensation

Proposal and evaluation of "HAPPicom"

You can get haptic feedback by placing the haptic device on your fingers.

You could be attached **emotion / emotion expression / scene portrayal information** to sentences such as stories and e-mails using haptic feedback.

Quotations: Rina Tamura, Shogo Okada, Takao Nishigaki, Katsumi Nitta (2014)
"Proposal and Evaluation of Haptic Text Communication System" HAPPicom "
"Journal of Artificial Intelligence Society" Vol. 30 (2015) No. 2 General paper /
Special feature papers on 2014 conference papers p. 417 - 428.

Hypothesis

A specific image can be given by tactile sense.

Experimental Process

- ① Collection and convergence of various haptic feedback patterns
-
- ② Impression evaluation of haptic feedback pattern collected

3. Research method

① Collection and convergence of various haptic feedback patterns

Outline of experiment

Target: 5 young healthy men

Period: December 5 - 9, 2016

Place: Kyoto Institute of Technology No.1 Tate

Equipment: microcomputer board, module, vibration motor, PC, IDE

3. Research method

Flow of experiment - Collection of vibration patterns -

Joy	Heart is light, bright ,pleasant. Feelings become bright
Anger	Get angry. Tired.
Fear	It's cold. Scared.
Peace	Relieve. Heart gets loose

3. Research method

Flow of experiment

Pattern explanation of joy, anger, fear, and peace

Operation practice (10 minutes)

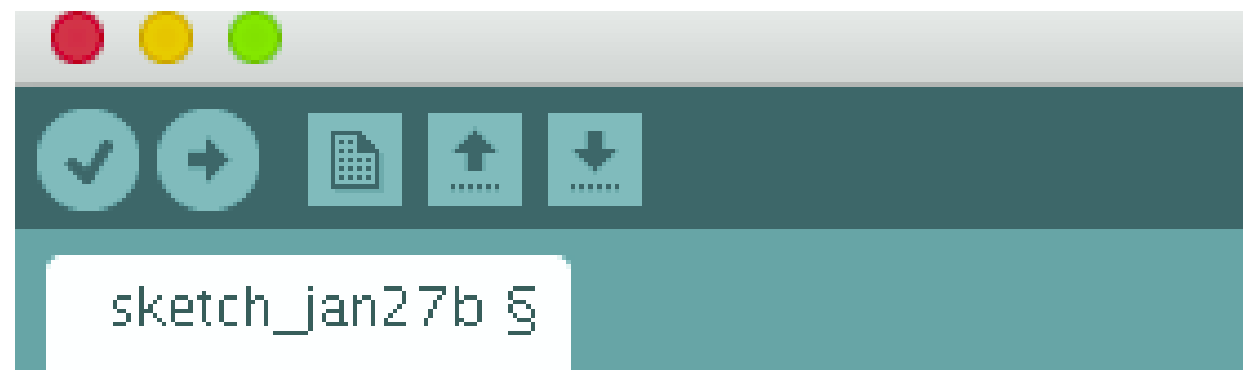
Create joy pattern

Create anger pattern

Create fear pattern

Create peace pattern

3. Research method



```
#include <Wire.h>
#include "Adafruit_DRV2605.h"
```

```
int num[] = {Enter command};
```

```
Adafruit_DRV2605 drv;
```

```
void setup() {
  Serial.begin(9600);
  Serial.println("DRV test");
  drv.begin();
```

```
  drv.selectLibrary(1);
```

```
  drv.setMode(DRV2605_MODE_INTTRIG);
}
```

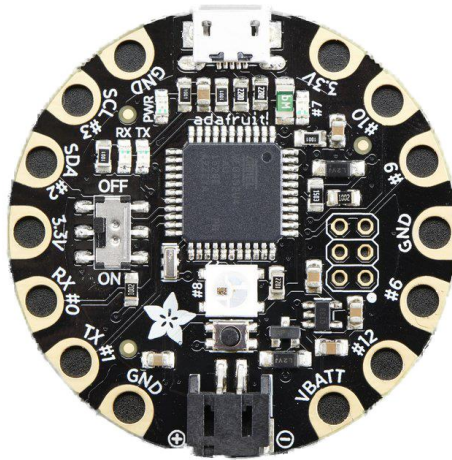
Enter command

Ex; int num[] = {3, 5};

Initial setting
Vibration interval is 1 second₁₄

3. Research method

Flow of experiment - Collection of vibration patterns -



Product name :

FLORA (Made by Adafruit)

Battery input	3.5-16V
USB input	4.5-5.5V
Clock speed	8mHz
Power consumption	8mA



Product name :

DRV2605L Haptic feedback Module
(Made by Adafruit)

Shared voltage	max 5.5V, min 2.5V
PWM	max 250kHz, min 10kHz
Load impedance(5.2V)	min 8Ω

It can be used with ERM (eccentric motor) and LRA (linear vibration motor)

3. Research method

Flow of experiment - Collection of vibration patterns -

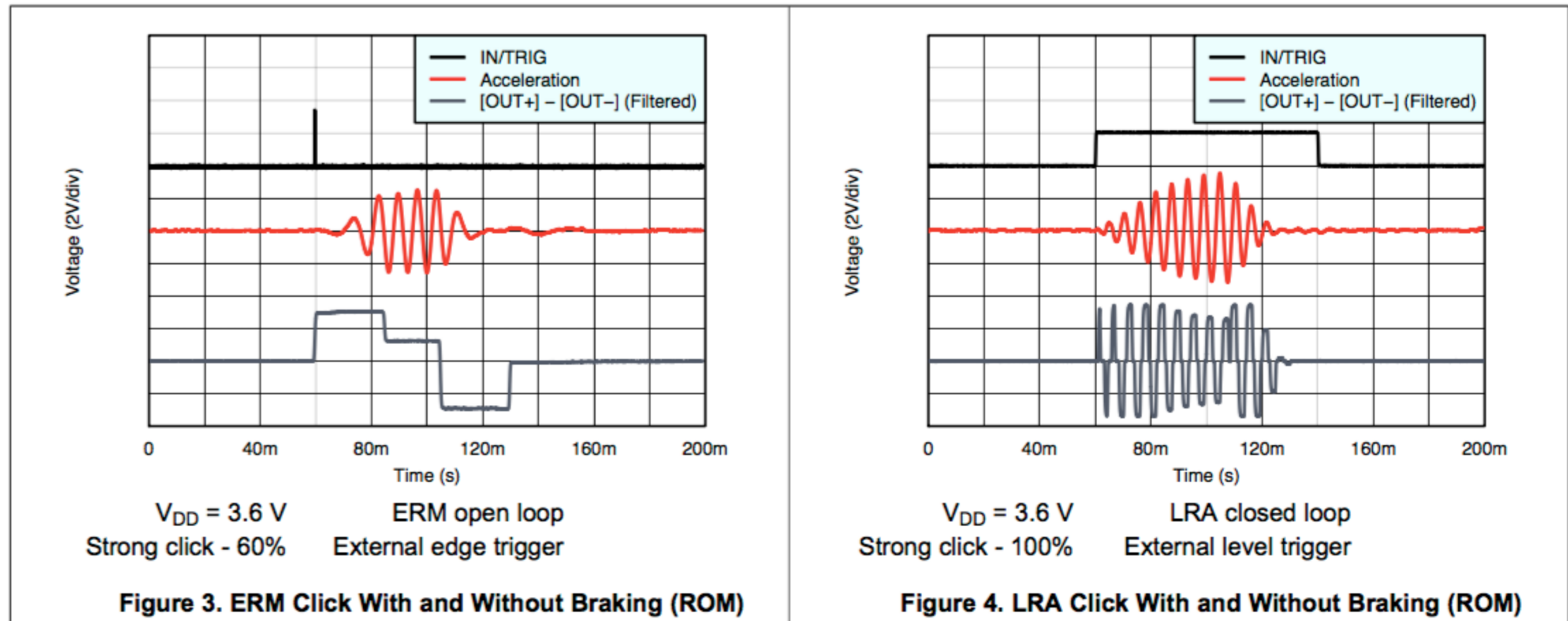


Fig 3-1 Characteristics of DRV 2605L

3. Research method

Flow of experiment - Collection of vibration patterns -

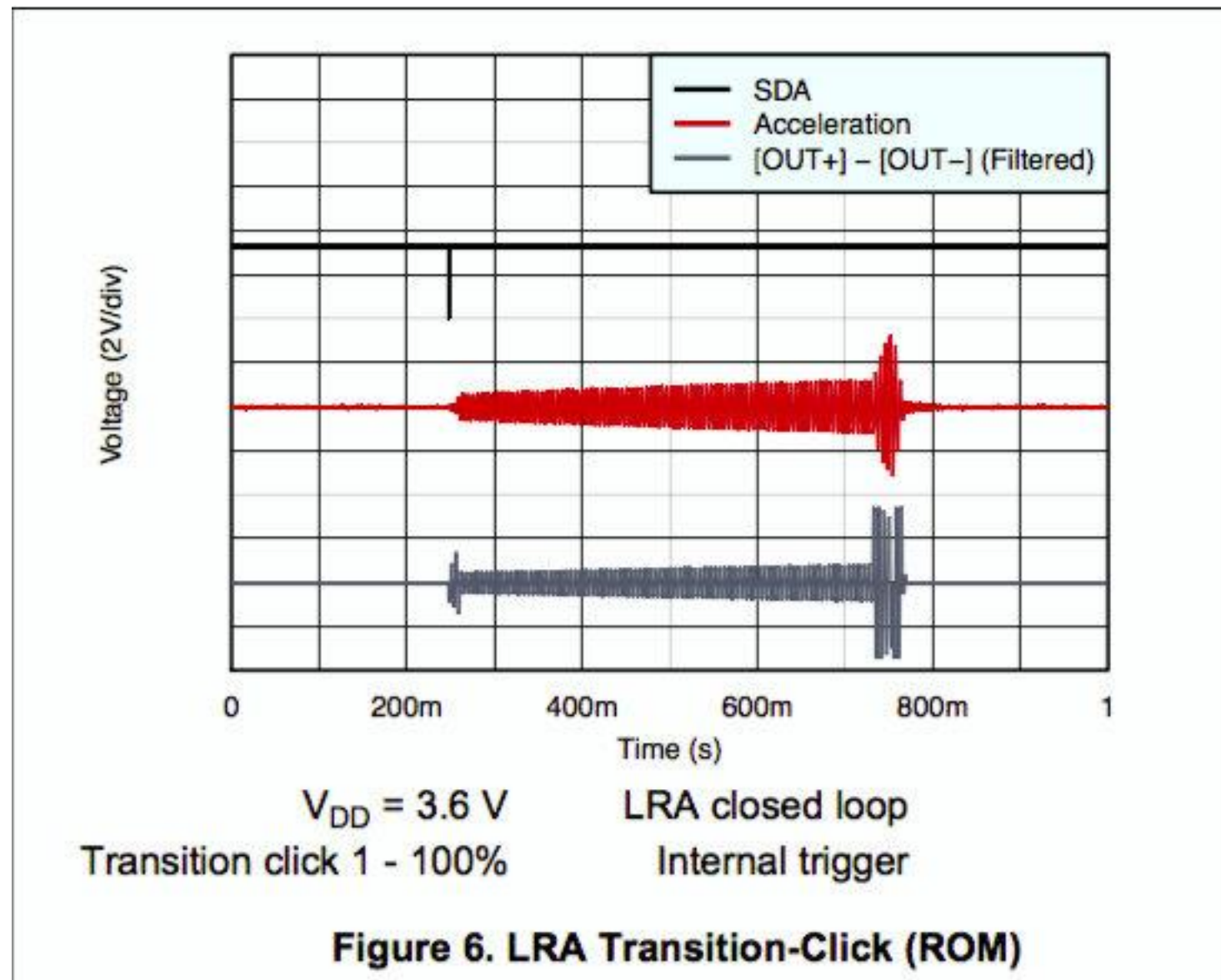


Fig3-2 Characteristics of DRV 2605L

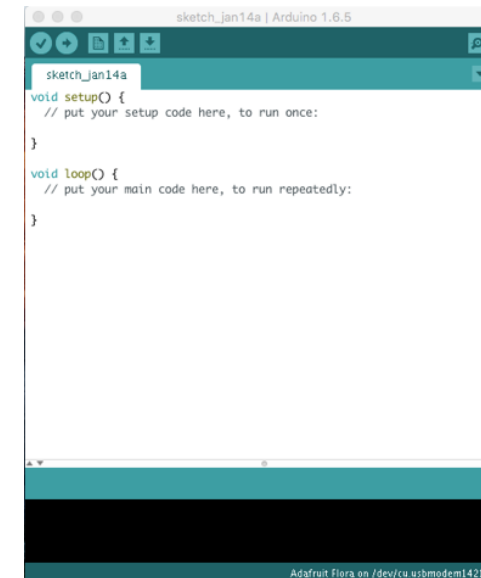
3. Research method

Flow of experiment - Collection of vibration patterns -



Product name : Vibration motor
(Made by Adafruit)

Operating voltage	2V-5V
Rotation speed	1100rpm(5V)
Power consumption	5V:100mA, 4V:80mA, 3V:60mA, 2V:40mA
Size	Diameter 10mm, thickness 2.7mm, weight 0.9g

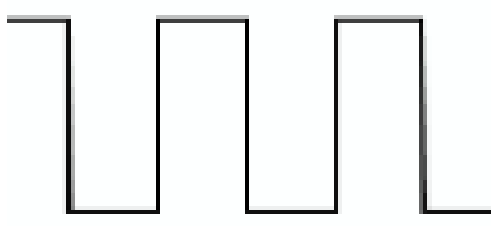


Product name : Arduino IDE
(Made by Arduino, LLC)

Used library	Adafruit DRV2605
Supported OS	Windows, mac etc

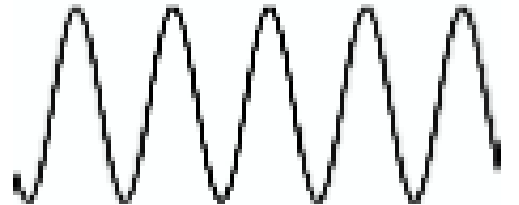
3. Research method

Flow of experiment - Collection of vibration patterns -

	Name	Program number	
1	Strong Click	1	Constant
2	Sharp Click	4	
3	Soft Bump	7	
4	Double Click	10	
5	Triple Click	2	
6	Medium Click	21	
7	Sharp Tick	24	
8	Short Double Click Strong	27	
9	Short Double Click Medium	31	
10	Short Double Sharp Tick	34	
11	Long Double Sharp Click Strong	37	
12	Long Double Sharp Click Medium	41	
13	Long Double Sharp Tick	44	

3. Research method

Flow of experiment - Collection of vibration patterns -

	Name	Program number	
14	Soft Fuzz	13	Continuous
15	Strong Buzz	14	
16	750ms Alert	15	
17	Buzz	47	
18	Transition Click	58	
19	Transition Hum	64	
20	Pulsing Strong	52	
21	Pulsing Medium	54	
22	Pulsing Sharp	56	
23	Long buzz for programmatic stoping	118	
24	Smooth Hum	119	

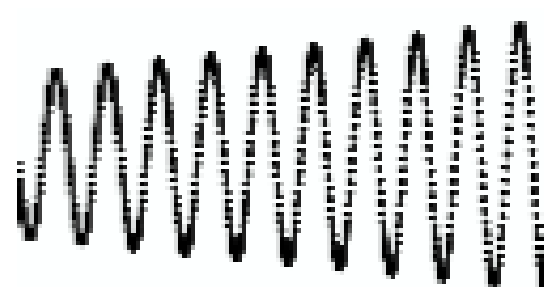
3. Research method

Flow of experiment - Collection of vibration patterns -

	Name	Program number	
25	Transition Ramp Down Long Smooth	70, 94	Continuous(descent) 
26	Transition Ramp Down Medium Smooth	72, 96	
27	Transition Ramp Down Short Smooth	74, 98	
28	Transition Ramp Down Long Sharp	76, 100	
29	Transition Ramp Down Medium Sharp	78, 102	
30	Transition Ramp Down Short Sharp	80, 104	

3. Research method

Flow of experiment - Collection of vibration patterns -

	Name	Program number	
31	Transition Ramp Up Long Smooth	82, 106	Continuous(rising) 
32	Transition Ramp Up Medium Smooth	84, 108	
33	Transition Ramp Up Short Smooth	86, 110	
34	Transition Ramp Up Long Sharp	88, 112	
35	Transition Ramp Up Medium Sharp	90, 114	
36	Transition Ramp Up Short Sharp	92, 116	

3. Research method

② Impression evaluation of haptic feedback pattern collected

Outline of experiment

Target: 21 elderly people (11 males, 10 females),
12 students (8 men, 4 women)

Period: December 12 - 26, 2016

Place: Kyoto Institute of Technology 15, Tate 1

Equipment: microcomputer board, module,
Vibration motor, PC, IDE,
Model (PLA resin) 138 × 65 × 20 mm



Fig 3.1 Prototype

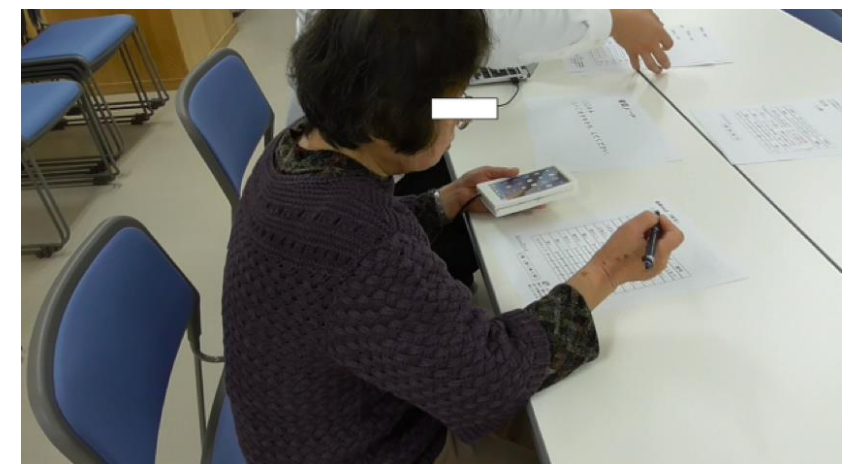


Fig 3.2 Experimental landscape

3. Research method

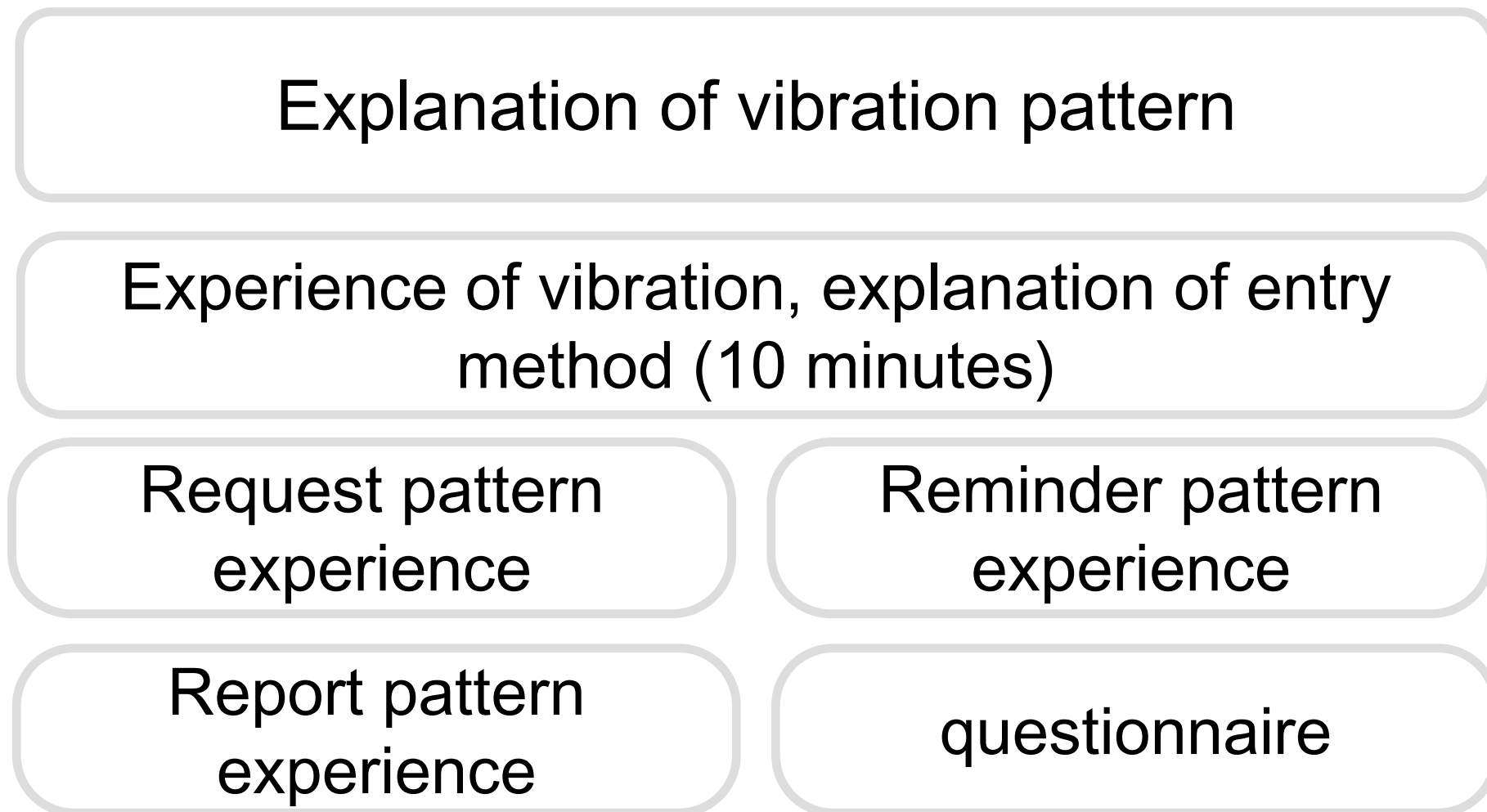
Flow of experiment

- Impression evaluation of vibration pattern -

Request	Please do it.
Reminder	Please hurry.
Report	I will report it.

3. Research method

Flow of experiment



*The order of experience is random

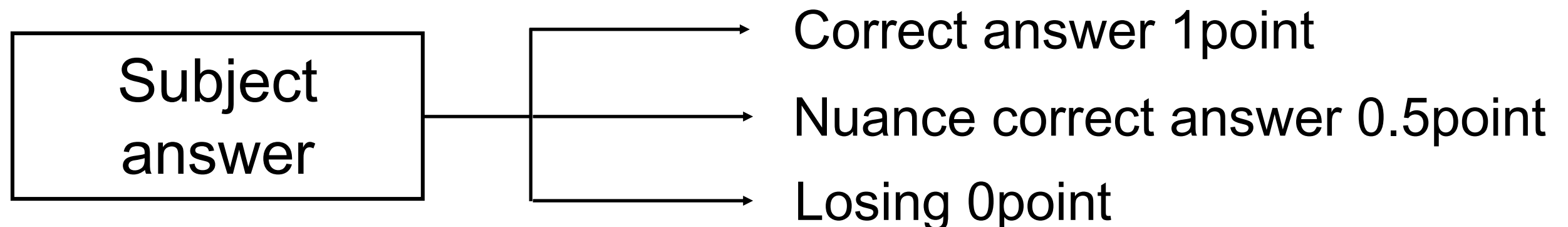
3. Research method

- Nuance -

☐ Joy ☐ Anger ☐ Fear ☐ Peace

Please tell me the impression when you receive mail and vibration.

Confirm whether it matches the creator's intention.



3. Research method

- Survey form -

Table 2.3.1 Impression Words and Nuances Used in the SD Method

1	Sad --- Cheerful
2	Unclearly --- Clearly
3	Dark --- Bright
4	Boring --- Fun
5	Uncomfortable --- Comfortable
6	feeble --- Powerful
7	Heavy---Light
8	Gentle --- Active
9	Cold --- Warm
10	Narrow --- Wide
11	Weak --- Strong
12	Negative - - Positive

3. Research method

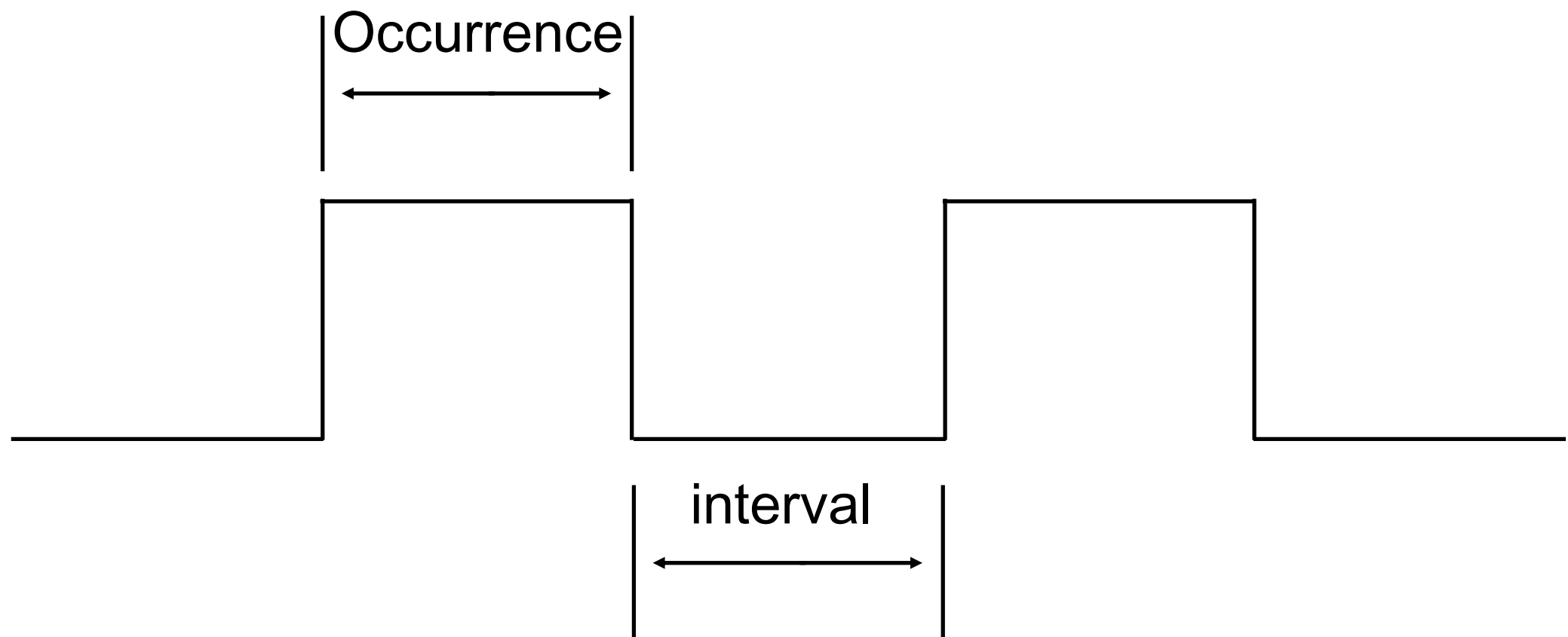
- Component -

Seconds [ms]	Time to generate vibration + interval (using delay)
Largest [%]	The number which the magnitude of the vibration from the command selected the maximum 100%.
Smallest [%]	The number of vibrations whose magnitude is not 0%, and vibration of 50% or less is selected from the command.
No vibration [%]	Number of patterns "0" that does not generate vibration from the command was selected.
Frequency [No]	The number of commands included in the created pattern.
Peak [No]	Number of vibrations divided in the section of command "0".

3. Research method

-Seconds [ms]-

Vibration is generated(ms) + interval(ms)



3. Research method - Largest -

EFFECT ID NO.	WAVEFORM NAME	EFFECT ID NO>	WAVEFORM NAME	E
1	Strong Click - 100%	42	Long Double Sharp Click Medium 2 – 80%	
2	Strong Click - 60%	43	Long Double Sharp Click Medium 3 – 60%	
3	Strong Click - 30%	44	Long Double Sharp Tick 1 – 100%	
4	Sharp Click - 100%	45	Long Double Sharp Tick 2 – 80%	
5	Sharp Click - 60%	46	Long Double Sharp Tick 3 – 60%	
6	Sharp Click - 30%	47	Buzz 1 – 100%	
7	Soft Bump - 100%	48	Buzz 2 – 80%	
8	Soft Bump - 60%	49	Buzz 3 – 60%	
9	Soft Bump - 30%	50	Buzz 4 – 40%	
10	Double Click - 100%	51	Buzz 5 – 20%	
11	Double Click - 60%	52	Pulsing Strong 1 – 100%	
12	Triple Click - 100%	53	Pulsing Strong 2 – 60%	
13	Soft Fuzz - 60%	54	Pulsing Medium 1 – 100%	
14	Strong Buzz - 100%	55	Pulsing Medium 2 – 60%	
15	750 ms Alert 100%	56	Pulsing Sharp 1 – 100%	

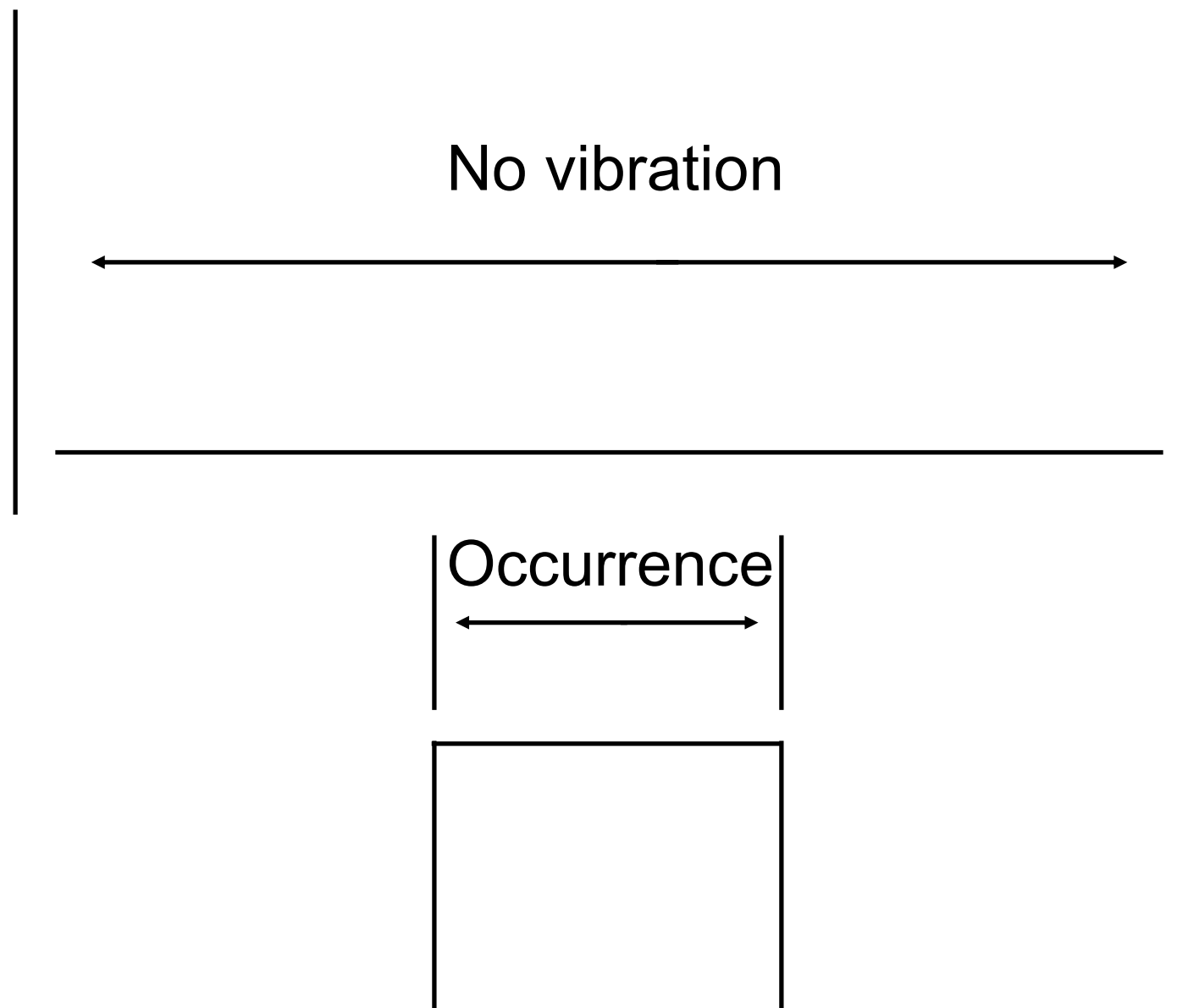
3. Research method - Smallest -

EFFECT ID NO.	WAVEFORM NAME	EFFECT ID NO>	WAVEFORM NAME	E
1	Strong Click - 100%	42	Long Double Sharp Click Medium 2 – 80%	
2	Strong Click - 60%	43	Long Double Sharp Click Medium 3 – 60%	
3	Strong Click - 30%	44	Long Double Sharp Tick 1 – 100%	
4	Sharp Click - 100%	45	Long Double Sharp Tick 2 – 80%	
5	Sharp Click - 60%	46	Long Double Sharp Tick 3 – 60%	
6	Sharp Click - 30%	47	Buzz 1 – 100%	
7	Soft Bump - 100%	48	Buzz 2 – 80%	
8	Soft Bump - 60%	49	Buzz 3 – 60%	
9	Soft Bump - 30%	50	Buzz 4 – 40%	
10	Double Click - 100%	51	Buzz 5 – 20%	
11	Double Click - 60%	52	Pulsing Strong 1 – 100%	
12	Triple Click - 100%	53	Pulsing Strong 2 – 60%	
13	Soft Fuzz - 60%	54	Pulsing Medium 1 – 100%	
14	Strong Buzz - 100%	55	Pulsing Medium 2 – 60%	
15	750 ms Alert 100%	56	Pulsing Sharp 1 – 100%	

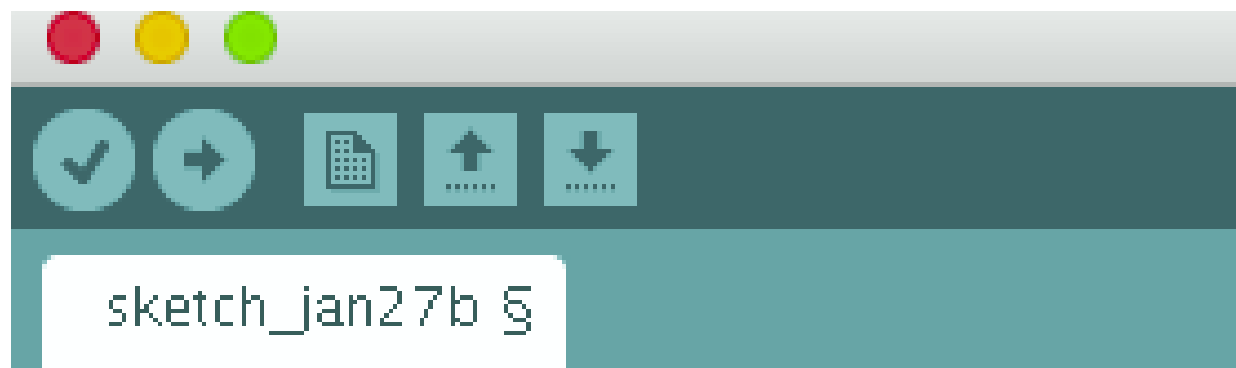
3. Research method - No vibration -

A pattern “0” which does not generate vibration from the command

Number selected



3. Research method - Frequency -



```
#include <Wire.h>
#include "Adafruit_DRV2605.h"
```

```
int num[] = {Enter command};
```

```
Adafruit_DRV2605 drv;
```

```
void setup() {
  Serial.begin(9600);
  Serial.println("DRV test");
  drv.begin();
```

```
  drv.selectLibrary(1);
```

```
  drv.setMode(DRV2605_MODE_INTTRIG);
```

```
}
```

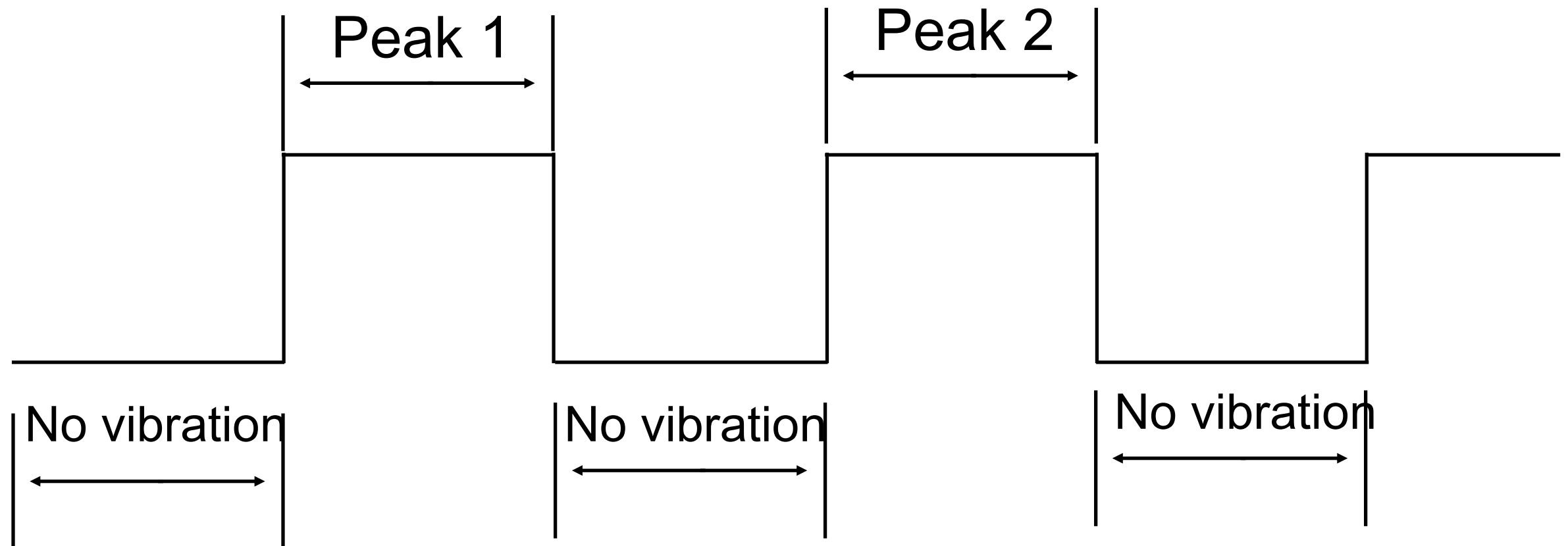
Function as array
Enter command

```
Ex;int num[] = {3, 5};
```

Initial setting
Vibration interval is 1 second

3. Research method - Peak -

Number of vibrations divided in the section of command "0"



Analysis Correlation between component and impression word

- Impression evaluation - Elderly (request)

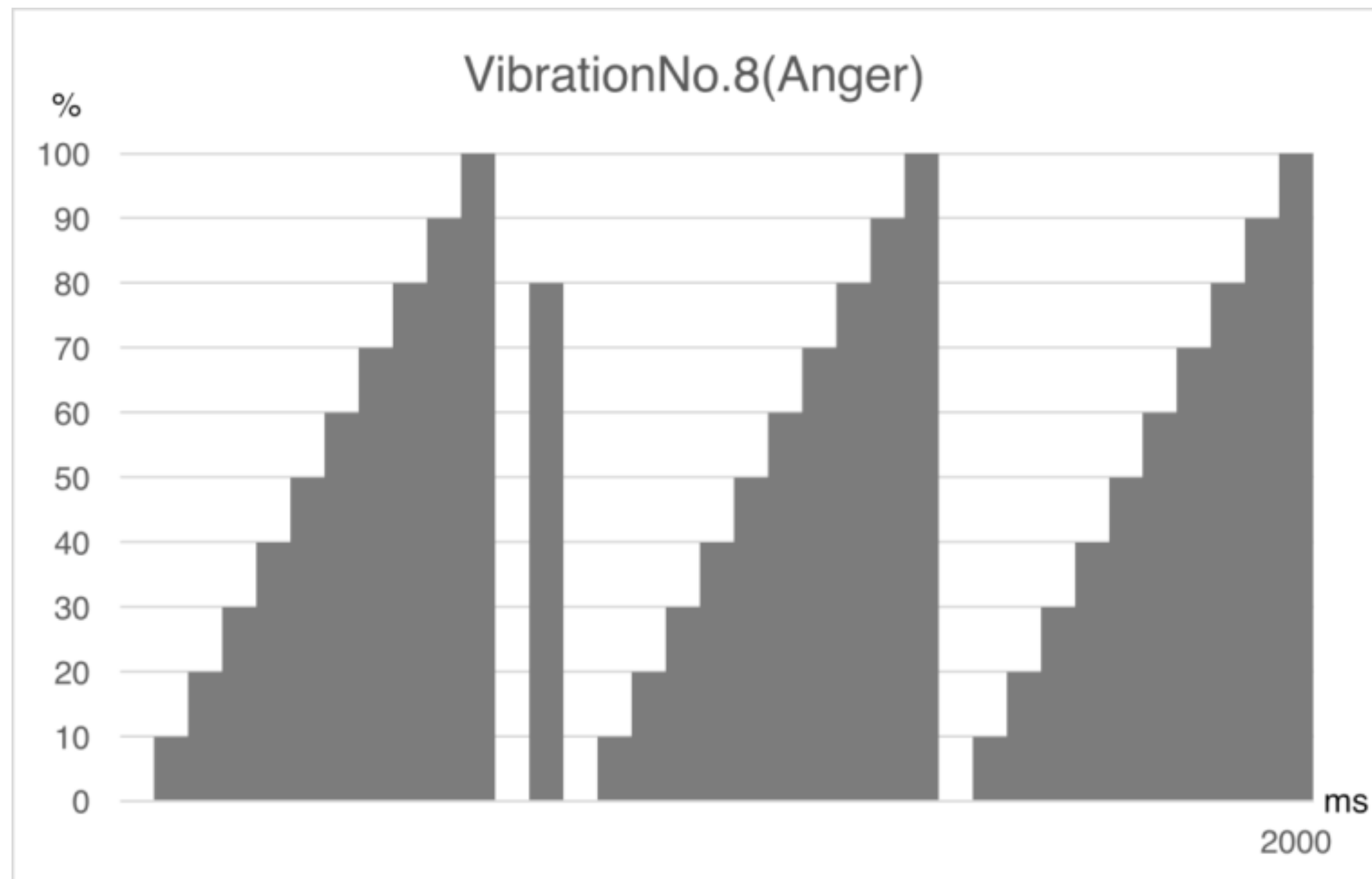
		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	-.231	-.216	-.225	-.225	-.321	-.252	.156	-.293	-.026	-.277	-.182	-.121
	有意確率 (両側)	.581	.608	.592	.591	.438	.547	.712	.482	.951	.507	.667	.776
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.498	-.491	-.516	-.476	-.440	-.468	.326	-.488	-.472	-.451	-.606	-.427
	有意確率 (両側)	.209	.217	.190	.233	.275	.243	.431	.220	.238	.262	.111	.291
	N	8	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.690	.714*	.717*	.688	.768*	.737*	-.832*	.675	.673	.779*	.651	.602
	有意確率 (両側)	.058	.047	.045	.059	.026	.037	.010	.067	.067	.023	.081	.114
	N	8	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.258	.268	.217	.343	.314	.306	.272	.332	.303	.270	.202	.395
	有意確率 (両側)	.537	.521	.605	.406	.448	.461	.514	.422	.465	.518	.632	.332
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.536	-.533	-.559	-.514	-.490	-.512	.310	-.567	-.429	-.490	-.648	-.467
	有意確率 (両側)	.171	.174	.150	.192	.218	.194	.454	.143	.289	.218	.082	.244
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.124	-.116	-.149	-.090	-.041	-.082	.002	-.135	-.060	-.055	-.261	-.071
	有意確率 (両側)	.770	.784	.725	.832	.924	.847	.997	.750	.887	.898	.533	.867
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	.251	.335	.287	.340	.359	.362	-.327	.303	.400	.368	.249	.366
	有意確率 (両側)	.548	.418	.491	.410	.383	.378	.429	.466	.326	.370	.552	.373
	N	8	8	8	8	8	8	8	8	8	8	8	8

Analysis Correlation between component and impression word

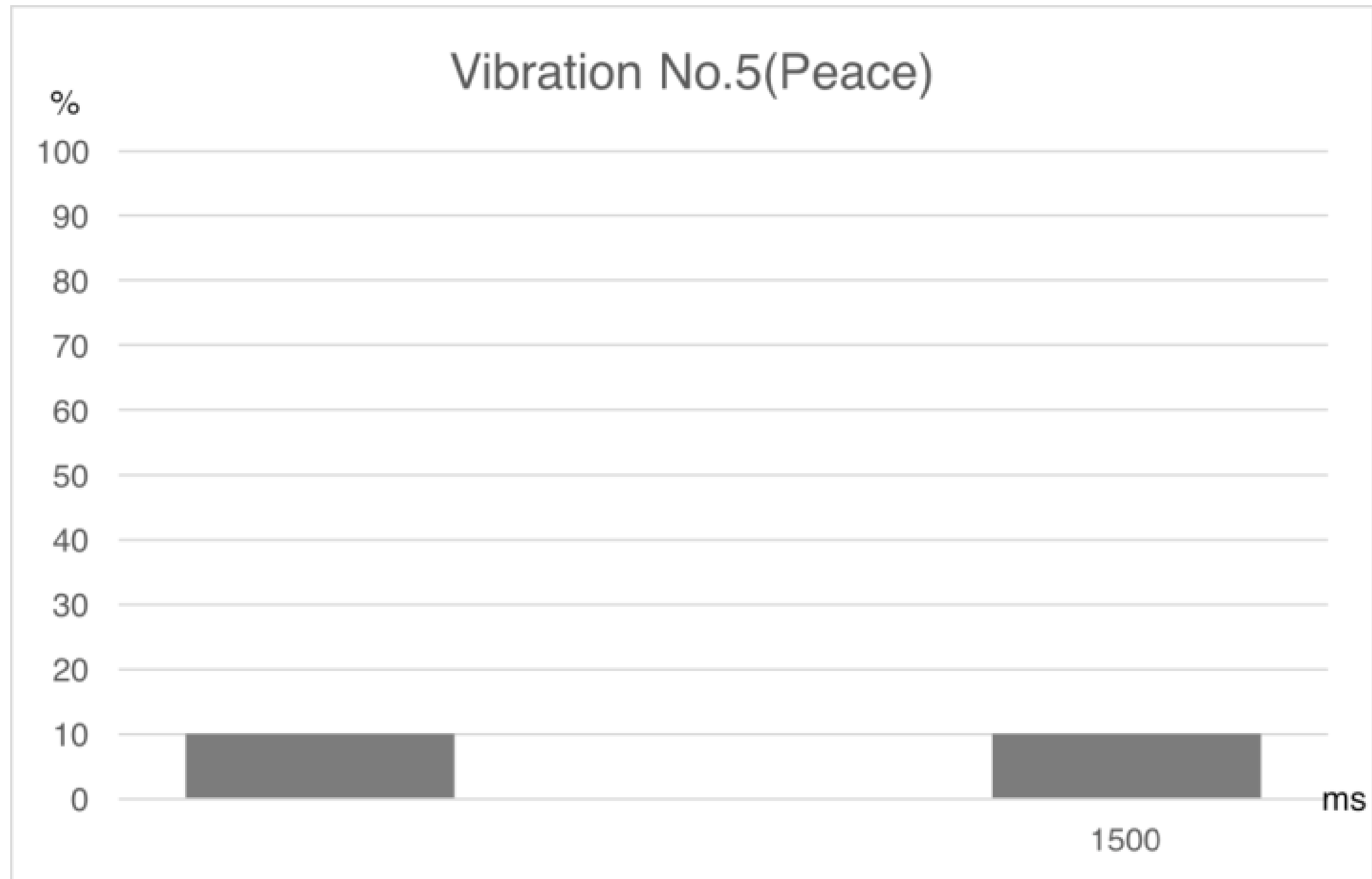
- Impression evaluation - Elderly (request)

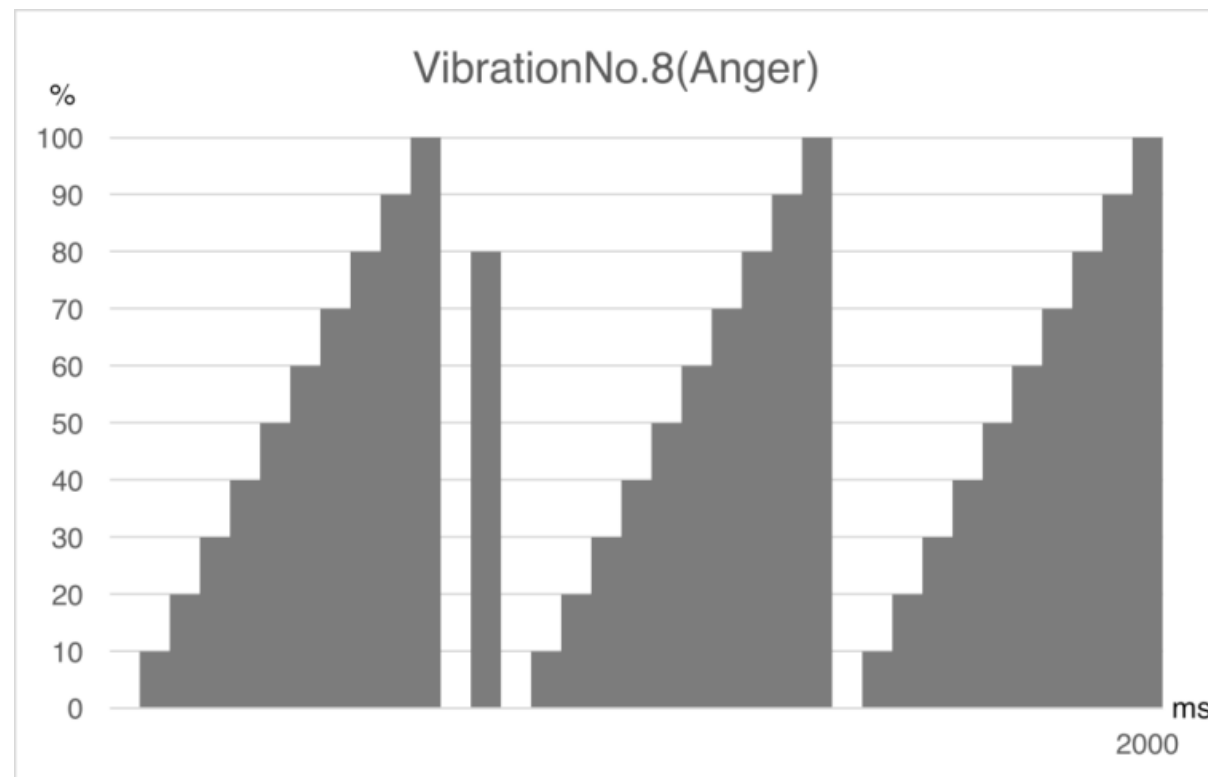
		陰気- 陽気	ぼんやり-はっ きり	暗い-明るい	つまらない-楽 しい	不快な-心地よ い	弱々しい-力強 い	軽い-重い	穏やか-活発	冷たい-あたた かい	狭い-広い	弱い-強い	ネガティブ-ポ ジティブ				
ニュアンス	Pearson の相関 係数	-. 231	-. 216	-. 225	-. 225	-. 321	-. 252	. 156	-. 293	-. 026	-. 277	-. 182	-. 121				
	有意確率（両側 ）	. 581	. 608	. 592	. 591	. 438	. 547	. 712	. 482	. 951	. 507	. 667	. 776				
	N	8	Unclearly --- Clearly		Dark --- Bright		Un comfortable - -- Comfortable		feeble --- Powerful		Heavy--- Light		Narrow --- Wide			8	
秒	Pearson の相関 係数	-. 498														6	-. 427
有意確率（両側 ）	. 209														1	. 291	
N	8														8		
最大	Pearson の相関 係数	-. 502	Largest		.714		-.717		.768		.737		-.832			. 602	
	有意確率（両側 ）														1	. 114	
	N														8		
最小	Pearson の相関 係数	. 258													. 268	. 217	. 343
有意確率（両側 ）	. 537	. 521	. 605	. 406	. 448	. 461	. 514	. 422	. 465	. 518	. 632	. 332					
N	8	8	8	8	8	8	8	8	8	8	8	8	8				
振動なし	Pearson の相関 係数	-. 536	-. 533	-. 559	-. 514	-. 490	-. 512	. 310	-. 567	-. 429	-. 490	-. 648	-. 467				
	有意確率（両側 ）	. 171	. 174	. 150	. 192	. 218	. 194	. 454	. 143	. 289	. 218	. 082	. 244				
	N	8	8	8	8	8	8	8	8	8	8	8	8				
振動数	Pearson の相関 係数	-. 124	-. 116	-. 149	-. 090	-. 041	-. 082	. 002	-. 135	-. 060	-. 055	-. 261	-. 071				
	有意確率（両側 ）	. 770	. 784	. 725	. 832	. 924	. 847	. 997	. 750	. 887	. 898	. 533	. 867				
	N	8	8	8	8	8	8	8	8	8	8	8	8				
peak	Pearson の相関 係数	. 251	. 335	. 287	. 340	. 359	. 362	-. 327	. 303	. 400	. 368	. 249	. 366				
	有意確率（両側 ）	. 548	. 418	. 491	. 410	. 383	. 378	. 429	. 466	. 326	. 370	. 552	. 373				
	N	8	8	8	8	8	8	8	8	8	8	8	8				

Analysis

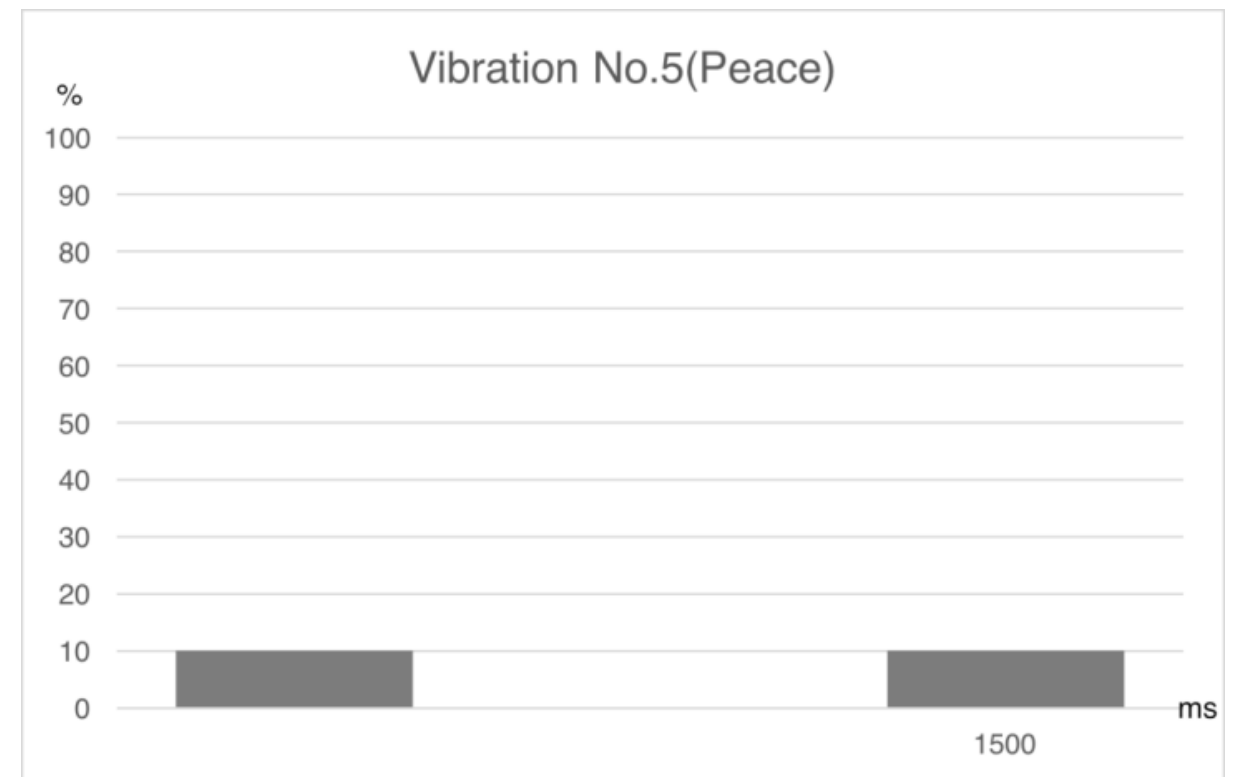


Pattern giving the impression of joy and comfort



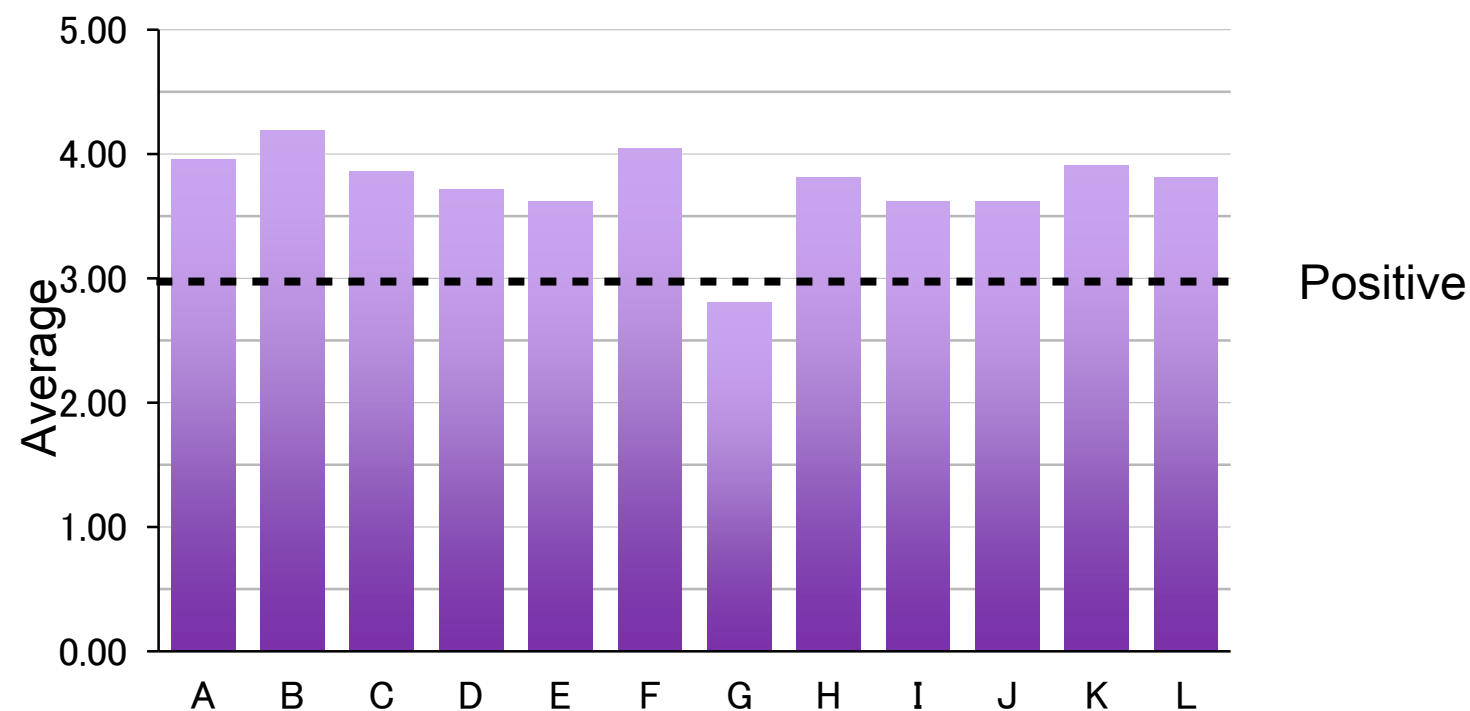


Pattern giving the impression of
joy and comfort



Pattern giving the impression of
anger or fear

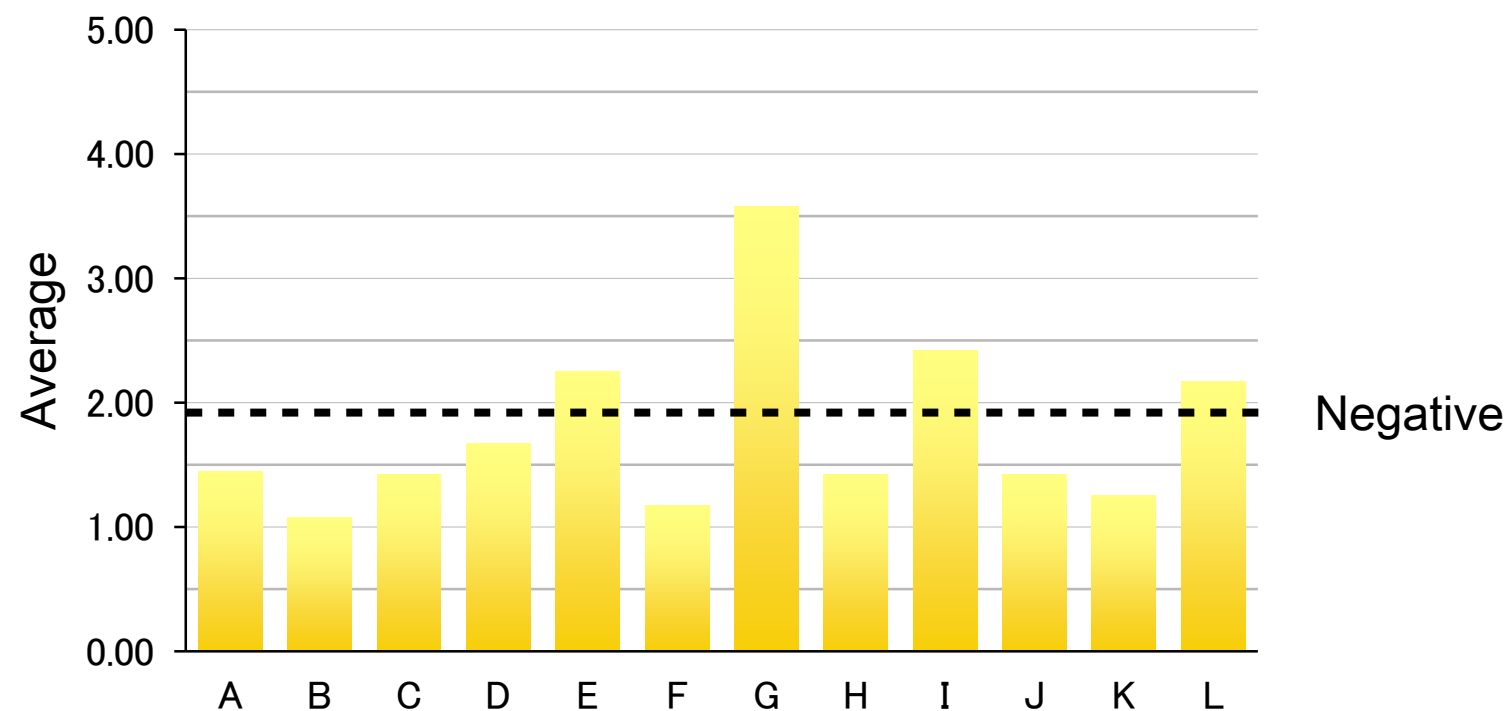
(point) **Vibration No. 8 Evaluation of anger (Elderly-request)**



Correct answer about creator's intention : 0.071 on average

Creator: expresses anger ➡ Subject: Impression of joy and relief

(point) **Vibration No. 5** Evaluation of peace (Elderly-request)



Correct answer about creator's intention : 0.214 on average

Creator: expresses peace ➡ Subject: Impression of anger / fear

Vibration No. 8 Evaluation of anger (Elderly-request)

Seconds [ms]	2000ms interval 500ms
Largest [%]	4points
Smallest [%]	3points
No vibration [%]	0point
Frequency [No]	4points
Peak [No]	3points

Analysis Pattern that gave **negative** impression

Vibration No. 5 Evaluation of **peace** (**Elderly**-request)

Seconds [ms]	1500ms interval 1500ms
Largest [%]	0point
Smallest [%]	2points
No vibration [%]	1point
Frequency [No]	3points
Peak [No]	0piunt

Analysis Correlation between component and impression word

- Impression evaluation - Youth (request)

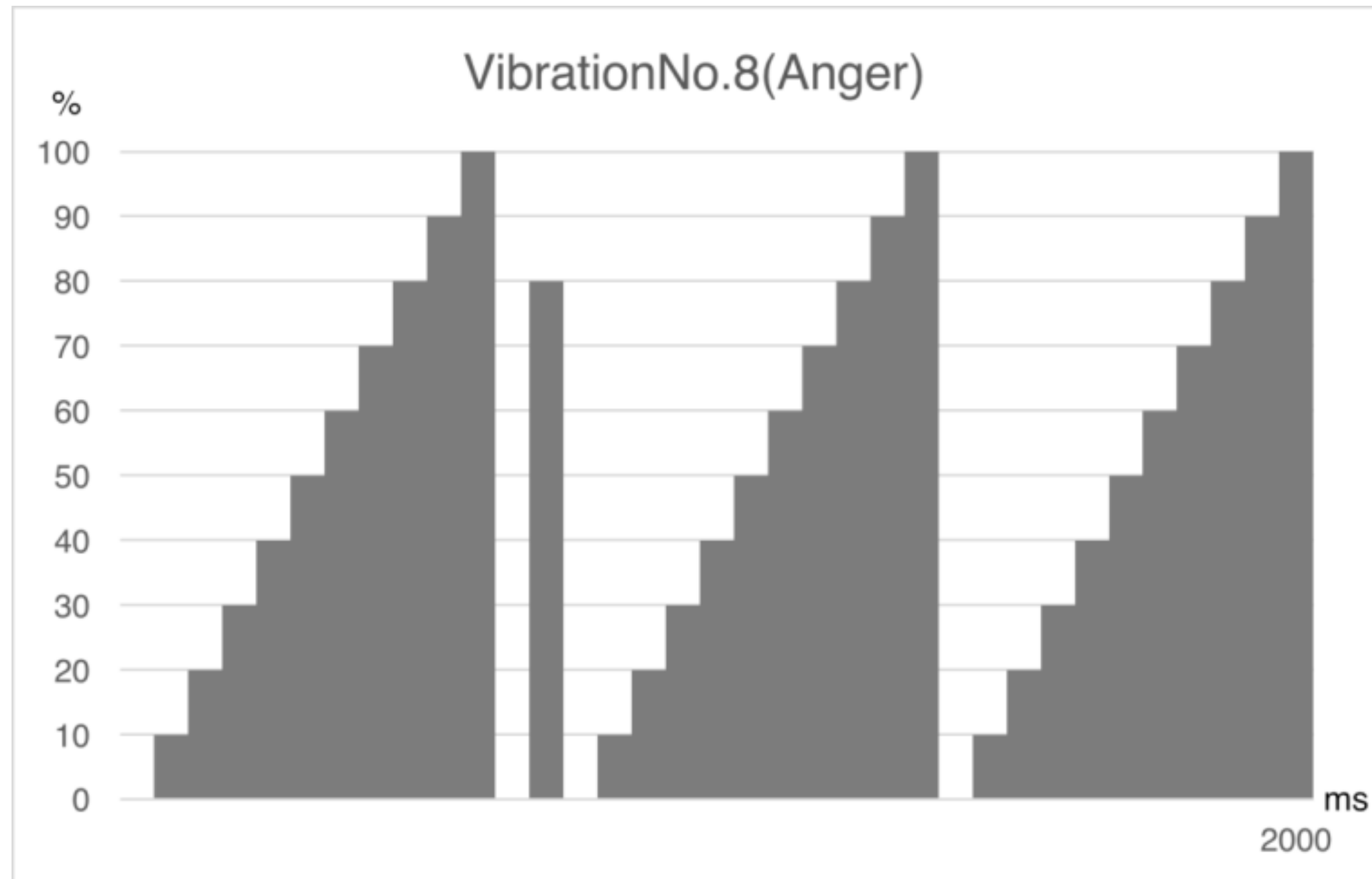
		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	.448	.131	.316	.443	.418	.157	.149	.262	.341	.024	.105	.375
	有意確率 (両側)	.266	.758	.446	.272	.302	.711	.725	.531	.408	.954	.805	.360
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.535	-.555	-.505	-.427	-.402	-.477	.086	-.501	-.607	-.152	-.434	-.433
	有意確率 (両側)	.172	.153	.202	.292	.324	.231	.840	.206	.110	.719	.282	.283
	N	8	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.538	.564	.511	.350	-.369	.674	-.802*	.654	.046	.816*	.740*	.175
	有意確率 (両側)	.169	.146	.195	.396	.369	.067	.017	.078	.915	.013	.036	.678
	N	8	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.230	.002	.130	.263	.116	.192	-.313	.194	.174	.354	.182	.183
	有意確率 (両側)	.583	.996	.758	.529	.785	.649	.451	.645	.680	.390	.666	.665
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.440	-.550	-.456	-.356	-.208	-.541	.209	-.516	-.572	-.249	-.493	-.370
	有意確率 (両側)	.276	.158	.256	.386	.622	.166	.619	.190	.139	.553	.215	.367
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.139	-.242	-.161	-.111	-.318	-.152	-.174	-.134	-.451	.173	-.089	-.196
	有意確率 (両側)	.742	.563	.704	.794	.442	.720	.681	.752	.262	.682	.835	.641
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	.286	.169	.205	.195	-.135	.272	-.616	.252	-.030	.577	.347	.063
	有意確率 (両側)	.492	.690	.626	.644	.750	.514	.104	.547	.944	.134	.400	.882
	N	8	8	8	8	8	8	8	8	8	8	8	8

Analysis Correlation between component and impression word

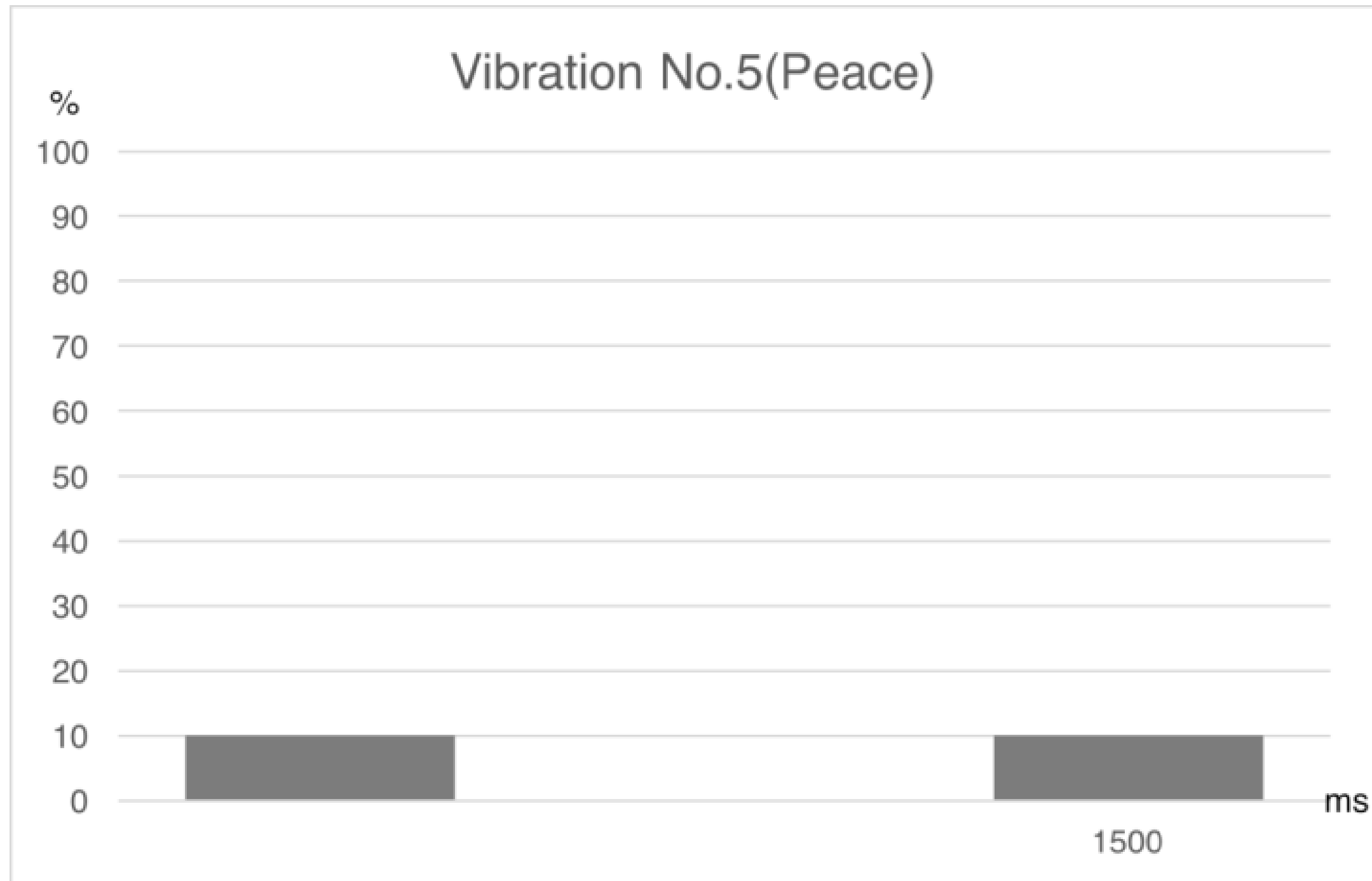
- Impression evaluation – Youth (request)

		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	.448	.131	.316	.443	.418	.157	.149	.262	.341	.024	.105	.375
	有意確率（両側）	.266	.758	.446	.272	.302	.711	.725	.531	.408	.954	.805	.360
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.535	-.555	-.505	-.427	-.402	Heavy--- Light		feeble --- Powerfu		-.607	-.152	-.434
	有意確率（両側）	.172	.153	.202	.292	.324					.110	.719	.282
	N	8	8	8	8	8					8	8	8
最大	Pearson の相関係数	.538	.564	.511	Largest		*.802		*.740		.046	.816*	.740*
	有意確率（両側）	.169	.146	.195							.915	.013	.036
	N	8	8	8							8	8	8
最小	Pearson の相関係数	.230	.002	.130	.263	.116	.192	-.313	.194	.174	.354	.182	.183
	有意確率（両側）	.583	.996	.758	.529	.785	.649	.451	.645	.680	.390	.666	.665
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.440	-.550	-.456	-.356	-.208	-.541	.209	-.516	-.572	-.249	-.493	-.370
	有意確率（両側）	.276	.158	.256	.386	.622	.166	.619	.190	.139	.553	.215	.367
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.139	-.242	-.161	-.111	-.318	-.152	-.174	-.134	-.451	.173	-.089	-.196
	有意確率（両側）	.742	.563	.704	.794	.442	.720	.681	.752	.262	.682	.835	.641
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	.286	.169	.205	.195	-.135	.272	-.616	.252	-.030	.577	.347	.063
	有意確率（両側）	.492	.690	.626	.644	.750	.514	.104	.547	.944	.134	.400	.882
	N	8	8	8	8	8	8	8	8	8	8	8	8

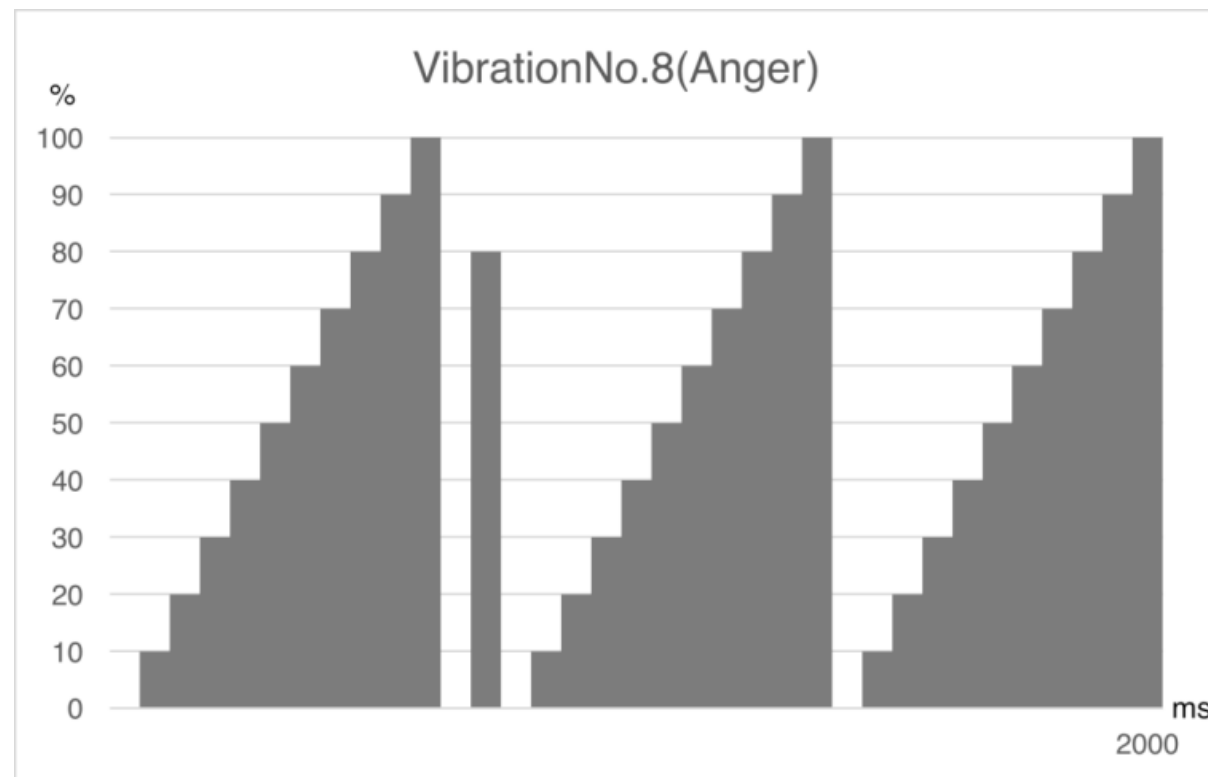
Analysis Pattern giving the impression of joy and comfort



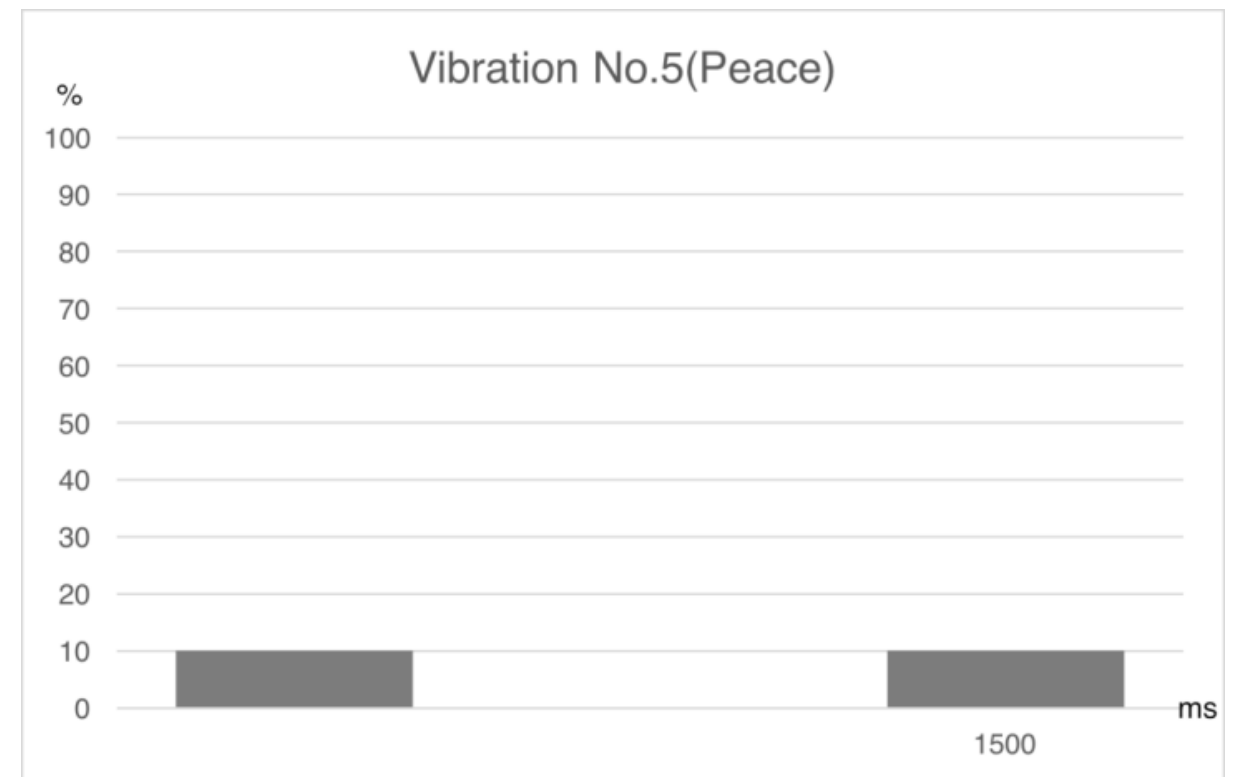
Analysis Pattern giving the impression of anger or fear



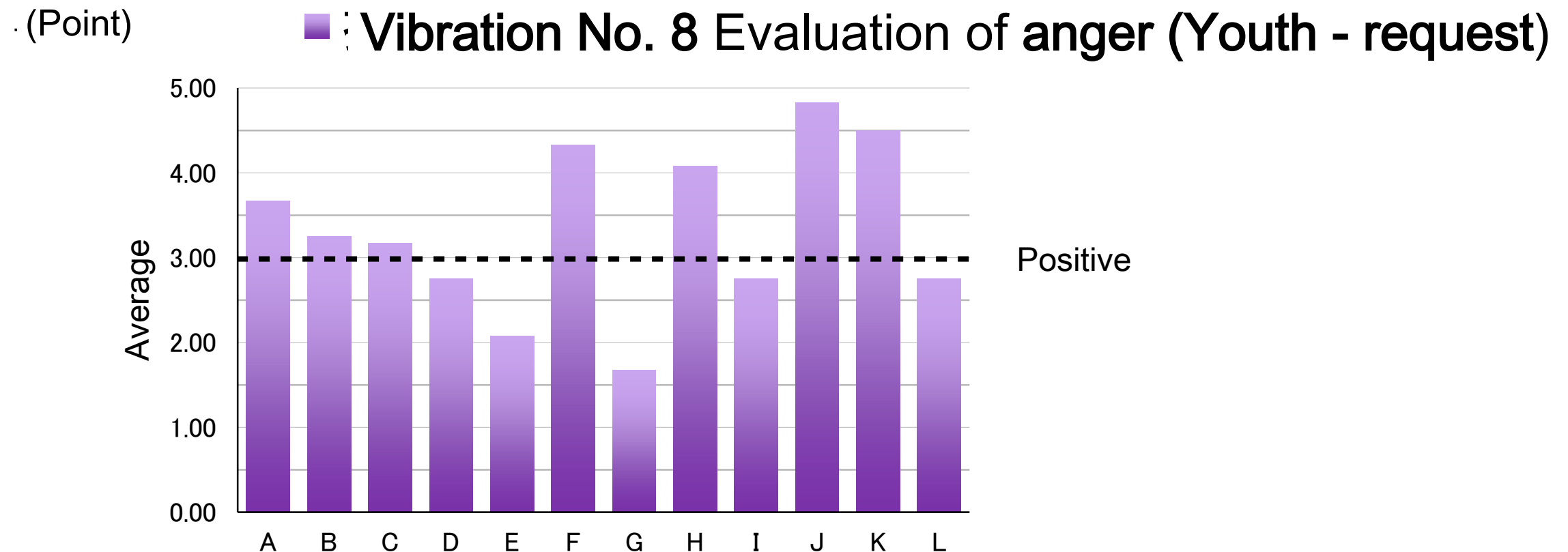
Analysis Comparison



Pattern giving the impression of
joy and comfort

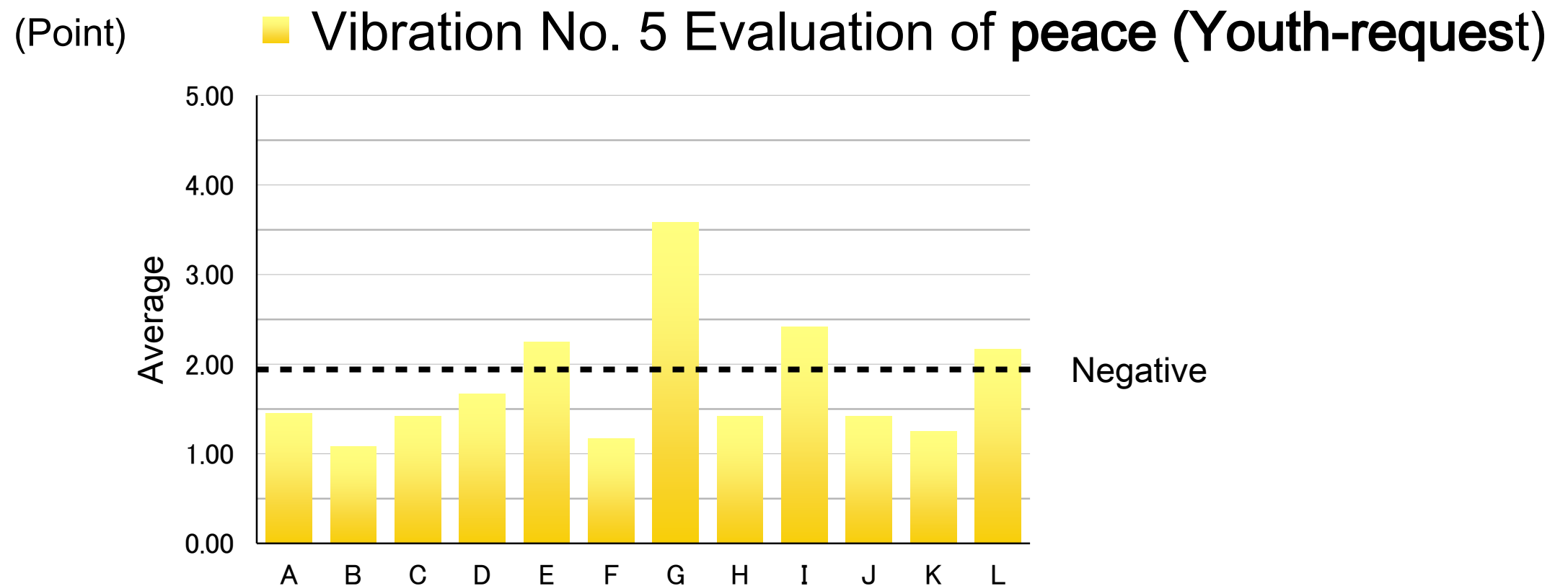


Pattern giving the impression of
anger or fear



Correct answer about creator's intention : 0.625 on average

Creator: expresses anger ➡ Subject: understanding intention



Correct answer about creator's intention : 0.50 on average

Creator: expresses peace ➡ Subject: understanding intention

Analysis

-Impression evaluation - Elderly (reminder)

		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	-.129	-.086	-.092	-.043	.102	-.221	-.147	-.264	-.159	-.108	-.171	-.194
	有意確率（両側）	.761	.840	.829	.920	.810	.600	.728	.527	.707	.798	.685	.645
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.458	-.560	-.544	-.435	-.523	-.496	.033	-.412	-.414	-.350	-.418	-.473
	有意確率（両側）	.254	.149	.163	.281	.183	.212	.938	.311	.307	.396	.302	.237
	N	8	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.574	.582	.586	.572	.589	.687	-.501	.700	.686	.636	.598	.620
	有意確率（両側）	.137	.130	.127	.139	.124	.060	.206	.053	.060	.090	.117	.101
	N	8	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.305	.248	.272	.358	.228	.179	-.337	.244	.298	.453	.319	.281
	有意確率（両側）	.463	.554	.514	.383	.588	.672	.414	.560	.474	.259	.442	.500
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.483	-.561	-.525	-.396	-.455	-.529	.038	-.456	-.408	-.362	-.485	-.505
	有意確率（両側）	.225	.148	.182	.331	.257	.178	.928	.256	.316	.378	.223	.201
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.100	-.198	-.155	-.030	-.139	-.125	-.176	-.030	.000	.034	-.093	-.104
	有意確率（両側）	.814	.639	.714	.944	.743	.769	.677	.943	1.000	.936	.827	.807
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	.249	.248	.248	.289	.429	.240	-.659	.254	.319	.440	.291	.262
	有意確率（両側）	.552	.554	.553	.487	.289	.567	.075	.543	.441	.275	.485	.530
	N	8	8	8	8	8	8	8	8	8	8	8	8

Analysis

-Impression evaluation - Youth (reminder)

		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	-.130	.177	-.085	-.069	-.115	.040	-.196	.041	-.003	.074	.095	.055
	有意確率（両側）	.759	.675	.841	.871	.787	.926	.642	.924	.995	.862	.823	.897
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.550	-.587	-.601	-.481	-.422	-.475	.325	-.510	-.363	-.306	-.509	-.430
	有意確率（両側）	.158	.126	.115	.227	.297	.235	.433	.197	.377	.462	.198	.288
	N	8	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.281	.641	.252	.277	-.221	.612	-.657	.451	.401	.697	.617	.483
	有意確率（両側）	.500	.087	.547	.507	.599	.107	.077	.262	.324	.055	.103	.225
	N	8	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.065	.231	.179	.303	-.341	.320	-.059	.105	.159	.311	.289	.193
	有意確率（両側）	.879	.582	.672	.465	.408	.440	.890	.804	.707	.453	.488	.647
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.520	-.638	-.488	-.424	-.157	-.564	.557	-.582	-.267	-.471	-.581	-.362
	有意確率（両側）	.186	.089	.220	.295	.711	.145	.152	.130	.523	.239	.131	.379
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.314	-.225	-.302	-.167	-.333	-.144	.162	-.239	-.040	-.024	-.168	-.066
	有意確率（両側）	.450	.592	.467	.693	.420	.734	.701	.569	.924	.955	.691	.877
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	-.003	.172	.120	.055	-.219	.222	-.098	-.095	.191	.281	.198	.173
	有意確率（両側）	.994	.684	.778	.897	.602	.597	.817	.823	.651	.500	.638	.682
	N	8	8	8	8	8	8	8	8	8	8	8	8

Analysis

-Impression evaluation- Elderly (report)

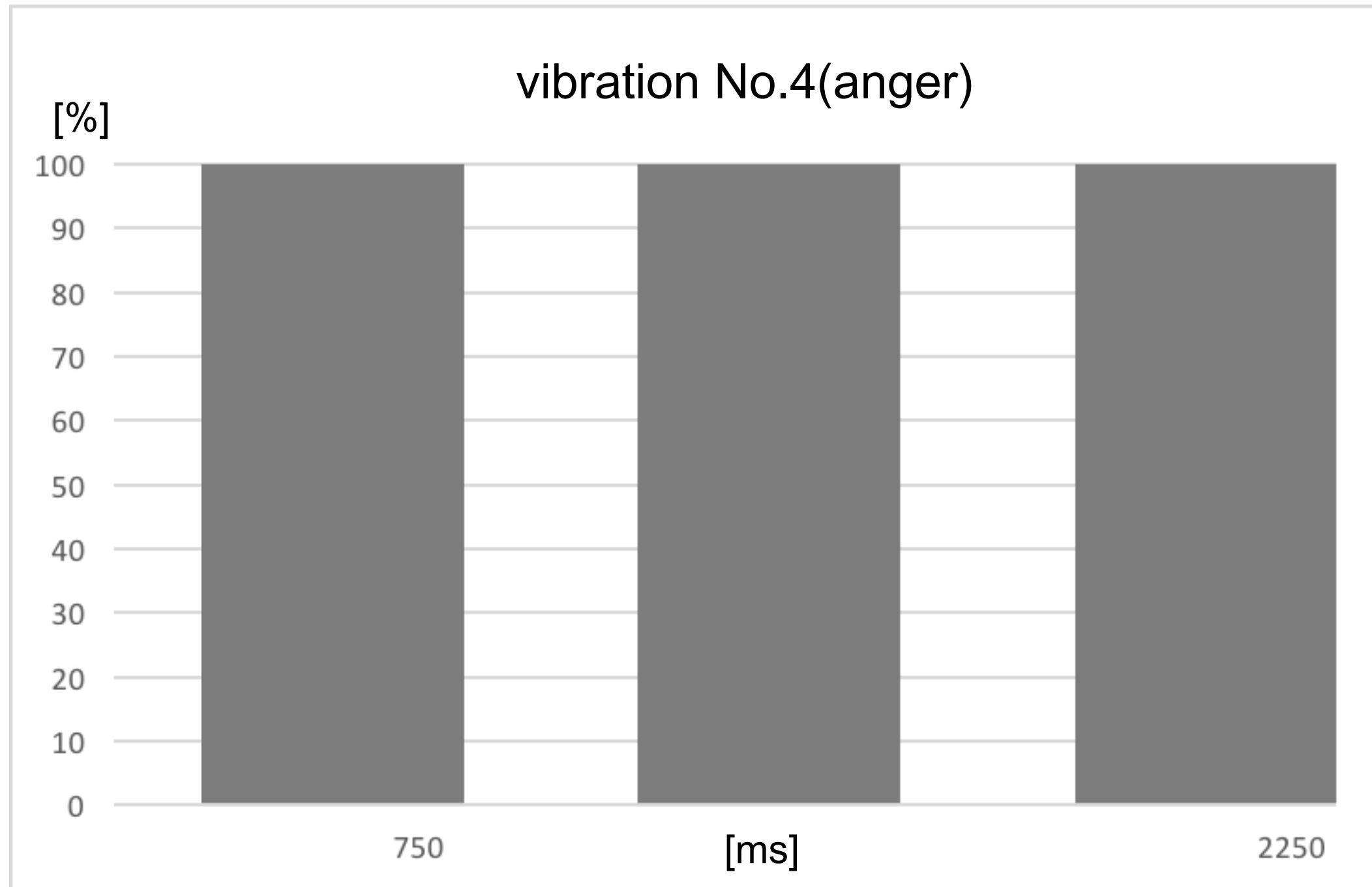
		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い
ニュアンス	Pearson の相関係数	-.013	-.015	.063	.213	.168	.046	.378	.038	.140	.060	.052
	有意確率 (両側)	.976	.972	.882	.613	.690	.913	.356	.928	.740	.888	.903
	N	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.600	-.607	-.581	-.628	-.725*	-.572	.023	-.584	-.686	-.496	-.514
	有意確率 (両側)	.116	.111	.131	.096	.042	.138	.957	.128	.060	.211	.192
	N	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.623	.638	.571	.476	.461	.626	-.759*	.600	.452	.619	.659
	有意確率 (両側)	.099	.089	.139	.233	.251	.097	.029	.116	.261	.102	.075
	N	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.194	.114	.286	.297	.121	.150	-.276	.105	.268	.329	.220
	有意確率 (両側)	.646	.788	.493	.475	.775	.723	.508	.805	.521	.427	.601
	N	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.663	-.655	-.644	-.665	-.730*	-.593	.199	-.632	-.740*	-.555	-.515
	有意確率 (両側)	.073	.078	.085	.072	.040	.122	.637	.093	.036	.153	.192
	N	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.272	-.286	-.251	-.319	-.422	-.230	-.232	-.289	-.386	-.151	-.144
	有意確率 (両側)	.515	.492	.549	.442	.298	.584	.581	.488	.345	.722	.734
	N	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	.140	.143	.145	.144	.017	.178	-.276	.122	.038	.244	.275
	有意確率 (両側)	.741	.736	.731	.733	.968	.674	.508	.773	.928	.561	.510
	N	8	8	8	8	8	8	8	8	8	8	8

Analysis

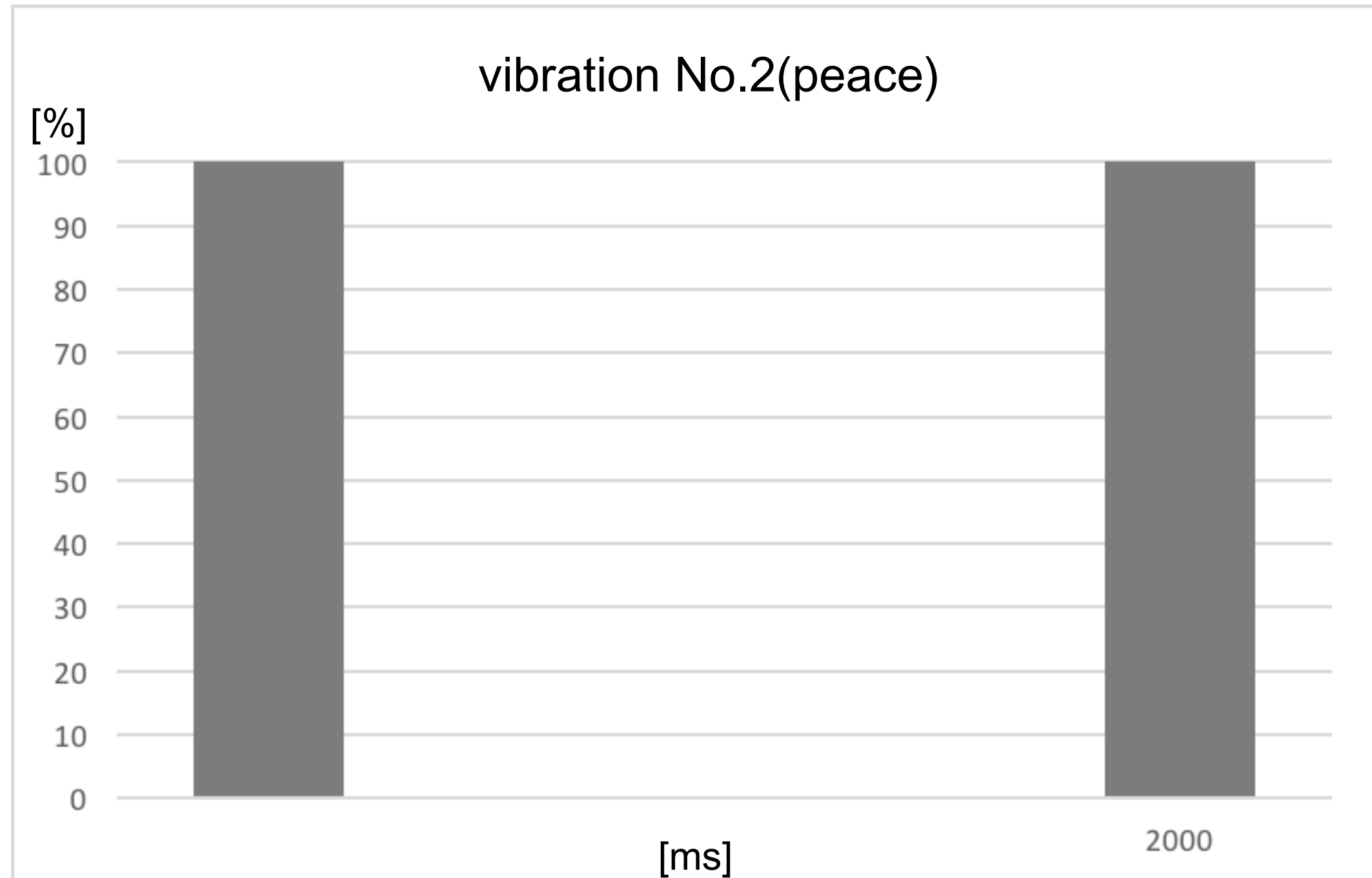
-Impression evaluation- Elderly (report)

		陰気- 陽気	ぼんやり-はつきり	暗い-明るい	つまらない-楽しい	不愉快-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い
ニュアンス	Pearson の相関係数	-.013	-.015	.063		Uncomfortable --- Comfortable	.046	.378	.038	.140	.060	.052
	有意確率 (両側)	.976	.972	.882			.913	.356	.928	.740	.888	.903
	N	8	8	8			8	8	8	8	8	8
秒	Pearson の相関係数	-.600	-.607				-.572	.023	-.584	-.686	-.496	-.514
	有意確率 (両側)	.116	.111			seconds	-.725		Heavy --- Light	.128	.060	.211
	N	8	8						8	8	8	8
最大	Pearson の相関係数	.623	.638						.600	.452	.619	.659
	有意確率 (両側)	.099	.089	.139	.233				.116	.261	.102	.075
	N	8	8	8	8				8	8	8	8
最小	Pearson の相関係数	.194	.114	.286	.297				.105	.268	.329	.220
	有意確率 (両側)	.646	.788	.493	.475	Largest			.805	.521	.427	.601
	N	8	8	8	8				8	8	8	8
振動なし	Pearson の相関係数	-.663	-.655	-.644		Uncomfortable --- Comfortable	-.593	.199		Cold --- Warm	-.555	-.515
	有意確率 (両側)	.073	.078	.085			.122	.637			.153	.192
	N	8	8	8			8	8			8	8
振動数	Pearson の相関係数	-.272	-.286				-.230				-.151	-.144
	有意確率 (両側)	.515	.492			No vibration	.584		No vibration		.722	.734
	N	8	8				8				8	8
peak	Pearson の相関係数	.140	.143				.178				.244	.275
	有意確率 (両側)	.741	.736	.731	.733		.674	.508	.773	.928	.561	.510
	N	8	8	8	8		8	8	8	8	8	8

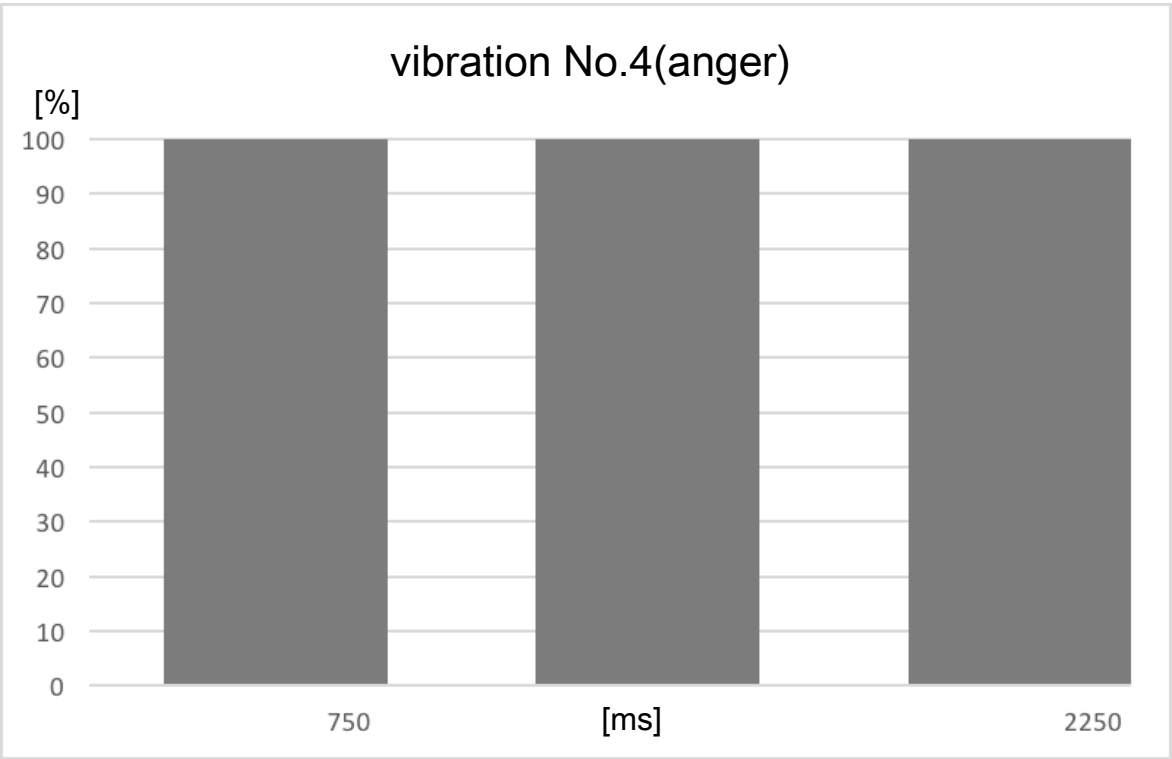
Analysis Pattern giving the impression of joy and comfort



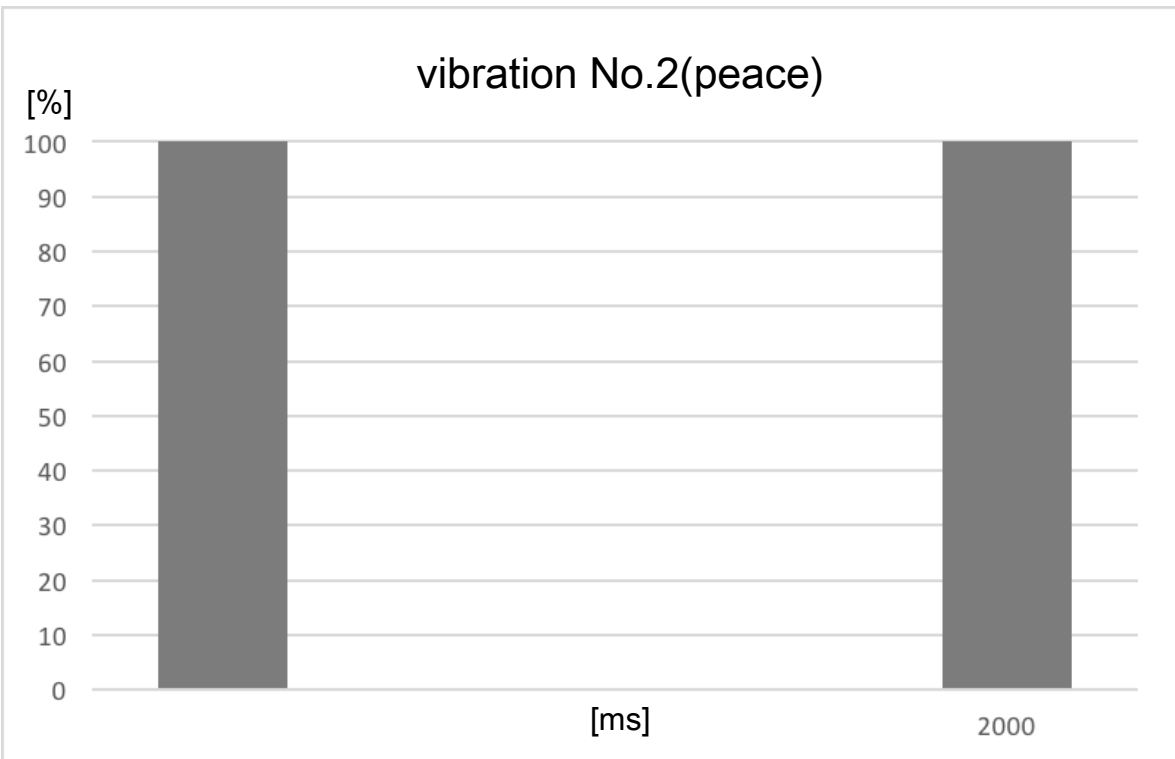
Analysis A pattern that gave an impression of anger or fear



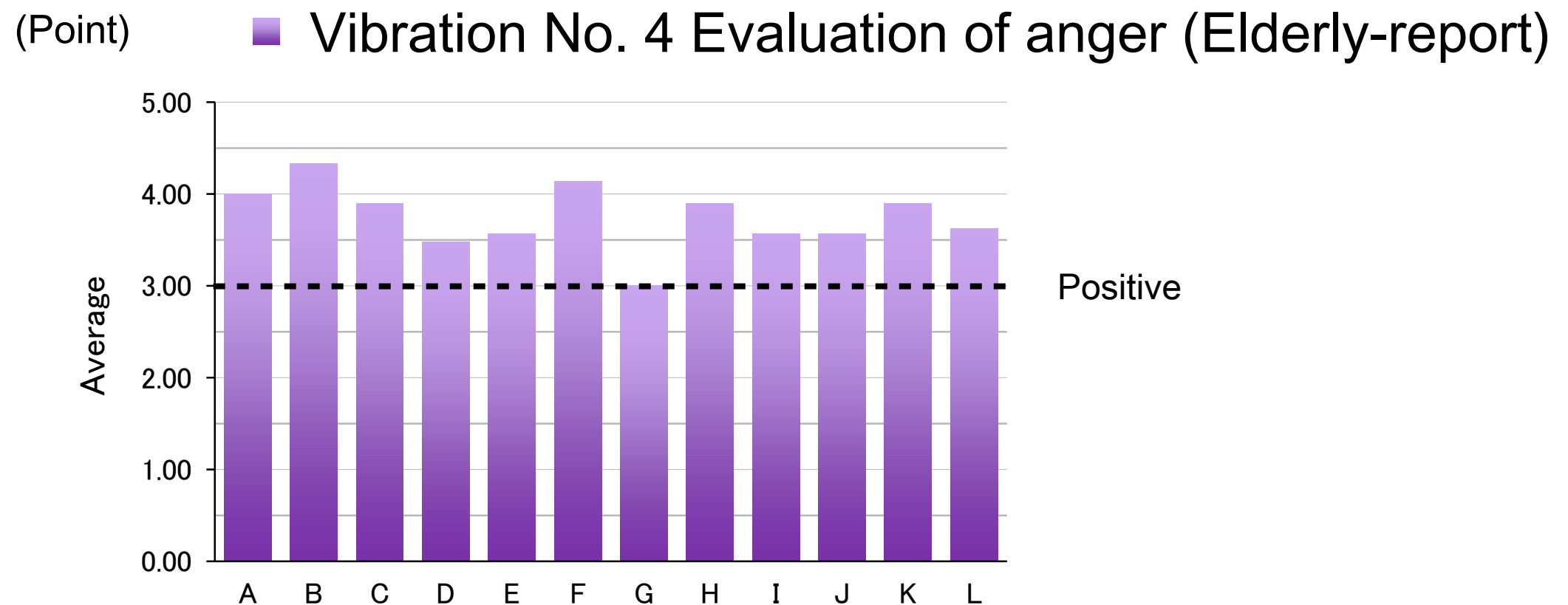
Analysis Comparison



Pattern giving the impression of
joy and comfort



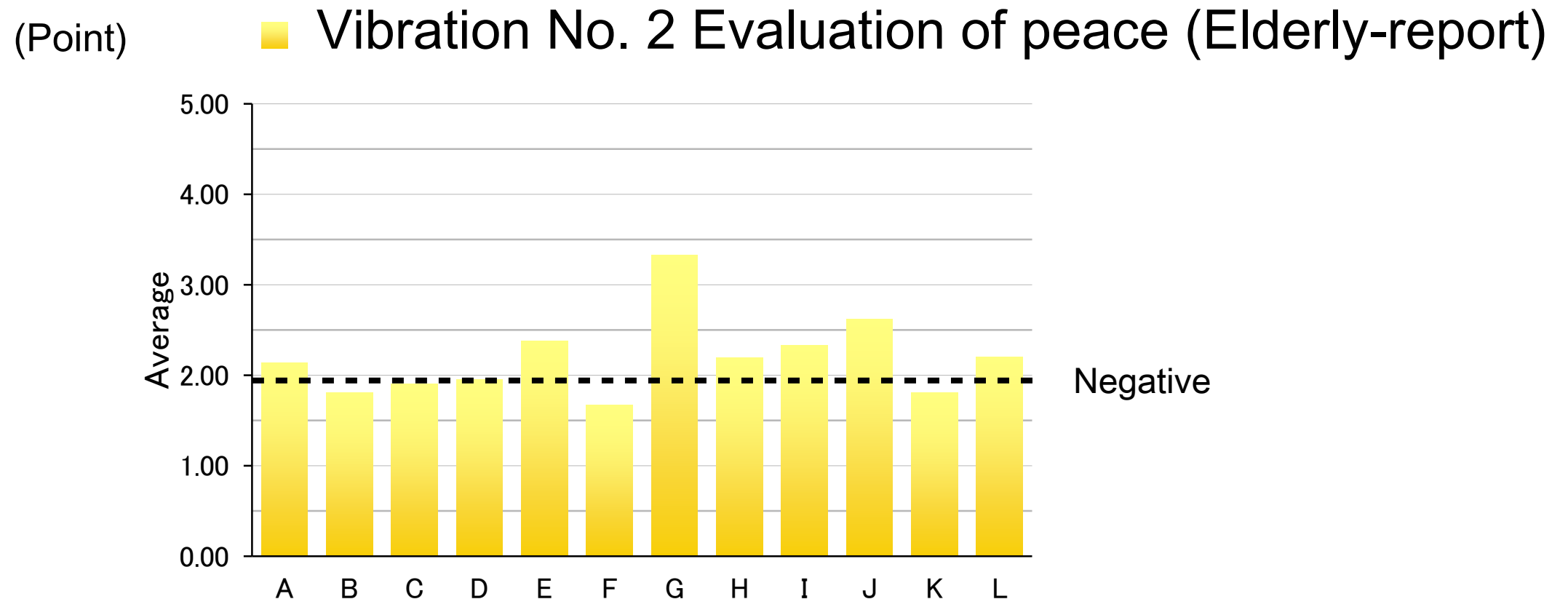
Pattern giving the impression of
anger or fear



Correct answer about creator's intention : 0.214 on average

Creator: expresses anger ➡ Subject: Impression of joy and relief

Analysis A pattern that gave a negative impression



Correct answer about creator's intention : 0.214 on average

Creator: expresses peace ➡ Subject: Impression of anger / fear

Analysis A pattern that gave a negative impression

Vibration No. 4 Evaluation of anger (Elderly-report)

Seconds [ms]	2250ms interval 500ms
Largest [%]	3points
Smallest [%]	0point
No vibration [%]	0point
Frequency [No]	3points
Peak [No]	3points

Analysis A pattern that gave a negative impression

Vibration No. 2 Evaluation of peace (Elderly-report)

Seconds [ms]	2000ms interval 1000ms
Largest [%]	2points
Smallest [%]	0point
No vibration [%]	2points
Frequency [No]	4points
Peak [No]	2points

Analysis

-Impression evaluation - Youth (report)

		陰気-陽気	ぼんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	.511	.379	.501	.470	.702	.153	.457	.401	.544	-.173	.205	.369
	有意確率（両側）	.196	.355	.206	.239	.052	.717	.255	.324	.163	.682	.627	.368
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.673	-.547	-.657	-.699	-.195	-.449	-.021	-.390	-.243	-.181	-.488	-.619
	有意確率（両側）	.067	.161	.077	.054	.643	.264	.961	.339	.562	.667	.220	.102
	N	8	8	8	8	8	8	8	8	8	8	8	8
最大	Pearson の相関係数	.405	.459	.390	.307	-.601	.632	-.670	.569	.388	.752*	.611	.476
	有意確率（両側）	.319	.253	.339	.460	.115	.093	.069	.141	.342	.031	.108	.233
	N	8	8	8	8	8	8	8	8	8	8	8	8
最小	Pearson の相関係数	.122	-.033	.112	.108	.152	.158	-.364	.241	.396	.425	.221	.323
	有意確率（両側）	.773	.938	.792	.800	.719	.709	.376	.565	.332	.294	.600	.435
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.619	-.534	-.608	-.603	-.116	-.500	.180	-.369	-.203	-.307	-.524	-.626
	有意確率（両側）	.102	.173	.110	.113	.784	.207	.671	.369	.630	.459	.182	.097
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.355	-.267	-.352	-.400	-.255	-.128	-.204	-.019	.081	.134	-.155	-.291
	有意確率（両側）	.388	.523	.392	.327	.542	.762	.628	.965	.848	.751	.715	.485
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	-.006	-.055	-.003	.135	-.457	.174	-.471	.170	.195	.481	.202	.128
	有意確率（両側）	.988	.897	.994	.749	.256	.681	.239	.686	.643	.228	.631	.762
	N	8	8	8	8	8	8	8	8	8	8	8	8

Analysis

-Impression evaluation - Youth (report)

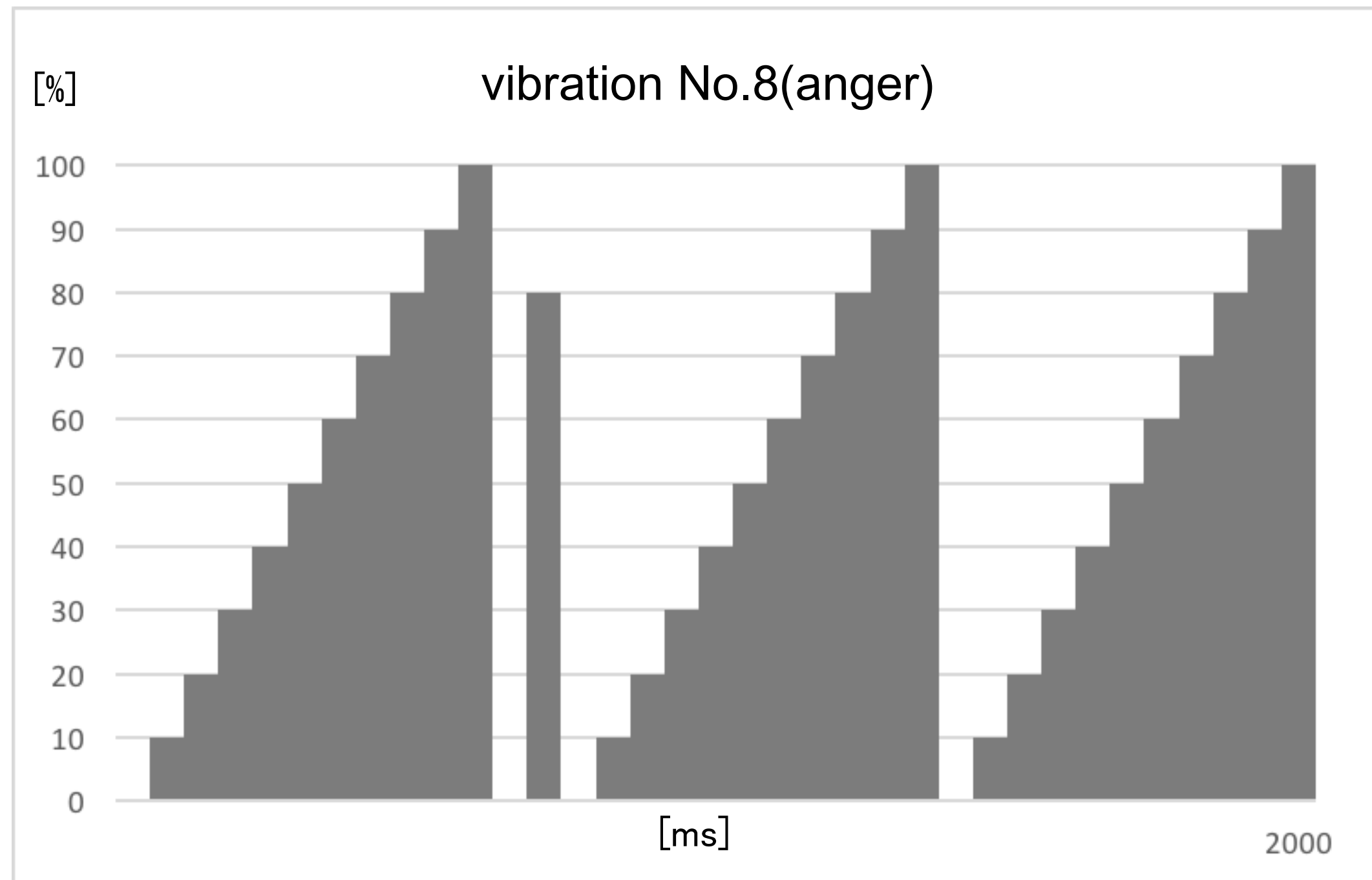
		陰気-陽気	ほんやり-はっきり	暗い-明るい	つまらない-楽しい	不快な-心地よい	弱々しい-力強い	軽い-重い	穏やか-活発	冷たい-あたたかい	狭い-広い	弱い-強い	ネガティブ-ポジティブ
ニュアンス	Pearson の相関係数	.511	.379	.501	.470	.702	.153	.457	.401	.544	-.173	.205	.369
	有意確率（両側）	.196	.355	.206	.239	.052	.717	.255	.324	.163	.682	.627	.368
	N	8	8	8	8	8	8	8	8	8	8	8	8
秒	Pearson の相関係数	-.673	-.547	-.657	-.699	-.195	-.449	-.021	-.390			-.488	-.619
	有意確率（両側）	.067	.161	.077	.054	.643	.264	.961	.339			.220	.102
	N	8	8	8	8	8	8	8	8			8	8
最大	Pearson の相関係数	.405	.459	.390	.307	-.601	.632	-.0				.611	.476
	有意確率（両側）	.319	.253	.339	.460	.115	.093	.0				.108	.233
	N	8	8	8	8	8	8	8				8	8
最小	Pearson の相関係数	.122	-.033	.112	.108	.152	.158	-.364	.241	.396	.425	.221	.323
	有意確率（両側）	.773	.938	.792	.800	.719	.709	.376	.565	.332	.294	.600	.435
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動なし	Pearson の相関係数	-.619	-.534	-.608	-.603	-.116	-.500	.180	-.369	-.203	-.307	-.524	-.626
	有意確率（両側）	.102	.173	.110	.113	.784	.207	.671	.369	.630	.459	.182	.097
	N	8	8	8	8	8	8	8	8	8	8	8	8
振動数	Pearson の相関係数	-.355	-.267	-.352	-.400	-.255	-.128	-.204	-.019	.081	.134	-.155	-.291
	有意確率（両側）	.388	.523	.392	.327	.542	.762	.628	.965	.848	.751	.715	.485
	N	8	8	8	8	8	8	8	8	8	8	8	8
peak	Pearson の相関係数	-.006	-.055	-.003	.135	-.457	.174	-.471	.170	.195	.481	.202	.128
	有意確率（両側）	.988	.897	.994	.749	.256	.681	.239	.686	.643	.228	.631	.762
	N	8	8	8	8	8	8	8	8	8	8	8	8

Narrow ---
Wide

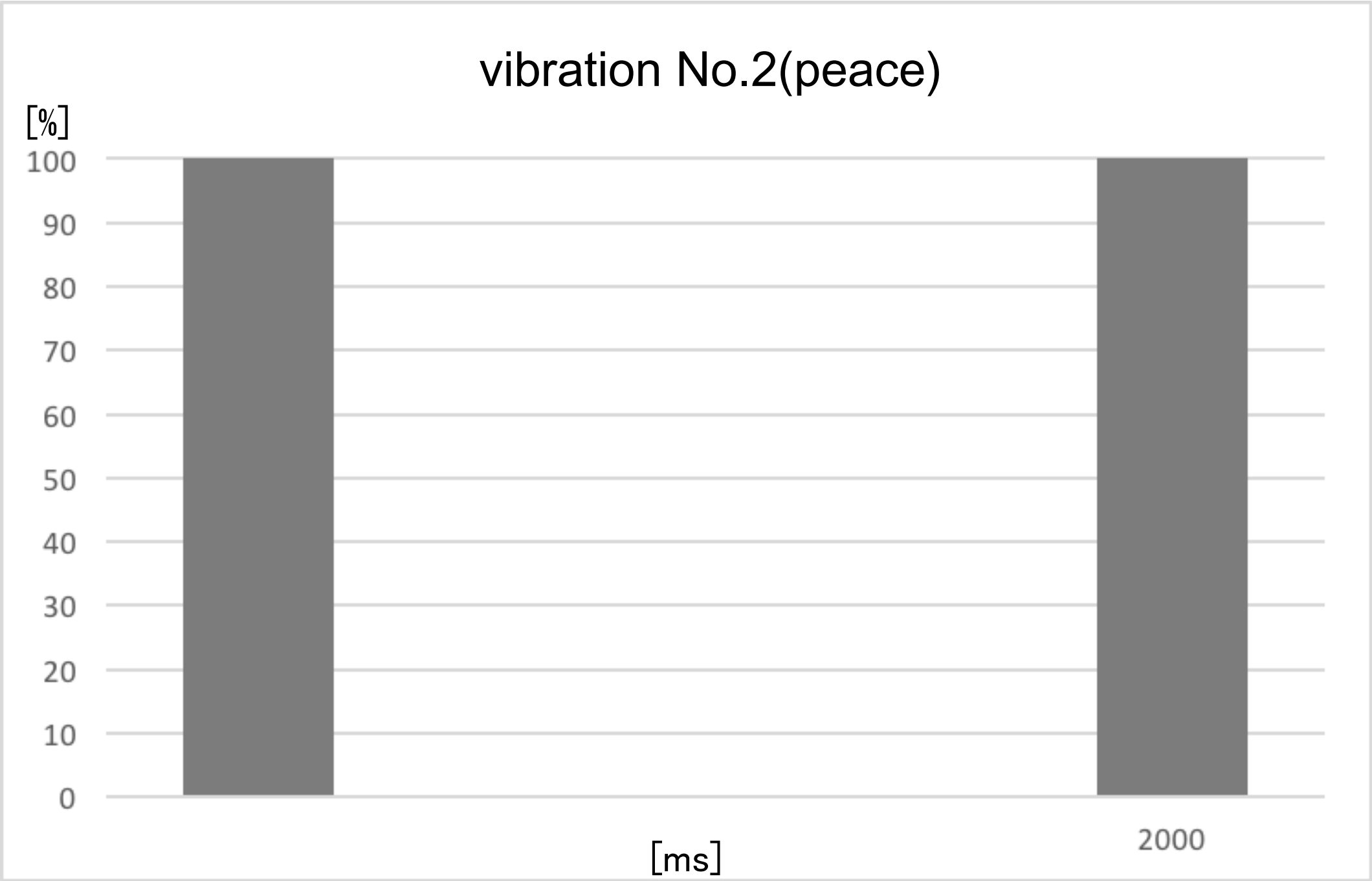
Largest

-.802

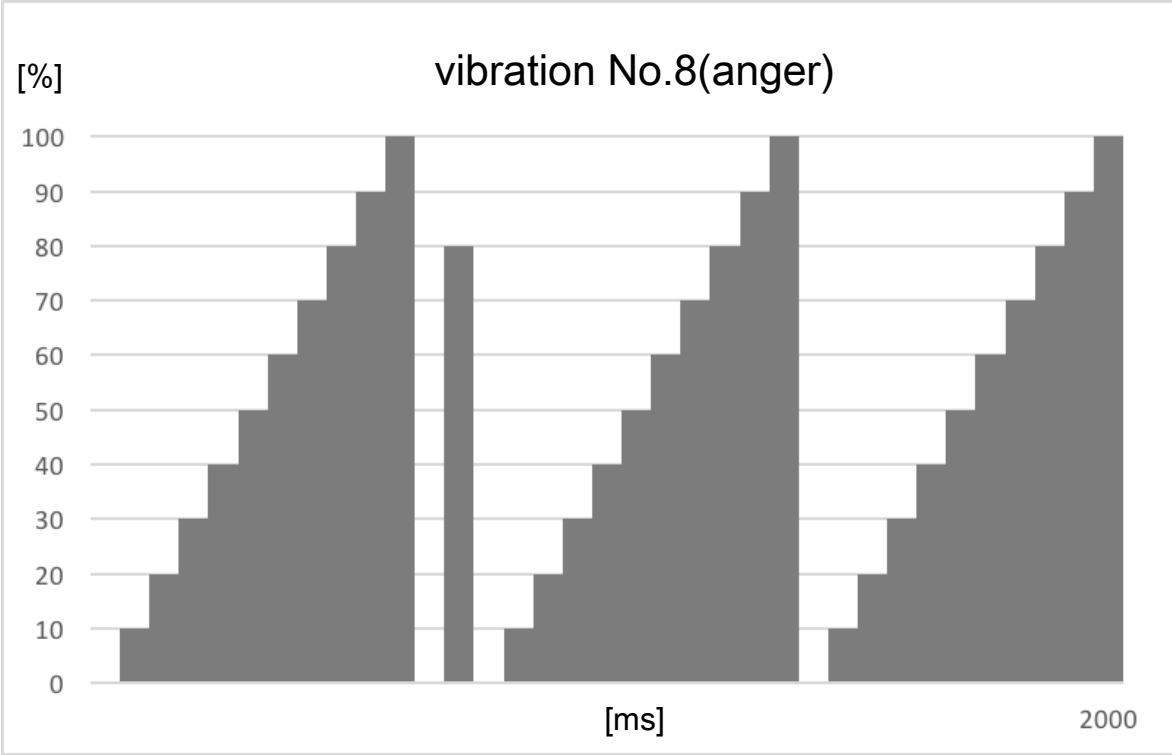
Analysis Pattern giving the impression of joy and comfort



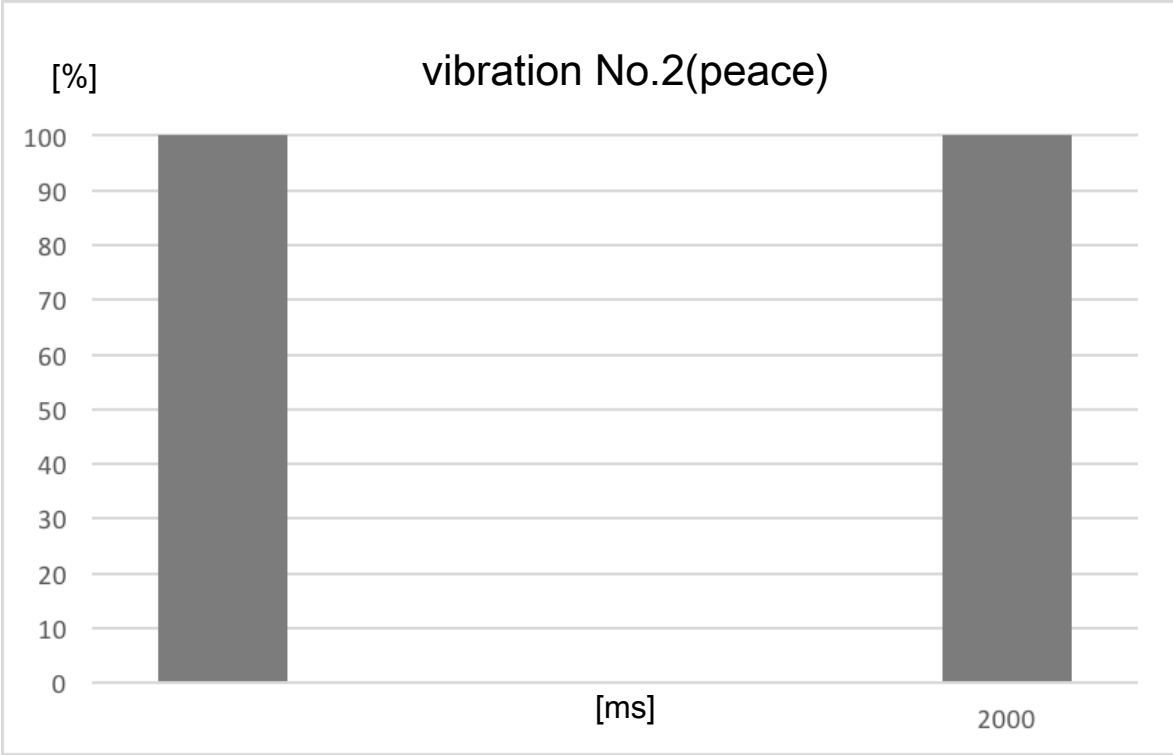
Analysis Pattern giving the impression of anger or fear



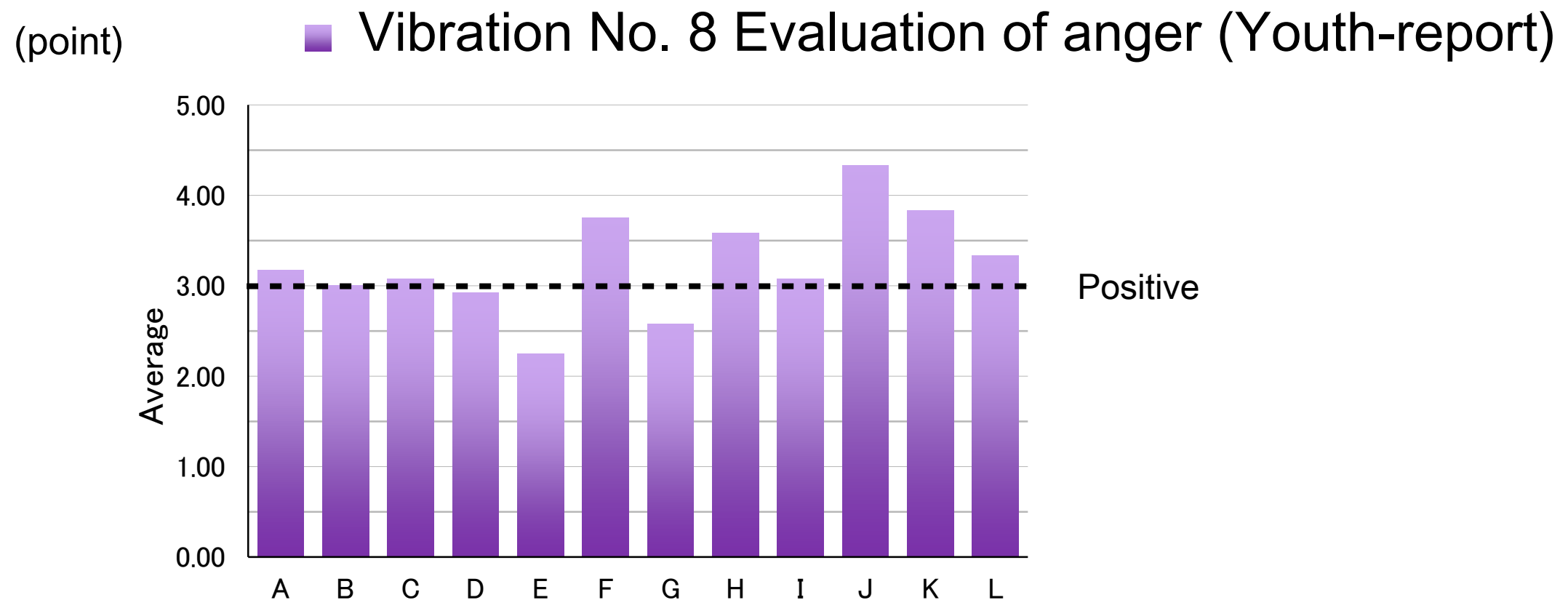
Analysis Comparison



Pattern giving the impression of
joy and comfort

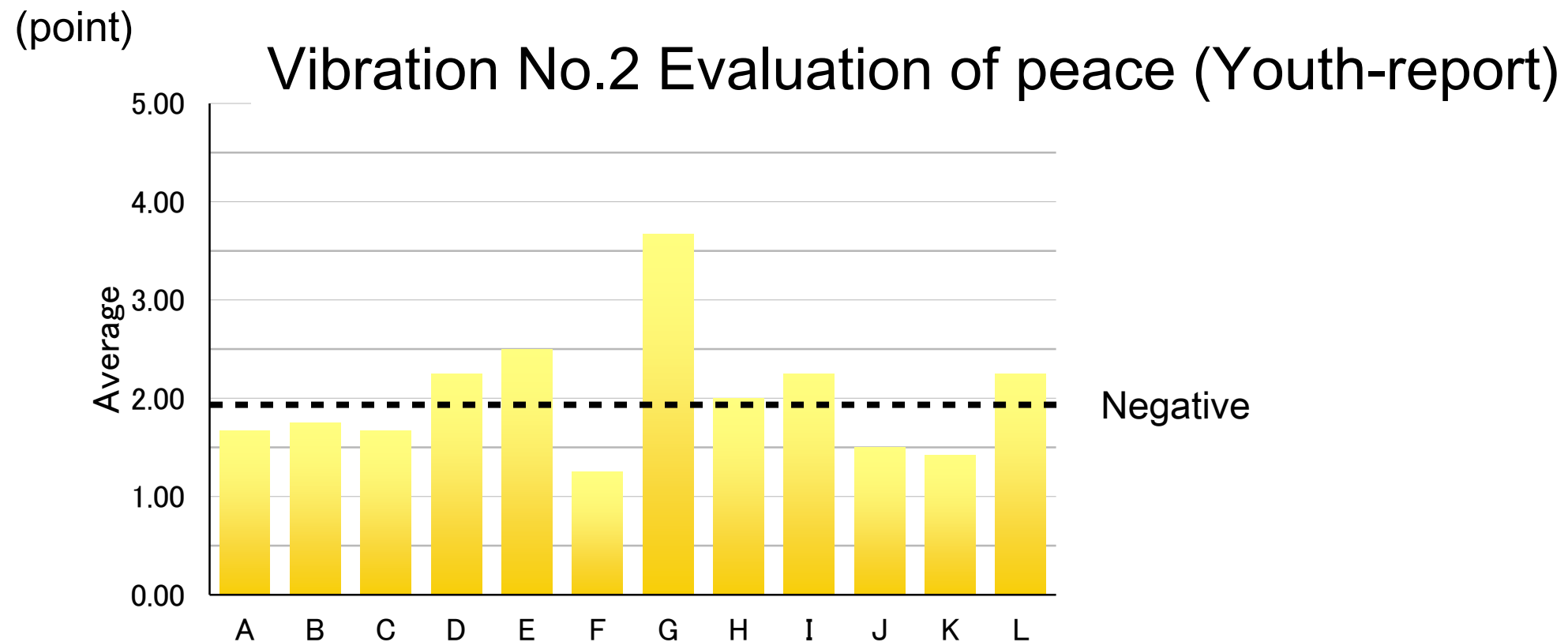


Pattern giving the impression of
anger or fear



Correct answer about creator's intention : 0.333 on average

Creator: expresses anger ➡ Subject: Impression of joy and comfort



Correct answer about creator's intention : 0.292 on average

Creator: expresses peace ➡ Subject: : Impression of anger / fear

4. Research method

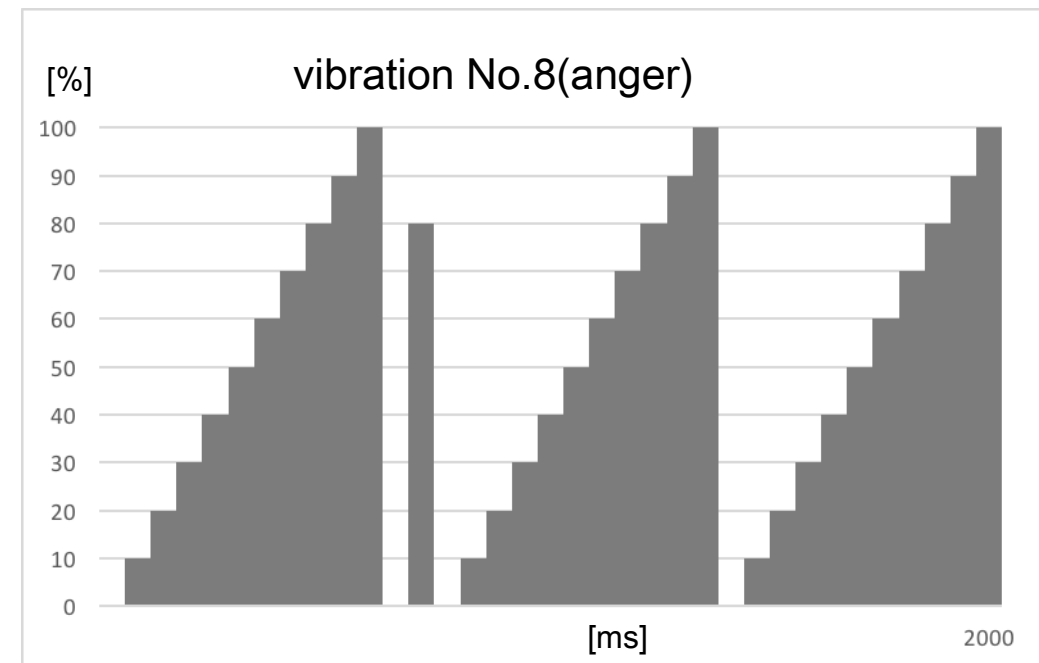
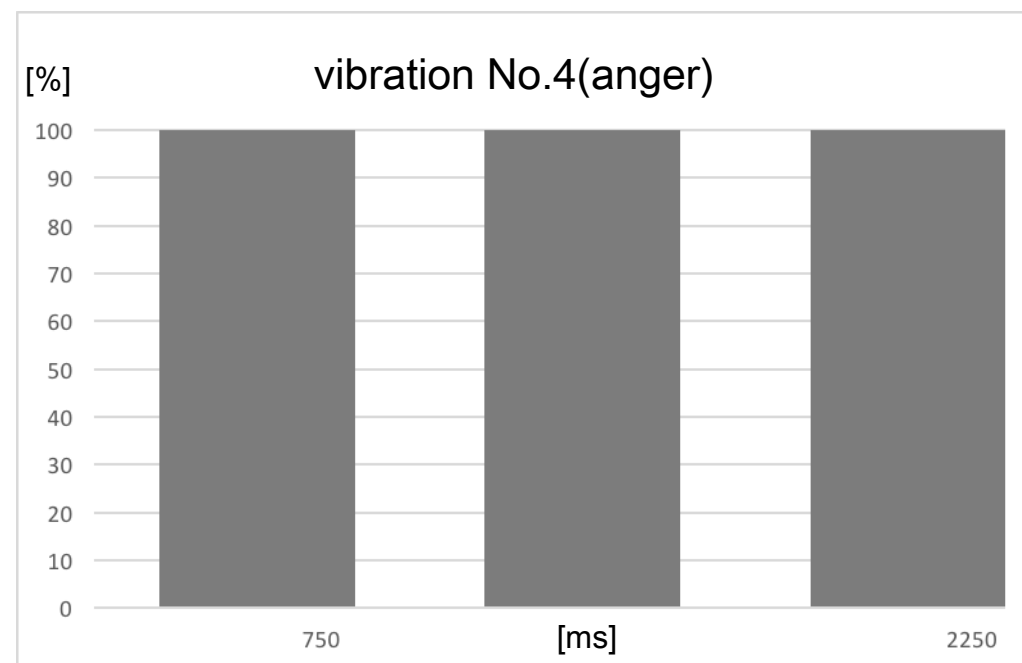
Pattern created by imaging anger



Impression that is pleased or relieved

vibration No.4

vibration No.8



4. Research method

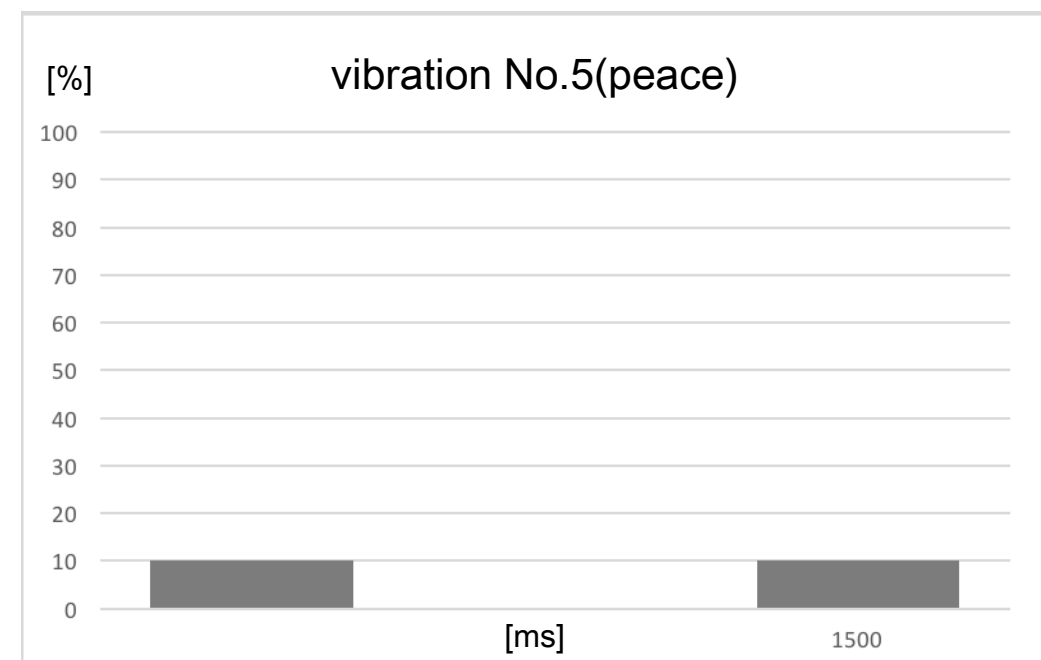
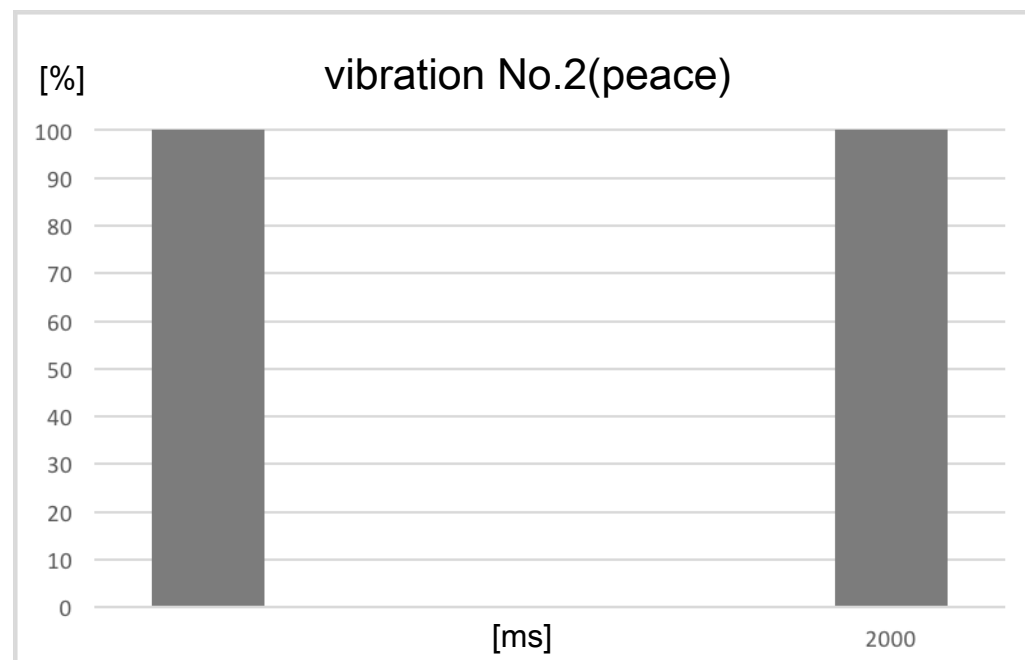
Pattern created by imbuing peace



Scary · anger or too weak impression

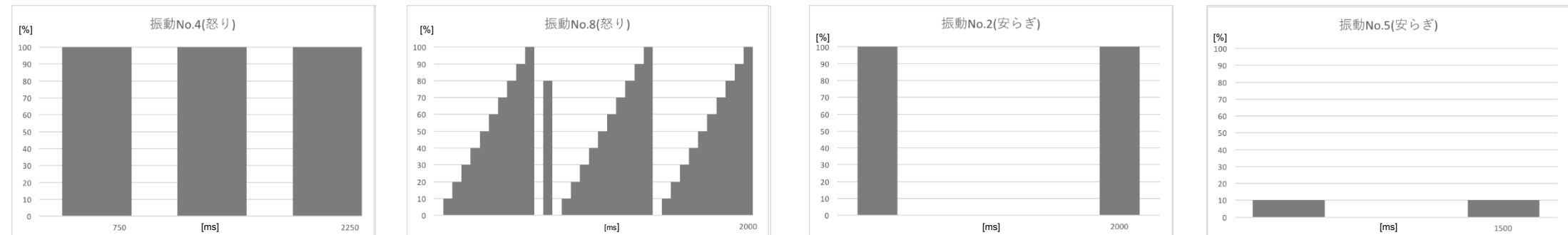
vibration No.2

vibration o.5



4. Research method

The intensity of vibration affects the user's impression.



The method of receiving is different between healthy young people and elderly people.

Heavy - Light

Narrow - Wide

Cold - Warm

Dark-Bright

Unclearly - Clearly

Weak - Strong

feeble - Powerful

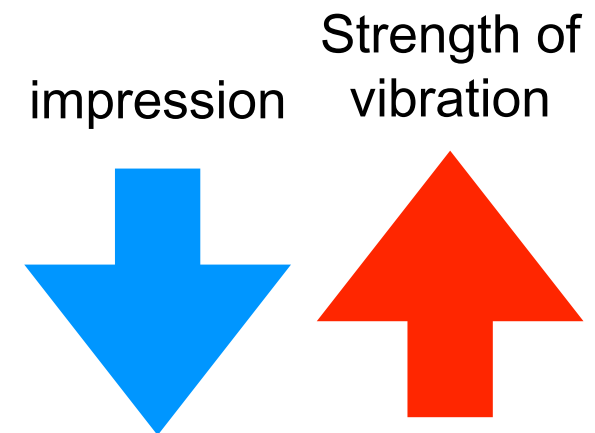
Uncomfortable - Comfortable

5. Conclusion

Youth

When the strength of vibration is large,
Youth have an impression of anger / fear.

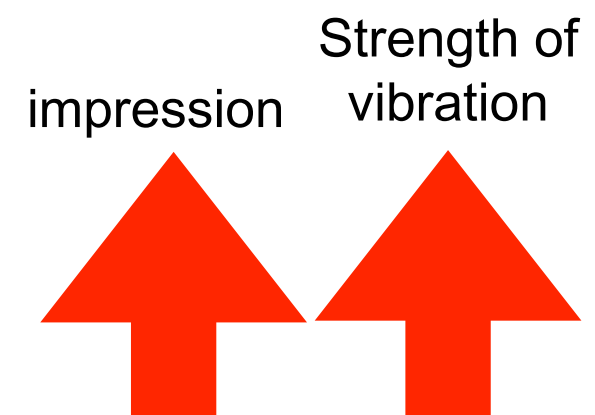
For youth, the impression on the intensity of
vibration is limited.



Elderly

When the strength of vibration is large,
Elderly have the impression of joy and relief.

Elderly have various impressions
On vibration intensity



5. Discussion Conclusion

As for the reason why the way of capturing the impression of young people and senior citizens differs in terms of requests and reports, it is thought that many elderly people are not so familiar with equipment with haptic feedback such as smart phones and game machines compared to young people.

As a result, elderly people tended to receive large vibrations positively. because the collected patterns were created for young people, It is thought that the opinion of the elderly is not reflected, which is considered as a factor.

The following conclusions are summarized from these analyzes.

- I. The impression that the magnitude of haptic feedback gives to users is different.
- II. Depending on the situation the user's impression on haptic feedback is different.

Although it was partial, I could prove the hypothesis "can give a specific image by tactile sense".

5. Summary

Subject	Impression evaluation of haptic feedback and how to convey nuance - Investigation of necessary factors for impression and nuance -
hypothesis	A specific image can be given by tactile sense.
Verification	Collection and convergence of patterns and their impression evaluation 1. Collection and convergence of user-defined haptic feedback pattern 2. Evaluation of haptic feedback patterns involving young and elderly people
Conclusion	The impression changes according to the magnitude of vibration. Young people: big vibrations give a bad impression. Elderly people: large vibrations give a good impression.

5. Future Issue

1. Few collection patterns and diversity
2. How to decide the definition of
haptic feedback component

References

- Shota Shirakami, Yuichiro Kinoshita, Kentaro Township (2016)
"Influence of various vibration feedback on smartphone on user's impression"
"Human Interface Society Journal" HIS, Vol. 18, No. 4, p.p. 103-108.
- Rina Tamura, Shogo Okada, Takao Nishigaki, Katsumi Nitta (2014)
"Proposal and Evaluation of Haptic Text Communication System" HAPPicom "
"Journal of Artificial Intelligence Society" Vol. 30 (2015) No. 2 General paper /
Special feature papers on 2014 conference papers p. 417 - 428.