A Proposal of the Emotion Hierarchy Diagram for Designing the Service Processes

Nanami Shimazaki, Yasuharu Nishi, and Michiko Tsubaki

Abstract

This paper proposes a method to design emotion-based service processes by decomposing highly abstract emotions into detailed emotions. First, we propose an Emotion Hierarchy Diagram (EHD) to decompose abstract emotions into detailed emotions and organize them for identifying and designing specific service processes. The identification steps for creating EHDs are listed. Further, we propose how to use the EHD for deriving service elements. Further, this study verifies whether the proposed EHD can derive service elements for high-quality emotions. We examine where individual differences appear in the EHD, and we find that these differences appear in the axes. Additionally, using statistical tests, we verify whether the service elements for high quality were listed when the EHDs are drawn in both cases, i.e., when the axes were fixed and when they were not.

Keywords

Service element • Quality of service • Customer's emotion • Hierarchization model • Detailed emotion

1 Introduction

The tertiary industry currently accounts for 70 % of Japan's gross domestic product (GDP). According to Reichheld [1], customers who receive highly valuable services will generate more profits through subsequent visits and positive word of mouth, while customers who receive poor service will do harm with negative word of mouth and by discouraging other potential customers. Therefore, it is necessary to study the process designs for highly valuable services.

Service delivers two types of quality: functional quality and emotional quality. A well-designed service can provide a cup of coffee in just a short time, which represents functional quality, while it can provide the emotions of "relaxation" or "excitement," which represent emotional quality. The research focusing on emotional quality has not advanced much, while the research focusing on improving functional service is quite extensive [2]. For example, although there are some service frameworks such as the service profit chain [3] or the service marketing triangle [4], there is little discussion about how these frameworks can be used for improving emotional quality.

A few prior studies examined emotional quality in the context of services. Parasuraman et al. (1998) proposed a SERVQUAL method to evaluate the quality of service [5] using five criteria: reliability, assurance, tangibles, empathy, and responsiveness. Emotional quality is implicitly included in the survey questions. The SERVQUAL method is not always reliable since the evaluation results of a specific service will be relatively lower because the criteria for the questions are derived from the evaluation of a generic service. Customer journey [6] is a method for visualizing a service process by focusing on the emotion experienced by customers during the service. However, it is difficult to use the customer journey method to improve

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Y. Sawatani et al. (eds.), *Serviceology for Smart Service System*, DOI 10.1007/978-4-431-56074-6_4

an emotion that is not yet experienced in the context of a particular service.

Next, we discuss the prior research on emotions in the psychology stream. Plutchik [7] proposed a three-dimensional circumplex model in which all emotions can be represented using eight basic emotions and their combinations. Higuchi [8] proposed a psychological model in which an emotion can be constructed with combinations of other emotions using factor analysis.

These models cannot decompose abstract emotions into detailed emotions because the emotions represented in the models are highly abstract and ambiguous. A highly abstract and ambiguous emotion could be associated with several detailed and inconsistent emotions. If a service is designed based on highly abstract emotions, it will deliver several detailed and inconsistent emotional services simultaneously; i.e., it will deliver service with low emotional quality.

For example, consider a café owner who has a service policy that the café will be based on a particular emotion, "excitement." This policy will lead to a confused service process in the café because the emotion "excitement" is too abstract to allow for the design of a specific service process.

Decomposing an abstract emotion into detailed emotions and designing service processes based on the detailed emotions with a focus on emotional quality are significant because there is very little prior research on emotional quality. Moreover, abstract emotions cannot be used to design service processes even if the service provider focuses on emotional quality.

This study proposes an Emotion Hierarchy Diagram (EHD) to decompose abstract emotions into detailed emotions and to choose one or more emotions from among them to determine specific service elements for designing a service process with high emotional quality.

The scope of this study is as follows.

The service classification scheme [9] classifies service products into 2 × 2 categories based on (1) the direct recipient of the service and (2) the nature of the act. The direct recipient of a service is classified into persons and things. The nature of the act is classified into tangible actions and intangible actions. The service classification scheme does not specify whether the service provider is a person or a machine. The scope of this study is limited to the context where the direct recipient of the service is a person, the nature of the act is a tangible action, and the service provider is a person.

2 Proposal of an Emotion Hierarchy Diagram

Ueda and Hoshino [10] show that an increase in the number of loyal customers makes the service more profitable when a store constructs a system to remind customers of "hope" hidden in the customer's unconscious depth psychology. In this study, "hope" is paraphrased as "excitement," and this study proposes a tool called the Emotion Hierarchy Diagram (EHD) for deriving a service element using a sample of applications based on "excitement."

There are two assumptions in the EHD:

Assumption 1: An emotion has a certain level of abstraction.
Assumption 2: The type of abstraction of emotions used is not a "has-a" type (composition or constituent) but an "is-a" type (inheritance or sub-typing), similar to the approach in object-oriented programming.

The components of the EHD are "top emotion," "detailed emotion," "branching line (for combinations)," and "axis." The top emotion is the most abstract emotion. Detailed emotions are decomposed along the axis. Detailed emotions have hierarchical relations. The emotion in the upper layer is a parent emotion, and that in the lower layer is a child emotion. This relation is relative. The branching line decomposes an abstract emotion into detailed emotions. The axis specifies the condition for decomposing the emotions. Figure 1 shows the components and notations of the EHD.

While drawing an EHD, options for the axis are required. This study refers to the "global structure of emotion types" proposed by Ortony et al. [11] for these options. Table 1 presents the options for the axis.

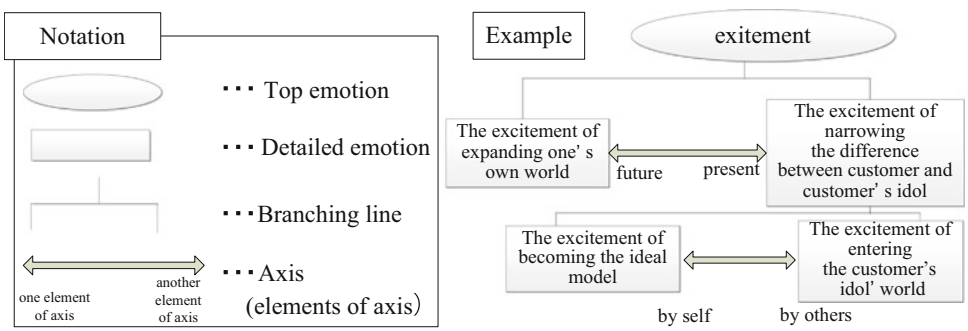

Fig. 1 Components and notations of an emotion hierarchy diagram

Table 1 Options for the axis in an EHD

Name of axis	Elements		
Time	Present	Future	Past
Accomplishment	By self	By others	
Cognition	Unknown	Known	
Gusto	Pleasure	Displeasure	
Who	Self	Others	
Charm	Attractive	Unattractive	

Figure 2 shows an EHD for "excitement." To draw the EHD, this study chose 330 articles at random from the 1,876 articles obtained as search results when the keyword "excitement" was used in the Nikkei BP database [12] on 1 November 2014.

Figure 2 classifies the excitement expressed in the 330 articles along three axes (*time*, *accomplishment*, and *cognition*). First, the *time* axis is used for decomposing "excitement" in Fig. 2. This study refers to the dictionary definition of "excitement" for deciding the axis in the first layer. Sanseido's Daily Concise Dictionary [13] defines "excitement" as "to make someone restless with pleasure or anticipation." We apply this meaning when we examine the axes in Table 1. The axes that can decompose joy and expectation are *time, accomplishment,* and *cognition*. We consider *time* to be the best axis for decomposing "pleasure" and "anticipation" because we consider pleasure to be a current emotion (in the present) and anticipation to be a future emotion. We choose "present" and "future" as elements of the axis because excitements in the past are thought to be recollections of past excitements (in one's mind). Since the real experience of excitement is important, not the recollections of past experiences, this study does not select "past" as an element of the time axis. Next, we choose a suitable axis for the child emotions. In this study, both the axes in the second layer are *accomplishment*. The emotion in the second layer of the present side decomposed by the *time* axis cannot be decomposed to further detailed emotions; the emotion in the future side decomposed by the *time* axis is decomposed to the second layer by *accomplishment* and to the third layer by *accomplishment* and *cognition*.

The EHD can be used to derive service elements via the *following steps:*

1. Decide an emotion that a service wants to build or stimulate.
2. Draw the EHD by examining this emotion using axes.
3. Choose the detailed emotions that a service wants to build or stimulate.
4. Derive the service elements from the detailed emotions.

3 Validation

This study conducts two types of verification.

Validation 1 determines where individual differences appear in the EHD because there may be individual differences in emotions. The verification is based on the assumption that individual differences appear in the axes if the variability of the detailed emotions when the axes are fixed is small and the variability when the axes are not fixed is large.

Procedure

1. The variability of the detailed emotions when the axes are fixed is calculated using cosine similarity in Sect. 3.1.
2. The variability of the detailed emotions when the axes are not fixed is calculated based on the choice of axes: different axes produce different detailed emotions, as discussed in Sect. 3.2.
3. Each characteristic of the verification is compared at the end of Sect. 3.2.

Validation 2 verifies whether the method proposed in this study can derive the service elements required to obtain high-quality emotion.

Procedure

1. The service elements derived from the abstract emotion, and the detailed emotions in the EHD when the axes are fixed are compared using the statistical result in Sect. 4.1.
2. The service elements derived from the abstract emotion and detailed emotions in the EHD when the axes are not fixed are compared using the statistical result in Sect. 4.2.

3.1 Validation of Individual Differences When the Axes Are Fixed

There were nine subjects (seven men, two women) in this validation exercise; they study in the second to third grade of university.

First, the aim of an EHD and the method for drawing an EHD were explained to the subjects. Subsequently, we gave the subjects the articles in the sample and the axes; the subjects drew the EHD using this information. We searched for articles in the Nikkei BP database using the keyword "excitement" on 1 November 2014 and found 1,876 articles. We chose 100 articles randomly from these search results. In this section, the axes and the order of use are fixed; however, the subjects were told that they did not have to decompose an emotion if they could not decompose it into detailed

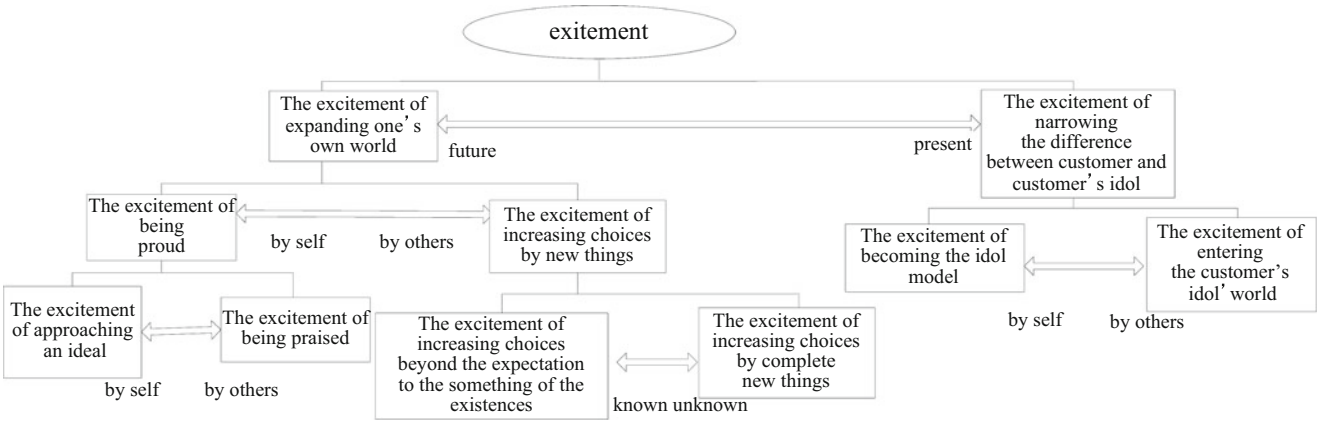

Fig. 2 The EHD for "excitement"

Table 2 Axes used in the EHD for "excitement" in Sect. 3.1

Name of axis	Elements		
Time	Present	Future	Past
Accomplishment	By self	By others	
Cognition	Unknown	Known	

Table 3 Detailed emotions in the EHD of one subject

1. Future side			
The excitement about imagining the future			
The excitement concerning something		The excitement about change around me	
The excitement of consecutive challenges	Unexpected excitement	The excitement about exceeding the last experience	The excitement about gradually increasing knowledge
2. Present side			
The excitement of touching a new thing			
The excitement of touching a new thing on one's own		The excitement of knowing many new things	

Table 4 Number of child emotions corresponding to the elements of the axis

1.	Time (future)
2.	Time (future) accomplishment (by self)
3.	Time (future) accomplishment (by others)
4.	Time (future) accomplishment (by self)
	Cognition (known)
5.	Time (future) accomplishment (by self)
	Cognition (unknown)
6.	Time (future) accomplishment (by others)
	Cognition (known)
7.	Time (future) accomplishment (by others)
	Cognition (unknown)
8.	Time (present)
9.	Time (present) accomplishment (by self)
10.	Time (present) accomplishment (by others)

emotions. Table 2 shows the given axes ordered according to use in this study.

Table 3 presents the detailed emotions in the EHD created by one of the subjects. In fact, there were nine sets of the detailed emotions. Table 4 shows the correspondence between the number of detailed emotions and the elements of the axis, and Table 5 shows the various emotions for each child emotion. The ID numbers in Table 5 represent the subject's number.

This study measured the degree of similarity between two excitements based on the semantic distance, which was calculated according to a word's frequency of appearance. We calculated cosine similarity based on the results of morphological analysis using MeCab [14]. Shiozu and Iwashita [15] used 0.25 as the standard for the degree of similarity. We follow this and assign green color to values with similarity greater than 0.25 and less than 0.5, blue color to values with similarity greater than 0.5 and less than 0.75, and red color to values with similarity greater than 0.75. Table 6 presents the cosine similarity of the first layer <1> and second layer <2>, for example, and Table 7 shows the percentages of each area of cosine similarity per detailed emotion.

From Table 7, we understand that the detailed emotions that are high in the hierarchy are inclined to a high level of similarity, by examining the results into two parts separated by the first layer (future parts <1>–<7>; present parts <8>–<10>). The level of similarity decreases if we increase the axes because the emotions decomposed by each axis have a corresponding variability. Moreover, *by self* has a higher level of similarity compared to *by others* in the *accomplishment* axis. When decomposing an emotion into detailed emotions by self or by others, "accomplishment by self" is easy to understand and is determinative. Thus, the level of similarity is high in the "by self" part. Further, the

Table 5 Each layer of excitement

(1) First layer <1>	
1.	The excitement of expecting the future to be better
2.	The excitement about the future
3.	The excitement of enhancing one's own capability
4.	The excitement of imagining the future
5.	The excitement of foreseeing the future
6.	The excitement of expanding one's own world
7.	The excitement of having a view of the future
8.	The excitement concerning the future
9.	The excitement for the future
(2) Second layer <2>	
1.	The excitement of discovering the future by oneself
2.	The excitement born from one's imagination
3.	The excitement about expanding the future
4.	The excitement about relating to the future
5.	The excitement of increasing one's own ability
6.	The excitement of increasing one's own ability
7.	The excitement of being a trigger for changing the future
8.	The excitement concerning the future created by one's behavior
9.	The excitement of behaving on one's own
(3) Second layer <3>	
1.	The excitement of expecting one's future to become better by others' behavior
2.	The excitement beyond one's imagination
3.	The excitement of expanding the future by other's ideas
4.	The excitement of change around oneself
5.	The excitement concerning an improved society
6.	The excitement of expanding the world
7.	The excitement about the thing that has not yet been achieved becoming real
8.	The excitement concerning the future given by others
9.	The excitement of changing circumstances
(4) Third layer <4>	
3.	The excitement of approaching the ideal world
4.	The excitement of consecutive challenges
5.	The excitement of enhancing self by known things
6.	The excitement of enjoying things
7.	The excitement from the accomplishment
8.	The excitement of accomplishing known things by oneself
9.	The excitement of doing something new by using known things
(5) Third layer <5>	
3.	The excitement of facing unknown results
4.	The excitement beyond expectation
5.	The excitement of enhancing self by unknown things
6.	The excitement of doing things not experienced before
7.	The excitement of imagining an unknown future
8.	The excitement of encountering unknown things by self's behavior
9.	The excitement of doing new unknown things
(6) Third layer <6>	
3.	The excitement of ideas that we can imagine
4.	The excitement of exceeding the previous experience
5.	The excitement about improving the entire society by using known things
6.	The excitement of enjoying something new
8.	The excitement of realizing known things given by others
9.	The excitement of hoping to change the environment
(7) Third layer <7>	
3.	The excitement from unexpected ideas
4.	The excitement of gradually increasing knowledge
5.	The excitement about the entire society improving by using unknown things
6.	The excitement of ranking up
7.	The excitement of expecting the appearance of new things that change our life
8.	The excitement about the unknown future given by others
9.	The excitement about unknown things given by others
(8) First layer <8>	
1.	The excitement of enjoying at that time and place
2.	The excitement of achieving desired things now
3.	The excitement in daily life
4.	The excitement of touching new thing
5.	The excitement of enjoying now
6.	The excitement of feeling great shakes now
7.	The excitement of getting close to something new or longing for something
8.	The excitement about the ideal or desired things
9.	The excitement about the present
(9) Second layer <9>	
2.	The excitement of becoming the ideal model
3.	The excitement of daily experience
4.	The excitement of touching something on one's own
5.	The excitement about one's own favorite
6.	The excitement of experiencing the extraordinary
7.	The excitement of gratifying one's desire
9.	The excitement about one's situation
(10) Second layer <10>	
2.	The excitement of simulated experience
3.	The excitement of similar things experienced daily by other persons
4.	The excitement of knowing many new things
5.	The excitement of something that happened
6.	The excitement of experiencing the ordinary
7.	The excitement of novelty and originality
8.	The excitement about the ideal or desired things given by others
9.	The excitement of response by others

elements of an axis that are "far from the meaning of the emotion," "difficult to imagine," and "not determinative" tend to have high variability.

The percentage where the level of similarity is greater than 0.25 is over 85 % for all the detailed emotions. When fixing the axes, the EHD has low variability.

3.2 Validation of Individual Differences When the Axes Are Not Fixed

There were 21 subjects (20 men, 1 woman) in this validation; they study in the second to third grade of university.

Table 6 Degree of similarity of different excitements

(1) First layer <1>

	1	2	3	4	5	6	7	8	9
1	1	0.471	0.408	0.481	0.51	0.589	0.655	0.436	0.516
2	0.471	1	0.577	0.68	0.722	0.667	0.617	0.772	0.73
3	0.408	0.577	1	0.471	0.5	0.722	0.401	0.535	0.474
4	0.481	0.68	0.471	1	0.825	0.544	0.63	0.63	0.596
5	0.51	0.722	0.5	0.825	1	0.577	0.668	0.668	0.633
6	0.589	0.667	0.722	0.544	0.577	1	0.617	0.617	0.73
7	0.655	0.617	0.401	0.63	0.668	0.617	1	0.571	0.676
8	0.436	0.772	0.535	0.63	0.668	0.617	0.571	1	0.676
9	0.516	0.73	0.474	0.596	0.633	0.73	0.676	0.676	1

(2) Second layer <2>

	1	2	3	4	5	6	7	8	9
1	1	0.447	0.559	0.426	0.625	0.577	0.64	0.456	0.668
2	0.447	1	0.5	0.381	0.447	0.516	0.381	0.49	0.478
3	0.559	0.5	1	0.381	0.447	0.516	0.381	0.49	0.598
4	0.426	0.381	0.381	1	0.426	0.739	0.546	0.311	0.456
5	0.625	0.447	0.447	0.426	1	0.577	0.533	0.365	0.535
6	0.577	0.516	0.516	0.739	0.577	1	0.616	0.422	0.617
7	0.64	0.381	0.381	0.546	0.533	0.616	1	0.389	0.456
8	0.456	0.49	0.49	0.311	0.365	0.422	0.389	1	0.488
9	0.668	0.478	0.598	0.456	0.535	0.617	0.456	0.488	1

Table 7 Percentage of each area of cosine similarity per detailed emotion

The layer				1st	2nd	
Number of detailed emotion				<1>	<2>	<3>
$0.75 \leq x$				2	0	0
$0.5 \leq x < 0.75$				27	16	9
$0.25 \leq x < 0.5$				7	20	26
$x < 0.25$				0	0	1
Percentage $0.75 \leq x$				0	0	0
Percentage $0.5 \leq x$				0.806	0.444	0.250
Percentage $0.25 \leq x$				1.000	1.000	0.972
3rd				1st	2nd	
<4>	<5>	<6>	<7>	<8>	<9>	<10>
0	0	0	0	0	0	0
3	6	0	1	10	5	2
18	12	15	18	25	15	22
0	3	0	2	1	1	4
0	0	0	0	0	0	0
0.143	0.286	0	0.048	0.278	0.238	0.071
1.000	0.857	1.000	0.905	0.972	0.952	0.857

First, the aim of the EHD and how to draw the EHD were explained to the subjects. Subsequently, we gave the subjects the articles and the example of the axes; the subjects drew the EHD using these. The articles were the same as those described in Sect. 3.1. Table 8 presents the example of the axes provided to the subjects. The subjects chose three axes each from the examples in Table 8 on their own.

Table 9 shows the detailed emotions in the EHD created by one of the subjects. Table 10 presents the axes used for Table 9.

Table 8 Examples of the axes

Name of axis	Elements		
Time	Present	Future	Past
Accomplishment	By self	By others	
Cognition	Unknown	Known	
Gusto	Pleasure	Displeasure	
Who	Oneself	Others	
Charm	Attractive	Unattractive	
(Unspecified)	Original axes		
(Unspecified)			
(Unspecified)			

Table 9 Detailed emotions in the EHD of one subject

1. Future side			
The excitement about the future			
The excitement about the things that are useful for oneself		The excitement of being useful to people other than oneself by doing new things	
The excitement about receiving praise	The excitement of expecting one's future	The excitement by being helpful to other people	The excitement of expanding the world for everybody
2. Present side			
The excitement of shaking emotions			
The excitement that one's wish comes true		The excitement that one may do it because another person granted an ideal	
The excitement of accomplishing what one wanted to do by oneself	The excitement of accomplishing one's wish by other's behavior	–	–

Table 10 Axes used for Table 9

Time (future, present, past)	
Benefits (to self, to many people)	
Accomplishment (by self, by others)	–

Table 11 presents the axes that were used by the subjects in the EHD. All the axes that were included in Table 1 are colored red in Table 11; the axis that was not included in Table 1 is colored black in Table 11. Table 11 (3) presents some of the axes that were examined in detail for the elements of the axes in Table 8 (shown in blue). Table 12 shows the number of each kind of axes, the total percentage, and the accumulation. The ID numbers in Tables 11 and 12 represent the subject's number.

The *time* axis is used for about 81 % of the classifications in the first layer in Table 12 (1). That is, the variability in the first layer is small. However, in Table 12 (2) the *accomplishment* axis has the highest percentage in the second layer

Table 11 The axes used

(1) First layer

1	Time
2	Time
3	Time
4	Time
5	Time
6	Time
7	Time
8	Time
9	Time
10	Cognition
11	Time
12	Accomplishment
13	Feeling by myself-sharing with others
14	Time
15	Time
16	Time
17	Time
18	Time
19	Time
20	Who
21	Time

(2) Second layer

1	Cognition	-
2	Accomplishment	-
3	The expectation-realization	-
4	Accomplishment	Accomplishment
5	Accomplishment	The material - The spirit
6	Accomplishment	Accomplishment
7	Accomplishment	Accomplishment
8	Who	Who
9	Accomplishment	Accomplishment
10	Accomplishment	Accomplishment
11	Accomplishment	-
12	Time	Time
13	Time	Time
14	Who	Who
15	Cognition	Cognition
16	passive - active	passive - active
17	The benefits to self- to many people	The benefits to self- to many people
18	Cognition	Cognition
19	Cognition	Time
20	Time	Time
21	Cognition	Cognition

(3) Third layer

1	The accomplishment	-	The accomplishment	-
2	The cognition	The cognition	-	-
3	who	-	-	-
4	The gainful something other than emotions - The gainlessness other than emotions	The gainful something other than emotions - The gainlessness other than emotions	The gainful something other than emotions - The gainlessness other than emotions	The gainful something other than emotions - The gainlessness other than emotions
5	The personal ability -The personal emotion	The cognition	-	-
6	The result by self behavior -based on knowledge and experience	The cognition	Extraordinary - famous	Out of imagination-looking down at self
7	The cognition	The cognition	The cognition	The cognition
8	The cognition	The cognition	The cognition	The cognition
9	The accomplishment	The accomplishment	The accomplishment	The accomplishment
10	who (for self)	who (for self)	who (for self)	who (for self)
11	-	The cognition	The recreation -The contest	-
12	The acquisition -The experience	The acquisition -The experience	The acquisition -The experience	The acquisition -The experience
13	-	-	-	-
14	The cognition	The cognition	The cognition	The cognition
15	who (for self)	who (for self)	who (for self)	who (for self)
16	who (others including self)	who (others including self)	who (others including self)	who (others including self)
17	The accomplishment	The accomplishment	The accomplishment	The accomplishment
18	A moment -long term	A moment -long term	A moment -long term	A moment -long term
19	-	Abstract - concrete	-	The gusto
20	The cognition (unknown)	The cognition (unknown)	The cognition (unknown)	The cognition (unknown)
21	who	who	who	who

Table 12 The number of each axis used for classification and the percentage

Axis	Number	Percentage	Accumulation
1. First layer in Table 11 (1)			
Time	17	0.809524	0.809524
Cognition	1	0.047619	0.857143
Accomplishment	1	0.047619	0.904762
Who	1	0.047619	0.952381
Others	1	0.047619	1.000000
2. Second layer in Table 11 (2)			
Accomplishment	13	0.342105	0.342105
Cognition	8	0.210526	0.552632
Time	7	0.184211	0.736842
Who	4	0.105263	0.842105
Others	6	0.157895	1.000000
3. Third layer in Table 11 (3)			
Cognition	17	0.253731	0.253731
Accomplishment	10	0.149254	0.402985
Who	5	0.074627	0.477612
Gusto	1	0.014925	0.492537
Axis composed by elements	16	0.238806	0.731343
Others	18	0.268657	1.000000

(34 %). In the third layer, the *cognition a*xis accounts for 25 % of all the axes. The percentage accounting for all the axes decreases down the hierarchy. That is, diverse axes are chosen in the lower layers. Further, no one chooses the same combination of axes, and no one draws the same combination of detailed emotions. The choice of axis changes according to the layer. Thus, when the axes are not fixed, the EHD has high variability.

To summarize the verification results, the variability of the detailed emotions when the axes are fixed is low; when the axes are not fixed, the variability of the detailed emotions is high. Thus, individual differences appear in the choice of axes. Further, for each axis, the variability tends to be high for the elements of the axis that are "far from the meaning of the emotion," "difficult to imagine," and "not determinative."

4 Validation of the Derivation of Service Elements

Next, we verify whether the EHD can derive service elements with high emotional quality in both cases: when the axes are fixed and when they are not.

4.1 Validation of Derivation of Service Elements When the Axes Are Fixed

There were 12 subjects (11 men, 1 woman) in this validation exercise; they study in the second to third grade of university. The subjects were divided into four groups. Each group

Table 13 Elements of the excitement café discussed in the brainstorming session before the EHD was drawn (Group B)

Dog and cat café
Soldering café
Camera café
Stationery café
Farmer café
Football café
Amusement park café
Entertainment café
Movie café

listed the elements of the excitement café in a brainstorming session before drawing the EHD. Table 13 presents the elements discussed by Group B before the EHDs were drawn.

Subsequently, the aim of the EHD and how to draw the EHD were explained to the subjects. Each subject created an EHD by decomposing excitement into detailed emotions with 100 articles. Further, the subjects identified the elements of the excitement café from the detailed emotions. Table 14 shows the selected detailed emotions and elements of the excitement café per subject in Group B. The ID represents the group-individual number.

The subjects evaluated the elements of the café proposed by the group members in both cases (using EHD and without EHD) with five points (low is one; high is five). Table 15 shows the average score of the elements.

After confirming that the average score is normally distributed by describing the normal plot, we conduct an F-test for the equality of the two variances. Here, we assume that the average score of the elements without EHD is distributed with $N(\mu_0, \sigma_0^2)$, while the average score when using EHD is distributed with $N(\mu_1, \sigma_1^2)$. The result of the F-test is $F = 1.096 < F_{0.05}(11, 10) = 2.943$. There is no significant difference in the two variances. Subsequently, we conduct the student's t-test to test the difference in the averages of $H_0 : \mu_0 = \mu_1$ vs $H_1 : \mu_0 < \mu_1$. The result of the t-test is $|t| = 3.874 > t_{21}(0.05) = 1.721$. Thus, the null hypothesis is rejected.

The population mean of the elements of the excitement café when using EHD is greater than that when not using EHD, as shown by the result of the t-test. Thus, when the axes are fixed, high-quality service elements are listed in the EHD.

4.2 Validation of the Derivation of Service Elements When the Axes Are Not Fixed

There were 21 subjects (20 men, 1 woman) in this validation exercise; they study in the second to third grade of university. The subjects were divided into four groups. Each group

Table 14 Detailed emotions and elements of excitement café selected by each subject in Group B

ID	Detailed emotions	Café elements
B-1	The excitement of experiencing the extraordinary	A café with Indian décor where customers enjoy Indian movies
	The excitement of experiencing the ordinary	A café where customers enjoy the stars in the sky
	The excitement of doing things not experienced before	A house full of tricks café
	The excitement of doing things not experienced before	A café fitted with mirrors all over
	The excitement of experiencing the extraordinary	
B-2	The excitement of imaging the impossible situations	An science fiction-themed café where customers can imagine impossible situations
		A café where customers can fire their imagination with materials like magazines or the Internet
	The excitement of sharing the experience with other persons	A café where customers can talk with 3–5 peoples around a big round table
B-3	The excitement of closing the distance between the idol and the ideal	A café where customers feel familiar with an idol
		A café serving a menu related to an idol
		A café whose owner is an idol
		A café where customers enjoy playing with well-mannered dogs
B-4	The excitement of making new things	A café where customers can use materials and tools from an electronic kit, and the staff help them when required
	The excitement given by others	A café where customers enjoy various movies on the big screen
	The excitement of studying or working	A café where customers can study or work without hesitation
		A café with private rooms to concentrate without distractions
	The excitement of challenging new thing	A café where customers can try out rock-climbing and bungee jumping
B-4	The excitement of challenging new thing	A café where customers can start a fire and serve coffee on their own
		A café with natural interior decoration
	The excitement of using new thing	A café where a machine prepares the food
		A café where robots serve the customers
		A café where customers have a cup of coffee with wearable devices

Table 15 Average score of elements of excitement café

ID	A-1	A-2	B-1	B-2	B-3	B-4
Without EHD	3.00	3.40	2.22	3.11	2.89	3.67
Using EHD	3.71	4.00	–	3.33	4.25	4.10
ID	C-1	C-2	C-3	D-1	D-2	D-3
Without EHD	3.89	3.67	2.50	3.23	3.54	3.62
Using EHD	4.75	4.09	4.67	3.67	4.40	3.33

Table 16 Elements of an excitement café discussed during brainstorming session by Group E before drawing the EHD

A café where we can imitate someone, e.g., samurai, prisoner, time traveler
A café where we can make something, e.g., plastic model, game
A café where the order from the menu is decided by the results of a game, e.g., party game, darts
A café where we can go on imaginary journeys using google maps and head-mounted display (HMD)
A café where a picture we draw is printed by a 3D printer
A café for examinees where past exams are available
A café where we can eat in-flight meals or space food
A café where we can eat food in a two-dimensional world of comics

listed the elements of the excitement café in a brainstorming session before drawing the EHD. Table 16 presents the elements discussed by Group E before the EHDs were drawn.

Table 17 shows the selected detailed emotions and elements of the excitement café per subject in Group E. The ID represents the group-individual number.

The subjects evaluated the elements of the café proposed by the group members in both cases (using EHD and without EHD) with five points. Table 18 shows average scores of these elements.

After confirming that the average score is normally distributed by describing the normal plot, we conduct an F-test for the equality of the two variances. Here, we assume that the average score of the elements without EHD is distributed with $N(\mu_0, \sigma_0^2)$, while the average score while using EHD is distributed with $N(\mu_1, \sigma_1^2)$. The result of the F-test is $F = 12.777 > F_{0.05}(20, 20) = 2.464$. There is a significant difference between the two variances. Subsequently, we conduct Welch's test to test the difference in the averages of $H_0 : \mu_0 = \mu_1$ vs $H_1 : \mu_0 < \mu_1$. The result of Welch's test is $|t| = 2.842 > t_{23}(0.05) = 1.713$. Therefore, the null hypothesis is rejected.

The population mean of the elements of the excitement café when using EHD is greater than that when not using EHD, as shown by the result of Welch's test. Thus, when the axes are not fixed, high-quality service elements are listed in the EHD.

Table 17 Detailed emotions and elements of excitement café selected by each subject in Group E

ID	Detailed emotions	Café elements
E-1	The excitement of encountering unknown things	A café where customers feel like traveling using google maps
	The excitement of urging something by self	A café where customers enjoy party games with strangers
E-2	The excitement that the customers cannot predict what will happen	A café where customers enjoy performances or sports such as magic or soccer
		A café where customers can be surprised by something such as surprising TV programs
	The excitement of experiencing various unknown things	A café where the staff teach the customers some knowledge and techniques that could expand the customers' life
E-3	The excitement of expecting something	A café where customers experience things using HMD
		A café where customers can try out unreleased products
E-4	The excitement from the satisfaction of becoming the ideal	A café where customers are served food eaten by *daimyos* long time ago
	The excitement of entering the ideal world	
	The excitement of growing up humanly	A café where customers communicate in languages other than the native language
	The excitement of stimulating our mind	
	The excitement of growing up humanly	A gym café where customers can order menu according to calorie consumption
	The excitement of stimulating our mind	
	The excitement of getting what it is difficult to get on one's own	Monster Hunter café where the menu is changed according to the result of a game
	The excitement of entering the ideal world	(Monster Hunter is a popular game in Japan)
	The excitement of getting something that is difficult to get on one's own	A café where a certain time period is re-created and the customers are treated as people of that time
	The excitement of getting something that is difficult to get because of our environment	
	The excitement of entering the ideal world	
	The excitement of getting what it is difficult to get by our environment	A café where customers are treated as dwarfs
	The excitement of entering the ideal world	

(continued)

Table 17 (continued)

ID	Detailed emotions	Café elements
E-5	The excitement of satisfying oneself mentally	A café where customers are served food from the comic world
		A café preparing clothes for costume play
E-5	The excitement of enjoying something	A café where there are rooms with various themes
	The excitement of enjoying something	A café where customers receive a status of utilization per month or year
E-6	The excitement of expecting famous or high evaluated things	A café where customers enjoy food prepared by a famous chef
	The excitement of encountering an extraordinary scene	A café where customers are served expensive coffee

Table 18 Average score of elements of excitement cafe

ID	E-1	E-2	E-3	E-4	E-5	E-6
Without EHD	3.63	3.38	3.63	3.75	4.00	3.13
Using EHD	4.50	4.00	5.00	4.33	4.75	1.00
ID	F-1	F-2	F-3	F-4	F-5	
Without EHD	3.67	3.44	3.33	3.56	3.33	
Using EHD	3.00	3.67	4.00	4.33	3.75	
ID	G-1	G-2	G-3	G-4	G-5	G-6
Without EHD	3.30	3.20	3.80	3.80	3.60	3.50
Using EHD	3.00	5.00	4.00	4.67	4.50	4.67
ID	H-1	H-2	H-3	H-4		
Without EHD	3.42	3.85	3.08	3.85		
Using EHD	4.50	5.00	4.33	4.60		

5 Conclusion

This study proposes an Emotion Hierarchy Diagram (EHD) to decompose abstract emotions into detailed emotions and to select them for deriving specific service elements to design a service process with high emotional quality.

This study conducts two types of verification. Validation 1 examines where individual differences appear in the EHD. We find that individual differences appear in the choice of axes.

Validation 2 verifies whether the method proposed in this study can derive the service elements required to obtain high emotional quality. We find that high-quality service elements were listed when the EHD was drawn in both cases: when the axes were fixed and when they were not.

However, the validity of the findings needs further verification.

Internal validity: The service elements were derived from the abstract emotion before the service elements were derived from the detailed emotions. Since the experience could be affected by deriving the service elements with high emotional quality, there were 3-week intervals between the processes. There were one or two women in each experiment. Thus, it is possible that gender difference affected the choice of axes or the service elements derived with high emotional quality. Whether gender has an impact needs to be verified in future research by increasing the number of women subjects.

External validity: Questions could be raised about the external validity since the experiments' subjects were only in the second to third grade of university. However, this method is not designed specifically for the second to third grade of university. The method could be useful for all people who have emotions. We would want to verify the utility of the proposed method for all ages and all levels of education by broadening the research objective.

To conclude, we present further directions for future research. Although the direct recipient of a service was defined as a person, the nature of the act as a tangible action, and the service provider as a person with regard to the scope of this study, the proposed tool and method could be applied in a context where the service provider is a machine. A machine could provide customers a service with high emotional quality if the machine could provide the service elements from the detailed emotions similar to what a person does.

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