

## A study on embarrassment associated with product use

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### ABSTRACT

User interactions with products or systems can produce positive feelings, e.g. pleasing, encouraging or challenging; or negative ones, e.g. annoying, depressing or even abusive. This study attempted to explore reasons for negative emotions associated with product use by probing into the embarrassing emotions aroused in a product-use situation. The results showed that the embarrassment associated with product use was caused by two constructs: losing control of the product and inappropriate operation. Both of the two constructs have impacts on embarrassing emotions; however, the structural model showed that for the embarrassment associated with product use, inappropriate operation stands out as a more significant construct than losing control of the product. Users tended to blame themselves for the embarrassing situation, believing that the embarrassment was a result of their improper use of the product or carelessness.

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### 1. Introduction

In consumer product design, emotional factors are increasingly weighed in as they are now important elements to be considered. Studies have confirmed that emotions greatly affect consumer satisfaction, product usability, and even consumer's willingness to purchase (Chaudhuri, 1998; Khalid, 2006; Phillips and Baumgartner, 2002; Sauer and Sonderegger, 2009; Westbrook and Oliver, 1991). For this reason, exploring product attributes that would arouse specific emotional responses and using the concept in product design becomes one of the vital tasks for product designers (Hsiao and Chen, 2006; Seva et al., 2007). In the process of product conceptualization, product appearance is an important stimulus that may trigger user's emotions. Related research and practical applications also leaned toward seeing product appearance or image as an emotion stimulus (Nagamachi, 1995, 2002). Emotions can also be aroused by other factors other than product appearance; in fact, stimulated emotion is multi-modal (Liu, 2003a). Hearing the slamming sound of a car door, touching the leather seats, or even sniffing the smell of a new car, can be factors that influence how a consumer evaluate a new car and may even be the deciding factors toward the purchase.

These kinds of affective evaluation may also come from the interactions between the consumer and the product or system (Liu, 2003a). Tsao and Hsiung (2000) explored the relationship between user behavior and product attributes from a behavioral perspective, and found that emotions vary with different product attributes which in turn affects consumer's product-use pattern. Tsao and Chen (2007) looked into the expectation of product use and found that by adding exciting and surprising elements onto the product, thus making the product interesting, users have higher expectations. Tsao and Tasi (2005) also found that besides product appearance, specific mode of operations or actions was able to stimulate user's feelings toward a lovely and innocent image. Hence, product attributes, such as appearance, color, texture or interface, are likely to trigger specific emotional responses associated with product use, thereby affecting users' product-use pattern.

Through interactions with products or systems, the derived experience or emotional response is multi-dimensional; and the overall sentimental response of the consumer is a composite response from multiple factors that may influence one another. These feelings can be positive emotions, e.g. pleasing, encouraging or challenging, or negative emotions, e.g. annoying, boring or even abusive (Liu, 2003b). How product designers shape the overall sentimental response they desire from the consumer depends on the purpose of the design, the target groups or specific product-use contexts. Norman (2002) proposed that successful and lasting design is dependent on the positive interactions between the user and the product; however, it is inevitable that consumers often

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experience negative emotions in the process of using a certain products, even if these sentiments are not deliberately meant for the consumers to experience.

In our daily lives, we may throw a can opener into the trash can for not being able to open a jar of jam and get irritated by it, or we may feel frustrated because a product is simply not user-friendly. These are all negative emotions users experience when interacting with products. Based on hierarchical cluster analysis, Huang et al. (2007) found that users exhibited annoying emotions when operating high-tech products and the annoyance was highly correlated with the complexity of the interface regardless of product attributes, design or function. Users also have a tendency to be verbally abusive products with human-like interface (Angeli and Carpenter, 2005). Therefore, how to avoid arousing negative emotions in product use but stimulate positive emotions becomes a matter of great concern for product designers.

Embarrassment is a common emotion of self-consciousness that often takes place in a social context. Almost everyone has had an embarrassing experience. Unlike shame, embarrassment is an awkward feeling aroused as a result of an individual's behavior that fails to gain social acceptance but it is not morally condemned (Tangeny, 1999). Goffman (1959), the pioneer in embarrassing emotion studies, pointed out that embarrassment occurred when personal privacy, shortcoming or tragic event was cognitively threatened or discredited. The feeling of embarrassment is partially caused by personal behavior, such as when a lie is exposed, a mistake is made or when one is caught farting or conducting sexual behavior. Embarrassment can also be caused

by other people's behavior, for example, when someone shows funny pictures of a person at a very young age, that person instantly becomes the laughingstock or target of ridicule, or when one witnesses others in an embarrassing situation (Edelmann and McCusker, 1986). Most of the studies on embarrassing emotions focused on consumer tendency and purchasing behavior of products that might cause embarrassment, such as buying adult books or personal care products, and on the impact of advertising on the attitude toward purchasing embarrassing products (Dahl et al., 2001; Lau-Gesk and Drolet, 2008; Rehman and Brooks, 1987). Some of the studies centered around embarrassment under social interaction, e.g. standing on a weight scale in front of the opposite sex, singing, dancing or acting like a clown before a big crowd, talking about an embarrassing topic or seeking medical assistance about an embarrassing disease (Geier and Rozin, 2008; Koch, 2006; Menees et al., 2005; Ogle et al., 2008; Van Boven et al., 2005). Other investigators conducted a series of studies on the physiological responses of test subjects in embarrassing situations (Drummond and Lim, 2000; Drummond et al., 2003, 2007). As regards the relation between embarrassing emotions and product use, Bonnici et al. (1996) discussed the embarrassment aroused when using discount coupons. However, embarrassing emotions aroused when using non-embarrassing products have not yet been investigated.

This study focuses on embarrassment to explore the underlying reasons for negative emotions associated with product use and the structural relations among the reasons. First, drawing from results of self reports, this study explored the embarrassing experiences of

**Table 1**  
Emotional reaction frequency for each case example.

Emotional Reaction	Case Code																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Anger	1	3	0	6	1	3	1	15	3	2	0	0	2	13	7	0	0	4	16	2	29	14	3
Fear	13	5	7	9	0	2	0	0	0	3	0	3	7	2	3	1	0	0	3	4	0	1	0
Sadness	0	4	1	1	0	0	0	0	0	0	0	0	1	1	5	1	0	0	2	0	2	1	0
Embarrassment	36	26	40	24	26	36	12	20	36	33	23	39	32	19	22	18	35	27	18	37	18	20	24
Contentment	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0
Happiness	0	2	0	1	7	2	0	2	2	0	1	3	1	9	0	1	0	5	3	2	0	2	3
Love	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Pride	0	0	0	1	0	0	1	0	0	0	1	1	0	1	2	1	1	0	1	2	1	0	0
No particular feeling	1	3	0	1	3	1	28	9	3	7	19	2	3	1	12	21	5	7	6	1	2	3	12
Active margin	51	43	48	44	38	44	42	46	44	45	44	48	51	47	51	43	41	44	49	49	52	42	42

Emotional reaction	Case code																						
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Anger	13	8	22	16	22	14	3	5	2	11	5	3	0	0	16	3	1	4	8	20	6	14	21
Fear	7	6	4	1	5	3	1	2	3	0	1	5	2	2	1	6	2	14	2	3	1	1	0
Sadness	1	2	5	0	1	2	0	1	0	6	5	5	0	0	2	0	1	1	0	1	0	8	3
Embarrassment	37	17	21	21	30	28	28	23	33	25	30	31	27	27	12	31	37	32	19	27	20	20	9
Contentment	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	1	0	1	0	0	0	0
Happiness	0	1	1	3	0	0	6	2	0	0	0	4	4	0	0	1	2	0	1	2	2	1	0
Love	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0
Pride	0	0	0	0	0	0	0	0	1	0	2	1	5	1	0	1	2	1	0	1	0	0	0
No particular feeling	1	9	1	9	0	2	6	11	3	4	6	1	7	14	11	6	0	4	12	1	12	5	12
Active margin	59	43	54	50	58	49	45	44	42	46	49	50	50	44	42	48	46	56	43	55	43	49	45

Emotional reaction	Case code																						
	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	Active Margin			
Anger	4	1	2	12	1	1	1	1	8	1	14	6	2	3	1	0	1	1	4				125
Fear	1	1	3	1	1	3	20	6	12	4	4	9	9	16	1	6	4	1	2				63
Sadness	4	0	0	4	0	3	6	1	3	0	2	1	1	4	0	1	1	2	1				19
Embarrassment	35	33	27	28	26	28	24	33	30	37	34	32	35	29	28	39	38	32	40				621
Contentment	0	2	1	0	1	3	0	0	0	0	0	0	0	1	0	0	1	0	0				6
Happiness	0	2	0	3	4	4	1	1	1	2	0	1	1	0	0	5	0	0	2				46
Love	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0				5
Pride	0	1	1	0	0	1	0	0	1	0	0	2	2	0	1	0	0	1	0				13
No particular feeling	7	8	7	2	9	4	0	3	1	7	3	3	2	2	12	0	5	7	1				150
Active margin	51	48	41	50	44	47	52	45	56	51	57	54	52	55	43	52	50	44	50				1048

users associated with product use through focus group discussions and used correspondence analysis to select representative case examples. Next, the present study compared similarities between the case examples by constructing a similarity matrix and utilized hierarchical cluster analysis to structure the case examples in establishing constructs for embarrassment caused in product use. Last but not least, covariance structure analysis was used to verify the causal relationship of embarrassment constructs associated with product use.

**2. Investigating the embarrassment constructs associated with product use**

*2.1. Case examples of embarrassment associated with product use*

This study collected case examples via the method of self report. The participants were asked about real-life embarrassing situations associated with product use based on personal life experiences or cases they have heard from others. There were a total of 37 participants (age 18–45; 12 males and 25 females). In total, 198 case examples were recovered. After excluding case examples with no direct relevance to embarrassment associated with product use, 133 case examples were obtained.

Since the collected case examples covered a wide range of reasons for embarrassment, focus group discussions were held to categorize the 133 case examples according to their underlying reasons. Members of the focus group consisted of nine designers with at least six years of experience in design (2 males and 7 females). The focus group reviewed the embarrassing case examples one by one and classified the reasons into 65 groups. In each group, depending on the degree of embarrassment, the most representative case example was selected for further verification analysis.

*2.2. Verifying case examples of embarrassment*

To further verify the 65 representative case examples chosen by the focus group were sufficient to produce embarrassing emotional responses, this study conducted a questionnaire survey. The questionnaire describes each of the 65 representative examples. Participants were asked to choose from the eight basic emotions – Anger, Fear, Sadness, Shame, Contentment, Happiness, Love and Pride (Laros and Steenkamp, 2005) for each of the 65 cases based on their personal emotional response possibly triggered by the situation described in the questionnaire. Participants can choose more than one emotion if they think the case example triggers multiple emotions; if the case example triggers no particular emotional reactions, participants can choose the option “No Particular Emotion Aroused”. As this study was designed to explore embarrassing emotions, “Shame” was replaced by “Embarrassment” as one of the eight basic emotions.

There were a total of 43 volunteer participants (19 males and 24 females). In order to avoid the impact of the first phase of survey, participants here did not include any of the participants in the previous phase. The results of basic emotions for each case example were summed up. Table 1 shows the cumulative number of basic emotions corresponding to each case example.

Correspondence analysis was used to examine the corresponding relationship between representative case examples and basic emotions. Chi-square test reached statistical significance ( $p < 0.01$ ,  $df = 512$ ), indicating a correlation between the two variables. When the generalized variance was in three-dimension, the cumulative description rate reached 0.705 ( $>0.5$ ). Ward’s Minimum Variance Method was then used to obtain the scores for all case examples and basic emotions in three-dimension. As presented in Fig. 1, 19

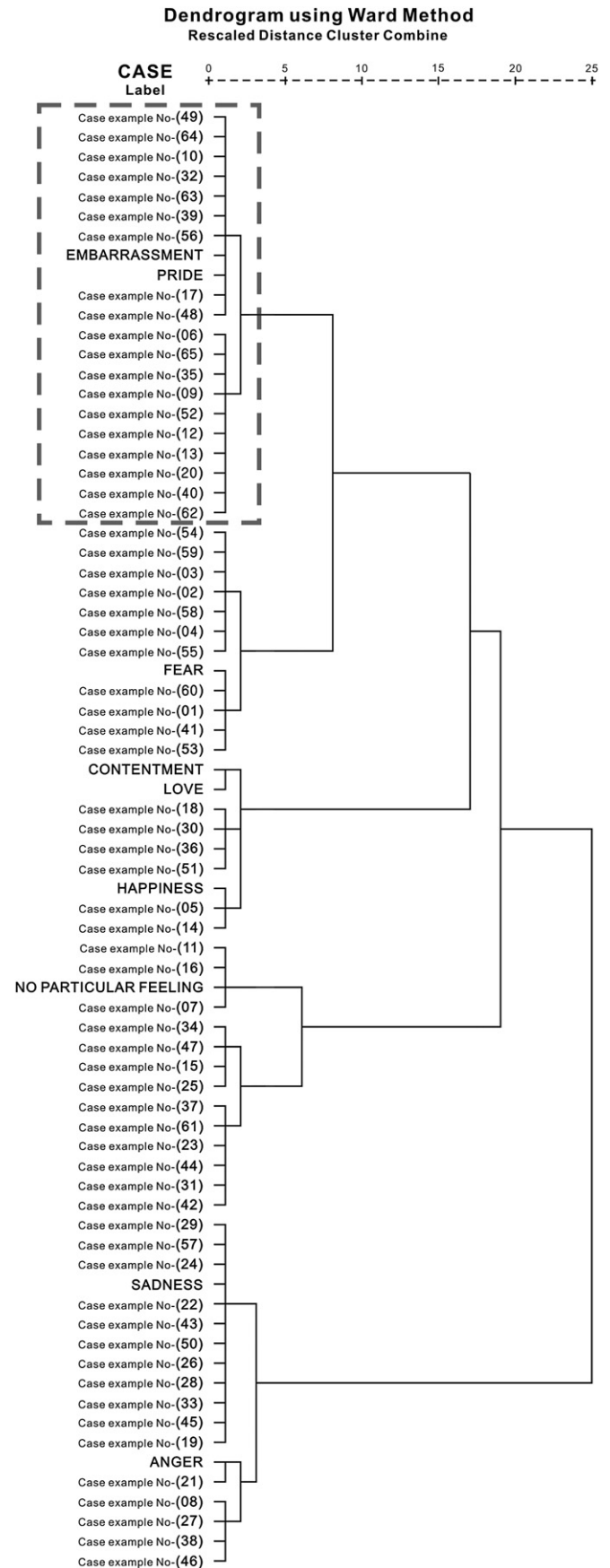


Fig. 1. Results of cluster analysis of 65 case examples and 8 basic emotions.

**Table 2**  
Description of the 19 representative case examples.

Original Case No.	Description	New Coded
Case-(06)	You had mistaken an automated teller machine to be voice controlled so when the machine asked you for the password, you actually told it your password out loud.	1
Case-(09)	Your credit card was declined at the cashier, just then you realized that it was your ATM card that you had given the cashier.	2
Case-(10)	You accidentally rested your arms on the horn while stopping at a red light. The motorcyclist in front of you kept staring back at you.	3
Case-(12)	You were in an elevator and you saw someone trying to get in. You wanted to press the "Open" button but mistakenly pressed "Close". The person was jammed between the doors.	4
Case-(13)	On a bus, you realized that there was no more stored-value credit to be deducted from your EasyCard (a contactless smart card for taking the public transit in Taipei) and you had no change on you. You had to ask other passengers on the bus to help you with the bus fare.	5
Case-(17)	You turned on your computer in a quiet library, and to your surprise, the Windows startup music was really loud because you forgot to turn off the speaker.	6
Case-(20)	Your feces were too large to be flushed down the toilet. You had to ask for help.	7
Case-(32)	Your EasyCard failed to work when you were exiting an MRT station or getting off a bus, inconveniently causing a big crowd to pile behind you.	8
Case-(35)	You were using a swim tube at the beach and no matter how hard you tried you could not get it off you.	9
Case-(39)	At a company meeting, you were using your own computer to give a presentation or briefing. Suddenly, a new-job-interview-for-you notice from Job Bank popped out on the screen.	10
Case-(40)	You brought your DVD player from home to school to present your assignment; however, you forgot to take out the adult video from it and offensive images were shown to the class.	11
Case-(48)	You overfilled your Slurpee cup at a convenient store and it was all over the machine.	12
Case-(49)	In a drug store, you were trying out a cosmetics sample but accidentally squeezing out too much from it. You really had trouble trying out all that you had squeezed from the sample.	13
Case-(52)	You were curious about pepper spray and tried it in a room. As a result, everyone rushed out of the door coughing.	14
Case-(56)	You intended to send a text message to A but it was sent to B by mistake.	15
Case-(62)	You were using the shell cracker to eat a crab leg. The slippery crab leg flew out of your hands and landed in the soup of the person dining at the next table.	16
Case-(63)	You were at a classy restaurant. You didn't know how to use knives and forks properly and made a lot of clanking noises.	17
Case-(64)	You were looking for something in your hand bag, and some very personal items were accidentally exposed.	18
Case-(65)	You thought it was a mirror that you looked into when you picked your teeth only to find that it was a single-mirror-glass window and everyone had watched all that you did.	19

out of the 65 case examples were found relating to embarrassing emotions associated with product use so they were selected as the representative case examples in this study. Table 2 details the 19 case examples.

### 2.3. Structural relationship of embarrassing emotions associated with product use

A similarity matrix was created based on the 19 representative case examples. A survey involving questionnaires was conducted to evaluate the similarity among the reasons causing

embarrassment on a 10-point scale (1: low similarity; 10: high similarity). The mean value for all questionnaires was calculated and shown in Table 3.

After the similarity matrix was converted into variant matrix, Ward's minimum variance method was used for further analysis. The 19 case examples were classified into 6 clusters according to their degree of similarity (Fig. 2). Each cluster is discussed in detail in the following section.

Cluster 1: This cluster included Case Example 12, 13 and 9. The common reason for embarrassment could be attributed to user exceeding the product's pre-set usage limits or exceeding the user's

**Table 3**  
Mean similarity matrix score for the embarrassing case examples.

Case	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
01	10.0	5.2	4.5	4.7	3.1	4.1	2.2	2.6	2.8	2.8	3.9	3.4	2.9	3.5	4.2	3.2	3.1	3.7	4.7
02	5.2	10.0	4.8	5.2	3.7	3.3	1.8	3.4	3.7	3.5	4.2	2.5	2.7	3.4	5.8	2.5	2.9	4.1	4.4
03	4.5	4.8	10.0	7.3	5.1	6.9	2.5	5.4	3.6	4.9	5.8	3.5	3.9	5.5	5.2	5.0	4.3	5.5	5.2
04	4.7	5.2	7.3	10.0	4.2	5.2	2.8	4.8	2.5	4.1	5.3	3.7	3.2	5.6	4.8	5.3	4.0	4.4	5.2
05	3.1	3.7	5.1	4.2	10.0	4.5	5.9	5.3	2.4	3.2	5.0	4.4	3.6	4.1	3.2	4.4	2.7	4.0	5.0
06	4.1	3.3	6.9	5.2	4.5	10.0	3.6	5.0	3.4	5.4	6.5	4.6	3.7	4.4	3.4	4.7	4.6	4.3	5.6
07	2.2	1.8	2.5	2.8	5.9	3.6	10.0	5.7	5.4	4.3	3.5	4.1	3.6	3.2	2.1	4.4	2.9	4.5	4.7
08	2.6	3.4	5.4	4.8	5.3	5.0	5.7	10.0	3.8	5.1	4.1	4.4	3.3	4.3	1.9	5.1	4.2	3.3	4.5
09	2.8	3.7	3.6	2.5	2.4	3.4	5.4	3.8	10.0	4.8	4.6	4.6	5.8	3.8	2.2	3.2	3.8	4.3	3.6
10	2.8	3.5	4.9	4.1	3.2	5.4	4.3	5.1	4.8	10.0	6.8	4.5	3.8	3.4	3.6	4.4	2.6	5.9	5.1
11	3.9	4.2	5.8	5.3	5.0	6.5	3.5	4.1	4.6	6.8	10.0	4.5	2.5	3.5	4.8	5.1	3.4	7.1	6.7
12	3.4	2.5	3.5	3.7	4.4	4.6	4.1	4.4	4.6	4.5	4.5	10.0	7.7	5.6	2.7	4.7	4.2	3.5	5.4
13	2.9	2.7	3.9	3.2	3.6	3.7	3.6	3.3	5.8	3.8	2.5	7.7	10.0	5.5	3.7	4.9	5.1	3.8	4.9
14	3.5	3.4	5.5	5.6	4.1	4.4	4.4	3.2	4.3	3.8	3.4	3.5	5.6	5.5	10.0	3.9	6.4	6.0	5.1
15	4.2	5.8	5.2	4.8	3.2	3.4	2.1	1.9	2.2	3.6	4.8	2.7	3.7	3.9	3.9	10.0	5.1	3.7	3.6
16	3.2	2.5	5.0	5.3	4.4	4.7	4.4	5.1	3.2	4.4	5.1	4.7	4.9	6.4	5.1	10.0	7.1	5.2	5.3
17	3.1	2.9	4.3	4.0	2.7	4.6	2.9	4.2	3.8	2.6	3.4	4.2	5.1	6.0	3.7	7.1	10.0	3.9	4.1
18	3.7	4.1	5.5	4.4	4.0	4.3	4.5	3.3	4.3	5.9	7.1	3.5	3.8	5.1	4.7	5.2	3.9	10.0	5.0
19	4.7	4.4	5.2	5.2	5.0	5.6	4.7	4.5	3.6	5.1	6.7	5.4	4.9	4.7	3.6	5.3	4.1	5.0	10.0

Note: Similarity score on a 10-point scale (1 = Not at all similar; 10 = Very similar).

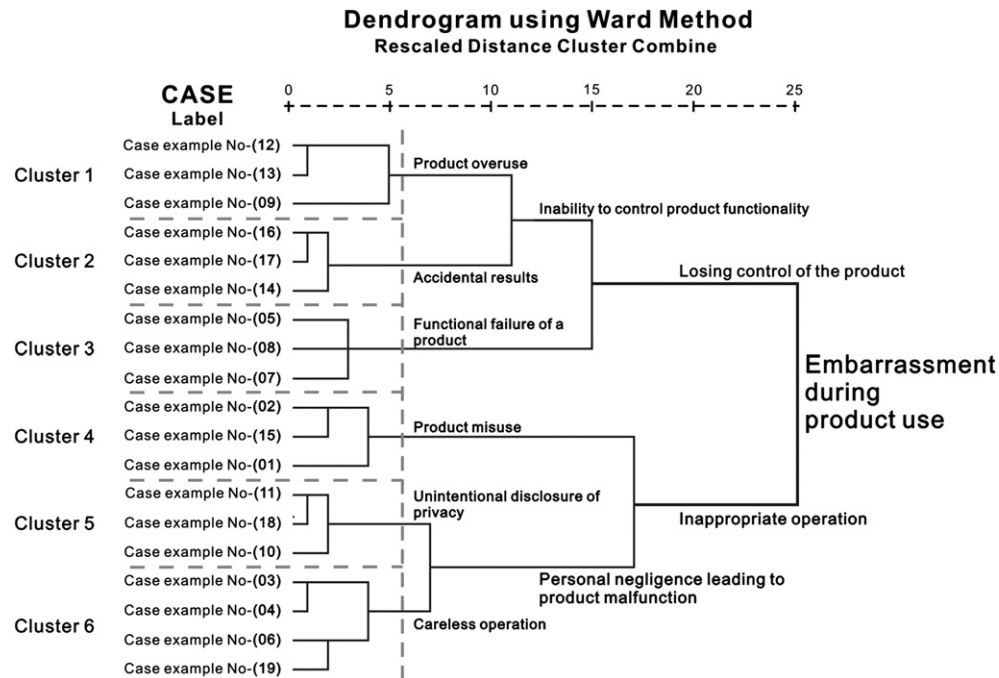


Fig. 2. Results of cluster analysis of the 19 case examples.

anticipation of amount of product use. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by product overuse.

Cluster 2: This cluster included Case Example 16, 17 and 14. The common reason for embarrassment could be attributed to the unexpected outcome in the product use. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by accidental results.

Cluster 3: This cluster included Case Example 5, 8 and 7. The common reason for embarrassment could be attributed to the product that is affected by foreign objects (force), causing inoperability or failure to retain the product's original function. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by functional failure of a product.

Cluster 4: This cluster included Case Example 2, 15 and 1. The common reason for embarrassment can be attributed to the user's wrong or improper use of a product. This means that the user is unaware of the fact that he/she is inadequately operating a product. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by product misuse.

Cluster 5: This cluster included Case Example 1, 18 and 10. The common reason for embarrassment could be attributed to operational errors or specific setting of a product (or a system), leading to unintentional exposure of personal privacy during the process of using a product. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by unintentional disclosure of privacy.

Cluster 6: This cluster included Case Example 3, 4, 6 and 19. The common reason for embarrassment could be attributed to personal careless operation or misunderstanding the function of the product. It can thus be inferred that the reason for embarrassment in this cluster of case examples was caused by careless operation.

To further explore the structural relationship of the reasons causing embarrassment in product use, a focus group was held to discuss the results obtained from the hierarchical cluster analysis. The focus group comprised seven product designers with at least six years of experience in product design, of whom four were

females and three were males. Based on the clustering results, the focus group participants developed the constructs for embarrassment aroused in product use or product interaction.

- (1) "Product overuse" and "accidental results" were classified as "inability to control product functionality." Drawing from the discussions of the focus group, embarrassment case examples in this cluster were mainly caused by user's overestimation of the product functionality or neglect of the capacity limit of the product, resulting in unexpected circumstances that may be embarrassing.
- (2) "Inability to control product functionality" and "functional failure of a product" were classified as "losing control of the product." Drawing from the discussions of the focus group, embarrassment case examples in this cluster were mainly caused by user's inability to effectively control the product functions and limitations or unawareness of the product losing its function.
- (3) Case examples in the "unintentional disclosure of privacy" and "careless operation" clusters were caused by personal operational errors or specific setting of a product (or a system). Drawing from the discussions of the focus group, these two clusters were classified as "personal negligence leading to product malfunction."
- (4) "Product misuse" and "personal negligence leading to product malfunction" may be classified as "inappropriate operation." Drawing from the discussions of the focus group, the embarrassing case examples in these clusters were caused by user's misinterpretation of product operation and function, resulting in an error in the operation.

Through the focus group discussions, two constructs were identified for the experience of embarrassment associated with product use: losing control of the product and inappropriate operation. Losing control of the product means that the user feels embarrassed as a result of the sudden occurrence of a product exceeding its capacity of product use or the user fails to notice the functional failure of the product in a timely manner. Inappropriate

**Table 4**  
Measurement items used in the SEM analysis (Case No.1 as an example).

[Case No1.]	Completely Disagree	Disagree	Somewhat Disagree	No Comment	Somewhat Agree	Agree	Completely Agree
You had mistaken an automated teller machine to be voice controlled and you actually told the machine your password out loud when it asked for the password. When faced with this embarrassing situation, you feel that...							
It's caused by product overuse.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's caused by an unexpected outcome.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's caused by functional failure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's caused by misuse of product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's caused by privacy exposure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's caused by user's carelessness while using the product.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
You have committed a breach of etiquette.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
You are thus in trouble.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
You are thus unwillingly put into the spotlight.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

operation means the embarrassment is caused by the user's cognitive misunderstanding of the mode of operation, careless operation or unintentional disclosure of personal privacy.

**3. Structural equation modeling analysis**

In this study, structural equation modeling (SEM) was used to verify the hypothesized causal relationship among the latent variables: losing control of the product, inappropriate operation and embarrassing emotions. The following is the present study's research hypothesis:

**Hypothesis.** User's embarrassment associated with product use is affected by both losing control of the product and inappropriate operation.

Based on the hypothesis, an embarrassment model was proposed. The model displays the relationship among losing control of the product, inappropriate operation, and embarrassing emotion. Losing control of the product and inappropriate operation were treated as exogenous variables, whereas embarrassment emotion was considered an endogenous variable.

**3.1. Measurement items**

A questionnaire was created that contained three constructs relating to the embarrassing experiences associated with product use: losing control of the product, inappropriate operation, and embarrassing emotion. "Losing control of the product" included

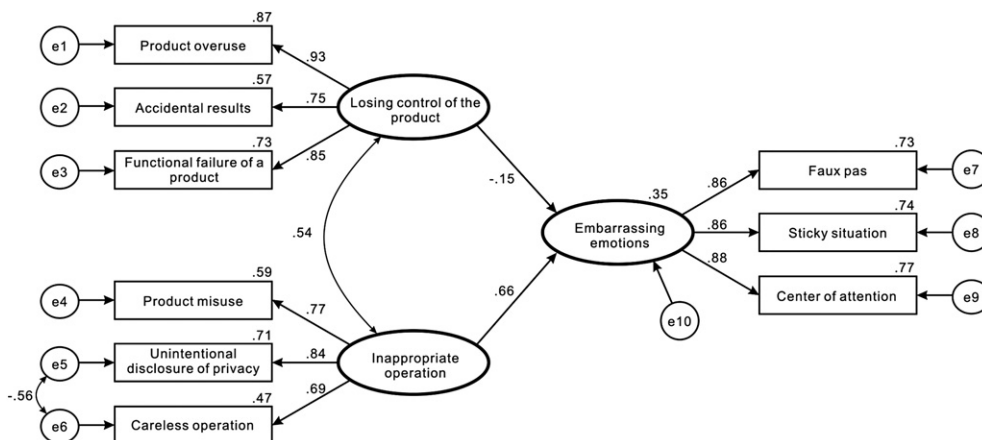
three indicators: product overuse, accidental results and functional failure of a product. "Inappropriate operation" included three indicators: product misuse, unintentional disclosure of privacy and careless operation. As for the "embarrassment" construct, faux pas, sticky situation and center of attention were included as the indicators based on Sabini's categorization of embarrassing emotions (Sabini et al., 2000). The questionnaire describes each of the 19 extracted representative examples. Based on the descriptions, participants were asked to choose their level of agreement with the 9 indicator variables of the 3 constructs respectively as shown in Table 4. Each question was measured on a 7-point scale, i.e. 1 denotes completely disagree and 7 means completely agree.

**3.2. Data collection and analysis**

120 participants were invited to complete a survey on a voluntary basis. A total of 116 participants (47 males and 69 females) completed the questionnaires for this study. The multiple-item scales of three constructs were subjected to a reliability test to determine whether the manifest variables reflected the hypothesized latent variables. Once the measures were validated, structural equation modeling was used to test the validity of the proposed model and the hypothesis.

**3.3. Results**

All reliabilities of the constructs were calculated and the level of internal consistency in each construct was acceptable. Cronbach



**Fig. 3.** Research model results.

alphas were  $\alpha = 0.881$ ,  $\alpha = 0.757$  and  $\alpha = 0.893$  for the constructs of losing control of the product, inappropriate operation, and embarrassing emotions, respectively. All construct reliabilities were above the minimum level of 0.7 as recommended by Nunnally and Bernstein (1994).

AMOS 7.0 was used to estimate model fit and the standardized parameter estimates were reported in Fig. 3. The goodness-of-fit of the model:  $\chi^2 = 55.187$ ;  $df = 17$ ;  $\chi^2/df = 2.399$  ( $<3$ ); RMSEA = 0.110 is greater than the acceptable value 0.08 and RFI = 0.863 is smaller than the recommended minimum value = 0.90, but they are marginal; NFI = 0.913 and the comparative CFI = 0.946, TLI = 0.915 and IFI = 0.947 are greater than 0.90. According to the standard of model fitting put forward by Hu and Bentler (1999), the results suggested a reasonable level of fit of the model.

Further analysis on the correlation between losing control of the product and inappropriate operation constructs showed the standardized path coefficient to be 0.538 ( $t = 4.030$ ), indicating significant correlation. The standardized path coefficient for inappropriate operation on embarrassing emotions was 0.660 ( $t = 4.321$ ), indicating significant causal relationship between inappropriate operation and embarrassing emotions. In other words, the more the user experiences inappropriate operation, the higher degree of embarrassment is aroused. However, when the effect of inappropriate operation on embarrassing emotions was included, the standardized path coefficient for losing control of the product on embarrassing emotions was not significant (path coefficient =  $-0.145$ ,  $t = -1.275$ ,  $p = 0.202$ ), signifying that for users experiencing embarrassment associated with product use, improper operation stands out as a more significant construct than losing control of the product.

#### 4. Conclusion and discussion

This study is an exploratory investigation on user's embarrassing emotions associated with product use. Using self reports, embarrassing case examples were collected. Through focus group discussions, the number of case examples was reduced. Correspondence analysis of embarrassing case examples and basic emotions was used to select 19 representative case examples. By comparing the similarity between the case examples and utilizing hierarchical cluster analysis, the present study concluded that the reasons for embarrassment in product use were based on two constructs, losing control of the product and inappropriate operation.

Based on the analysis on the causal relation between embarrassing emotions and the two constructs respectively, both losing control of the product and inappropriate operation showed positive impact on embarrassing emotions in their own way (path coefficients were 0.214 and 0.597 respectively). However, when the effect of inappropriate operation on embarrassing emotions was included, the standardized path coefficient for losing control of the product on embarrassing emotions was not significant, meaning that for users experiencing embarrassment associated with product use, improper operation stands out as a more significant construct than losing control of the product. Despite functional failure being an indicator variable leading to embarrassment under the "losing control of the product" construct, users may blame themselves for the embarrassing situation as a result of personal inappropriate operation and think the same embarrassing situation will not happen to other people.

By examining case examples that constitute the "inappropriate operation" construct, it was found that misunderstanding of the operation and function of a product was the main factor causing embarrassment while using it. The reasons for operation mistakes are generally attributed to absentmindedness, and the embarrassing emotional responses usually do not pose a serious damage. Nevertheless, product designers should still be responsible in minimizing the possibility of errors by providing intuitive cues,

establishing good mental models, as well as feedback mechanisms on the product itself.

This study targeted on embarrassment to explore the underlying reasons for negative emotions associated with product use. However, not all negative emotions are entirely negative. Just as the opponent-process theory proposed by Solomon (1980) stated, emotions are paired, and when one emotion in a pair is experienced, the other is suppressed. The reason why people go on roller coaster rides, go bungee jumping or watch horror movies is to enjoy the negative emotions, such as fear or panic, and to turn them into positive emotions, such as pride and satisfaction (Norman, 2004).

Studies also showed that in some cases, negative emotions can have positive effects. When people are experiencing a negative emotion, they are less likely to make erroneous judgments or decisions that may put them at a disadvantage. There are even more evidences that showed negative emotions could stimulate a more affable and more specific information processing mode, leading to more accurate assessment (Forgas, 2007). For example, at a nuclear power plant where "real-time" and "safety" are highly emphasized, using negative emotions like caution and fear to design control devices that act as a design constrain can avoid operational mistakes (Swindells et al., 2007). Therefore, how to use product designs to convert negative emotions into positive ones are no doubt topics to be explored and studied in the future.

This study employed the method of self report for an extensive collection of embarrassing case examples associated with product use. The participants were not asked to describe a particular product or the specific situation of product use, since the main purpose was to obtain an overall structural concept of embarrassing emotions associated with product use. For this reason, whether the two constructs in this study, losing control of the product and inappropriate operation, can be applied to specific products, such as high-tech devices, should be further verified. Moreover, whether specific product attributes such as appearance, texture, color or even the mode of operation are emotion stimuli that may arouse embarrassment is also a topic worthy of future study.

The study also adopted the method of structural equation modeling to investigate the causal relation between embarrassing emotions and the two constructs, named "losing control of the product" and "inappropriate operation." However, the authors would like to remind the viewers that the cross-sectional data collected in this study might not be capable of revealing the true causal relationship.

#### References

- Angeli, D.A., Carpenter, R., 2005. Stupid Computer! Abuse and Social Identity. Abuse: the Dark Side of Human-Computer Interaction, pp. 19–25.
- Bonnici, J., Campbell, D.P., Fredenberger, W.B., Hunnicutt, K.H., 1996. Consumer issues in coupon usage: an exploratory analysis. *J. Appl. Business Res.* 13, 31–40.
- Chaudhuri, A., 1998. Product class effects on perceived risk: the role of emotion. *Int. J. Res. Mark.* 15, 157–168.
- Dahl, D.W., Manchanda, R.V., Argo, J.J., 2001. Embarrassment in consumer purchase: the roles of social presence and purchase familiarity. *J. Consumer Res.* 28, 473–481.
- Drummond, P.D., Back, K., Harrison, J., Helgadottir, F.D., Lange, B., Lee, C., Leavy, K., Novatscou, C., Orner, A., Pham, H., Prance, J., Radford, D., Wheatley, L., 2007. Blushing during social interactions in people with a fear of blushing. *Behav. Res. Ther.* 45, 1601–1608.
- Drummond, P.D., Camacho, L., Formentin, N., Heffernan, T.D., Williams, F., Zekas, T.E., 2003. The impact of verbal feedback about blushing on social discomfort and facial blood flow during embarrassing tasks. *Behav. Res. Ther.* 41, 413–425.
- Drummond, P.D., Lim, H.K., 2000. The significance of blushing for fair- and dark-skinned people. *Pers. Ind. Diff.* 29, 1123–1132.
- Edelmann, R.J., McCusker, G., 1986. Introversiveness, neuroticism, empathy and embarrassment. *Pers. Ind. Diff.* 7, 133–140.
- Forgas, J.P., 2007. When sad is better than happy: negative affect can improve the quality and effectiveness of persuasive messages and social influence strategies. *J. Experim. Soc. Psychol.* 43, 513–528.
- Geier, A.B., Rozin, P., 2008. Weighing discomfort in college age American females: incidence and causes. *Appetite* 51, 173–177.

- Goffman, E., 1959. *The Presentation of Self in Everyday Life*. Anchor Books, New York.
- Hsiao, K.A., Chen, L.L., 2006. Fundamental dimensions of affective responses to product shapes. *Int. J. Ind. Ergon.* 36, 553–564.
- Hu, L.T., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equation Model.* 6, 1–55.
- Huang, J.S., Ma, M.Y., Chen, C.H., 2007. Research on predicting models of annoyance under the operation of digital hi-tech products. *Des. Stud.* 28, 39–58.
- Khalid, H.M., 2006. Embracing diversity in user needs for affective design. *Appl. Ergon.* 37, 409–418.
- Koch, L.H., 2006. Help-seeking behaviors of women with urinary incontinence: an integrative literature review. *J. Midwifery Women's Health* 51, e39–e44.
- Laros, F.J.M., Steenkamp, J.-B.E.M., 2005. Emotions in consumer behavior: a hierarchical approach. *J. Bus. Res.* 58, 1437–1445.
- Lau-Gesk, L., Drolet, A., 2008. The publicly self-consciousness consumer: prepared to be embarrassed. *J. Consum. Psychol.* 18, 127–136.
- Liu, Y., 2003a. Engineering aesthetics and aesthetic ergonomics: theoretical foundations and a dual-process methodology. *Ergonomics* 46, 1273–1292.
- Liu, Y., 2003b. The aesthetic and the ethic dimensions of human factors and design. *Ergonomics* 46, 1293–1305.
- Menees, S.B., Inadomi, J.M., Korsnes, S., Elta, G.H., 2005. Women patients' preference for women physicians is a barrier to colon cancer screening. *Gastrointest. Endosc.* 62, 219–223.
- Nagamachi, M., 1995. Kansei engineering: a new ergonomic consumer-oriented technology for product development. *Int. J. Ind. Ergon.* 15, 3–11.
- Nagamachi, M., 2002. Kansei engineering as a powerful consumer-oriented technology for product development. *Appl. Ergon.* 33, 289–294.
- Norman, D.A., 2002. Emotion and design: attractive things work better. *Inter. Magazine* 4, 36–42.
- Norman, D.A., 2004. *Emotional Design: Why We Love (Or Hate) Everyday Things*. Basic Books, New York.
- Nunnally, J.C., Bernstein, I.H., 1994. *Psychometric Theory*, third ed. McGraw-Hill, New York.
- Ogle, S., Glasier, A., Riley, S.C., 2008. Communication between parents and their children about sexual health. *Contraception* 77, 283–288.
- Phillips, D.M., Baumgartner, H., 2002. The role of consumption emotions in the satisfaction response. *J. Consum. Psychol.* 12, 243–252.
- Rehman, S.N., Brooks, J.R., 1987. Attitudes towards television advertisements for controversial products. *J. Health Care Marketing* 7, 78–83.
- Sabini, J., Siepmann, M., Stein, J., Meyerowitz, M., 2000. Who is embarrassed by what? *Cogn. Emot.* 14, 213–240.
- Sauer, J., Sonderegger, A., 2009. The influence of prototype fidelity and aesthetics of design in usability tests: effects on user behavior, subjective evaluation and emotion. *Appl. Ergon.* 40, 670–677.
- Seva, R.R., Duh, H.B.-L., Helander, M.G., 2007. The marketing implications of affective product design. *Appl. Ergon.* 38, 723–731.
- Solomon, R.L., 1980. The opponent-process theory of acquired motivation: the costs of pleasure and the benefits of pain. *Am. Psychol.* 35, 691–712.
- Swindells, C., MacLean, K.E., Booth, K.S., Meitner, M.J., 2007. Exploring affective design for physical controls. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, April 28–May 3, San Jose, CA, USA, pp. 933–942.
- Tangney, J.P., 1999. The self-conscious emotions: shame, guilt, embarrassment and pride. In: Dalglish, T., Power, M.J. (Eds.), *Handbook of Cognition and Emotion*. John Wiley & Sons Ltd., New York, pp. 541–568.
- Tsao, Y.C., Chen, S.Y., 2007. The expected image in the process of using products. In: *Proceedings of the International Conference on Kansei Engineering and Emotion Research*, October 10–12, Sapporo, Japan.
- Tsao, Y.C., Hsiung, C.C., 2000. Relationship between the adverbial images of complex actions in using utensils and the forms of the utensils. In: *Proceedings of the 5th Annual International Conference on Industrial Engineering – Theory, Applications and Practice*, December 13–15, HsinChu, Taiwan, pp. 577–582.
- Tsao, Y.C., Tasi, C.N., 2005. A study on the lovable image of product function. In: *Proceedings of the 1st Global Chinese Industrial Design Conference*, November 5–6, Taoyuan, Taiwan, pp. 171–175 (in Chinese).
- Van Boven, L., Loewenstein, G., Dunning, D., 2005. The illusion of courage in social predictions: underestimating the impact of fear of embarrassment on other people. *Organ. Behav. Hum. Decis. Process* 96, 130–141.
- Westbrook, R.A., Oliver, R.L., 1991. The dimensionality of consumption emotion patterns and consumer satisfaction. *J. Consum. Res.* 18, 84–91.