



How to Transfer the Innovation Knowledge from Craft Art into Product Design

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How to design highly-reputable and hot-selling products is an essential issue in product design.

The character toys (dolls, mascots, or called "公 仔" in Mandarin) are very popular in eastern Asia, particularly in Taiwan, Japan, and Hong Kong.







The character toy is not only a craft work but a commercial product.







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The character toy is well suitable to be an object to illustrate how the innovation knowledge can be used.

However, the way that consumers look at product image is usually different from the way that product designers look at product elements or characteristics.

In addition, product designers design a product by considering physical elements or characteristics of the product, while craft artists create their works relying largely on their own particular expertise or experience.



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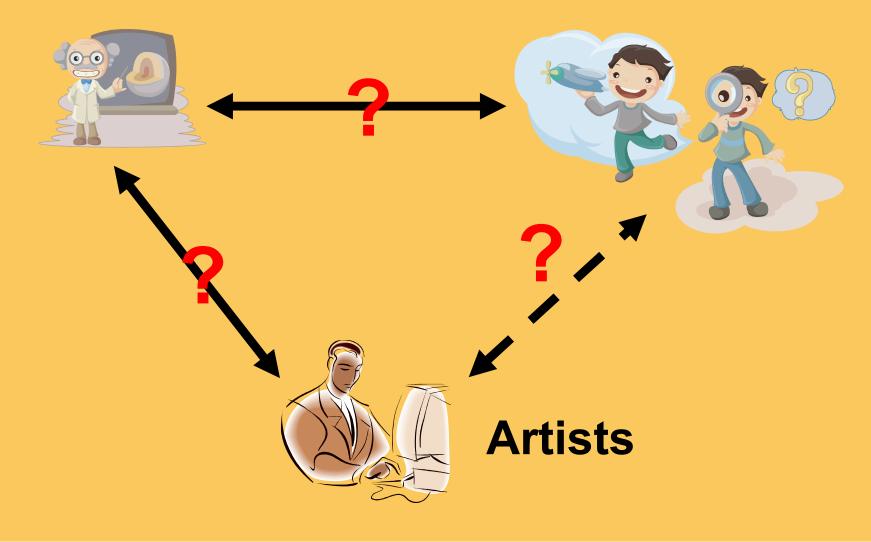
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Designers

Consumers







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It is quite difficult to describe clearly by quantitative models or mathematical formulas, because it is concerned with the creation and innovation of human nature.

- There is a gap between product designers and craft artists, due to the difference of the creation purpose and target.
- It is a real challenge to transfer the innovation knowledge from craft art into product design.





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In order to explore the relationship between consumers' emotional feelings and product form elements, Kansei Engineering is adopted in this study to design highly-reputable and hot-selling products.

Kansei Engineering is as an ergonomic consumer-oriented methodology and design strategies for affective design to satisfy consumers' psychological requirements.





We conduct an experimental study using the concept of Kansei Engineering in order to collect numerical data about the character toys.

- **1. Extracting experimental samples of character toys**
- 2. Conducting morphological analysis of character toys
- **3. Assessing** emotional feelings of character toys



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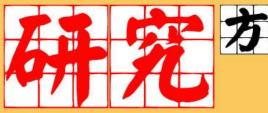
Experimental Procedures

1. Extracting experimental samples of character toys

■We first collect 179 character toys and then classify them based on their similarity degree by a focus group.

■Then the hierarchy cluster analysis is used to extract representative samples of character toys.

■The 35 representative character toy samples are selected by the cluster tree diagram.



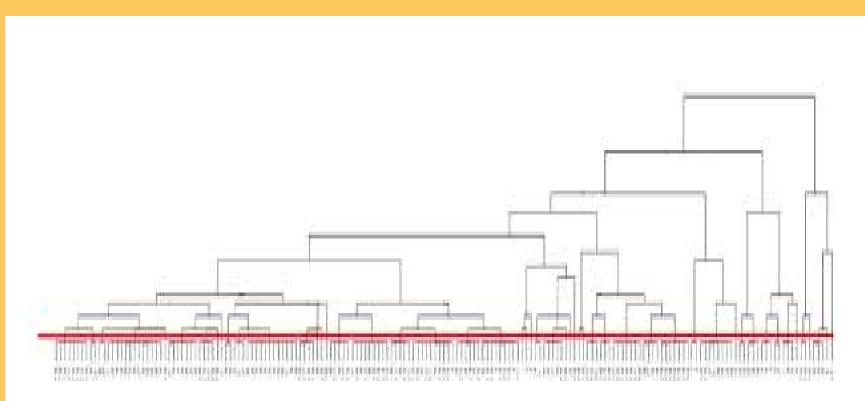
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Experimental Procedures

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1. Extracting experimental samples of character toys

The hierarchy cluster analysis and the cluster tree diagram





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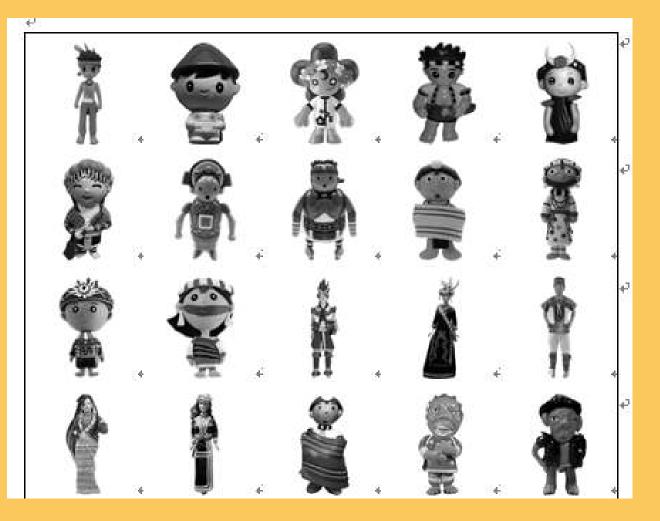
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Experimental Procedures

1. Extracting experimental samples of character toys

The 35 representative character toy





Experimental Procedures

2.Conducting morphological analysis of character toys

The morphological analysis is used to extract the product form elements of the 35 representative character toy samples.

The five subjects of the focus group are asked to decompose the representative samples into several dominant form elements and form types.

The result of the morphological analysis has 7 product form elements and 24 associated product form types.



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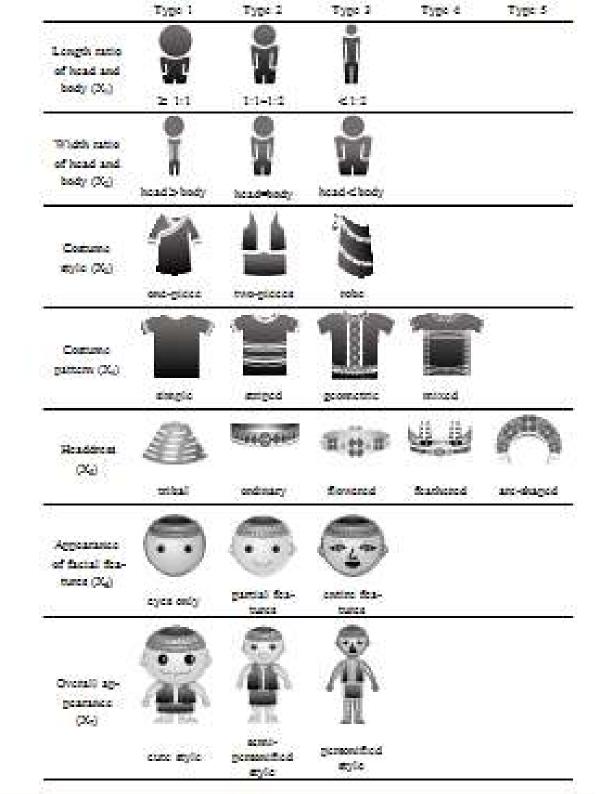
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- Length ratio of head and body
- Width ratio of head and body
- Costume style
- Costume pattern
- Headdress
- Appearance of facial features
- Overall appearance





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Experimental Procedures

3. Assessing emotional feelings of character toys

In Kansei Engineering, emotion assessment experiments are usually performed to elicit the consumers' psychological feelings or perceptions about a product using the semantic differential method.

Image words are often used to describe the consumers' feelings of the product in terms of ergonomic and psychological estimation.

■In this paper, three representative image words are "cute (CU)", "artistic (AR)", and "attractive (AT)".



Experimental Procedures

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3. Assessing emotional feelings of character toys

■To obtain the assessed values, a 100-point scale (0-100) of the semantic differential method is used.

■150 subjects (70 males and 80 females with ages ranging from 15 to 50) are asked to assess the form (look) of character toy samples on a image word scale of 0 to 100,

■For example, where 100 is most attractive on the AT scale.



Experimental Procedures

3. Assessing emotional feelings of character toys

The assessment result

<u>ب</u>											
_	No.₽	$X_{l^{\varPhi}}$	$X_{2^{\mathcal{O}}}$	$X_{3^{\phi}}$	$X_{4^{\mathcal{O}}}$	$X_{5^{e^{\flat}}}$	$X_{6^{\phi}}$	$X_{7^{\mathfrak{o}}}$	CU_{e^2}	AR	AT₽
	1.0	3₽	2₽	1 ₽	1₽	4₽	3₽	3₽	73₽	<mark>61</mark> ₽	64₽
	2₽	10	1₽	1 ₽	1₽	10	2₽	10	72₽	45₽	43₽
	3₽	2₽	2₽	1 @	3₽	3₽	1₽	10	70 ₽	64₽	71₽
	4₽	2₽	3₽	2₽	4₽	2₽	2₽	2₽	<mark>63</mark> ₽	52₽	54₽
	5₽	2₽	2₽	1 ₽	1₽	4₽	2₽	1₽	<mark>68</mark> ₽	59₽	55₽
	6₽	2₽	2₽	2₽	4 ₽	3₽	2₽	2₽	65₽	<mark>66</mark> ₽	69₽
	7₽	2₽	2₽	2₽	4 ₽	5 e	2₽	2₽	52₽	<mark>66</mark> ₽	61₽
	8⊷	2₽	3 ₽	2₽	4 ₽	4₽	2₽	2₽	53₽	<mark>61</mark> ₽	60⊷
	9₽	2₽	2₽	3₽	2₽	2₽	2₽	2₽	<mark>63</mark> ₽	59 ₽	59⊬
	10 ₽	20	2₽	1₽	3₽	2₽	2₽	2₽	55₽	<mark>6</mark> 3₽	65⊬

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Quantification Theory Type I

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The assessment result provides a numerical data source using Quantification Theory Type I to build an innovation knowledge model, which can be used to develop a design support system for the new product design.

The QTTI can be regarded as a method of qualitative and categorical multiple regression analysis method, which allows inclusion of independent variables that are categorical and qualitative in nature, such as product form elements and quantitative criterion variables within Kansei Engineering.



Quantification Theory Type I

- We use the QTTI analysis to examine the relationship between the 7 product form elements and 3 product images.
- 7 independent variables are the 7 product form elements and 3 dependent variables are the cute, artistic, and attractive product images.



Quantification Theory Type I

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The result of QTTI analysis

1	.1	CU image₽	AR image+?	AT image₽	
Form element.,	Form type.,	Form type grade + (Category grade) + (Category grade) + (Putial correlation coefficient)+	Form type grade≁ Form element grade≁	Form type grade≁ Form element grade≁	
Length ratio of Xihead and body.	≧_1:1.,	-1.57.	1.96.	5.76.	
	1:1~1:2.,	-5.26. 0.70.,	-5.02. 0.73.,	-3.74. 0.34.,	
	≤1:2.,	18.05.	10.29.	-0.91.	
Width ratio of X2head and body.	head>body.a	1.71.	-8.63.	-6.15.	
	head=body.a	-2.14. 0.29.,	3.30. 0.76.,	2.43. 0.29.,	
	head <body.a< td=""><td>1.91.</td><td>3.73.</td><td>2.51.</td></body.a<>	1.91.	3.73.	2.51.	
X3.1 Costume style.	one-piece.,	-0.47.	-4.40.	-2.29.	
	two-pieces.,	-1.55. 0.46.	1.87. 0.64.,	0.42. 0.36.	
	robe.,	7.97.	9.04.	6.89.	
X4.1 Costume.1 pattern.1	simple.1 striped.1 geometric.1 mixed.1	12.19. -1.35. 0.71., 1.63. -7.14.	0.72. -3.56. 0.69., 8.04. -2.95.	-2.88. -1.84. 0.59., 9.38. -3.75.	



Innovation Knowledge Models

Applying QTTI to build an innovation knowledge model

CU: $y = 59.4 - 1.57X_{11} - 5.26X_{12} + 18.05X_{13} + 1.71X_{21} - 2.41X_{22} + 1.91X_{23} - 0.47X_{31}$ -1.55X₃₂+7.97X₃₃+12.19X₄₁-1.35X₄₂+1.63X₄₃-7.14X₄₄-6X₅₁-3.76X₅₂+6.59X₅₃ +0.49X₅₄+8.3X₅₅+7.33X₆₁+0.76X₆₂-2.74X₆₃+4.59X₇₁+6.42X₇₂-14.04X₇₃ (4.1)

AR: $y = 60.43 + 1.96X_{11} - 5.02X_{12} + 10.29X_{13} - 8.63X_{21} + 3.30X_{22} + 3.73X_{23} - 4.4X_{31} + 1.87X_{32} + 9.04X_{33} + 0.72X_{41} - 3.56X_{42} + 8.04X_{43} - 2.95X_{44} - 2.39X_{51} - 3.36X_{52} + 2.55X_{53} + 1.64X_{54} + 6.66X_{55} + 1.26X_{61} - 1.76X_{62} + 0.97X_{63} + 0.86X_{71} + 2.53X_{72} - 4.49X_{73}$ (4.2)

AT: $y = 64.51+5.76X_{11}-3.74X_{12}-0.91X_{13}-6.15X_{21}+2.43X_{22}+2.51X_{23}-2.29X_{31}+0.42X_{32}+6.89X_{33}-2.88X_{41}-1.84X_{42}+9.38X_{43}-3.75X_{44}-2.01X_{51}-1.87X_{52}-0.05X_{53}+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73}$ (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73} (4.3)+0.96X_{54}+5.95X_{55}+5.47X_{61}-0.56X_{62}-1.18X_{63}-5.45X_{71}-2.71X_{72}+9.80X_{73}



Design Support Knowledge

Design support knowledge for new character toy design

Form element.	With "cute" image.	With "artistic" image.	With "attractive" image.	
X_1 . Length ratio of head	≤1:2₽	<1:24	<u>≩</u> 1:1₽	
^{A1.} 'and body₽	ę	<u>≧</u> ,1:1€	с,	
😴 Width ratio of head	head≤body⇔	head≤body+ ³	head < body+ ³	
X _{2.1} and body ⁴²	head≥body¢	head=body* ³	head=body+ ³	
X3.1 Costume style+2	robe4⊃	robe⇔	robe₄⊃	
A3., Costume style-	ę	two-pieces4 ⁰	two-pieces+ ⁰	
X4., Costume pattern.,	simple₀⊃	geometric4⊃	geometric≁⊃	
A4.1 Costume pattern.1	geometric+ ²	simple₄⊃	¢	
	arc-shaped+ ²	arc-shaped* ²	arc-shaped4 [⊅]	
X_{5} , Headdress e^{i}	flowered∢⊃	flowered↔	feathered* ²	
	feathered₽	feathered*	с,	
Appearance of facial X6 features4	eyes only≁'	eyes only4⊃	eyes only∜	
∽6.º features.€	partial features+ ²	entire features+ ³	с,	
V 0	semi-personified.	semi-personified.	personified≁	
X _{7.1} Overall appearance.1	cute.,	cute.,	с,	

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In this paper, we have conducted an experimental study on character toys to demonstrate how a consumer-oriented design approach can be used to transfer the innovation knowledge from craft art to product design.

The consumer-oriented design based on the process of Kansei Engineering has used the QTTI technique to build 3 innovation knowledge models (i.e. the CU, AR, and AT models).





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The result has shown that the innovation knowledge models can help product designers determine the optimal form combination of product design for a particular design concept of product image.

Furthermore, the consumer-oriented design approach has been built a character toy design support database, in conjunction with the computer-aided design (CAD) system, to help product designers facilitate the product form in the new product development process.



Other applications





Other applications

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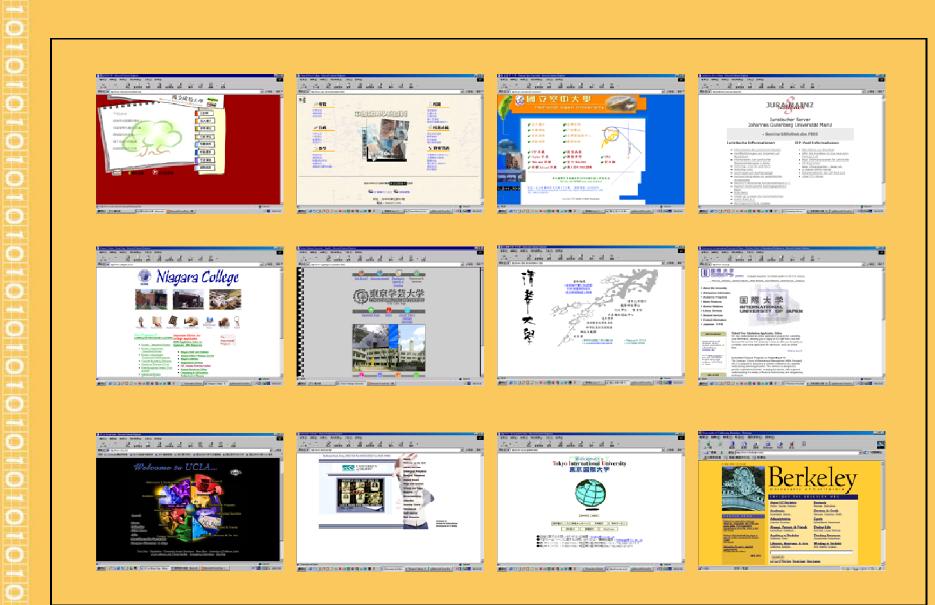
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Other applications





Publications

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Thanks for your listening...

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