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The Relationship between 2D Positioning Ability and Realistic Drawing Skill

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Abstract

Realistic drawing ability is a fundamental human trait. However, the cognitive constituents of this ability are poorly understood. This study aims to evaluate the contribution of Two-dimensional (2D) positioning skills in the performance of realistic drawing. 2D positioning refers to an important observation technique employed by artists to locate the correct position of an object in its representation on a blank canvas. Two different types of 2D positioning techniques are considered: absolute positioning (using the canvas boundaries as positioning reference) and relative positioning (using already-drawn components as reference). We used a line-arrangement experimental task to evaluate the positioning abilities of experts and novices; we further measured their realistic drawing ability in a realistic drawing task. Pearson correlation-coefficient analysis showed that both positioning abilities are positively correlated with realistic drawing abilities, but that the two positioning abilities are not correlated. While expert participants were found to be significantly better at absolute positioning than the novice, their relative positioning performance does not differ from that of the novice. These results suggest that absolute and relative positioning are two independent observation techniques, and that experience might improve absolute positioning skills. This implies that absolute positioning is a more advanced technique requiring both training and practice.

Keywords

2D Positioning, Absolute Positioning, Relative Positioning, Realistic Drawing Skill

1. Introduction

Mastering realistic drawing takes long years of practice. It is a skill in which even experienced artists are still in the process of refining. Furthermore, realistic por-

traits exhibit obvious differences between artists. It is therefore worth investigating what cognitive abilities are involved in the creation of realistic drawings.

The production of a realistic drawing involves a series of complicated actions, including visual processing and motor skills. The specifics of this process have yet to be elucidated by the scientific community. Cohen and Bennett (1997) identified four phases involved in the completion of a realistic drawing. Phase 1 involves observation of the target object. In Phase 2 the artist determines which part (of the whole) will be represented and what method she/he will employ to represent the object. Phase 3 requires eye-hand coordination to represent what she/he observes. Phase 4 requires objective evaluation of the finished product and effective revision. Their research results suggest that the key to success in realistic drawing lies in astute observation, which is believed to increase the effect of realism in a representation. The quality of observation is negatively affected by the illusions and delusions maintained by the observer. Illusions refer to "perceptual constancies", which affect performance even to the point of inaccuracy (Cohen & Earls, 2010). The size, shape, color, and brightness of an object might all be affected by perceptual constancies (Cohen & Jones, 2008; Day, 1972; McManus, Loo, Chamberlain, Riley, & Brunswick, 2011; Mitchell, Ropar, & Ackroyd, 2005; Ostrofsky, Kozbelt, & Cohen, 2015; Ostrofsky, Kozbelt, & Seidel, 2012; Perdreau & Cavanagh, 2011; Todorovic, 2002, 2010). Delusions pertain to an artist's knowledge of the object under observation, since this prior knowledge tends to guide an artist in her/his representation. Kozbelt, Seidel, El Bassiouny, Mark and Owen (2010) explored visual attention from the perspective of delusions. Other researchers have investigated the relationship between "frequency of observation" and art creation. Cohen (2005) suggested that frequent observation allows for a high-quality working memory of the observed object, which ensures the accuracy of its representation. Cohen and Bennett (1997) were the first researchers to establish the existence of a correlation between correct observation and realistic representation.

While different approaches such as top-down or bottom-up might produce different observations, it is the observer's ability which plays the most important role in drawing. Carson and Allard (2013) examined whether an artist's ability to correctly observe the angle of an object affects the representation of realistic drawing. Results indicate that the more experienced an artist is, the better she/he is able to depict the angle of the target object. A highly experienced artist can draw all angles with the same accuracy, whereas a less experienced drawer would find some angles harder to depict than others.

This study is focused on another factor of observation as yet unexplored: perception of the location of an object. When working on a realistic artwork, the first thing is to find out the right position and create a truthful composition on canvas. This can be achieved by a multitude of methods. For example, we may use our hands as a viewfinder with which to compose a real-life picture and thus set referential positions for any objects inside the "window". We also need a referential system by which we are able to locate the correct position of any objects

on the canvas and thus make a truthful representation. This technique is called "2D positioning". There are several approaches to achieve 2D positioning throughout the drawing process. The artist may use the boundary of the canvas as the referential system in selecting an appropriate starting point. This is called "absolute positioning". As more lines and objects are represented on the canvas, there are a larger number of components which can be employed as references to locate succeeding objects. This is called "relative positioning".

The above two techniques are commonly adopted by artists attempting to draw a realistic drawing. We aimed to ascertain the interplay of abilities in absolute positioning, relative positioning, and realistic drawing. In addition, drawing or painting experience also affects retrieval of visual information and the level of accuracy and precision of realistic drawing. This suggests that the difference between a novice and an expert lies not only in drawing skills, but also in their cognitive abilities (e.g., Cohen & Bennett, 1997; Cohen & Jones, 2008; Kozbelt, 2001; Kozbelt & Seeley, 2007; Mitchell, Ropar, Ackroyd, & Rajendran, 2005; Schlewitt-Haynes, Earthman, & Burns, 2002). The literature indicates that previous drawing experience might have an impact on 2D positioning techniques; this study aims to confirm that correlation.

2. Method

We designed three tasks to measure three dimensions of art creation: absolute positioning, relative positioning, and realistic drawing. All participants were involved in all three tasks. The first two tasks aimed to assess a drawer's absolute and relative positioning abilities. The scope of measurement in the positioning tasks is observation by eye, and excludes other factors such as skill of motion control by wielding a pen, eye-hand coordination, and shape constancy. In a series of computer-aided tests, participants were required to place lines displayed on the interface in the right locations. In the process, they could only check the locations of these lines by eye while moving the mouse upward and downward to change the lines on the interface. Participants did not use brushes to copy these lines. The "absolute positioning" task was designed with a frame over the interface that resembles the boundary of a canvas, so participants could use the frame as a referential point. In the "relative positioning" task participants moved a group of lines on the interface with reference to each other, as if they were doing jigsaw puzzles. The "realistic drawing" task required representation of still-life objects, and realism was evaluated in an ecologically valid context. The result of this measurement was correlated with abilities in absolute positioning and relative positioning. Details regarding these data acquisition tasks are provided below.

2.1. Participants

We selected 51 participants from college and graduate institutions. There were 28 females and 23 males, with an average age of 23.2 years (SD = 2.73). We divided them into two groups according to their drawing experience. Among

them, 19 participants were categorized as "experts", who either have received professional training in art creation, or are students in design fields and whose hobbies include drawing or painting. The other 32 participants were categorized as "novices".

2.2. Task #1: Measurement of Absolute Positioning Ability

This task measures the ability to apply absolute positioning, which refers to the ability to use the boundary of the canvas as a referential point to locate the position of the object to be drawn. A fixed black-line frame was used to indicate the boundary of the canvas. Participants were expected to move the lines inside the frame to their correct locations.

2.2.1. Materials

Participants were required to use desktop computers (Windows 7, 19" LCD screen (EIZO S2133-H)) to perform the tests, and a keyboard and a mouse was provided to navigate the interface. Using FLASH as the programming language, we created a two-toned inter-face over a LCD screen. Two identical black-line frames are displayed on a white back-ground (shown in Figure 1), which is 340 pixels × 474 pixels with the visual angle is 13.7*19.0. The left frame serves as the referential zone, while participants operate on the right frame. The two frames are not placed on the same horizontal surface so as to increase the level of difficulty of the task.

To start, a single line would appear in the referential zone. This represents the moment an artist takes up his pencil or brush to make his first mark. In the operating zone, a similar line would be shown at a different location and angle. Participants were required to move the line in the operating zone until it matched

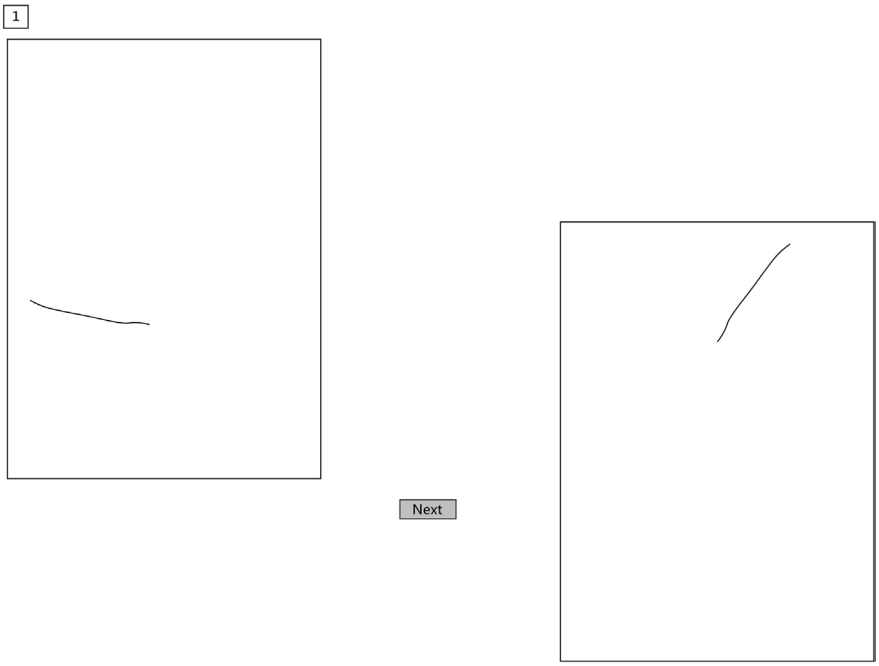

Figure 1. User interface for Task #1.

the location and angle of the line in the referential zone. The participant clicks on a mouse with his right hand to select the line, while his left hand presses the arrow keys on the computer keyboard to adjust the angle of the line. Once the line is matched in terms of position, the participant presses the "Next" key and starts to move the next line. A total of 60 lines are presented. They differ in length, orientation, and shape. All black lines are organic curves ranging between 18 and 268 pixels (visual angle between degrees 0.7 - 10.8).

2.2.2. Procedure

Participants were required to move the line within the operating zone as quickly as possible until the two lines look identical. This had to be done by eye; hands, rulers and other tools were prohibited. They were not explicitly told that the black-line frame can be used as a referential point for positioning.

2.3. Task #2: Relative Positioning Ability

We hypothesized that artists tend to use already-drawn lines and objects as referential points to anchor their starting point. This task aims to measure the ability to apply relative positioning. In this task the lines comprising an image are scrambled, and participants are required to move them to the right position, similar to a jigsaw puzzle. They can use any lines already in their correct position as clues to determine which line to move next.

2.3.1. Materials

The equipment used in this task was the same as that used in Task #1. This program was also written in the FLASH programming language. We created a two-toned interface on a 19" LCD screen (EIZO S2133-H). Two identical black-line frames are displayed (Figure 2) inside which 20 - 30 random lines are shown on a white background. Participants were asked to put a pattern or figure

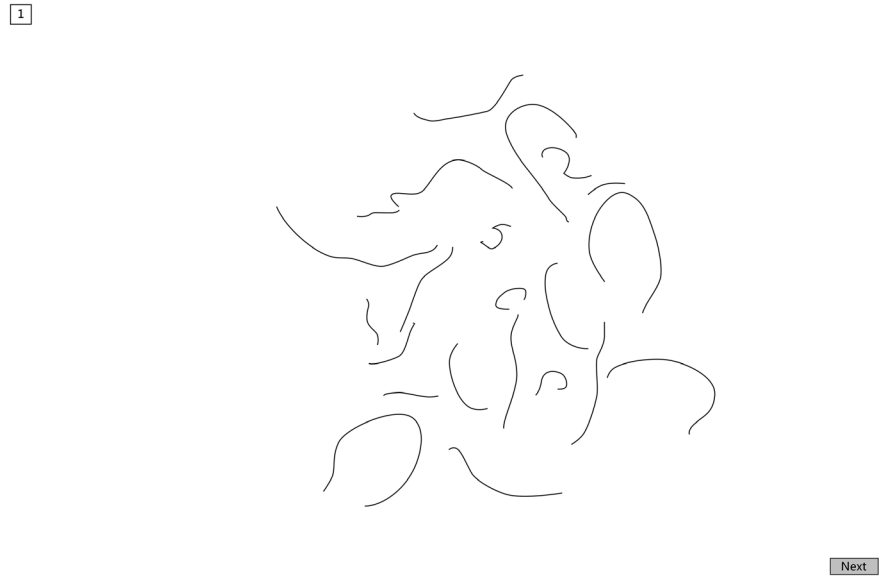

Figure 2. User interface for Task #2.

back together (Figure 3): a bird on a branch (comprising 33 lines), a human face (comprising 27 lines) and the head of a cow (comprising 22 lines). The visual angle is 19.3*14.8 for a complete image. We chose images of animals and humans over human-made objects mainly because they are made up of organic curves with fewer straight lines. This poses a greater challenge for participants.

2.3.2. Procedure

Participants were given a printed A3 image. They were asked to use a computer mouse to move the irregular lines on the computer screen to recreate the printed image. The print is rendered at 170% of the computer image (visual angle at 32.8*25.2 degrees) so participants had to make a conscious effort to trace the exact position.

Participants were asked to recreate the original pattern by eye as quickly as possible. The print was placed on the desk, and could not be held nearer to the screen as a reference. Participants could use the mouse and left and right keys on the keyboard to adjust the direction of the lines.

2.4. Task #3: Realistic Drawing Ability

This task was designed to measure the participant's drawing ability in the format of still-life drawing that conforms better to ecological validity than the two previous tasks.

2.4.1. Materials

There are two groups of still-life objects. This first is made up of four apples (left inset of Figure 4). The four apples are of different varieties, thus exhibiting differing textures, size, and color. They were randomly arranged at varying depths, which means participants must pay close attention to bring out a sense of space. The second stimulus was a doll (50 cm). It is of slightly different proportions to those of an average human, and was placed in an exaggerated posture. This stimulus is far more complicated than the apple stimulus. The various components (curly hair, flannel, gauze, and body of the model) pose a much higher degree of challenge.

2.4.2. Procedure

Participants were asked to faithfully represent the two still-lifes. They were given an hour to complete each drawing.

Figure 3. Stimuli used in Task #2.

Figure 4. Still-lifes used in Task #3.

2.4.3. Drawing Tools and Supplies

Participants were seated a meter across from the still-life object. The table on which the inanimate object was laid was of the same height as the participant's desk. Participants worked on sheets of white paper (393 × 273 mm) with a 2B pencil and an eraser.

2.5. Data Evaluation

Three expert raters were asked to score the efforts of the participants in each of the three measurements. Expert raters have received professional training in art creation more than 10 years. Their current occupation are art teachers, and have experience of evaluating drawings.

Task #1: All 3060 lines completed by 51 participants were randomly mixed for scoring. Each line was scored on a 7-point scale (1-weak to 7-strong) in terms of accuracy in position and angle. Raters scored the work by each participant using Photoshop CS6. Before scoring, we overlaid a correct version onto the layer completed by each participant. The frames of both layers were meticulously aligned. Raters could open or close the correct version. We then collated the scores to obtain the mean value of the 82 lines done by each participant to determine absolute positioning ability.

Task #2: All 153 pictures completed by 51 participants were randomly mixed for scoring. Each picture was scored on a 7-point scale (1-weak to 7-strong) in terms of accuracy. Raters scored all pictures using Photoshop CS6. Before scoring, we overlaid a correct version onto the layer completed by each participant. This version was located by selecting one line that was overlaid exactly. Raters were able to move the correct version as needed. We then collated the scores to obtain the mean value of the three pictures done by each participant to determine relative positioning ability.

Task #3: The 102 pictures completed by 51 participants were randomly mixed for scoring. Each picture was scored on a 7-point scale (1-weak, 7-strong) in terms of accuracy. This was judged in terms of the relative positions of each object, their forms and shapes, shadows and materials, and realistic representation in its entirety. Emotive inputs and creativity should be excluded from considera-

tion when making scores. Lastly we obtained the mean values of both pictures—four apples and the action figure—which quantified the realistic drawing ability of each participant.

3. Results & Discussion

3.1. Inter-Rater Reliability

All the scoring results were produced by professional raters. We calculated the standard score (z-score) as a way to analyze the aforesaid three abilities. We used Pearson's correlation to evaluate the inter-rater reliability. The inter-rater reliabilities for all three measurements are listed in Tables 1-3. Overall, the ratings given by the three raters are highly correlated.

3.2. Correlation of Absolute Positioning Ability, Relative Positioning Ability, and Realistic Drawing Ability

The correlation coefficient of absolute positioning ability and realistic drawing ability is r = 0.40 (n = 51, $p = 0.004$), whereas the correlation coefficient of relative positioning ability and realistic drawing ability is r = 0.37 (n = 51, $p = 0.008$). A scatter plot summarizes the results (Figure 5). Both indicate a positive correlation between positioning abilities and realistic drawing ability. Thus our hypothesis that both absolute positioning ability and relative positioning ability are correlated to the degree of accuracy exhibited in a realistic drawing is sup-

Table 1. Inter-rater reliability of Task #1.

	Task #1	
	Rater1	Rater2
Rater2	0.79**	
Rater3	0.85**	0.89**

**Correlation is significant at the 0.01 level (2-tailed).

Table 2. Inter-rater reliability of Task #2.

	Task #2	
	Rater1	Rater2
Rater2	0.71**	
Rater3	0.89**	0.63**

**Correlation is significant at the 0.01 level (2-tailed).

Table 3. Inter-rater reliability of Task #3.

	Task #3	
	Rater1	Rater2
Rater2	0.90**	
Rater3	0.85**	0.87**

**Correlation is significant at the 0.01 level (2-tailed).

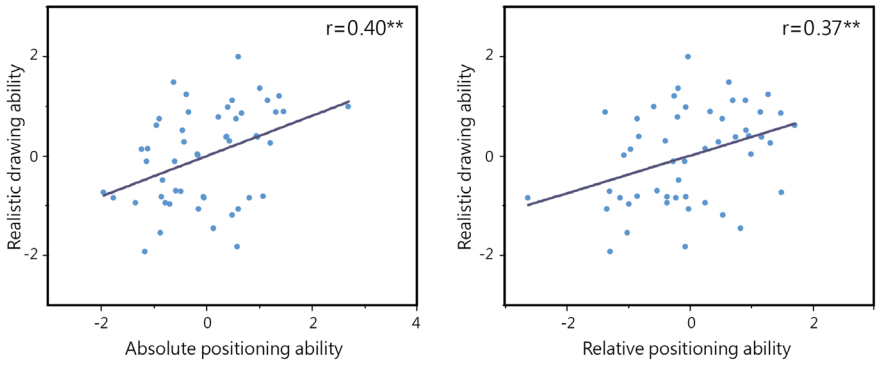

Figure 5. Scatterplot: (a) absolute positioning ability vs realistic drawing ability; (b) relative positioning ability vs realistic drawing ability.

ported. That is, the better one's absolute positioning ability, the more sophisticated one's production of realistic drawings. The same principle applies to relative positioning ability.

The correlation coefficient of absolute positioning ability and relative positioning ability is r = 0.16 (n = 51, $p = 0.263$), which indicates no correlation. A scatter plot summarizes the results (**Figure 6**). We then used two-Way ANOVA to test the interaction between the two 2D positioning skills. No significant interactions were observed for absolute positioning and relative positioning ($F(1, 49) = 0.05$; $p = 0.83$). Therefore we conclude that these abilities are independent of each other.

3.3. Differences between Experts and Novices in Observation Skills

An Independent-Sample T Test was conducted to compare realistic drawing performance in experts and novices. There was a significant difference in the scores between the expert group (M = 0.64, SD = 0.71) and the novice group (M = −0.38, SD = 0.88); $t(49) = 4.27$, $p = 0.00$.

We conducted an Independent-Sample T Test in experts' and novices' absolute positioning abilities. Results indicate a significant difference in the absolute positioning abilities of the expert group (M = 0.37, SD = 0.95) and their novice counterparts (M = −0.22, SD = 0.89); $t(49) = 2.23$, $p = 0.03$. However, an Independent-Sample T test showed no significant difference in the relative positioning abilities of experts (M = 0.25, SD = 0.80) and novices (M = −0.17, SD = 0.97); $t(49) = 1.58$, $p = 0.12$.

The results of Independent-Sample T Test indicate that participants from the expert group outperformed their counterparts in the novice group in realistic drawing and absolute positioning abilities. Yet there was little disparity in terms of relative positioning ability between the two groups. We presume this has something to do with the existence of more referential points in relative positioning. More referential point serves as a clue, thus reducing the difficulty of the task. Even a novice can locate an exact position when there are sufficient referential points.

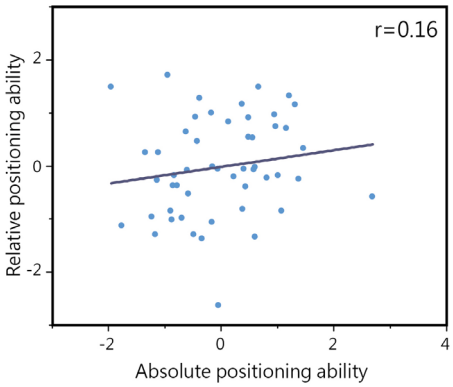

Figure 6. Scatterplot of absolute positioning ability vs relative positioning ability.

In the measurement of absolute positioning ability, participants could only use the frame (indicating the boundary of the canvas) as a referential point. Without the chance to cross-reference, the difficulty of the task increased. This suggests this task is more discriminating. In this task, the expert group outperformed their counterparts.

4. Results & Discussion

Although we depend on visual processing in our everyday lives, the skills required to draw a realistic artwork require much more sophisticated observational strategies than we normally employ. Artists need to closely observe the proportions of the target objects, their relative positions, and even the relationships among the objects and the surrounding space. This study validates the observational strategies used in 2D positioning processes prior to sketching. An artist uses different referential points as clues within the space so as to locate the exact position for the object yet to be drawn. This study assesses two 2D positioning methods: absolute positioning (which uses the boundary of the canvas as the sole referential point), and relative positioning (which uses the already-sketched lines or objects as a referential system).

Results indicate that these two 2D positioning skills are quite different. They both help to improve the production of a realistic drawing. That is, the better one's absolute positioning ability or relative positioning ability, the more sophisticated one's performance of realistic drawings. This result can be applied in the instruction of realistic drawing skills. When one is in good command of 2D positioning skills, one may find it easier to locate the correct position of an object and render more satisfactory realistic drawings. However, absolute positioning is a relatively specialized skill, while one does not need a lot of practice to acquire relative positioning ability. With regard to absolute positioning, the differences shown in novices and experts might be due to the reasons stated below. The first possibility is that absolute positioning calls for more talent and on average the experts are more gifted than the novices. The second possibility is that absolute positioning ability requires more intense training to develop, and the experts have received more training and practiced for longer. It is also possible that the

observed difference is as a result of a combination of contributions from both talent and training (with differing proportions of influence). If "absolute positioning" is generally considered an endowment or gift, then it should be measured by aptitude testing, rather than time spent in training. Contrarily, if the ability of "absolute positioning" can be acquired, then we can predict that performance in this skill is affected by the length of time spent in training, irrespective of one's score in the aptitude test. Given the scope of information garnered for this study, we cannot determine which influence is bigger. This is an area for further research.

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Development of Perfume Bottle Visual Design Model Using Fuzzy Analytic Hierarchy Process

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Abstract

With the popularization of internet shopping, visualization of goods package has become an important factor in communicating goods characteristics and plays a critical role in influencing consumers' purchase decision. This phenomenon is particularly apparent in the case of mature consumer goods such as perfume products, chocolate, daily commodity, and so on. To construct a decision support model for assisting package designers to create a satisfying product package based on consumers' affective responses, a series of visual experiment evaluation for perfume bottle package is conducted in the current study. The fuzzy analytic hierarchy process-based approach is proposed to construct the decision support model for perfume bottle visual design. In the current study, the feasibility of constructing model based on the fuzzy analytic hierarchy process approach is demonstrated and the resulting model can provide perfume package designers with an understanding of developing a new design alternative in the conceptual design stage.

Keywords

Package Visual Design, Perfume Bottle, Multiple Consumers' Psychological Perceptions

1. Introduction

A conspicuous or high quality package design is one way that a new product can stand out from familiar packages offered by the competition (Berkowitz, 1987). If the package design of a product communicates high aesthetic quality, consumers frequently assume that the product is high quality, and vice versa. Furthermore, consumers are likely to generate perceptional response to a product by means of its package, i.e. a product feels, looks, while viewing product package (Underwood et al., 2001). Thus, the consideration of consumers' psychological perception (CPP) to package visual design plays a critical role in purchase

decisions since it communicates useful information to consumers at the decision making time. This phenomenon is particularly apparent in the case of mature consumer goods such as perfume products, chocolate, cosmetic, daily commodity, and so on. Therefore, it is essential for package designers or companies to comprehend consumers' psychological perception (CPP) to package design of a product and to develop a consumer-oriented visual design model so as to generate the suitable design alternatives during the conceptual design process.

Many package design studies have conducted systematic approach to construct a design model and to obtain a better understanding regarding CPP to package design of a product (Henson et al., 2006; Ares & Deliza, 2010; Gofman et al., 2010; Metcalf et al., 2012; Fernqvist et al., 2015). In general, the effectiveness of the systematic design approach is crucially determined by the choice of analytical techniques. Techniques such as analytic hierarchy process (Lin et al., 2008), conjoint analysis (Ares & Deliza, 2010; Demirtas et al., 2009) and quantitative theory type I (Lin & Wei, 2014) are commonly employed. Analytic hierarchy process (AHP) is particularly useful to demonstrate the weight/utility of each design element by pairwise comparison method and the unsophisticated calculation process and it has high practicability in the conceptual design evaluation. However, the expression of CPP to package design of a product is commonly multiple and vague. AHP does not take into account the uncertainty of one's description to a number. To take the multiple CPPs and the imprecision of human linguistic expressions into consideration, the fuzzy set theory is introduced (Zadeh, 1994) to strengthen the capability of AHP to construct the visual design model which satisfies the requirements of multiple CPPs in this study.

An integrated approach which combines fuzzy set theory with AHP (designated hereafter as the Fuzzy AHP) is proposed to develop the decision support design model for perfume bottle visual design. The perfume product is chosen for illustration purposes since the consumers' purchase decision is governed not only by its perfume characteristic for use, but also by the affective response induced by its package. The remainder of this study is organized as follows: Section 2 reviews the background of AHP and fuzzy set theory. Section 3 presents the research implementation. Section 4 illustrates the construction of perfume bottle visual design model based on Fuzzy AHP. Section 5 presents a brief conclusion.

2. Methodological Review

2.1. Analytic Hierarchy Process (AHP)

Analytic hierarchy process (AHP) is a systematic and scientific method. It is able to order individual professional comments into a hierarchy and then analyze this hierarchy to increase the efficiency of the evaluation. A nine-point scale is frequently used to convert the participants' verbal responses or preferences by means of the options such as equally important (1), moderately important (3), strongly important (5), very strongly important (7), and extremely important (9) (Saaty, 1994). Although the nine-point scale has the advantages of simplicity and

easiness for use, it does not take into account the uncertainty associated with the mapping of participants' perception to a number.

2.2. Fuzzy Set Theory

To take the imprecision of human qualitative evaluations into consideration, fuzzy set theory (Zadeh, 1994) is introduced to solve the problems involving the absence of sharply defined criteria. The key idea of fuzzy set theory is that an element has a degree of membership in a fuzzy set (Zimmermann, 1996). A fuzzy set is defined by a membership function. The most commonly used range for expressing the degree of membership is the unit interval [0, 1]. Fuzzy set theory thus is used to solve such kind of problems, and it has been applied in a variety of fields. In this study, the triangular fuzzy number is used to represent subjective pairwise comparisons of selection process in order to capture the vagueness. As shown in **Figure 1**, the triangular fuzzy number $\tilde{A} = (l, m, u)$, l and u mean the lower and upper bounds of the fuzzy number $\tilde{A}$, respectively, and m is the median value for $\tilde{A}$. The membership function is defined as Equation (1). The operational rules of addition and multiplication of $\tilde{A}_1 = (l_1, m_1, u_1)$ and $\tilde{A}_2 = (l_2, m_2, u_2)$ are displayed as following Equations (2) and (3).

$$u_{\tilde{A}}(x) = \begin{cases} (x-l)/(m-l), & l \le x \le m \\ (x-u)/(m-u), & m \le x \le u \\ 0, \text{ otherwise}, & 0 \le l \le m \le u \end{cases} \tag{1}$$

Addition of the fuzzy number $\oplus$

$$\tilde{A}_1 \oplus \tilde{A}_2 = (l_1, m_1, u_1) \oplus (l_2, m_2, u_2) = (l_{1+} l_2, m_{1+} m_2, u_{1+} u_2) \tag{2}$$

Multiplication of the fuzzy number $\otimes$

$$\begin{aligned} &\tilde{A}_1 \otimes \tilde{A}_2 = (l_1, m_1, u_1) \otimes (l_2, m_2, u_2) = (l_1 l_2, m_1 m_2, u_1 u_2) \\ &\text{for } l_1; l_2 > 0;\ m_1; m_2 > 0;\ u_1; u_2 > 0 \end{aligned} \tag{3}$$

2.3. Fuzzy AHP

From the discussions above, this study proposes an integrated scheme, combining fuzzy set theory with AHP (Fuzzy AHP). The triangular fuzzy numbers parameterized by triplet numbers are used to represent the perfume bottle evaluation of multiple affective responses as well as to construct the pairwise comparison matrix. The procedure of Fuzzy AHP is described as follows.

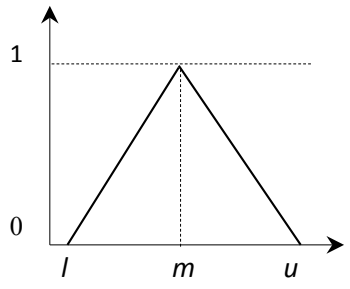

Figure 1. Triangular fuzzy number.

Step 1: Constructing the fuzzy judgment matrix and determining the weight vector: The fuzzy judgment matrix $\boldsymbol{A}$ is the matrix of the combination of m candidate alternative and n evaluation criteria and the weight vector $\boldsymbol{W}$ based on n evaluation criteria is constructed as following Equations (4) and (5). The elements of the fuzzy judgment matrix $\boldsymbol{A}$ and weight vector $\boldsymbol{W}$ are represented by five triangular fuzzy numbers, i.e. $\tilde{1}-\tilde{9}$. The five triangular fuzzy numbers are defined with the corresponding membership function and the meaning as shown in Table 1. Then, WT is the transpose of the weight vector $\boldsymbol{W}$ and it can be described as Equation (6).

$$\boldsymbol{A}=\left[a_{ij}\right]_{m\times n}=\begin{bmatrix}\tilde{a}_{11} & \tilde{a}_{21} & \cdots & \tilde{a}_{1n}\\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2n}\\ \vdots & \vdots & \ddots & \vdots\\ \tilde{a}_{m1} & \tilde{a}_{m2} & \cdots & \tilde{a}_{mn}\end{bmatrix} \tag{4}$$

$$\boldsymbol{W}=\left[\tilde{w}_j\right]_{1\times n}=\begin{bmatrix}\tilde{w}_1 & \tilde{w}_2 & \cdots & \tilde{w}_n\end{bmatrix} \tag{5}$$

$$\boldsymbol{W}^{\mathrm{T}}=\begin{bmatrix}\tilde{w}_1\\ \tilde{w}_2\\ \vdots\\ \tilde{w}_n\end{bmatrix} \tag{6}$$

Step 2: Constructing the weighted fuzzy judgment matrix and calculating the final fuzzy scores of candidate alternatives: The weighted fuzzy judgment matrix can be obtained by means of Equation (7). Based on the result of Equation (7) calculation using the operational rules of Equation (2) and Equation (3), the fuzzy sequencing vector $\boldsymbol{S}$, show as $\left[\tilde{s}_i\right]_{m\times 1}$, can be obtained. Then, the $\tilde{s}_i$ of fuzzy sequencing vector is the final fuzzy scores of the candidate alternatives.

$$\boldsymbol{S}=A\otimes W^{\mathrm{T}}=\begin{bmatrix}\tilde{a}_{11} & \tilde{a}_{21} & \cdots & \tilde{a}_{1n}\\ \tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2n}\\ \vdots & \vdots & \ddots & \vdots\\ \tilde{a}_{m1} & \tilde{a}_{m2} & \cdots & \tilde{a}_{mn}\end{bmatrix}\otimes\begin{bmatrix}\tilde{w}_1\\ \tilde{w}_2\\ \vdots\\ \tilde{w}_n\end{bmatrix}=\begin{bmatrix}\tilde{s}_1\\ \tilde{s}_2\\ \vdots\\ \tilde{s}_m\end{bmatrix} \tag{7}$$

Step 3: Defuzzifying the fuzzy scores and ranking the candidate alternatives: It is necessary to define a method for building a crisp ordering of $\tilde{s}_i$ to rank the candidate alternative since the final fuzzy scores of candidate alternatives are the type of fuzzy numbers. In this study, the fuzzy numbers are defuzzified and ranked by the fuzzy mean value (Wu et al., 2004). $\tilde{s}_i$ is a triangular fuzzy number (l,m,u). Its mean $\vec{x}(\tilde{s}_i)$ is defined as Equation (8).

Table 1. Definition of relative fuzzy number and membership function

Fuzzy number	Meaning	Membership function
$\tilde{1}$	Equally important	(1, 1, 3)
$\tilde{3}$	Moderately important	(1, 3, 5)
$\tilde{5}$	Strongly important	(3, 5, 7)
$\tilde{7}$	Very strongly important	(5, 7, 9)
$\tilde{9}$	Extremely important	(7, 9, 9)

$$\vec{x}(\tilde{s}_i) = (l + m + u)/3 \tag{8}$$

Then, the fuzzy numbers $\tilde{s}_1, \tilde{s}_2, \cdots, \tilde{s}_m$ can be ranked according to the value of the fuzzy mean $\vec{x}(\tilde{s}_i)$ to determine the optimum candidate alternative.

3. Research Implementation

3.1. Constructing Qualitative Definitions of Perfume Bottle

To explore the consumers' psychological perceptions (CPPs) to perfume bottle visual design, approximately one hundred commercially-available perfume bottle pictures with similar view-angles are collected in this study. The discussion of focus group (McDonagh et al., 2002) involving 5 package/graphic designers is conducted to classify the perfume bottle pictures based on the similarity of their appearance, and 53 perfume bottle pictures shown as **Figure 2** are retained in accordance with the visual dissimilarity of perfume bottle. Then, the morphological analysis is used to define the perfume bottle into several dominant design elements and features based on the experiences of 5 designers by means of a discussion. **Table 2** presents the 8 important design elements which are finally determined, and their corresponding features.

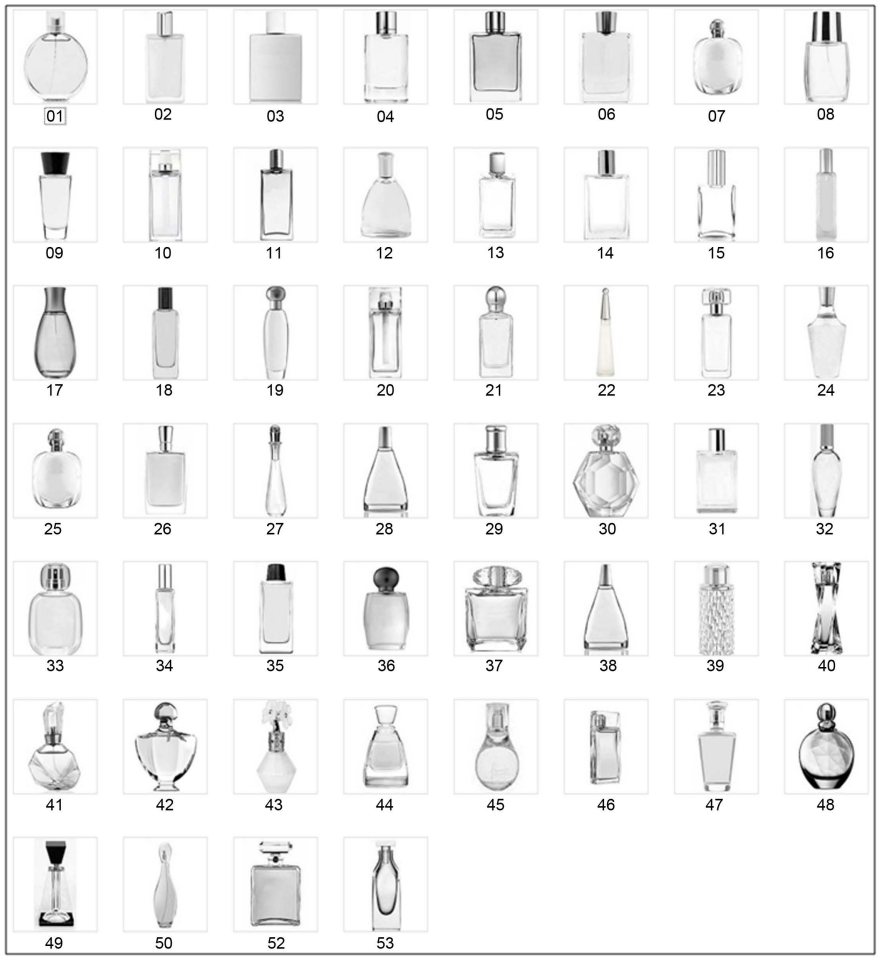

Figure 2. Fifty-three existing perfume bottle samples.

Table 2. Definition of perfume bottle visual design.

Features / Elements	Type 1	Type 2	Type 3	Type 4	Type 5
Shape of bottle cap (X_1)	Square (X_{11})	Sphere (X_{12})	Trapezoid (X_{13})	Inverse trapezoid (X_{14})	
Material of bottle cap (X_2)	Glass (X_{21})	Plastic (X_{22})			
Surface of bottle cap (X_3)	Transparent effect(X_{31})	Semiopaque effect (X_{32})	Plating effect (X_{33})	Facet effect (X_{34})	
Width-to-height proportion of bottle cap shape (X_4)	2:1 (X_{41})	1:1 (X_{42})	1:0.67 (X_{43})	1:0.5 (X_{44})	
Shape of bottle body (X_5)	Square (X_{51})	Circle (X_{52})	Trapezoid (X_{53})	Inverse trapezoid (X_{54})	Hexagon (X_{55})
Surface of bottle body (X_6)	Transparent effect (X_{61})	Semiopaque effect (X_{62})	Facet effect (X_{63})		
Width-to-height proportion of bottle body shape (X_7)	2:1 (X_{71})	1:1 (X_{72})	1:0.67 (X_{73})	1:0.5 (X_{74})	
Proportion of cap shape height to body shape height (X_8)	3:1 (X_{81})	1:2 (X_{82})	1:1 (X_{83})		

3.2. Creating Evaluation Samples of Perfume Bottle

In order to accommodate the 8 design elements and the corresponding features, the orthogonal design is conducted to array the conditions of evaluation samples in this study. The result of orthogonal design is shown in Table 3. Subsequently, three package/graphic designers, each with more than three years' of design experience are invited to create the perfume bottle evaluation samples based on the qualitative definition scheme shown in Table 2. As shown in Figure 3, a total of 32 samples are created for evaluation of perfume bottle image.

3.3. Selecting Representative Consumers' Psychological Perceptions

Although many different image words are used when describing commodity package, the image words applicable to perfume bottle are more limited. In this study, 3 package/graphic designers, each with 3 years experience (two males and one female), and 3 white-collar individuals from non-design backgrounds (one male and two females) are invited to participate in a discussion aimed at identifying suitable image words with which to describe the possible consumers' psychological perceptions (CPPs) when presented with the perfume bottle samples. The image words are elicited from the participants using the following four-step procedure:

Step 1: The 53 perfume bottle samples are reviewed, and the image words (in Chinese) used by the individual participants to describe their CPPs of the image projected by each perfume bottle are recorded.

Table 3. Orthogonal design of perfume bottle samples.

Evaluation Samples	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
No. 1	X_{12}	X_{22}	X_{31}	X_{41}	X_{54}	X_{62}	X_{73}	X_{83}
No. 2	X_{11}	X_{22}	X_{33}	X_{41}	X_{52}	X_{62}	X_{72}	X_{81}
No. 3	X_{14}	X_{21}	X_{34}	X_{44}	X_{51}	X_{61}	X_{74}	X_{81}
No. 4	X_{12}	X_{21}	X_{33}	X_{44}	X_{52}	X_{63}	X_{72}	X_{82}
No. 5	X_{11}	X_{22}	X_{34}	X_{42}	X_{54}	X_{62}	X_{73}	X_{81}
No. 6	X_{11}	X_{21}	X_{32}	X_{43}	X_{53}	X_{61}	X_{72}	X_{83}
No. 7	X_{11}	X_{22}	X_{34}	X_{43}	X_{55}	X_{61}	X_{71}	X_{82}
No. 8	X_{14}	X_{22}	X_{32}	X_{41}	X_{55}	X_{63}	X_{71}	X_{82}
No. 9	X_{14}	X_{21}	X_{33}	X_{42}	X_{53}	X_{61}	X_{73}	X_{82}
No. 10	X_{13}	X_{22}	X_{34}	X_{41}	X_{53}	X_{63}	X_{74}	X_{82}
No. 11	X_{13}	X_{21}	X_{31}	X_{43}	X_{52}	X_{62}	X_{74}	X_{82}
No. 12	X_{13}	X_{21}	X_{32}	X_{41}	X_{52}	X_{62}	X_{73}	X_{81}
No. 13	X_{12}	X_{22}	X_{32}	X_{42}	X_{54}	X_{62}	X_{72}	X_{82}
No. 14	X_{13}	X_{21}	X_{32}	X_{44}	X_{54}	X_{61}	X_{71}	X_{83}
No. 15	X_{11}	X_{22}	X_{33}	X_{44}	X_{55}	X_{62}	X_{74}	X_{83}
No. 16	X_{12}	X_{21}	X_{34}	X_{42}	X_{52}	X_{63}	X_{71}	X_{83}
No. 17	X_{14}	X_{21}	X_{33}	X_{43}	X_{55}	X_{62}	X_{71}	X_{81}
No. 18	X_{13}	X_{21}	X_{31}	X_{42}	X_{55}	X_{61}	X_{72}	X_{83}
No. 19	X_{13}	X_{22}	X_{33}	X_{42}	X_{51}	X_{63}	X_{71}	X_{81}
No. 20	X_{13}	X_{22}	X_{34}	X_{44}	X_{53}	X_{61}	X_{72}	X_{82}
No. 21	X_{14}	X_{22}	X_{32}	X_{44}	X_{52}	X_{61}	X_{73}	X_{83}
No. 22	X_{12}	X_{21}	X_{34}	X_{43}	X_{55}	X_{61}	X_{73}	X_{81}
No. 23	X_{13}	X_{22}	X_{33}	X_{43}	X_{51}	X_{63}	X_{73}	X_{83}
No. 24	X_{12}	X_{22}	X_{31}	X_{44}	X_{53}	X_{62}	X_{71}	X_{81}
No. 25	X_{11}	X_{21}	X_{31}	X_{44}	X_{51}	X_{63}	X_{73}	X_{82}
No. 26	X_{12}	X_{22}	X_{32}	X_{43}	X_{51}	X_{61}	X_{74}	X_{81}
No. 27	X_{12}	X_{21}	X_{33}	X_{41}	X_{54}	X_{63}	X_{74}	X_{82}
No. 28	X_{11}	X_{21}	X_{31}	X_{41}	X_{51}	X_{61}	X_{71}	X_{81}
No. 29	X_{14}	X_{22}	X_{31}	X_{43}	X_{54}	X_{63}	X_{72}	X_{81}
No. 30	X_{14}	X_{21}	X_{34}	X_{41}	X_{51}	X_{62}	X_{72}	X_{83}
No. 31	X_{11}	X_{21}	X_{32}	X_{42}	X_{53}	X_{63}	X_{74}	X_{81}
No. 32	X_{14}	X_{22}	X_{31}	X_{42}	X_{52}	X_{61}	X_{74}	X_{83}

Step 2: The Focus Group method is applied to select 25 suitable image words (see **Figure 4**) for the perfume bottles.

Step 3: The Kawakida Jirou (K.J.) technique (Cross, 1994) is then applied to classify the 25 image words in accordance with their semantic similarities by means of the discussion of focus group. As shown in **Figure 4**, three basic groups are identified.

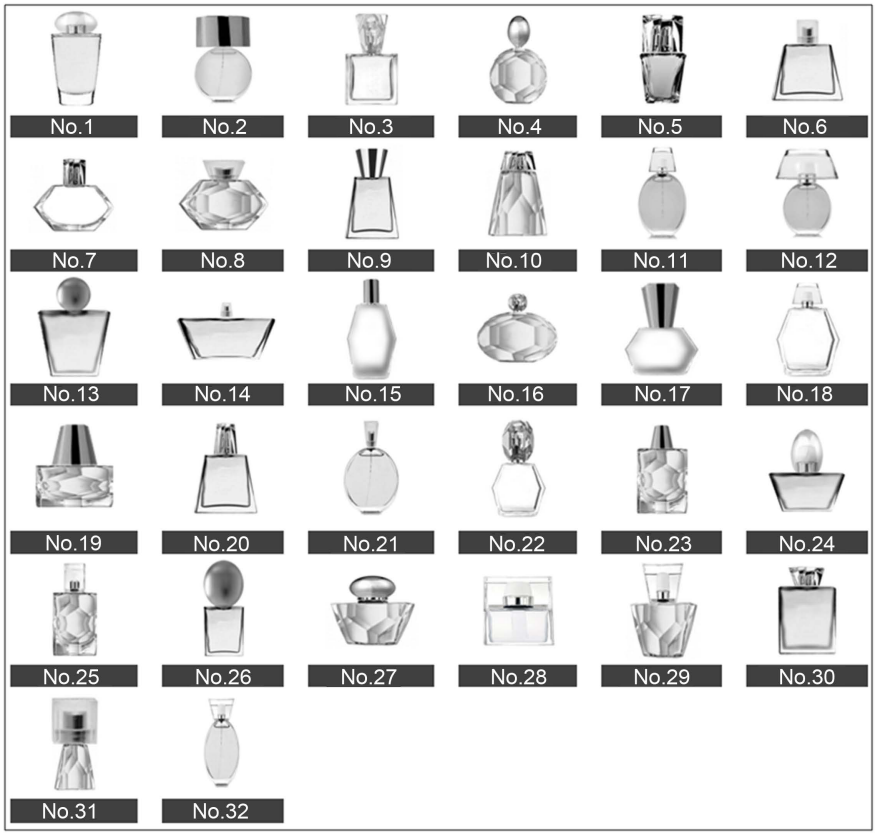

Figure 3. Thirty-two perfume bottle evaluation samples.

Youthful and Vigorous			
Youthful	Vigorous	Personal	Sprightly
Cheerful	Spirited	Nimble	Peculiar

Feminine and Graceful			
Feminine	Graceful	Elegant	Sexy
Slender	Delicate	Alluring	Noble
Gorgeous	Gentle		

Modern and Novel			
Modern	Novel	Progressive	Prevalent
Innovative	Concise	Succinct	

Figure 4. Selection and classification of image descriptors.

Step 4: From each group, one image words is chosen to represent the overall characteristics of the group, i.e. Youthful and Vigorous (Y. & V.), Feminine and Graceful (F. & G.), Modern and Novel (M. & N.).

3.4. Perfume Bottle Visual Evaluation

Eighty-four subjects (54 males, 33 females; age from 19 to 34 years old) are invited to evaluate the CPPs induced by the perfume bottles. The three representative CPPs are quantified using three 5-point scales. The 32 perfume bottle samples and the three 5-point scales are integrated into an interface constructed by using Visual Basic software, as shown in Figure 5. After each subject had evaluated all of the samples, the evaluative data are recorded for the usage of establishing the perfume bottle visual design model.

3.5. Modeling the Correlation between Perfume Bottle and Consumers' Psychological Perceptions

To construct a systematic design model respecting CPP to the visual effect of perfume bottle, the evaluation results obtained for the visual evaluation of perfume bottle are used to establish the correlation between perfume bottle and CPP. Since the data of evaluation results are the 5-point scale average values of eighty-four subjects in each of three CPPs, the proper fuzzy numbers are then defined to represent the 5-point scale average values as shown in Table 4. Fur-

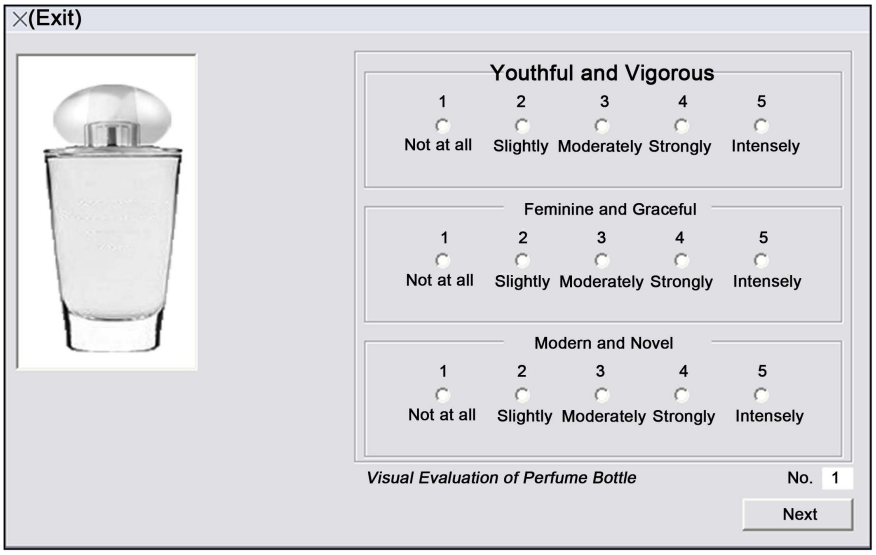

Figure 5. Perfume bottle evaluation interface.

Table 4. Definition of 5-point scale average values and verbal expression correspond to fuzzy number.

5-point scale average value	Verbal expression	Fuzzy number	Membership function
Below 2.09	Not at all (1)	$\tilde{1}$	(1, 1, 3)
2.10 - 2.89	Slightly (2)	$\tilde{3}$	(1, 3, 5)
2.90 - 3.69	Moderately (3)	$\tilde{5}$	(3, 5, 7)
3.70 - 4.49	Strongly (4)	$\tilde{7}$	(5, 7, 9)
Above 4.5	Intensely so (5)	$\tilde{9}$	(7, 9, 9)

thermore, this study treats the task of satisfying CPP to perfume bottle as a multi-objective design activity. Therefore, the Fuzzy AHP is introduced to analyze and to determine the optimum perfume bottle alternative which satisfy multiple CPP requirements.

4. Construction of Perfume Bottle Visual Design Model

4.1. Constructing the Fuzzy Judgment Matrix and Determining the Weight Vector for Perfume Bottle Evaluation

In constructing the perfume bottle visual design model using Fuzzy AHP, the average values (see Table 5) of the three CPPs obtained in the evaluation trials described in Section 3.3 are uniformly convert into the fuzzy number based on the definition of the first column of Table 4. For example, in sample 1, the average values of the three CPPs, *i.e.* "Y. & V.", "F. & G." and "M. & N.", are 2.98, 2.25 and 3.52, respectively. According to the definition of first column of Table 4 and Equation (4), the average values of the three CPPs in sample 1 can be represented by a fuzzy number, and, respectively. Then, the fuzzy judgment matrix A for perfume bottle can be shown below.

$$A_{\text{perfume bottle}} = \begin{bmatrix} \tilde{3} & \tilde{3} & \tilde{5} \\ \tilde{3} & \tilde{3} & \tilde{5} \\ \tilde{5} & \tilde{1} & \tilde{3} \\ \tilde{5} & \tilde{5} & \tilde{7} \\ \vdots & \vdots & \vdots \\ \tilde{3} & \tilde{5} & \tilde{7} \\ \tilde{3} & \tilde{5} & \tilde{3} \\ \tilde{1} & \tilde{3} & \tilde{3} \end{bmatrix} \tag{9}$$

With respect to the weight decision, a set of specific multiple CPPs to perfume bottle are hypothetically designated by consumer groups or package designers in this study. For example, if a particular consumer group expects a new perfume bottle with "strongly Y. & V." (4), "slightly F. & G." (2), and "moderately M. & N." (3). According to the definition of second column of Table 4, and Equation (5), the fuzzy weight vector W for perfume bottle can be represented below.

Table 5. Average values and the corresponding fuzzy number for 32 perfume bottle samples.

Sample No.	Y. & V.			F. & G.			M. & N.		
	Avg	Sd	Fn	Avg	Sd	Fn	Avg	Sd	Fn
1	2.98	±0.93	$\tilde{3}$	2.25	±0.94	$\tilde{3}$	3.52	±0.86	$\tilde{5}$
2	2.06	±1.02	$\tilde{1}$	2.12	±0.72	$\tilde{3}$	3.36	±0.79	$\tilde{5}$
3	3.05	±0.78	$\tilde{5}$	1.72	±0.66	$\tilde{1}$	2.42	±1.08	$\tilde{3}$
4	3.61	±0.81	$\tilde{5}$	3.46	±1.03	$\tilde{5}$	3.92	±0.69	$\tilde{7}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
30	2.81	±0.69	$\tilde{3}$	3.05	±0.76	$\tilde{5}$	3.97	±0.87	$\tilde{7}$
31	2.31	±0.91	$\tilde{3}$	3.77	±0.93	$\tilde{5}$	2.93	±0.71	$\tilde{3}$
32	2.03	±0.93	$\tilde{1}$	2.31	±0.96	$\tilde{3}$	2.19	±1.12	$\tilde{3}$

The "Avg", "Sd" and "Fn" indicate the "Average value", "Standard deviation" and "Fuzzy number", respectively.

$$\boldsymbol{W}_{\text{Perfume Bottle}} = \begin{bmatrix} \tilde{7} & \tilde{3} & \tilde{5} \end{bmatrix} \tag{10}$$

4.2. Constructing the Weighted Fuzzy Judgment Matrix and Calculating the Fuzzy Scores of Perfume Bottle

Subsequently, $\boldsymbol{W}^{\mathrm{T}}$ for perfume bottle can be obtained from the transpose of the weight vector $\boldsymbol{W}$, and the weighted fuzzy judgment matrix can be constructed based on Equation (7). Then, the fuzzy scores of perfume bottle can be calculated by using the fuzzy sequencing vector $\boldsymbol{S}_{\text{perfume bottle}}$ shown below.

$$\boldsymbol{S}_{\text{Perfume Bottle}} = \begin{bmatrix} \tilde{3} & \tilde{3} & \tilde{5} \\ \tilde{1} & \tilde{3} & \tilde{5} \\ \tilde{5} & \tilde{1} & \tilde{3} \\ \tilde{5} & \tilde{5} & \tilde{7} \\ \vdots & \vdots & \vdots \\ \tilde{3} & \tilde{5} & \tilde{7} \\ \tilde{3} & \tilde{5} & \tilde{3} \\ \tilde{1} & \tilde{3} & \tilde{3} \end{bmatrix} \otimes \begin{bmatrix} \tilde{7} \\ \tilde{3} \\ \tilde{5} \end{bmatrix} = \begin{matrix} l, & m, & u \\ \end{matrix} \begin{bmatrix} (15,55,119) \\ (15,41,101) \\ (19,53,113) \\ (33,85,161) \\ \vdots \\ (23,71,143) \\ (11,51,115) \\ (9,31,87) \end{bmatrix} \tag{11}$$

4.3. Defuzzifying the Fuzzy Scores and Ranking the Perfume Bottle Alternatives

Finally, the defuzzification process is calculated in this step of the current study. Based on Equation (8): $\vec{x}(\tilde{s}_i) = (l + m + u)/3$, the mean values of the triangular fuzzy numbers (*l, m, u*) for each perfume bottle sample can be obtained by calculating the fuzzy number of fuzzy sequencing vector $\boldsymbol{S}_{\text{Perfume Bottle}}$. Accordingly, the 32 perfume bottle samples can be ranked the highest to lowest based on their fuzzy mean values. As an illustration, Table 6 shows the top 5 ranking perfume bottle alternatives, and Figure 6 shows the optimum combination of the deign elements and their corresponding features for top 1 alternative. This result shows that the designers should consider "the trapezoid shape", "the glass material", "the transparent effect" and "approximately 1:1 proportion of width-to-height" for perfume bottle cap design, and "the hexagon shape", "the transparent effect" and "approximately 1:0.67 proportion of width-to-height" for perfume bottle body, and "approximately 3:1" for the proportion of cap shape height to body shape height when creating perfume bottle prototype designed to satisfy the "strongly Y. & V.", "slightly F. & G." and "moderately M. & N." of multiple CPPs in the conceptual design stage.

Table 6. Result of defuzzification and ranking alternatives.

Rank	Perfume Bottle No.	Fuzzy number $(\tilde{s}_i)$			Fuzzy mean $\vec{x}(\tilde{s}_i)$
		l	*m*	*u*	
1	18	57	117	169	114
2	25	57	107	169	109
3	27	41	101	171	104
4	9	39	95	175	103
5	16	39	95	161	98

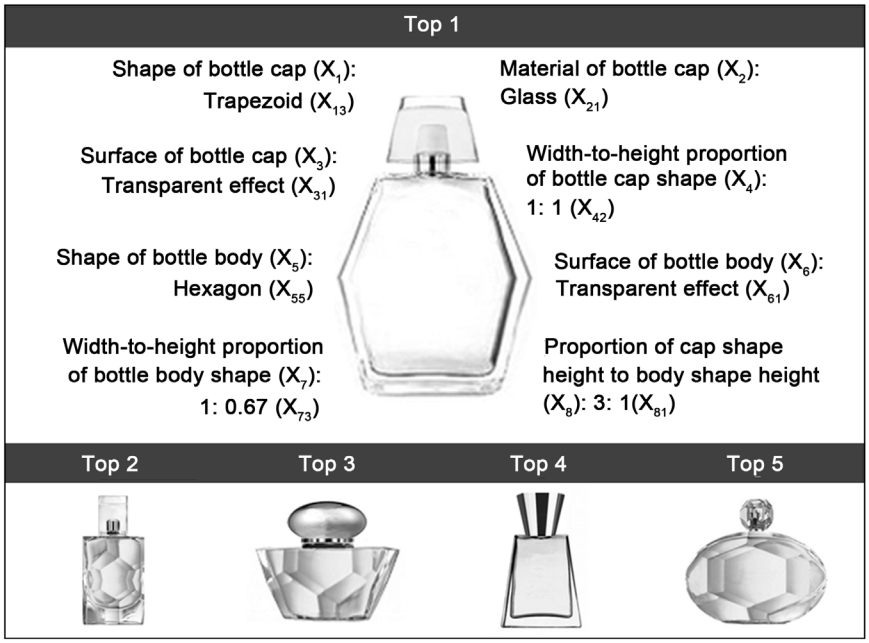

Figure 6. Top 5 perfume bottle alternatives.

5. Conclusion

This study has conducted a perfume bottle evaluation to develop the Fuzzy AHP-based design support model based on multiple CPPs. One of contributions of this study consists in proposing an integrated approach based on fuzzy set theory and analytic hierarchy process for modeling the correlation between perfume bottle and multiple CPPs. Moreover, the integrated approach can be extended to develop a design support model and to present the suitable design elements and design features for perfume bottle visual design. Accordingly, the development of design support model can assist package designers to obtain the prototype of optimum perfume bottle alternatives in the conceptual design stage. Furthermore, the Fuzzy AHP-based design support model in conjunction with the computer aided design system can facilitate the new perfume bottle design process. Overall, this Fuzzy AHP-based approach provides an effective mechanism for the package visual design of perfume bottle. In future studies, the generality of the design model constructed by Fuzzy AHP approach could be investigated by considering a variety of consumer goods examples.

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Design Aspects of Scoring Systems in Game

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Abstract

Scoring systems are a key component of game mechanics, and provide a mechanism whereby players are rewarded with point value whenever they accomplish a task in the game. The growing complexity of scoring systems underlines the importance of determining the degree to which the design of a scoring system affects player satisfaction. However, this requires a comprehensive understanding of the functions and design aspects of scoring systems. This study interviewed experts in the field of gaming to identify the 20 most important functions of scoring systems with the aim of elucidating current trends. The researchers then conducted a questionnaire survey among game designers and avid game players to evaluate each of the 20 functions in 12 representative games. Finally, multidimensional scaling (MDS) was employed to identify the main dimensions associated with the design of scoring systems. Our results indicate that perceivability, controllability, and relation to achievement are the primary aspects of design in the scoring systems commonly found in games.

Keywords

Scoring System, Game Design, Scoring Functions, MDS, Scoring System Design Aspects

1. Introduction

The scoring system used in any kind of game can have considerable influence on the satisfaction of players during gameplay. Scoring acts as a type of positive feedback and reward system capable of spurring players on toward greater challenges (Shneiderman, 1992). Game designers have traditionally tended to adopt quantitative scoring systems as a means of enhancing the enjoyment of participants in their gameplay. However, scoring systems are becoming increasingly diverse, and the attitudes of game players toward these the systems employed can strongly influence the degree of satisfaction they feel toward the game as a

whole. Clarifying the relationship between scoring systems and satisfaction in gameplay requires that one understands the design aspects and functions of scoring systems.

Scoring often serves as a bridge between games and players, and thereby provides an indication of the degree to which game players are intent on achieving the objectives of the game (Schell, 2008). In other words, scoring is a way of measuring success (Rollings & Adams, 2003). Because scoring stimulates players to act, game designers frequently design scoring systems as a system by which to guide players through the game (Adams & Dormans, 2012). Burgun (2012) and Bates (2004) indicated that games require scoring systems to increase the likelihood that a game will be played repeatedly. In this way, scoring could be seen as a means of prolonging the life of games. The methods used in the presentation of scores can be obvious or subtle. In interactive story games, scoring is not perceived by players, despite the fact that the total score ultimately determines the outcome of the game (Crawford, 2013).

Designers seeking to use a scoring system to connect players with games must possess a clear understanding of how the system can influence the satisfaction of the players. Such an understanding makes it possible to adjust the scoring system for optimal effects. Howard and Sheth (1969) determined that an outcome is considered acceptable only if it exceeds the value of the opportunity cost. Evans (1976) indicated that a decline in one's sense of satisfaction reduces one's willingness to use a system. Scoring systems are generally used as instruments of self-assessment and comparison, and can sometimes indirectly influence gameplay (Wang & Sun, 2011). According to Malone (1981), score-keeping is an important part of what makes playing a game a pleasurable experience. Therefore, it stands to reason that improving the design of scoring systems would lead to players feeling more satisfied with a game.

Increased diversity in scoring methods is making it increasingly difficult to identify the specific aspects of scoring that have the greatest impact on player satisfaction. Without the means to classify scoring systems, game designers are forced to implement scoring based largely on personal experience. This study was an attempt to categorize the scoring systems used in commercially distributed and relatively well-known games according to their functionality. Specifically, the process involved three steps:

1) Description of the functions of scoring systems.
2) Compilation of these functions into a questionnaire enabling the assessment of scoring systems by avid game players and game designers.
3) Conversion of the results using multidimensional scaling (MDS) to determine the potential psychological dimensions of the assessed scoring systems.

In the first step, analysis of scoring systems was conducted from the perspectives of game designers as well as game players. Experts in the field of gaming as well as individuals who frequent forums on game design were consulted to compile a database of descriptive characteristics related to scoring systems. In the second step, the resulting concepts were then used to produce a questionnaire,

which was administered to game designers and avid game players with the aim of assessing the scoring systems in several representative games. In the final step, the design aspects of scoring systems were then categorized using MDS.

MDS is a dimension reduction technique used to convert data related to the distance (or dissimilarities) between pairs of individuals in a group into the configuration of the same individuals in space (perceptual maps). This is achieved while maintaining as much as possible, the relative relationships within the original data (in the form of distance or dissimilarity matrices). Following conversion, proximal distance between pairs of individuals can also be used to represent similarities/dissimilarities for use as inputs for MDS. Correlation coefficient matrices are one example of using the degree of correlation as a representation of similarity. The benefit of using MDS lies in its capacity to convert high-dimensional data related to the scoring systems into a low-dimensional configuration in space (perceptual map). Reducing the number of dimensions makes it possible to represent core design aspects of the scoring systems. Compared to principal components or factor analysis, both of which can also reduce dimensionality, MDS usually gives a model of smaller number of dimensions and its spatial configuration is generally easier to interpret. Furthermore, even though that sometimes one cannot assume a linear relationship between distances and dissimilarities, multidimensional scaling nevertheless provides a simple dimensional model that is easy for one to grasp.

This study evaluated questionnaire data on 12 scoring systems. Collectively these systems comprise 20 different scoring functions. These functions were converted into dissimilarity matrices. The mean scores related to system function, as provided by game designers and avid game players, were used as original data, with each function represented as a dimension. Thus, the data are multidimensional. The researchers then used SPSS (IBM_Corp., 2012) to derive correlation coefficient matrices for the scoring systems. Following conversion, the correlation coefficient matrices were input into MDS for processing. The researchers observed the elbow on the RSQ function (see **Figure 3**) and the stress scree plot (see **Figure 4**) to determine how many dimensions to use in interpreting the scoring system. The researchers named the dimensions, each of which represents a design function of a scoring system, after comparing the differences between their two most extreme points.

This categorization scheme provides valuable insight into the distribution of various scoring systems among the various types of games. After identifying the trend of each axis, the researchers can categorize all scoring systems by type. This will enable us to identify the design elements of scoring systems for different types of games. The researchers can also study the scoring design of highly satisfying games, searching for regularities in order to enable an exploration of the relationship between the core aspects of scoring systems and gaming satisfaction. Once the researchers understand the regularities of scoring systems for different game types, the researchers can test whether gaming satisfaction could be improved by adjusting scoring systems. Regularities identified in the design of

scoring systems among the various types of games can be used to improve scoring systems or serve as reference for designers aiming to deviate from current norms and develop new gaming systems.

2. Method

This study adopted metric MDS to enhance the objectivity of our exploration of the design aspects of scoring systems. Our investigation was conducted in two stages: 1) identifying the intended functions of various scoring systems and 2) assessing these functions in the context of existing games using a questionnaire. The results were then analyzed with the aim of categorizing the issues that must be considered in the design of a scoring system.

2.1. Rationale of MDS

This study employed multidimensional scaling (MDS), a dimension reduction technique to describe complex data using a minimal number of dimensions. Beginning with a similarity matrix, MDS can be used to uncover the hidden configurations—in other words, the dimensions—within a group of data. For an illustrative purpose, the researchers can take a color study as an example to demonstrate how similarity/dissimilarity matrices can be used to identify these configurations. A group of participants were asked to evaluate the similarity of 14 different types of spectral color (Ekman, 1954). Each color was labeled based on nanometer wavelengths (W434, .., W674). The participants were then asked to compare the "qualitative similarities" between pairs of colors. Table 1 shows a modified version of the similarity matrix provided by Ekman. It has been transformed into an SPSS data set suitable for use by ALSCAL. The matrix contains

Table 1. Similarity matrix using data reported in Ekman (1954).

W434	W445	W465	W472	W490	W504	W537	W555	W584	W600	W610	W628	W651	W674
86	-	-	-	-	-	-	-	-	-	-	-	-	-
42	50	-	-	-	-	-	-	-	-	-	-	-	-
42	44	81	-	-	-	-	-	-	-	-	-	-	-
18	22	47	54	-	-	-	-	-	-	-	-	-	-
6	9	17	25	61	-	-	-	-	-	-	-	-	-
7	7	10	10	31	62	-	-	-	-	-	-	-	-
4	7	8	9	26	45	73	-	-	-	-	-	-	-
2	2	2	2	7	14	22	33	-	-	-	-	-	-
7	4	1	1	2	8	14	19	58	-	-	-	-	-
9	7	2	0	2	2	5	4	37	74	-	-	-	-
12	11	1	1	1	2	2	3	27	50	76	-	-	-
13	13	5	2	2	2	2	2	20	41	62	85	-	-
16	14	3	4	0	1	0	2	23	28	55	68	76	-

Adapted from "Dimensions of color vision" by Ekman, 1954, *Journal of Psychology*, 38(2), 467-474.

the averaged judgments of 31 participants regarding the similarities of 14 colors (wavelengths). The higher the score, the more similar these colors appeared to the observers. The matrix was then input into SPSS for dimension reduction using MDS.

The resulting scree plot (Figure 1) clearly shows that the elbow falls between two dimensions, which means that spectral colors can be adequately described using two dimensions. The perceptual map (Figure 2) illustrates the distribution

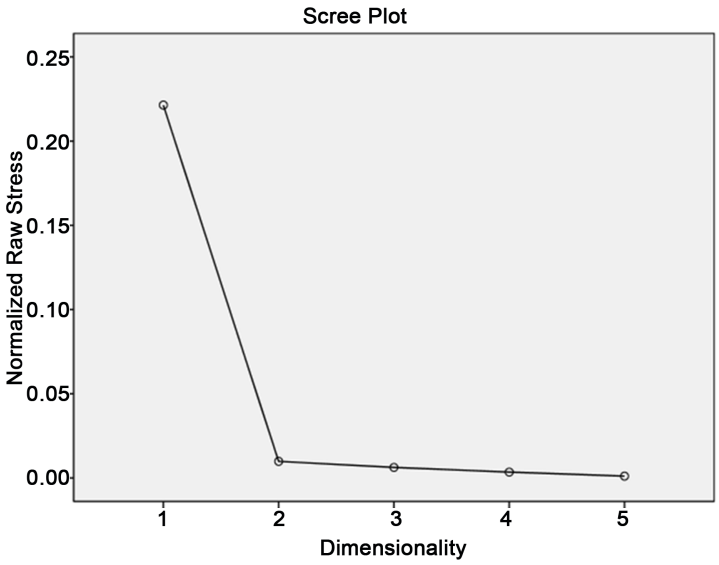

Figure 1. Stress scree plot. Adapted from "Dimensions of color vision" by Ekman, 1954, *Journal of Psychology*, 38(2), 467-474.

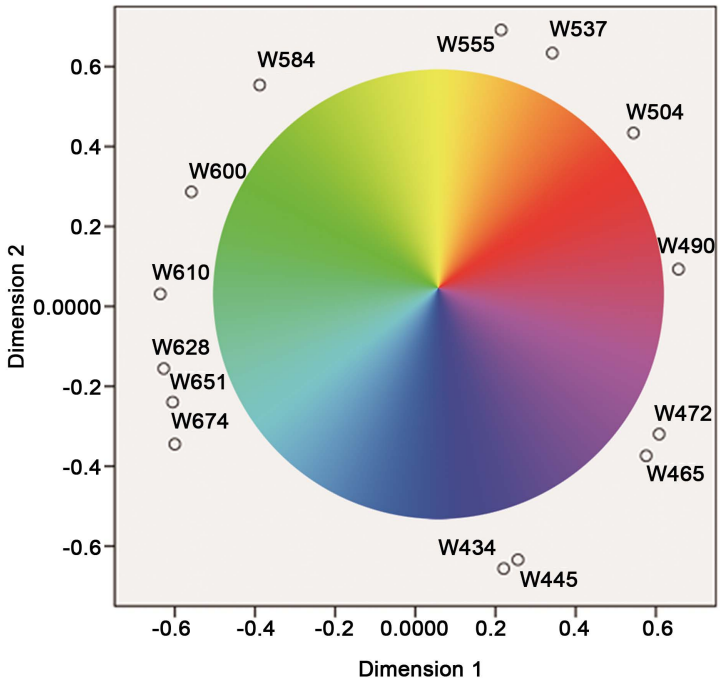

Figure 2. Perceptual map for Dimension 1 and 2. Adapted from "Dimensions of color vision" by Ekman, 1954, *Journal of Psychology*, 38(2), 467-474.

of the 14 colors among the two dimensions, with a configuration resembling a color wheel. The differences between the extreme points of the two dimensions show that in Dimension 1, colors approaching W610 are closer to cyan, and colors closer to W490 are similar to magenta. In Dimension 2, colors approaching W555 are closer to yellow, and colors closer to W434 resemble blue.

Scoring systems are extremely complex. The researchers must first objectively ascertain the attributes of scoring systems, and then have game designers or players compare the similarities of attributes against systems. The distance between scoring systems is used to build the dissimilarity matrix. Next, MDS is used to configure each scoring system using a minimal number of dimensions. Lastly, the researchers evaluate the meaningfulness of each dimension by comparing the difference between its two most extreme points.

2.2. Functions of Game Scoring Systems

Most scoring systems are designed with a number of functions in mind, and many scoring methods are subtle in their effects. This made it exceedingly difficult to identify a set of scoring functions directly from the literature or game manuals. After discussion with a professor of Digital Media at the Georgia Institute of Technology who has over 20 years of industry and academic experience in game design, the researchers selected 35 commercially distributed and relatively well-known classic games (Table 2) based on game types and studied the functions of their scoring systems. In order to avoid biasing the game selection towards any particular region, the researchers chose iconic games that are extremely popular in both Asia and the U.S. Despite slight differences between these two regions, their gaming interests are very similar. After the initial analysis, the researchers eliminated games with highly similar scoring systems and identified a list of 15 functions. The researchers then posted these findings on a well-known website dedicated to game development, Gamedev.net, asking participants to comment on and make suggestions. The four participants in the discussion comprised three game designers (with 5, 25, and 27 years of industry experience, respectively) and one game reviewer (who had posted over 7000 reviews at GameDev.net). Inputs from these participants were integrated into the final list of scoring functions. Following a final revision and confirmation from the professor, our analysis provided a total of 20 scoring functions, as shown in Table 3.

2.3. Rating of Scoring Systems

- Participants in questionnaire survey

Our participants were avid game players or designers, who were required to have a certain level of existing knowledge about these games. All of the participants should have more than five years of experience playing games. Game designers should have at least one-year experience in game design. This criterion required us to employ purposive rather than random sampling. The researchers posted an invitation on the PTT Game Design board to recruit game designers

Table 2. 35 classic games.

Genres	No.	Games
Action	1	*Pac-man*
	2	*Super Mario Bros*
	3	*Asteroids*
	4	*Space Invaders*
	5	*Street Fighter*
Strategy	6	*Civilization*
	7	*Starcraft*
Role-Playing	8	*Dungeons & Dragons*
	9	*Final Fantasy*
	10	*Zelda*
	11	*Ultima online*
Sports	12	*Pong*
	13	*NBA* 2*K*13
	14	*Major League Baseball* 2*K*13
	15	*Madden NFL* 25
	16	*F*-1 *Race*
Music	17	*Dance Dance Revolution*
	18	*Rock band*
Simulation	19	*Black & White*
	20	*The oregon trail*
	21	*The Sims*
Adventure	22	*Zork Nemesis*
	23	*Nancy Drew: Alibi in Ashes*
	24	*Uncharted*
	25	*Bioshock*
	26	*Monkey-island*
	27	*Myst*
Casual	28	*Angry birds*
	29	*Crystal Quest*
	30	*Tetris*
Social virtual world	31	*Minecraft*
	32	*There*
Facebook game	33	*Candy crush*
	34	*FarmVille*
	35	*Words with friends*

Table 3. Functions of scoring system.

No.	Function	Description
1	Goal	To serve as the goal of the game
2	Guidance	To guide players to perform certain actions
3	Feedback	To present positive or negative feedback
4	Extension	To encourage players to continue playing
5	Measurement	To measure abstract concepts
6	Differentiation	To differentiate individual players
7	Advertisement	To serve as an advertisement for prompting new players to join and old player to play again
8	Restriction	To restrict the actions of players within a certain range of values
9	Time	To restrict the actions of players with real time
10	Assistance	To can assist players to enter a new level
11	Plot	To influence the plot of the game
12	Achievement	To guide the setting of personal goals
13	Progress	To serve as a criteria for reaching another level or status
14	Status	As an expression of player status
15	Identity	As an expression of identity or prominence
16	Conversion	To enable conversion from one type of currency/points/entities to another
17	Sharing	To be shared with other players
18	Competition	To serve as a standard for competition among players
19	Control	To be controlled or distributed by players
20	Concealment	To be concealed and not easily seen or perceived by players.

and avid game players to fill out an online questionnaire survey (Table 3). PTT is a well-known bulletin board system (BBS) in Taiwan, with over 100 game designers participating in discussions on its Game Design board. To overcome the difficulties in recruiting willing participants, the researchers also invited some game designers from Softstar Entertainment Inc. (where the first author previously worked), and other game developers to take part in the survey. The researchers obtained data from a total of 34 participants, including eight avid game players and twenty-six game designers, eleven of whom had more than five years of experience and fifteen of whom had between one and five years of experience. All of the participants had more than five years of experience playing games.

2.4. Classification of Scoring Systems

- Online questionnaire

The questionnaire shown in Table 4 was used for evaluating the 12 scoring system. The questionnaire was compiled on the online questionnaire system, my Survey. Each item of this questionnaire is a five-point Likert scale with which the participant was to evaluate one of the scoring system functions listed in Table 2. The participants were asked to estimate the proportions of the 20 functions in

Table 4. The questionnaire used for rating.

			Does not include	Maybe includes	Slightly includes	Includes	Strongly includes
1	Goal	To serve as the goal of the game	○	○	○	○	○
2	Guidance	To guide players to perform certain actions	○	○	○	○	○
3	Feedback	To present positive or negative feedback	○	○	○	○	○
4	Extension	To encourage players to continue playing	○	○	○	○	○
5	Measurement	To measure abstract concepts	○	○	○	○	○
6	Differentiation	To differentiate individual players	○	○	○	○	○
7	Advertisement	To serve as an advertisement for prompting new players to join and old player to play again	○	○	○	○	○
8	Restriction	To restrict the actions of players within a certain range of values	○	○	○	○	○
9	Time	To restrict the actions of players with real time	○	○	○	○	○
10	Assistance	To can assist players to enter a new level	○	○	○	○	○
11	Plot	To influence the plot of the game	○	○	○	○	○
12	Achievement	To guide the setting of personal goals	○	○	○	○	○
13	Progress	To serve as a criteria for reaching another level or status	○	○	○	○	○
14	Status	As an expression of player status	○	○	○	○	○
15	Identity	As an expression of identity or prominence	○	○	○	○	○
16	Conversion	To enable conversion from one type of currency/points/entities to another	○	○	○	○	○
17	Sharing	To be shared with other players	○	○	○	○	○
18	Competition	To serve as a standard for competition among players	○	○	○	○	○
19	Control	To be controlled or distributed by players	○	○	○	○	○
20	Concealment	To be concealed and not easily seen or perceived by players	○	○	○	○	○

the 12 scoring systems, ranging from "does not include" to "strongly includes". Representative examples were provided to prevent participants from being confused with regard to the subtleties of various scoring systems. The researchers also added links to videos for a number of the example games to illustrate the form and function of the various scoring systems.

- Multidimensional scaling

This study employed the built-in MDS function (ALSCAL) of SPSS for the processing of the data in Table 5 into distance matrices showing dissimilarities among the various scoring systems. This made it possible to proceed with dimension reduction and the computation of perceptual maps.

Table 5. Assessment results of game scoring system. A: Top score system, B: Health system, C: Evaluation system, D: Experience point system, E: Abilities system, F: Talents system, G: Resources system, H: Moral-calculus system, I: Trade system, J: Plot scoring system, K: Pong scoring system, L: Timer system.

	A	B	C	D	E	F	G	H	I	J	K	L
Goal	87.65	71.76	92.35	85.88	76.47	80.59	72.35	78.82	80.00	80.59	91.18	91.18
Guidance	68.24	79.41	88.24	81.76	87.06	85.29	86.47	87.65	83.53	85.88	84.71	88.24
Feedback	77.65	75.29	84.12	73.53	75.88	73.53	73.53	83.53	72.94	78.82	81.76	81.18
Extension	70.00	50.59	77.06	85.29	71.18	72.94	67.06	64.12	80.00	66.47	64.12	67.65
Measurement	58.82	60.59	74.12	65.88	67.06	64.71	63.53	72.35	68.24	72.94	60.00	62.35
Differentiation	65.29	61.76	71.18	77.65	84.12	87.06	50.00	78.24	60.59	62.35	70.00	61.76
Advertisement	51.76	41.76	60.00	60.00	60.00	64.71	50.00	60.59	68.24	61.18	57.06	58.82
Restriction	51.76	72.94	65.29	75.88	74.12	75.29	82.35	73.53	75.88	74.12	60.59	78.82
Time	61.18	52.94	64.12	61.76	48.24	44.12	65.88	54.71	65.88	49.41	53.53	78.82
Assistance	75.29	57.06	75.88	82.35	71.18	69.41	62.94	74.71	64.71	81.76	56.47	74.71
Plot	53.53	54.71	57.06	66.47	58.82	54.71	62.35	86.47	59.41	94.12	45.29	55.88
Achievement	82.94	72.35	88.24	81.76	74.12	77.06	69.41	84.71	79.41	70.59	79.41	90.59
Progress	82.35	68.82	80.00	81.76	65.29	74.12	72.35	81.76	64.12	88.82	60.00	78.82
Status	71.76	85.88	79.41	80.59	84.71	78.82	73.53	80.00	67.65	64.71	80.00	67.65
Identity	74.71	55.88	75.88	72.35	65.88	64.71	54.12	78.24	71.76	50.00	66.47	57.65
Conversion	55.29	40.59	44.12	50.59	40.59	45.29	61.18	36.47	80.00	30.00	28.24	31.18
Sharing	67.65	47.65	71.18	58.82	51.18	56.47	51.76	46.47	60.00	40.59	57.06	55.29
Competition	88.24	71.76	93.53	64.71	65.29	65.29	74.71	52.94	61.18	37.65	91.76	84.12
Control	52.94	63.53	66.47	74.71	82.94	89.41	85.29	70.59	75.88	61.76	53.53	52.35
Concealment	50.00	48.82	40.00	39.41	49.41	51.76	42.35	57.65	38.82	80.59	35.29	32.35

3. Results and Analysis

3.1. Assessment Results of Game Scoring Systems

Table 4 presents assessments made by the 34 participants with regard to the 20 scoring system functions and how they pertain to the twelve game scoring systems (A to L). Each cell contains the mean score awarded by the participants for one function associated with scoring systems. For example, when "Does not include" is selected, the Goal function of the Top score system earns 0 points. In contrast, the assessments of "Does not include", "Maybe includes", "Slightly includes", "Includes", and "Strongly includes" receive 25, 50, 75, and 100 points, respectively. The total scores awarded by participants for the Goal function of the Top score system was then divided by 34, resulting in 87.65, which represents the weight of the Goal function in the Top score system. The first column lists the functions of the scoring system with the scoring systems listed across the top.

3.2. MDS Data Analysis

- Scree Plot

The MDS process requires that the user determine a reasonable number of dimensions for the perceptual maps, based on the patterns displayed in the scree plots. Figure 3 and Figure 4 present the scree plots based on RSQ and stress. As

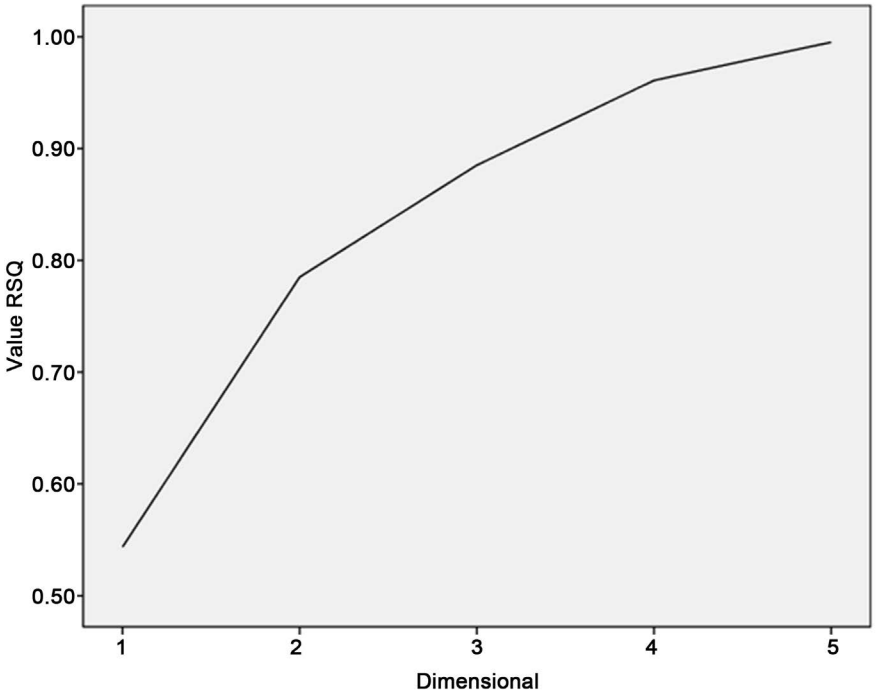

Figure 3. RSQ scree plot.

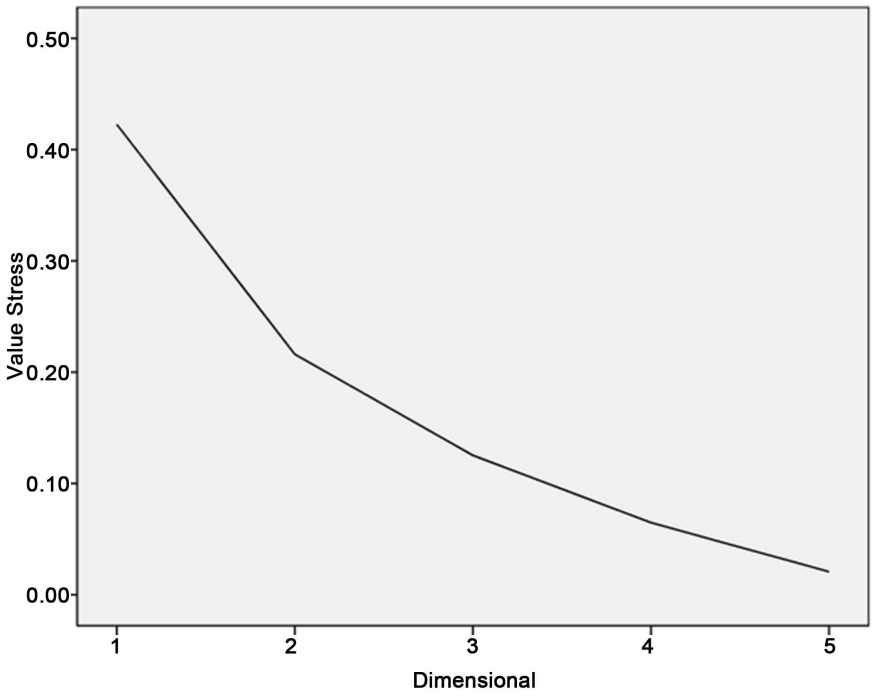

Figure 4. Stress scree plot.

the stress scree plot does not show a clearly distinguishable elbow, the researchers used the RSQ plot to determine the number of axes. The researchers found that three axes could be used to explain approximately 90% of variance. Any benefit to be gained from using more dimensions would be overshadowed by the increased complexity in interpreting data. Therefore, the researchers employed

three axes to explain the scoring systems in order to provide sufficient explanatory power.

- Perceptual maps

In the Figure 5 and Figure 6, the perceptual maps present the distributions associated with the scoring systems in three-dimensional space (Table 6). For the sake of convenience, the researchers deconstructed the maps into two-dimensional figures: first axis-second axis, first axis-third axis, and second axis-third axis (X, Y, and Z). The axes were designated according to their two most extreme points. A group of analysts, each equipped with five or more years of experience in game development, was then assembled to propose names for the axes according to differences between the two extreme points. Analyst 1 is the author of this paper and has experience developing multiple MMORPG at Softstar Entertainment. Analyst 2 is a game designer at Interserv International Corporation, and has developed Internet community games as well as game apps. Analyst 3 is a game designer at IGS and has developed many types of arcade games. Following in- depth discussion, a consensus was reached. The first axis involves the plot scoring system and the Pong scoring system, the main difference between them being the perceivability. The two most extreme points on the second axis were the trade system and the timer system, with the greatest difference in controllability. The two most extreme points on the third axis were Top score system and the health system, which differed most in achievement. Thus, following a group discussion, the three axes were named Perceivability, Controllability, and Relation to Achievement.

Perceivability indicates the level of awareness players have of their scores. Controllability refers to the degree of control assigned to players with regard to the scores they receive. Finally, relation to achievement refers to the importance of the score to the players. Each type of scoring system provides specific means by which players can connect with the game. The three dimensions are analyzed in detail in the following Discussion section.

Table 6. The 3D coordinates of all scoring systems used in this study.

	Scoring systems	Reference	Dimensions		
			1	2	3
A	Top score system	Tetris	1.3186	0.4973	−0.9630
B	Health system	Street Fighter	0.0635	0.5484	1.4482
C	Evaluation system	Dance Dance Revolution	1.2122	0.1688	−0.9149
D	Experience point system	Final Fantasy	−0.1321	−0.4990	−0.8118
E	Abilities system	Dungeons & Dragons	−0.4651	−0.4109	0.5552
F	Talents system	World of Warcraft	−0.4605	−0.9634	0.2110
G	Resources system	Starcraft	0.1247	−0.9704	1.1625
H	Moral-calculus system	Black & White	−1.5397	0.3153	−0.5341
I	Trade system	The Sims	0.3916	−1.8279	−0.3372
J	Plot scoring system	Heavy Rain	−3.0778	0.8361	−0.2108
K	Pong scoring system	Pong	1.5388	1.0142	0.6785
L	Timer system	F-1 Race	1.0259	1.2915	−0.2836

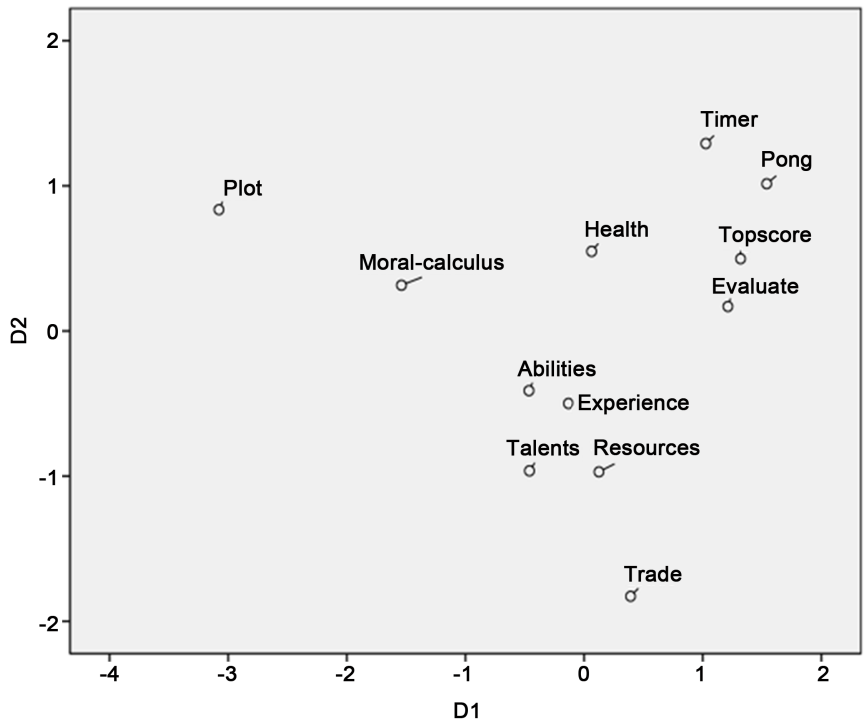

Figure 5. Perceptual map for Dimension 1 and 2.

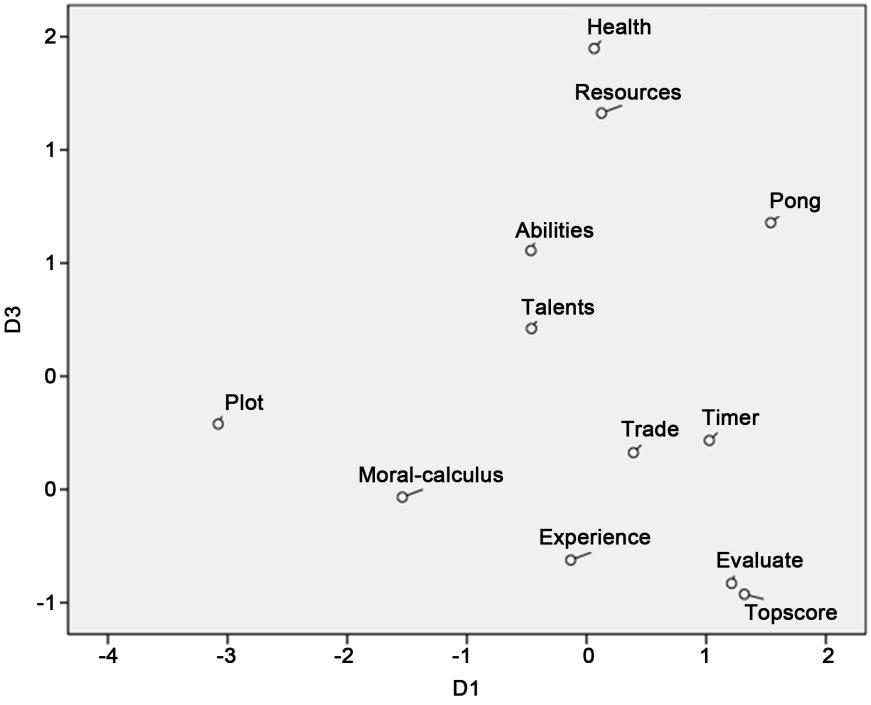

Figure 6. Perceptual map for Dimension 1 and 3.

4. Discussion

This study used multidimensional scaling (MDS) to identify the following three aspects of scoring systems that should be considered in the design of games: perceivability, controllability, and relation to achievement.

4.1. Perceivability

This dimension refers to the extent to which players are aware of the existence of the scoring system. This affects how immersed players become in the game and what gaming strategies they develop. Highly perceivable scoring systems are usually used in games that require decision-making strategy. Players make decisions that reduce/increase their scores in order to maneuver themselves into more advantageous positions. Games with strong story appeal, on the other hand, employ less perceivable scoring systems, to prevent players from shifting their focus from the storyline.

- Highly perceivable

A perceivable scoring system means that players can see and refer to their scores, which are usually displayed as numerical values on screen. Players can adjust their behavior based on their cumulative scores, which indicate their performance. Score-oriented games usually have highly visible scoring systems. In baseball games, for instance, the final victory is determined by the scores of each team. Players must understand their scores in order to devise offensive or defensive strategy. Puzzle games like *Tetris* (Pajitnov & Pokhilko, 1984) are also designed to encourage players to pursue higher scores. Current and personal best scores are displayed on-screen so that players can comprehend their position at a glance.

- Barely perceivable

Games with this rating have scoring systems that are not easily visible to players. This approach is mainly used to prevent concern over scores interfering with the experience of the game. It is intended that players make decisions based on what is shown on screen, with each choice having a corresponding point value. Scores are then tallied in the background and the results used to determine the progression of the player through the game.

In the interactive narrative *Heavy Rain* (Sony, 2010), no scoring system is explicitly explained or blatantly obvious. Rather, the scores are tallied in the background according to the decisions made by players throughout the game. Even though the scores are not easily perceived by players, the total score plays a crucial role in determining the outcome of the story. Open world games, in which players have scope to engage in destructive behavior, often have an embedded, albeit invisible, ethics system to encourage players to take responsibility for their actions. The development of the player through the game is based on the ethics score, which is increased by constructive behavior and decreased by destructive behavior. Many role play and virtual romantic games have non-perceivable scoring systems based on intimacy and attraction. The game is designed to encourage the player to observe and react to changes in the behavior of the other virtual characters without being able to view the attraction score.

4.2. Controllability

Scoring systems can also be categorized according to the amount of control players can exercise with regard to their scores. Controllability affects the free-

dom of players to manipulate their own score and whether they can employ multiple game strategies. In highly controllable scoring systems, scores represent a quantity of resources that can be converted into other resources of an equivalent value. Scoring systems with low controllability usually have fixed feedback mechanisms; although there is limited scope for players to change or convert scores, the feedback indicates whether an objective has been achieved.

- High controllability

Adams and Dormans (2012) listed four functions of economies: production, consumption, transfer, and consumption of resources. Scores can be used to indicate a quantity of economic resources or converted from one resource into another. In strategy games such as *StarCraft* (Blizzard, 1998), scores represent quantities of resources in the form of units. Players are able to combine resource units to produce other resources of an equivalent value. This concept is also applied in *The Sims* (Maxis, 2000), in which currency can be converted into furniture of equal value.

The skill points earned by players in some RPGs, such as *World of Warcraft* (Blizzard, 2004), can be freely distributed by players in order to influence the professional development of their character, which can have a significant influence on their capabilities later in the game. This method is also common in role-playing sports games such as the *MLB* 2*K* (2K, 2005) series. Following each game, the system rewards players for good performance by endowing them with skill points, which can be applied by the player to enhance the skills they seek. Bartering systems in games such as *The Sims* can also be considered a type of point distribution system, in which players determine the means by which to allocate their money in the purchase of virtual products.

- Low controllability

Some aspects of scoring allow limited participant control. These are generally determined according to the designers who implemented them, such that the players must passively accept these factors as a predetermined mechanism. For instance, players in a basketball game can only score between one and three points for each shot. In speed-based games, timers present fixed values that apply to all players, meaning that players are unable to manipulate time at will. In puzzles games such as Tetris, different numbers of tiles correspond to different point values. Players have less opportunity to control these scores as they are generated through predefined feedback mechanisms.

4.3. Relation to Achievement

Scoring systems can be divided according to their objective meaning to players. These objectives may be goal of a game or the psychological objectives of the players. This dimension affects the lifespan of the game. A player who no longer feels challenged to achieve something in a game is significantly less willing to continue playing the game. The greater the level of achievement offered by the scoring system, the greater the level of challenge.

- Highly correlated to achievement

Some scoring systems do not influence the progress of the game, but rather indicate the personal achievement of a player. For example, gaining a high score is not the primary goal in Tetris; however, many players attach greater importance to gaining a high score than to achieving the objectives of the game. The desire to obtain a higher score sometimes presents a challenge that players cannot resist. The rating system in *Dance Dance Revolution* (Konami, 1998) evaluates the dance moves made by players during the game. Each move corresponds to a certain number of points, and players can receive higher scores by adjusting their movements and the precision of their timing.

Many pay-per-use gaming systems use this type of scoring system to encourage players to play a game repeatedly in order to obtain a higher score. This concept is also implemented in gaming consoles to extend the lifespan of games that would otherwise be played only once or twice. Players spend more time trying to break their own records or the scores of others and thereby gain a sense of achievement. This characteristic of encouraging participants to play repeatedly can also be found in other types of scoring systems. One example is the skill points in RPGs, which encourage players to try out characters that feature different skills.

- Barely correlated to achievement

Scoring systems that have a low relation to achievement are generally binary in nature, such as the health system in *Street Fighter* (Capcom, 1987), in which a player ends up either alive or dead. Achievement related to these scoring systems is not viewed as an objective target. For example, the resources in *Starcraft* can only be converted into other valuable resources. Accumulating these resources is necessary; however, the sense of achievement is experienced as a secondary benefit.

4.4. Three Dimensions in Scoring System Design

The results above are meant to clarify for game designers the aspects of scoring systems that should be considered in the design of games. The researchers also present the distribution of various types of scoring system in the most common gaming categories. For instance, the scoring system in RPGs is based mainly on controllability and relation to achievement, whereas interactive narrative games adopt a more subtle scoring approach that is less perceivable to players but exerts significant influence on the outcome of the game. Racing games use a system of timing, which presents low controllability but higher relation to achievement and perceivability. Clearly, scoring systems differ in their design aspects. The researchers believe that the degree of influence each of these design aspects has within a scoring system influences the satisfaction of players. By optimizing the proportion of each of these aspects in a scoring system, the researchers can increase their value.

Scoring systems largely determine how long players stay in a game and represent the most obvious form of feedback with regard to the choices made by a player or the player's performance. As such, the scoring mechanism has an es-

sential impact on player satisfaction. Scores can be tangible or intangible, and exist in any form within a game. They can be presented in the form of numbers, text, or images or be entirely hidden from the players. The feedback provided by a scoring system also varies from game to game. Regardless, the purpose of scoring is to quantify the performance or status of players. If the scores that are awarded fall short of player expectations, players can feel disconnected from the game, which undermines player satisfaction. In contrast, when players are able to connect the scores they receive with the values that the scores represent, they are more likely to continue challenging themselves in the game. Unfortunately, game designers are often over-dependent on the scoring system, which frequently leads to an excessive number of scoring systems in a game, some of which are neglected by players. Such scoring systems are easily neglected by players, but designers still hope that they can prolong the duration of gameplay. In this case, it is even more crucial to consider what a scoring system means to players, whether players can connect with the game through the scoring system, and how satisfied players are in the scoring system. Excessive numbers of scoring systems can confuse players, such that the scores lose the meaning that designers had hoped to achieve. When game designers consider the relationship between scoring systems and player satisfaction, they generally focus on the balance among game parameters. Receiving rewards for their actions helps to increase the satisfaction felt by players; however, the researchers believe that the purpose and presentation of scoring systems also affect the gaming experience of players. Game designers must understand the feelings of players towards scoring systems to enhance the feeling of connectedness with the game.

With regard to research limitations, the researchers were unable to employ random sampling (purposive sampling was used instead), due to the requirement that participants have a certain level of existing knowledge about the games. Also, the range of our study does not cover all types of scoring system used in contemporary games. It is difficult to include more than 15 types of stimuli in MDS. More stimuli require participants to evaluate more items, which affects the quality of research. Therefore, the researchers focused on globally popular, commercially marketed games when selecting scoring systems.

5. Conclusion

Our results provide a valuable reference for game developers in the design of scoring systems, allowing them to consider beforehand the experiences they want to convey via the scoring system. The results show that the various scoring systems are evenly distributed among different types of games, which means that scoring systems do not simply give feedback to players but also have their own substantive uniqueness in different types of games. As for the niches that various scoring system combinations may have in the functional implications of different types of games, this requires further investigation. Future researchers could delve into the distribution of these design aspects in the scoring systems of games that bring greater satisfaction in order to determine the correlation be-

tween player satisfaction and various scoring systems. This could also help to reveal patterns in the scoring systems used in particular types of games. The exploration of scoring systems from these aspects could further our understanding of how scoring systems influence players, whether they have significant interaction effects with game type, and whether certain game types can use scoring systems with certain dimensions.

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The New Role of Instructors and Curators for the First-Year Architectural Design Students in Taiwan

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Abstract

Taiwan has become a renowned Chinese cultural showcase in recent years. For architectural instructors, bringing student class efforts to the public has become a part of pedagogical events and the purpose of this study. Instructors who are also designers have established a pattern of collaborating with local small galleries for organizing design exhibitions. The result is a new collaborate pedagogical pattern which enables design students to reach out to society and, in the meantime, open up a window of diversity for the galleries as test workshops for design practice. This pattern has been carried out for three years. The results not only encourage students, but also motivate them with an open-mind learning attitude in a real social space.

Keywords

Pedagogy, Cultural and Creative Space, Design Studio

1. Introduction

In recent years, numerous annual nationwide exhibitions have been held for academic design-related departments. One of the largest exhibitions in Taiwan, Young Designers' Exhibition or YODEX, has attracted 126 departments from 63 local universities and colleges, plus 16 design schools from 5 foreign countries. In total, more than 9000 students and 4000 works are displayed over a period of 4 days. The exhibition has also attracted more than 95,000 visitors in 4 days (Taiwan Design Center, 2016). For years, most of the showroom partitions were torn down immediately after the exhibition, without being recycled.

YODEX is usually held in May, close to the end of a semester. Students usually have to save money and prepare for a long time ahead of this event. The advan-

tage is obvious, in which an international interaction platform has been created. While this exhibition may be very common for professional designers, it nevertheless is very time- and resource-consuming for students. In order to display as many works as possible, exhibitions are usually held at the end of a semester. Although works which illustrate a chronological learning trail are good, the workload at the end of a semester usually adds to students' burden and potentially compromises the quality of the exhibition. Although some visitors may understand the concepts and mockups developed during the design process, the exhibition focuses on the final results instead of the entire design process. In other words, many design development aspects are not introduced.

The biggest challenge of YODEX and other graduation exhibitions are the limited number and opportunity of exposure. For the rest of the three college years, very few exhibitions were held outside the university, so smaller scale exhibitions with more frequent occurrences may be a solution for this situation, especially for the first year or junior students still in school. This concern has led to an alternative strategy, holding an exhibition in the middle of a semester. The scale does not have to be large. With an appropriate arrangement of works and concept illustration, the learning process can also deliver design requirements and solutions to public.

The purpose of this study is to incorporate the pedagogical model of architectural design and the business model of an art gallery for the first-year architectural design studio, and form the viewpoint of instructor, also as a curator. In contrast to one large scale exhibition in four years or one exhibition each semester, an experiment of one exhibition in the middle of a semester or near the end has been tested for three years. The exhibition will act like a footprint of the learning process for students and instructors as well.

2. Space as a Platform or a Showroom

Art gallery tops the choice among different types of space being considered for mid-semester exhibition. The function of an art gallery can be classified into three parts: a showroom, a place to trade arts, and being the manager of artists. A showroom is a place that provokes interaction between people and arts. The interaction, which is a specific kind of local cultural experience, may lead to a new creation of arts (Artlib, 2013; Lin, 2015). As an incubator, the scale of a gallery has gradually changed into twofold: a large scale chain gallery and a small individual one (Tully, 2015). The latter, with limited resources and supports for young artists, has created new business patterns including an artist- or curator-oriented display, a combination of showroom and coffee shop or book store, or an education program (Chen, 2013). A clear message has been delivered that this is a gallery for everyone and is also a community art center with auxiliary functions like ticket sales or short art courses.

In addition to creating values for arts, artists, and collectors, the appropriate business model and elements have to be analyzed (Wang, 2012). The value of a gallery is based on all the possible values made by the creativity or the diversity

of the arts it displayed. The value-added model of a gallery usually has to be adjusted dynamically by the strategy that can accommodate the changes of scales in these days (Wang, 2012).

The important viewpoint of the incubator for future artists with diversified interests should be extended to college students. Combination the function of a local gallery and the student works from the Department of Architecture has become the first step to achieve that. The collaboration not only creates a connection between the future designers and the clients, but also educates neighborhood community with better understanding of architectural design.

A space for exhibition is a platform for the exchange of creative design or to share design-related thoughts. To support the functionality of a platform, both software and hardware have to be integrated for ensuring efficient and effective communication. Software can cater to the exhibition program, design logistics, or social network. Hardware can be the facilities or environment to support the exhibition. Both software and hardware are run by the curator or the contributors of the platform.

There are situations where the emphasis is disoriented, i.e. the exhibitions are the hardware, instead of being run or supported by hardware. While designing a typical creative space for art display is common, cases nevertheless show that the space takes control over the exhibition. While the interior design should be as beautiful as an exhibition, the showroom is not the purpose itself. The term "creative space" is frequently used, even a restaurant can be one without typical exhibition activity. So, it remains to be seen if a restaurant is a dining space without an exhibition program, or a creative space with a well-established exhibition program with auxiliary support facilities like a coffee shop.

3. When a Pedagogical Model Meets a Business Model

The exchange of creative design needs a platform and an operations model. The public cultural and creative spaces (CACS) in Taiwan are usually promoted and sponsored by governments. The purpose is to encourage as many artistic subjects as possible, from music, dance and painting, to multimedia. It is similar to a creative platform for professionals or amateurs, and for practice or academics. There is also private CACS which is created based on a business model, combining promotion, preservation and profit. For a young artist, both the public and private CACSs have to go through a series of evaluations prior to the exhibition or investment, let alone student works. The pedagogy model of performance simulation, generation, evaluation (Oxman, 2008) is difficult to reach out beyond the campus. The result is usually a typical corridor linear panel-stage display layout in an empty hallway (**Figure 1**). Still, many design varieties exist (**Figure 2**) and design communication should be extended to an environment with more public exposure.

4. Cultural and Creative Spaces (CACS)

A CACS is not just a space; it needs a theme or a program to operate. A typical

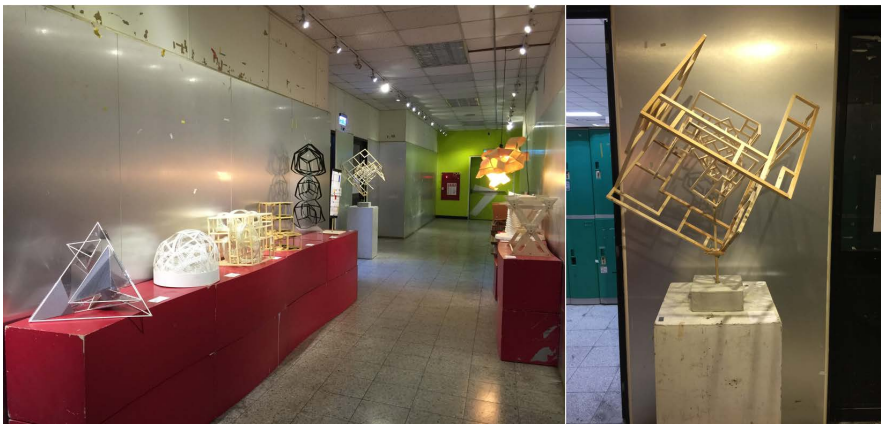

Figure 1. A typical linear panel-table display layout in a corridor outside a design studio.

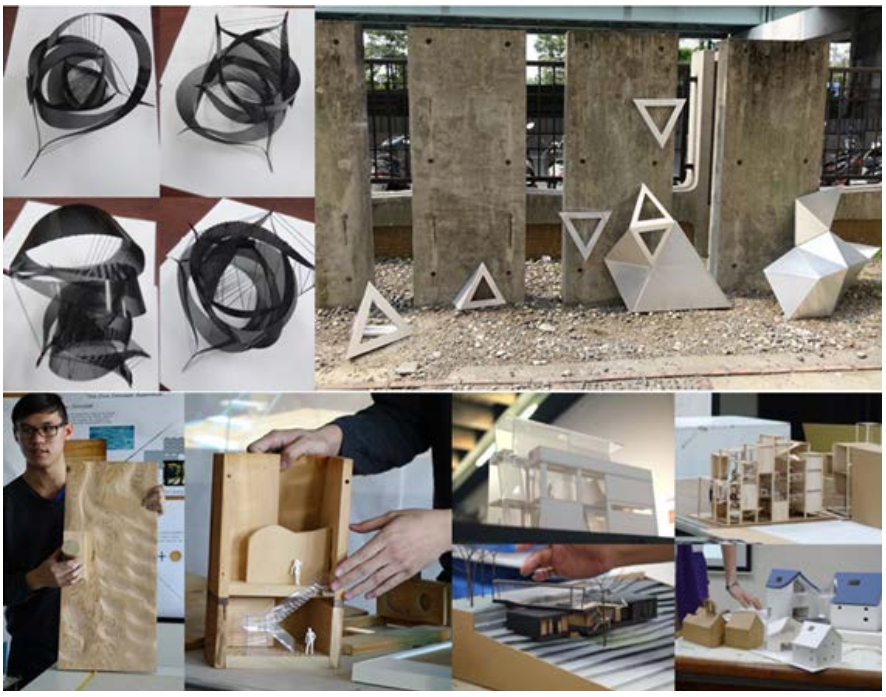

Figure 2. Design projects with a number of varieties.

solution, or the easiest approach, is to combine daily activities with pre-defined design subjects. An example can be found in local restaurants or tea houses (Youth Design[3], 2015), which have created new food culture with modern or traditional design language. Related spaces or applications can be found in the following types:

- New constructions or new designs: restaurant (Wang & Wang, 2015; Yao, 2015), tea house;
- Old buildings: distribution office of Taiwan Tobacco & Liquor Corporation (Youth Design[1], 2015), elementary school (Youth Design[2], 2015), train station warehouse, dormitory, residence, granary;
- Historical buildings: renovated into a CACS for phonograph, music box (NewsRadio, 2013).

The Pros/Cons of Using Coffee Shops for Exhibitions

Exhibitions in CACS have been a standard combination for a long time. CACS as coffee shop seems to be a perfect alternative, since people can enjoy coffee and snacks, while casually enjoying visual contact with surrounding design works. A space with appropriate flexibility would benefit from combining both models (Figure 3). Based on the statistics of the Minister of the Economy, the top 5 coffee chains have added up to 593 shops, a 7.9% increase from 2012 (Lin, 2013). In the ninth month of 2015, the number of coffee shops reached 2435, for a 12% yearly increase (Kuo, 2015). The shops with special cultural characteristics or being list as "must visit" are the top choice for exhibitions.

Nevertheless, in a coffee shop, the original different business model led to a different space layout; consequently, very limited table display space is available in a coffee shop. All of the table-based display has to be modified to make the best use of vertical wall or panels. One of the solutions is to create small horizontal spaces using laminates, shelves, or even acrylic boxes supported by an existing hanging system. With proper layout lighting fixtures, walls are face-lifted into a gallery-like display panels, except that more leisure atmosphere is offered (Figure 4).

5. Reaching out to Society

The original exhibitions were made by the first-year architectural students. The

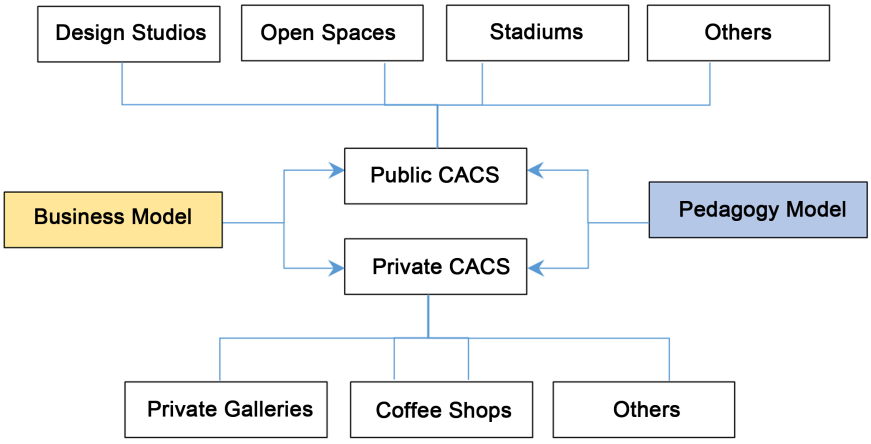

Figure 3. The inter-relationship between a business model and a pedagogical model.

Figure 4. An integration of CACS, a coffee shop, and exhibition (top).

purpose was to open the minds of students to public opinion, instead of being limited to the university. Public opinion, whether professional or amateur, helps students to re-think the ways their designs interact with people (Figure 5). Most likely this is the first exhibition in a student's life. Many students invite their family members to exhibitions, and that indirectly opens up the minds of parents, especially when a lot of adaption has to be conducted in the first year of university. Reaching out to society does not have to be on a large scale. A small community gallery (Figure 6) is also feasible and at a more accessible human scale.

5.1. Connections

Social media have created a prevailing manner of exhibition. Most early exhibitions were static, i.e. the designs only showed up in the gallery and all the people had to visit in person to see or to experience the works. These days, Facebook® (FB) allows users to stream activity in real time, and any person can put his/her design interpretation on YouTube® and count the hit rate, let alone Instagram® or Twitter®. Specific group like Pinterest® is more focused on the design-oriented interaction that can be shared by people who are familiar or who have not learned some topics.

It is possible that when a small gallery or one-person gallery was selected, very few responses were received. Other than the internet media, the exhibitions have discovered a specific traditional 2D media that has evolved with a new role: the tour book or magazine. Many foreign and local tourists (in the middle of Figure 7) plan their tours based on the sightseeing information of Taiwan. Although people can check similar information on the internet, the most recent activi-

Figure 5. The in-shop design demonstration and modified display installation.

Figure 6. The connection of a small gallery and a community.

ties are sometimes updated with more detailed introductions in the magazines published monthly (to the left of Figure 7). Tourists from different countries visited the gallery and left comments on the gallery's FB. Students are also happy to see their design shown in different types of media, which increases the credential of their portfolios.

5.2. Activities: Forum, Seminars

Other than pedagogy-oriented exhibitions, exhibitions for artists and designers are also held frequently in the same place. The exhibitions are usually held with forums or seminars in which the artists and designers can meet audiences face-to-face. Exhibitions are also open to children who can play/interact with the design directly (Figure 8). The activities of forum or seminars also inspire student's works that the interactions are now part of new design resources for the rest of their college years.

6. Conclusion

A new model that combines business and pedagogical characteristics has been created. The model applies public business space as a platform or a showroom to exchange creative design or to share design-related thoughts. The space is also considered as an incubator for future artists with diversified opportunities. The original motivation came from the new roles of architectural design instructors and curators in Taiwan. The combination of the two roles has proven to be very successful not only for the first-year students, but also for the family member's and public perception of the academic activities. In the future, new opportunities

Figure 7. Report from monthly magazine (left), foreign visitors (middle), and poster (right).

Figure 8. The interaction between children and artworks.

will be created to have students and professional designers gather together with broader instructional opinions invited.

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Contemporaneity of Spanish Rural Architecture Intervention and Economic Sustainability

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Abstract

From the second half of the 20th century onwards, Spanish rural architecture has suffered a transformation regarding its farming and ranching model. The economic unsustainability of the family economy has led to further action for the viability of the system. This transformation has meant a new mindset to the owner of the farm and livestock, who had to consider whether continuity was given to the exploitation or the countryside/field was changed and adapted to a new use such as rural tourism, restoration, or for collective uses such as holiday camps, cultural centers or others. Owners who have decided to continue the exploitation they were developing have had to industrialize it and thus extend it in a considerable percentage. That has meant the need to intervene significantly in the rural architectural heritage. A wide and varied range of results has been obtained in these interventions: from the fossilization or destruction of assets, to the achievement of harmony and coexistence between tradition and modernity in this heritage, the result of which represents the contemporaneity of rural architecture.

Keywords

Rural Architecture, Economic Sustainability, Architectural Intervention, Relationship between Economy and Rural Architecture, Rural Contemporary Architecture

1. Introduction

One of the most powerful elements of the rural landscape is housing (Woods, 2005) which is surrounded by the fields that are part of the same agricultural and livestock activity which constituted an economic and legal unit (Garcia, 1975) that remains today as an indivisible farm.

In Spain rural homes have a wide toponymy that identifies them according to the Autonomous Community where they are located. For instance, going from north to south of Spain, we have Galicia with its Pazo and the Hórreo as a secondary building; in the País Vasco there is the Caserío, the Masia in Catalonia, in Valencia the Barraca, in Mallorca the Possessió and in Andalucía the Cortijo.

For centuries the Spanish rural economy has rested in a substantial way in subsistence agriculture. As operating units were generally small, farmers were not allowed to maintain a number of heads that could enable them to make a living from livestock only. Therefore this activity was combined with subsistence farming (García, 1975). The capacity of the plants was also reduced, which didn't allow a large number of cattle. It was a simple manifestation of a rural economy of autarkic character.

Fonseca considers that "the fundamental problem is that the house should be considered as an instrument of rural exploitation, whose repayment must tax the remaining agricultural costs".

At the late nineteenth century and early in the twentieth century the existence of that concern is observed at least since modern programs of economic reform and rural society are formulated. Reform implies the need to adapt the conditions of the area to the new demands of agrarian capitalism (Monclús & Oyon, 1988).

From the second half of the twentieth century small farms gradually became economically unviable by its need for modernization and therefore of considerable economic investment.

This meant that those who decided to continue the exploitation of the work had to transform the construction of new buildings and adapt the existing humble buildings, in order to obtain adequate facilities according to the change in the economic model of agricultural and livestock exploitation (Giménez & Sanchez, 1994).

This has also meant a significant transformation for the rural architectural heritage due to the industrialization of the same holding or to the acquisition of a new use intended to rural tourism, catering, social practices or other.

In those devoted to new uses, the original distribution has been in many situations completely modified in order to suit the housing needs of the new use. In other situations, due to the lack of financial means, junior fittings have been made, such as painting, repairing cracks, removing dampness, etc. (Curós, 2004). Building a bathroom and a kitchen has been the prototype for expansion or renovation exceeding the initial lack of toilets. When the family has continued to live in the same house and has expanded, its operation has been significantly reforming housing services (Villanueva & Leal, 1991).

Of all the interventions, no matter whether they are alterations, additions or new constructions in such a distinctive architecture and a very sensitive and vulnerable landscape, in a too high percentage results are not very satisfactory. In many situations there has been little enough respect and sensuality in translating the rural architectural language in contemporary times. The current legis-

lation is collaborating in obtaining these results due to its rigidity and to unilaterally lead the designer to obtain clones of this architecture (Curós, 2004).

In the farm, like in other jobs, the available family labour and the non-strictly monetary exchanges, as well as the ability of management and decision of the household, are vital elements not only for the holding to move on, but also for the failure of the economic development of others (Giménez & Sanchez, 1994).

Commercial agriculture experienced a significant improvement from the year 1940. The two main agricultural products were cereals and wine products. The evolution of Spanish livestock had similar trends although being less dramatic (Monclús & Oyon, 1988).

The rural world has recently come into an accelerated phase of transformation and has fully entered into the market circuits, losing more than half of its manpower and altering its cultural habits and landscape.

The progressive development of capitalism has simultaneously led to an impoverishment of small agricultural entrepreneur (Etxezarreta, 1977).

This situation has happened not only in Spain but throughout Europe, where the traditional agriculture of artisanal and family type has been disappearing and has been replaced by a more industrial agriculture with entrepreneurial features.

In Spanish agriculture, the abandonment of the field by small farmers has taken place parallel to the establishment of large farms and livestock enterprise mounted by former landlords or absentee new capitalists with exploitations based on paid labour.

The progress of agriculture and its productive orientation is increasingly subordinated to the monopolistic strategy of the strongest sectors of the industrial monopolies (Etxezarreta, 1979).

It has been observed in Spain a break of the correlation between agriculture and the rural economy (Garrabou, 2010).

The policies are designed to support models of industrial and corporate agriculture, concentration of food distribution in the hands of 4 or 5 large areas, and the entry of subsidized food that compete unfairly with local products (Duch, 2010).

We can say that in the family farm a family exploits land "by exploiting itself" (Naredo, 1996).

2. Methodology

The methodology of this research has had its difficulties simply because there are no records in the different Spanish Autonomous Communities. These include however the whole number of existing rural households which are still active, having transformed farming and ranching to adapt them to our days, or having acquired a new use. There is no kind of homogenization among the records that exist between regions or they are not classified by the different uses. Therefore the study responds to a reading and interpretation of the data available by regional governments as it would be impractical to have to do this fieldwork in the whole of Spain; yet this study leads to a diagnosis of the current situation of this

interesting and rooted vernacular heritage. This information could be obtained through public administration, by means of licensing for architectonic interventions or for use changes. Thus, it would be necessary to unify a record with the same data and criteria, which should be available in each region. This would enable the achievement of dated, much more homogenized studies for the whole country, which would allow being aware of the health of this rural heritage.

2.1. Study Areas

This study was conducted in six regions of Spain which show a representativity of the whole country comprehensively. These communities differentiate themselves by having a very distinctive and unique rural architecture of the place and with great personality which shows a range of diverse and interesting rural architecture in the country.

The six types of rural architecture offer a complete reading of Spain, by responding to the geographic and climatological diversity of each of the most significant rural areas of the Spanish territory: from the north (mountainous) to the south (plains) and the Mediterranean coast and Balearic Islands (in the Mediterranean sea).

The studied communities and the nomenclature of its rural architecture is as follows:

1-Galicia: Pazo (housing) and Horreo (building for agricultural use)

2-País Vasco: Caserío

3-Cataluña: Masía

4-Valencia: Barraca

5-Malllorca: Possessió

6-Andalucia: Cortijo

The Pazo and the Hórreo

The Pazo is a Galician rural house of manor type. Its name derives from pa-

lace and is described as a stately mansion. It is related to the monastic architecture and constitutes a solid walled building containing the manor itself and annexed buildings within the same enclosure with garden. They usually contain one or two towers originally with a defensive purpose. They have three floors, ground floor and first floor, which is for housing, and the attic. The interior layout of the manor of the main floor has several bedrooms, some of which are interconnected, the living room and dining room, and a reception room for visits preceded by a hall and kitchen.

The facades are thick walls of local stone with a wood structure and Arab-tile roof.

The outbuildings used to house the family of stewards, who took care of the noble family, the surrounding land and the animals housed in their blocks.

In the enclosure there was usually a dovecote and a chapel.

Another building very common in rural Galicia, the "hórreo", is a very particular construction because of its structure, and is designed to store and dry agricultural products, as a barn.

It is a key element in the architectural, economic and cultural context of the Galician countryside. Its most common use is for the storage, drying and retaining of corn because it is necessary to have good ventilation, insulation and moisture protection as well as a proper system of defence against insects, rodents and birds. Mainly they are rectangular but there are circular or square ones as well.

It is constructed with stone, wood or mixed-construction and they are raised off the ground with a small structure of stone or wood supports, feature which prevents soil moisture and provides ventilation. The pitched roof can be of various types: thatch, slate, stone tiles or Moorish tiles.

The sides of the barn have slots or gaps to dry and ventilate the grain stored therein (Pérez, 2010).

Pazo Santa Marta de Bavio. A Coruña. Photograph: Joan Curós

Hórreo A. Sayo. A Coruña. Photograph: Joan Curós

The Caserío

The Caserío is an isolated rural home surrounded by its land and other buildings in the rural exploitation of the Basque Country with both morphometric and constructive features according to the site.

They are based on the ground floor, mostly devoted to animals, crops and forages and the top or upper floors where the home and the barn were located.

As for the constructions, they are made of stone and wood panelling, with pitched roof on stand perpendicular to the main facade covered with Arabic tiles (Ainz, 2001).

There are villages built largely of wood mainly up to the sixteenth century. Thereafter stone dominates depending on the region and the abundance of a particular building material. In combination with the wood, brick is used creating a type of house that bears a striking resemblance to the farmhouses of some regions of Switzerland and southern Germany. Horizontal brick or masonry filling can be perceived, as well as the structural framework drawing. Both features give the village a great visual beauty.

This new system allowed new schemes, such as changing the layout of the facades and interior organization. In the twentieth century the cubic "caserío" dominates, with four slopes. *In the eighteenth century the Tower houses reach their best expression. They are the well-known palace "caseríos" with volume and stone as main characters.*

Nevertheless, the ground floor used to be generally raised with masonry factory, as well as the facade exposed to rain.

Very typical to the Basque Country are the very flown eaves, supported by other props.

The organization of the floors of the "caserío" has a great simplicity. Almost all "caseríos" are oriented towards the East or the South The floor is divided into three bays to the main facade. When there is a dwelling in the ground floor, the sides are usually occupied by kitchen and bedrooms, and the center one is intended to a passage that leads to the block. Almost all floors of this type allow the house to have two dwellings. On the floor, accessible by a staircase, there are

the remaining bedrooms to the side and very often a room with alcove, where the great feasts are held and the guests are housed in the central bay.

The complete absence of toilets in most "caseríos" is striking, and it is not conceived ordering the laundering of villages inside and outside, and this state of things is tolerated at odds with all the precepts of hygiene (Baeschlin, 1968).

The main entrance is located usually on the main facade facing south and in some cases through the porch, prior to the entry porch, although there are "caseríos" where it can be found in a side facade.

The farmhouse is a basic unit of economic production and social reproduction.

Caserío Aurtenetxe-Mungia. Vizcaya. Photograph: Joan Curós

The Masia

The "Masia" is the most significant icon of the rural world from Catalonia. It is the isolated dwelling in rural area where it shelters those people whose task is to take care of the farming and ranching as family economic structure. It is articulated with other secondary buildings intended to house livestock and crops derived from the land. The ensemble of these elements, buildings and land is known as "*mas*".

The first Masia appeared between the ninth and tenth centuries although most date from the fourteenth and fifteenth centuries. In the eighteenth century there was a boom of growth and reforms in most of them due to agricultural splendour, a feature which was projected on buildings and especially in the farmhouse (Curós, 2004).

The *Masia* was not a closed building but grew throughout its history answering the needs of the same property, both at the agricultural and the livestock level.

Its exterior morphology varies depending on the geographical area where it is located and therefore there are different types of them. Regarding its organiza-

tion and internal structure, there is a fairly widespread prototype of the three bays with walls perpendicular to the main facade facing generally south (Curós, 2004).

There are two bays farmhouses and others with more than three bays, which are added through their respective growths from the body of classical structure or three-bays-structure named as the architect Josep Danés, a scholar expert in the subject of the *masia*.

Almost all of them have ground floor, main floor and attic floor. In the humblest situations, the ground floor was shared between animals and people. The kitchen, the cellar and other outbuildings were on the first floor. In many other farm houses, the living place was entirely in the first or main floor, with a wider central bay room known as the noblest area of the house used for family celebrations, and the side bays intended for the bedrooms. It was common to place the kitchen at the end of the central and north-sided corridor. Upstairs, there was the area to store grain or crops as space ventilation and drying of grain products, which acted simultaneously as insulation to avoid heat dissipation (Curós, 2006).

The construction processes were simultaneously simple and effective, which offered an architecture without any pretension but with great functionality. The materials used were in its vicinity, stone and wood due to the reduced ability of means of transport at that time. Therefore the result was an architecture in a dialogue with the place, based on thick perimeter walls of stone and mortar with wooden structure (Curós, 1995, 1999).

It was common in the manorial *masies* to have in its facades or at least in the main ones a white painted plastering to protect the wall. It was also common to have arched galleries that gave a more important architectural aspect to the farm and used to match frontally with the access road. Most of them had been added during the eighteenth century to give more impetus on its facade which functionality was to prolong the interior rooms that led to them.

The main entrance of the house is often the one which is on the south side, which is also the most relevant one of the house (Curós, 2004).

Masia el Callís. Vall de Bianya. Gerona. Photograph: Joan Curós

The Barraca

The *barraca* is parallelepiped-plant construction next to the ½ proportion between the walls front and side, built with side walls of adobe and wood *pie-droits* on which a high-inclination vegetal cover stands. It forms a very oblique-dihedral angle with the ridge cap, which closes the upstream and downstream facades with non-load-bearing elements (Sanchís, 1999). It is a typical construction transformed after a strong process of idealization, the symbol of the house of the Huerta of Valencia.

The original forms of the shed floor were elliptical or slightly rounded up to become rectangular, which stabilizes the shape of the *barraca*. From this geometric configuration, the interior space maintains a full process of transformation that presents a few alternatives changing throughout history. The Barraca contains a side corridor that opens the doors to the upstream and downstream façade through which the various units that occupy the opposite side are connected (del Rey, 2010).

According to Max Thede, originally there was only one interior centralized space and centralized with a home. This interior space was later compartmentalized and the doors on the sides close to the plant were kept. Over time the main stay, which contained the home, is placed at the entrance, and the home is settled attached to one side of the plant.

Three constructive elements define the *barraca*: the right feet, the walls of enclosure, and the cover.

The most primitive walls include right feet of wood, called winds, which support the covering structure; the space was closed with hurdles covered with mud. Later walls are continuous and build with dried adobe and straw. A ridge beam rests on these walls and supports the structure of the covering. These walls have usually a considerable thickness, approximately 45 cm. They are placed by clay as mortar and the unions are revised with clay or mud. The perimetral wall is crowned with a chariot crossbeam that serves as support to the sloping and horizontal suspenders of the covering and the roof structure (del Rey, 2010).

The structure of the roof is formed by a beam ("biga solera") plus the aerial structure, which is made of some parts called "pares de lima" or tilted structure that constitutes the dihedral of cover. In addition there is also the beam ("biga-cumbrera") that unifies the whole, and the straps of assembly. The hurdle of the roof is made with canes tied to a rope and coated with gypsum mortar by both sides. It is covered with vegetation placed in sheaves with a thickness of 15 cm thick overlapping approximately 1.10 m with layers tied to the support of the perpendicular cane and ends with a layer of mud on the ridge. Subsequently the points are trimmed, are bundled and the sheaves are combed with forks of cane (Curós, 2004).

The front and back enclosure will be carried out with a partition of double reed subject to tilted straps and horizontal beam with perpendicular canes placed in its interior that is mixed with clay mud and with litter of approximately 12 cm (Gosálvez, 1998).

Barraca of Valencia. Photogrph: Joan Curós

The "possessió"

The *possessió* is an emblematic witness of the architecture and countryside of Mallorca (Valero, 2014).

The *possessió* concept, referring to large parcels of land for the cultivation and field work and organized around an architectural complex, is well known in the Majorcan culture since medieval times for its important relationship with, among others, territorial, economic and social aspects.

The fundamental characteristic of their origins were fortified structures because the first necessity of the new settlers was protection (Hernandez, 2014).

Many of them are far from the coast in order to prevent attacks and looting of piracy. They are often placed on a small hill or elevation, or on the slopes of the mountain, locations that were exploited to collect rain water coming from the top of the mountain. They would also be established at the boundary between the land suitable for cultivation and the forest environment (Garcia & Oliver, 1986). Some exceptions are on the coast though.

The possessió is an ensemble composed of the *cases delssenyors (*houses of the landlords*)*, *cases delsamos (*houses of the tenants*)*, rooms for the *missatgers* (messengers) and other laborers, gardens, mills, warehouses, barns, stables, pigsties and other agricultural outbuildings.

Throughout history they have been growing according to the needs of the farm. A common structure in *possessions* allows the enlargement of the building forming a central closed courtyard of the house known as *clastra* as a protection element.

In most cases, they are simple structures, of rectangular plant with one or two bays and variable height, between one and three floors. In its development, galleries and porches have been added throughout the nineteenth and early twentieth century.

The access to the estate is often perpendicular to the main facade and to the access of the dwelling. The well-known *portal forà* is the access to the courtyard, formed by a round arch or segmental arch with stone voussoirs which acquires an excellent role in the courtyard.

The courtyard is a distributor space, from which different parts of the architectural ensemble are organized. It eases also the access to the *casa dels senyors,*

the *casa dels amos*, the chapel or agricultural units, such as wine cellar to keep the mill to the production of oil or the barn or barns for storing grain and straw crops. The pavement of the courtyard is usually made of boulders, which are sometimes combined with slabs (Vibot, 2007).

The finish of the facades is in many of them a light color plaster, although there are also other ones with an exposed stone finish.

The social hierarchy in *possesió* is a characteristic feature of this type of assembly. It is common to have a main body, wider than the rest with a maximum of three floors. Downstairs, we can find the tenant's house (*casa de l'amo*), where the kitchen and the dining room would be located, along with other places dedicated to provide shelter to workers. There is also a noble floor, where the landlord would reside during his stay in the *possessió*. In the case there was a third floor, it was normally used as storage place or as residence for workers. Furthermore, it is common to allocate to the noble floor the second floor of the body that closes the entrance floor, leaving, on the first floor, space for a porch or lobby.

The chapel is a present element in many of the *possessions*. Its provision varies within the architectural ensembles but tends to be in one of the sides of the lobby of the *possessió* between the *portal forà* and the courtyard. In other situations it is located in the inner courtyard. It is a simple type of small rectangular plant covered with star-shaped vault.

The towers of the *possession* tend to be square, rectangular or circular. They can overcome in one or two heights to the rest of the ensemble, and are built in stone and very unified in the total constructed area. Currently many of them have become part of the inhabited areas (Vibot, 2007).

Actually, this castellated image was the sign of prestige of the new settlers. In fact, it was common in many cases that the battlements that crowned the old and new buildings were nothing more than a mere ornament (Hernandez, 2014).

The initial mud walls and the paralleling of masonry of horizontal courses were gradually replaced by irregular masonry.

In the initial stages, the cover used to be flat, especially in those houses where there was a difficulty in placing tiles in an orderly manner. Over time almost all covers were modified to one- or two-sided roofs.

Possessió Son Tèrmens. Mallorca. Photograph: Joan Curós

The Cortijo

The farmhouses are big farms and stockbreeders of hundreds of hectaresin Andalucía.

Their unlike location has driven to the existence of its variety. They can differ for being grain-producing or cattle-producing and simultaneously existing subtypes inside every type.

They are closed structures concerning a big courtyard, configured by the proper housing for the owner, buildings for storage like granaries or *siloes*, blocks for the animals, hayricks, etc. They project in its surroundings an open space with their corresponding accesses and cultivation.

It is common to find the farmhouses in high places, in the highest points of the hillocks to be able to dominate a big part of its grounds, and where there is more fresh breeze in summer evenings and produces a better stay; simultaneously this allowed to fan the grain pile. Nevertheless, many of them also appear in flatter areas. Another important aspect for its emplacement was the water supply.

There is noorientation that could be considered too disruptive, which gave some freedom in its establishment, but many of the *cortijos* stood facing east or south where the main facades of the houses stood, although there are several ones with opposite orientation. They look for the maximum of sunshine and light.

It always dominates in the *cortijos* a strong sense of horizontality: they are buildings of plain. Only occasionally are there a few block towers over others, increasing their relevance in the set. Usually it is the dwelling, but this does not distort the idea of horizontality (Florido, 1989).

The farmhouse is a dynamic, alive work, that has not been done with a preset plan but has been growing in different directions and organically as the needs were demanding and which has resulted in the configuration of the active set found today.

They are austere sets mainly with flat and smooth surfaces where elements like arches, balconies are rare. Also decorative simplicity is the norm and little more than a specific and very localized detail (a plaque, a tile with a picture, or the name of the farm) (Florido, 1989).

There are numerous windows, essential in a climate of high temperatures where the defence against heat is much more important than against the cold. This aspect entails that there is cross ventilation. In the outbuildings where ventilation is less important, the window size is smaller.

The portal of entrance to the courtyard is whether unbuilt or accessed through a dependency. On larger area farms there are several courtyards that have been formed through the evolution of the farm (Olmedo, 2010).

The kitchen is the main place in all the villages, located in an easily accessible place in the set, as the front body. It is the place where life is made, where people eat, cook and stay.

The forges and ironworks were common units in *cortijos* since they allowed to carry out an essential work for agriculture like the repair and forging of the tillage implements. Some of them contained also the processing area of oil and wine.

Talking about constructive systems, in reference to walls, where stone is scare, those have been performed for centuries in the sedimentary areas by kneading and rolling the ground with some lime to give them major consistency. To construct them, two vertical and parallel wooden planks where placed which, mostly in the load-bearing walls, had a considerable thickness (often even more than 50 cm). It was frequent as well that the walls were reinforced, whenever it was considered to be necessary but much especially in the granaries, whose walls had to support very high pressures.

The plaster of the walls was performed with plaster although nowadays the mortar is more frequently used. All the walls were impregnated with lime with a dazzling whiteness, only sometimes with a notice of yellowish ochre colour in the fronts or estates to give a decorative note. The white colour is due to the strong summer heat. The hollows of the facades are flat, slightly numerous, of limited size and have an irregular disposition provoked more by the needs that are generated from the interior of the building ventilation and lighting. There is a presence of arbours and verandas as intermediate spaces to live and work: (Olmedo, 2010).

The granaries are usually accommodated in buildings of two floors or in the first floor in order to prevent the moisture. To support the load and span distances, arcades and vaults were constructed on props in the ground floor, with wooden trusses in the deck and with a wooden structure on the rest of the slabs. The ground floor used to house livestock/cattle.

In the decks, due to the wood scarcity in the area, the use of charred log was frequent in a lot of dependences. The roof mainly gabled, with ridgepoles parallel to the facades, resting on the pairs, which are beams arranged towards the top axis every meter or meter and a half. There are roofs of one and four tails as well. There are also flat decks, sometimes made of soil, of brick or of mixes, although over time sloping decks were adopted. Every year the hut in the summer was tinked, assuming the roof had been very spoiled with the winter rains (Florido, 1989).

Even when risk is higher in fires rather than in rains, these were very frequent. Also strong winds were dangerous, as they completely dismantled the constructions.

From 1940 onwards, the replacing of the covers of half-burned logs began to take place and pine or chestnut wood appeared instead, sometimes also from eucalyptus or poplar and, less often, from olive tree or oak. It is coated then with Arabic tiles.

Courtyards used to be paved with pebbles.

Cortijo Nava. Huelva. Photograph: Joan Curós

2.2. Data Obtained

There is no census or inventory of rural buildings in Spain and therefore information extraction is different in each community.

2.2.1. Galicia

The most comprehensive document and where the maximum number of buildings is inventoried are the two publications issued by the Association of Architects of Galicia and the Galician government entitled *Pazos de Galicia. Análisis documentaly Pazos de Galicia*. Catalog: files. There is an inventory of a totalof 645 *pazos* of which 209 belong to the Coruña, 149 to Lugo 170 to Pontevedra and 117 to Ourense.

According to the Galician regional government there are 120,000 agriculture farms but this does not mean that each one contains a *pazo* and the same occurs for the 140,000 remaining livestock farms.

According to data provided by the Department of Tourism of the Galician Government there are 86 *pazos* engaged in rural tourism oragrotourism, 15 of which are locatedin La Coruña, 19 in Lugo, 27 in Orense and 25 in Pontevedra.

2.2.2. Basque Country

There is an approximate census provided by the Statistical Department of the Basque Country. According to it, there are 5,400 *caseríos*, 742 of them are dedicated to rural tourism and agrotourism; 371 of them are in the Basque Country, 86 in Álava, 117 in Bizkaia and 168 in Gipuzkoa.

2.2.3. Catalonia

There is a detailed account for municipalities called “Catálogos de Masías”, thought it is currently under development and it is performed in a 30% of the

total.

In the doctoral thesis of Joan Curós a selection of 1283 equivalent *masies*was made, approximately between 4% and 5% of which is about 30,000 masies.

According to 2014 data provided by the Department of Territory and Sustainability of the Generalitat de Catalunya, 2311 are devoted to rural tourism oragrotourism, 600 in the province of Barcelona, 784 in Gerona, 329 in Tarragona and 598 in Lérida.

The number of farms according to the Statistical Institute of Catalonia (Idescat) is 1646.

2.2.4. Valencia

According to the website of the Valencian Government there are 27 huts catalogued, of which 19 of them are dwellings, and of these eight are inhabited, 3 are to reform, 2 act as workshop house, 2 are in ruin and 1 is a restaurant.

2.2.5. Mallorca

In the island of Mallorca there is no census of *possessions* either and we have to refer to the publications on the subject.

There is a publication entitled *Les Balears* written by Archduke Lluís Salvador, which referred to several possessions, another publication entitled *Possessions de Mallorca*, by Miquel Segura, which contains a substantial record, its four volumes include 120 registered possessions. With a smaller record there is the publication *Les possessions de Mallorca,* by Tomàs Vibot, containing a total of 45 *possessions* in two volumes.

From the Department of Tourism of the Majorcan Government there is a census of 231 possessions engaged in rural tourism.

2.2.6. Andalucia

In this community a census of *cortijos* is being prepared at the moment. According to the Andalusian Autonomous Govermnent, it will be finished in a few months.

So far there are few publications with high rigour on the Andalusian rural heritage published by the Autonomous Government itself. There is a publication for each province except for Huelva and Jaen, which are under development.

The publications have the title *Cortijos, haciendas y lagares* and in each one there is a list of inventoried buildings which is the most comprehensive documentation existing so far.

In Almería there are 423 inventoried *cortijos*, 105 of which appear studied in the publication and from this sample it can be assessed that 42% have no use, 16% have agricultural and livestock purposes and 30% have a residential use.

According to the Registry of Tourism of the Junta de Andalucía in 2014 there were 49 *cortijos* dedicated to rural tourism.

In the province of Cádiz there are 857 inventoried *cortijos* and 338 are studied in the publication, 86% of which are engaged in farming and ranching, 4% inresidential and hotel use and 9% have no use.

24 of them are listed in the tourist registration of the Autonomous Government as they are engaged in rural tourism.

In Córdoba there are 1988 registered *cortijo*s of which 799 are studied in the two volumes containing this collection. Of these, 61% are devoted to farming, 15% to residual agricultural use and 9% to the use of accommodation. And according to the Andalusian Goverment there are 27 registered ones intended for use in rural tourism.

In the province of Granada 2685 *cortijos* are registered and 229 of these are analyzed in that publication. 48 *cortijos* are inscribed in Tourism and are dedicated to rural tourism.

In Huelva and Jaén there are no registers of *cortijos*. Regarding rural tourism, though, there are 5 of them in Huelva and 24 in Jaén.

In Málaga province there are 1264 *cortijos* registered and 136 of them are studied in the publication of the Government of Andalusia. From this sample, 71.1% are devoted to farming and ranching, 12.59% to residential, hotel, museum, and social headquarters use and 16.30% lack of use.

In the Government's record of tourism there are 60 *cortijos* engaged in rural tourism.

Finally in Seville there are 2092 registered *cortijos* and 351 of them are studied in the publication on *Cortijos, Haciendas y Lagares de Sevilla*. 56% of them are engaged in farming and ranching, 12% are devoted to non-farming activities, and activities related to hotel industry (accommodation, catering, events....) and the exclusive residential dedication, and 11% of them have no use.

According to the Andalusian Ministry of Tourism and Trade, there were in 2014a total of 13 *cortijos* dedicated to rural tourism.

3. Results

Many scientists are finding it difficult to come to grips with the new model of rural development that emerges slowly but persistently in both policy and practice. Nevertheless, we believe a paradigm shift is also taking place at the level of associated theory. The modernization paradigm that once dominated policy, practice and theory is being replaced by a new rural development paradigm (Van der Ploeg, Renting, Brunori, Knickel, Mannion, Marsden, de Roest, Sevilla-Guzmán, & Ventura, 2000).

Agriculture is one of the most potent and enduring emblems of rurality. For centuries, agriculture was in most rural regions not only the overwhelmingly dominant source of employment, but also the driving force of the rural economy and a pervasive influence in the organization of rural society and culture.

In Spain, more than eight out of ten rural people were dependent on agriculture in 1970; by 2000 it was less than one in three. There are, of course, individual villages and towns in which agriculture is still the major employer, but these are increasingly confined to the more remote rural regions and even within such places farming tends to be significant rather than dominant in the local labour market.

Many processes of rural restructuring involve a notion of modernization. Changes to farming practices, for example, were advanced under the banner of "agricultural modernization", which meant mechanization, specialization, larger farm units and the use of agri-chemicals and other technologies to maximize production (Woods, 2005).

The hectares of land retired under the European Union's set-aside scheme were 103.2 in 1988-92 875 in 1993-94 and 1610.6 in 2001-02, according to Ilbery and Bowler, 1998, European Union DGVI.

To assess the industrialization of agriculture, "industrialization" must be defined. The observed changes include increased labour productivity, purchased farm inputs and machines, crop specialization, land reorganization, huge irrigation works, international markets, complex output processing, and the appearance of large corporations.

Land and machinery investments are large-scale investments which must be amortized over long periods, making it difficult for farmers to respond to "market signals". This intensifies cycles of under- and over-production of particular commodities, which strongly affect profits and greatly increase investment risk.

Marx anticipated that these distinctions between agriculture and manufacture might disappear: they were moments in a historical process of uneven development of two sectors of necessary productive activity, under capitalism (Fitz-Simmons, 1986).

This state of affairs is increasingly unacceptable. Concentration in agricultural production, the overproduction of goods, the widening intervention of the state in agriculture, and the penetration of industrial and finance capitals into agriculture and the technological treadmill these create for producers, demand the further development of a political economy approach which relates specifically to capitalist agriculture (Marsden, Munton, Whatmore, & Little, 1986).

The regional disparities increased and tensions grew between farming on the one hand and landscape, nature, environment and product quality on the other (Roep, 2000).

Current modern housing systems are poorly designed when considering the behavioural and adaptive needs of animals. Systems are often simple in design and boring in its in appropriate use of materials (Pond, Bazer, & Rollin, 2012).

Within the framework of rural development new forms and mechanisms for co-ordination and conflict management must be developed. This will become increasingly important as new forms of farm-based rural development activities emerge and different actors compete for access to opportunities and resources in new arenas such as rural tourism and nature and landscape conservation.

Pluriactivity can no longer be seen as heralding the demise of the farm, rather it has become one of the new pillars supporting European farming.

In recent years a more holistic view of multifunctionality has emerged, which that places more emphasis on the interlink ages of the concept with rural development, culture, the consumption countryside, societal needs, agency-led patterns and processes of agricultural and rural change, as well as environmental issues (Wilson, 2007).

Certainly there are new societal demands for tourist experiences, quality products, and an environment with high natural value; the same demands represent new opportunities for farmers and other rural entrepreneurs. In many rural areas, there is a realignment of sector activities to strengthen the interrelatedness of activities. Agriculture can play a crucial role here, since the diversity of natural habitats and the scenic beauty of landscapes are closely related to the type and intensity of land use and provide a new resource base for the development of rural or Green tourism (Van der Ploeg, Renting, Brunori, Knickel, Mannion, Marsden, de Roest, Sevilla-Guzmán, & Ventura, 2000).

Selecting a specific set of non-traditional farm-based activities in tourism, the method she this set develops indicates how precise spatial targeting could assist the optimum location of activities from the point of view of archieving rural policy targets for economic activity and population levels (Midmore & Harrison, 1996).

Rural tourism is the one with most different forms depending on the territory. These include, for example, rural guesthouses of Valencia, the Balearic rural tourism farms and the País Vasco, the *masia* of Catalonia, the rural estates in Galicia and the Balearic Islands, and the manors and the *pazos* and villages of rural tourism in Galicia (Gil & Ribeiro, 2015).

Other policy issues relate to the environment of rural areas. To some extent these are linked to the grand question of trade liberalisation and how it affects rural economies: at least opportunistically, because they open up "green boxes". Extension of multi-sector economic modelling to include natural environmental systems has so far been explored inadequately. Equally, though, much of the current discussion of policy development is dominated by the difficulty of applying the principle of sustainability. By refocusing its capability for structural analysis, the multi-sector modelling approach has much to offer here (Midmore & Harrison, 1996).

Policy developments concerned with the environment and nature suggest an extension of the agricultural work on "nature-society relations" (Morris & Evans, 2004).

One such theme, which has only recently attracted the sustained gaze of rural researchers is the commodification of rural areas, where rural environments are being exploited to match the demands of contemporary consumption.

A "new age" of ecology, however, has begun in a slow, fledgling and uneven way, and it demands significant comparative analysis. The concepts are by no means exclusive to the sub-discipline. However, they represent central critical connections or bridgeheads through which such disciplines and theories could be progressed (Marsden, 2004).

Commodification includes profiting from new forms of organizing recreation, leisure and tourism, which can be sold in a more privatized "pay-as-you enter" type of rural environment. It includes the development of particular styles of living through special riches in the rural housing market (such as service class development). It even includes a reorganization of labour requirements, both to

service these other commodities, and indeed maintain the backdrop of a manicured rural landscape which is, the necessary context for those commodities (see Cloke & Goodwin, 1992).

4. Conclusion

Rural areas and the agricultural sector are currently subject to a number of changes (Van Huglenbroeck & Durand, 2003).

Capitalist modes of production have dominated the exploitation of rural resources in the modern era, but the conditions of operation of agrarian and resource capitalism have varied both temporally and geographically, framed by different political-economic regimes (Woods, 2010).

All this does not prevent the new rurality to be set in every time more diversified activities, and increasingly dependent on endogenous characteristics of each area, whether called rural tourism, natural resources, or processing of raw materials, not to mention that the attraction certain rural areas are beginning to exercise towards the implementation of certain industries linked to leisure.

Agriculture is no longer the main source of income of rural households and this role is taken by other sources such as services, rural industry or even construction. All these sectors are growing at the expense of agriculture (Garcia, 1998).

In fact, in some rural households there are a growing number of rents which are obtained from non-agricultural activities. At the same time, not all incomes generated by agriculture are perceived by agricultural households (García, 2011).

In data obtained for the accomplishment of this research provided by the respective regional governments of Spain, it is worth noting that there is no comprehensive record of them, notwithstanding there is some key data in which we can detect that the rural architecture dedicated to tourism is more relevant in the north of Spain than in the rest of the country. This leads at the same time to greater economic investment in rural heritage of the north to the adaptation and conversion of new uses in these buildings.

The number of active arable and livestock farming is by far much higher than in farms dedicated to tourism or reconversion for a use change. There is currently no record to deduce whether these exploitations have been industrialised since the existence of folk architecture or if many of them are newly created. Still both require a much higher economic investment than the one needed for the adaption to new uses of the building.

The main conclusion is that the agricultural innovation systems' perspective provides a comprehensive view on actors and factors that co-determinate innovation, and in this sense allows understanding the complexity of agricultural innovation (Darnhofer, Gibbon, & Dedieu, 2012).

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Structuring User Experience Design with Affective Concerns

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Abstract

Most current designs are aimed at achieving success in the market. The design industry is generally interested in creating designs that can connect with users. However, not all designs successfully connect with users or create valuable design experiences. Hence, scholars in the discipline of user experience are increasingly investigating user experience mechanisms including the roles of human needs, affective concerns, thoughts, and actions. Studies have revealed that different senses, such as the auditory and visual, are connections influencing design consumption experiences. Such experiences highly influenced user satisfaction with designs. This finding could invoke a shift in the current design trend, from a function-oriented to an experience-oriented approach. Studies have also demonstrated that affective concerns have become a promising aspect of design experience and enhanced the influence of experience on an individual's memory. Hence, affective concerns are crucial factors in the perception of design experience. Studies on design and affective concerns have investigated techniques for intentionally eliciting the affective concerns of users through designed solutions. Thus, the current study aimed to investigate the relationships between affective changes and design outcomes and developed tools for supporting designers in introducing affective concerns in design. In addition, a critical literature review was undertaken to investigate the state of the art in user experience and analyze, compare, and enhance existing knowledge. The investigation revealed the understanding of the affective changes which is one of the important factors to influence the perception of design experience. This understanding is an essential criterion of shaping the design experience for users. Hence, a set of guideline was proposed for generating user experience with affective concerns. It is a tool for designer to shape the design experience with affective concerns of users.

Keywords

User Experience Design, Affective Concerns, Designers

1. Introduction

Research has investigated methods for creating designs that can connect with consumers (Arhippainen & Tahti, 2003; McCarthy & Wright, 2004). Current methods for achieving such connections involve combining aesthetic, instrumental, and symbolic functions. Nevertheless, such methods generally focus on the function of design in design consumption, thus constituting the main development direction of the design industry (Fogg, 2002; Hassenzahl, 2006; Mahlke & Thuring, 2007; Hekkert & Schifferstein, 2008; Kelly, 2009). Moreover, investigating experience design by focusing solely on design functions is not sufficient. Most designers manipulate the design process from this functional perspective; thus, they neglect aspects such as consumer experience, consequently limiting the opportunities to provide additional design solutions and satisfy users' needs. According to a previous study, consumers received greater satisfaction from the overall design experience than from the functions of design outcomes. This finding inspired scholars to further explore user experience and strategies for designing solutions for users. Studies on design and emotion have suggested that the mechanisms of user experience include the roles of human needs, affective concerns, thoughts, and actions. Different senses, such as auditory and visual experiences, influenced users' experience in design consumption. However, studies investigating techniques for introducing affective concerns into experience design are limited. This study explored how the interactions between users and design outcomes and their enhancement effect on design experiences. Thus, this study investigated methods for optimizing experience design through affective concerns. A new framework of user experience is proposed herein, according to a literature review. This framework illustrates the interactions between users and designers. According to the concept of this framework, the role of affective concerns in experience was examined in an empirical study. Users were recruited to rank the affective concerns they experienced, and the stimulation of their affective concerns by design outcomes was investigated. A design tool was proposed as a reference for eliciting experiences. This tool helped designers to generate experience with affective concerns as they intended. The results are expected to provide a guideline for enriching user experience with affective concerns and inspiring further exploration in design studies.

2. Human-Design Interactions in Experience Design

Experience refers to users' or audiences' perception of interactions with people, devices, and events. Clicking on an interesting image online and ordering an item through an app on a mobile phone is two of the numerous formats of interactions. Scholars have investigated the principles of human-design interactions. Nielsen (1994) focused on the interactions among users and tasks; the study evaluated the number of users in design consumption and the quantity of human-design interaction tasks required for creating the most enjoyable experience for users. In Green (2008), a set of empirical measurements was developed for testing users' satisfaction with an interface; the study established quan-

titative usability specifications such as the number of users using a human-interactive system, the times they had used the system, and the number of errors made during design consumption.

Green (2008) investigated the principle of iterative design. After determining the users and tasks and applying a set of empirical measurements, the experience designer performed the following steps of iterative design: design the user interface; test the design; analyze the results; and finally, repeat all steps until a sensible, user-friendly experience is realized (Green, 2008). Some interactions do not require immediate actions, but instead stimulate audiences' affective concerns. On the basis of the provided insights into experience design, the concept of experience design can be described as follows:

- It is an interaction that is coordinated.
- It is a controlled interaction that reflects the expectation of designers.

A successful experience designer should know their audience or users adequately. In other words, an experience should not focus solely on the implications of usability, visual elements, and physical forms. Experience designers are expected to orchestrate an interactive experience with affective concerns both with and without physical responses.

3. Role of Affective Concerns in Experience

Understanding the role of affective concerns in experience is necessary before investigating techniques for introducing affective concerns into experience design. Freud (1937) studied the process of thinking from a psychological perspective. The study revealed the involvement of various types of memory in thinking, namely working memory and long-term memory. Moreover, the study discovered that working memory, which processes information, interacted with long-term memory, which comprises different categories such as individual experience, value and missions, learned knowledge, and skills; the combined memory is recalled and serves as a reference in decision-making. Together, the working and long-term memory guide an individual's judgments, responses, and actions (Craik & Lockhart, 1972; Longueville, Le Cardinal, Bocquet, & Daneau, 2003). After an event, individuals use their intrinsic affective concerns and goal relevance to evaluate the event and its outcomes (Scherer, 1997). This process is the primary appraisal stage and initiates the attribution of individuals' responses, which later affect their ability to control their responses. An individual's cultural expectations or norms are involved in the primary appraisal stage. In judgment appraisal, however, designers incorporate their personal affective concerns into the decision-making process, thereby influencing their decision-making abilities (Bandler, Grinder, Stair, & Bateson, 2005). Examined the structure of experience; the study proposed that "selection", "distortion", and "generalization" are the "three universals of human modeling", which are adopted by individuals for coding and encoding their understanding of experiences. Selection was defined as the filtering of the elements of an experience, distortion is the process of finding areas of emphasis for long-term memory, and generalization is the

process that shapes the beliefs of the individual. These steps constitute the foundation for applying affective concerns in experience.

4. Affective Concern Stimulations Shaping Experience through Visual and Auditory Stimuli

A clear understanding of the relationships between affective concerns, cognition, and motivation is required before exploring the effect of affective concerns on visual communication. Some scholars exploring affective concerns have adopted the psycho-evolutionary concept that affective concerns are evolving evaluative patterns that enable an individual to respond to the external environment quickly and effectively (Nielsen, 1994). Rosenberg (1998) further developed this theory and proposed that a response to affective concerns could be considered as the prior process of judgement and actions. This process could prompt an individual to perceive and categorize critical information from the external environment or events. The process was denoted as an "appraisal process."Moreover, this process is reflected inherently and is based on cognition; it features understanding, interacting with the surrounding environment, and shaping perceptions (Gratch & Marsella, 2005). Faiola and Matei (2005) also investigated how the dynamics of affective concerns influence an individual's responses on a web-based platform; in the study, a web-based platform was developed by designers of various cultural backgrounds. The research team asked the participants to express their preferences for web-based platforms according to their own bias and affective concerns. When the participants viewed the web-based platforms, their bias and affective concerns engendered 70 types of complex appraisal processes and subjective evaluations (Faiola & Matei, 2005). The study determined that affective concerns were inextricably linked with users' appraisal of web-based platforms and aesthetic elements in the visual communication they displayed. When the role of affective concerns in the motivation process is understood, the corresponding theories can serve as a reference for further exploring the function of affective concerns in visual communication and their roles in the enhancement of user experience.

Some studies have further investigated how stimulating users' aesthetic experience (*i.e.*, aesthetic elements) elicits users' response through visual communication. Scholars have suggested that some aesthetic elements were applicable for evoking individuals' affective concerns, and that such concerns were changed when they were processing information. Some elements have been identified in studies conducted in the past 10 years. A study on the functioning of aesthetics and preferences in web-based media determined that the arrangement of the design elements influenced the participants' perceptions of the web page design; these perceptions were based on several criteria such as "legibility" and "comprehension" (Schenkman & Jonsson, 2000). According to the findings of this study, the design integrating pictures and aesthetics garnered a strong preference among users, suggesting that the users' preference for the design elements was influenced by their impression of the "beauty of the pictures (design element)".

However, the study did not further investigate the effect of specific design elements on affective concern (Gobé, 2001). This effect was first explored by a study on color (Gobé, 2001): Gobé proposed that color served as the element of aesthetics that stimulated aesthetic responses through influencing the neurons in the brain.

Therefore, color schemes that consider an individual's response to particular colors can stimulate specific moods, as discovered by Zettl (1990); the study further explored the influence of color on audiences and determined that the parameters of a color (e.g., from coolness to warmth) could affect mood. In addition to color, studies have investigated the impact of other design elements on users' or audiences' affective concerns. Typefaces have been considered one of the major contributors to aesthetic appeals that influenced affective concerns, as noted in user feedback (Zettl, 1990; Watzman, 2003). On the basis of this feedback, Watzman (2003) created a bold and assertive typographic design. It elicited recognizable responses from the users. In their visual communication design, some design scholars have applied the concept that affective concerns influence response (McCartney & McCartney, 2014; Lockner & Bonnardel, 2014). Explored the coding of visual and audio elements in individual learning processes. The studies found that during an experience, users remember the visual and auditory elements they have received. In some situations, the visual and auditory elements may initiate an internal dialogue, through which the individual learns the experience and converts it to long-term memory. These elements would then be adopted as the standard elements and are coded when the individual starts to communicate with others. The message receiver (another individual) recognizes the constructed visual and auditory material through kinesthetic encoding. This process prompts users to engage in interpretation processes.

5. Model Explaining How Affective Concern Stimulations Shape Experience

On the basis of the preceding descriptions regarding the relationship between affective concerns and experience design, **Figure 1** illustrates a model explaining the mechanism through which affective concern stimulations shape experience.

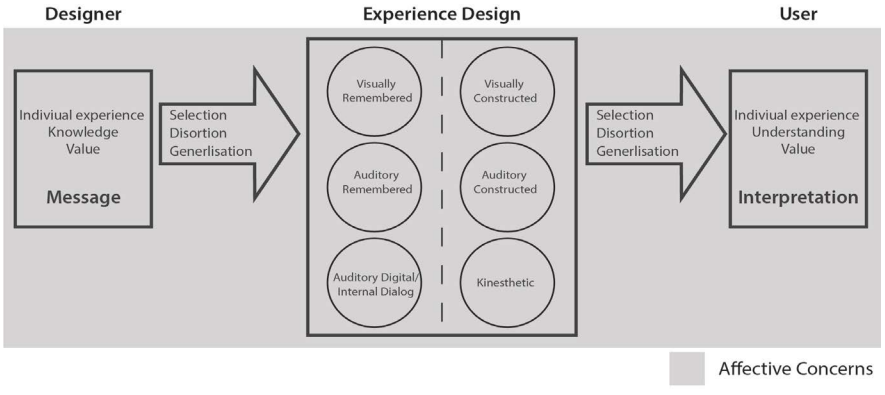

Figure 1. Model explaining how affective concern stimulations shape experience.

Designers present a message based on their individual experience, knowledge, and value. Selection, distortion, and generalization a reapplied to reconstruct the elements from their long-term memory. Subsequently, they engage in the process of coding the visually remembered, auditory-remembered, and internal dialogues. When users consume the experience design, they obtain the constructed visual, auditory, and kinesthetic elements. Through the selection, distortion, and generalization aspects of the encoding process, the users' interpretations are generated.

6. Guidelines for Generating User Experience with Affective Concern Stimulations

On the basis of the literature review and the proposed model, guidelines for generating user experience with affective concerns are proposed:

- Define the main affective concern related to the experience to be shaped for users.
- Determine whether users have had any similar experience with this affective concern.
- Determine whether users have had any visual memory related to this affective concern.
- Determine whether users have had any auditory memory related to this affective concern.
- Determine whether any of the internal dialogues generated by the visual and auditory memories are related to this affective concern.

7. Guidelines for Generating User Experience with Affective Concerns

7.1. Aim and Methodology

To examine the accuracy of the proposed model and the effectiveness of the proposed guidelines, this study conducted a set of field observations and interviews with designers and users. The field observation was a structured observation. The participants were designers that were randomly invited from the Hong Kong design industry, all of whom had less than 1 year of working experience. They were divided into two teams and then assigned a design task.

A total of 100 local Hong Kong participants were invited to participate in this stage of the study. Each of the participants was asked to collect 50 samples of print material that they considered representative of experience design.

To understand how citizens identify the features of experience design, gaining input from a wide spectrum of citizens was crucial; consequently, the generalization of research participation was essential. Therefore, participants with different educational backgrounds and ages were recruited. The profile of the participants (**Figure 2**) is outlined as follows:

- Twenty of the participants were undergraduate design students.
- Twenty of the participants were randomly recruited members of the working class, aged between 30 and 40 years.

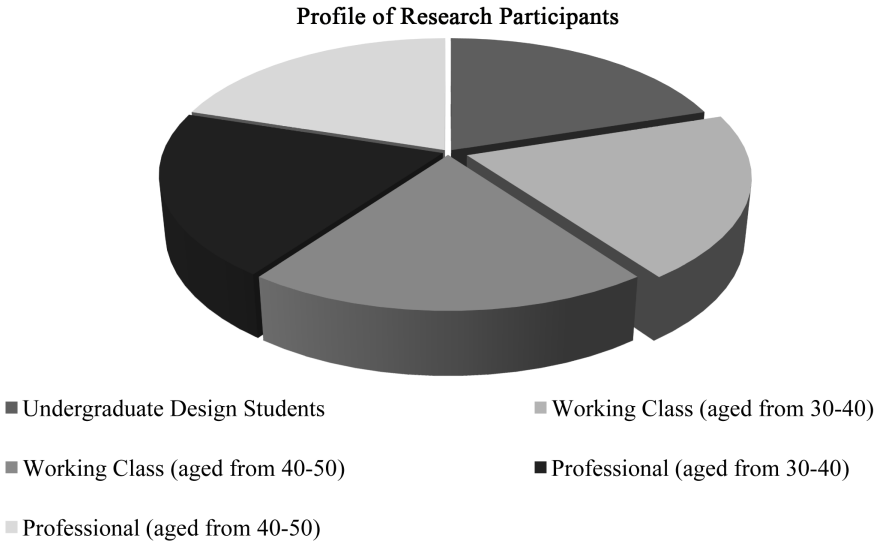

Figure 2. Background information on the recruited participants.

- Twenty of the participants were randomly recruited members of the working class, aged between 40 and 50 years.
- Twenty of the participants were randomly recruited professionals aged between 30 and 40 years.
- Twenty of the participants were randomly recruited professionals aged between 40 and 50 years.

7.2. Procedures

The study was conducted in two stages (Table 1). Stage 1 involved field observations, which examined the manipulation of the experience design process with and without the proposed guidelines for introducing affective concerns. The field observations assessed 30 designers and 100 users through a video-recorded interview. The 30 designers were separated into two groups: Design Team A and Design Team B. Design Team A followed the proposed guideline of introducing affective concerns (details of the guideline were mentioned above), whereas Design Team B did not.

Users assessed the experience design produced, and their assessments were recorded. Subsequently, the users' feedback was analyzed to determine whether the professionals' affective concerns were delivered effectively through the experience design. In Stage 1, some questions were posed to the designers during the design process to obtain their feedback:

1. What is the design objective for the project?
2. What do you expect the team to accomplish?
3. Approximately what percentage of the design objective has been accomplished?
4. On a scale of 1 - 100, how close is the final outcome to your initial expectations?

In Stage 2, users were asked the following questions regarding their experience, to assess the experience design outcomes:

Table 1. Research agenda.

Stage	Objective of the corresponding stage	Methodology
Stage 1: Field observation	To observe the manipulating of experience design process with/without the Guideline of introducing Affective Concerns	Design Team A -15 designers worked with the guideline of introducing Affective Concerns Design Team B -15 designers worked without the guideline of introducing Affective Concerns
Stage 2: The assessment of experience design outcomes	To discover whether the participated designers' affective concerns were delivered effectively through the experience design.	-100 users evaluated experience design -compared the scores and feedbacks from the users on the two different design teams

1. Do you know the design objective for the project?
2. What did you expect the design to accomplish?
3. Approximately what percentage of the design objective has been accomplished?
4. On a scale of 1 - 100, how close is the final outcome to your initial expectations?

7.3. Results

The 100 recruited users consumed the 30experience design outcomes and provided a score for each (100 marks as the highest and 1 mark as the lowest). The average score for the experience designs under the guidelines of introducing affective concerns (Team A) was 86 marks, while the average score for the experience designs not under the guidelines of introducing affective concerns (Team B) was 53 marks. The feedback provided by the users can be highlighted as follows. The users indicated that the human-centered solutions, which were generated under the affective concern guidelines, were much more enjoyable, because the presentations of visual and audio elements were considerably more effective in satisfying their needs. In addition, the field observation on the design process of the design teams revealed that Team A, which adopted the guidelines for introducing affective concerns, was much more effective in generating creative experience designs than was Team B (Tables 2-4).

7.4. Discussion

According to the participants' feedback, designers and users connected through the design experience. The affective concerns were operated and elicited by the perceived meaning of the designers and users in that specific time juncture. The participants described their experience according to the affective process presented in the literature. Their feedback provided evidence for corroborating the concept that individuals develop emotional experience as an integral element for configuring a situation in design experience. Individuals respond to affective

Table 2. Percentage of matchingdesigner and user evaluations on the experience design.

The percentage of matching designer and users' evaluations on the experience design	Design outcomes from Team A (Generated under the guideline of introducing Affective Concerns)	Design outcomes from Team B (Generated without guideline of introducing Affective Concerns)
Average scores	88	56

Table 3. Percentage of the design objective accomplished.

The percentage of the design objective accomplished	Design outcomes from Team A (Generated under the guideline of introducing Affective Concerns)	Design outcomes from Team B (Generated without guideline of introducing Affective Concerns)
Average scores	86	53

Table 4. Users' evaluations ofthe final outcome againsttheir initial expectations.

Users' evaluations on the final outcome to the initial expectations	Design outcomes from Team A (Generated under the guideline of introducing Affective Concerns)	Design outcomes from Team B (Generated without guideline of introducing Affective Concerns)
Average scores	78	46

concerns that arise as they step into a situation. The individuals' feedback toward the emotions constitutes the affective elements, which drive their judgment and reactions during the design experience. The individuals subsequently categorize the affective experience, and this triggers further affective operation, thus shaping their long-term memory (based on the original experience). Comparing the proposed model and the participants' feedback revealed that both had similar flows, from pre-encounter "givens" to encounter, then to evaluations and further responses, in turn shaping the givens of subsequent encounters. Hence, the participants' feedback revealed the effectiveness and accuracy of the proposed model, as well as the effectiveness of the proposed guidelines.

8. Conclusion

Most current designs are aimed at achieving success in the market. However, the design industry is generally interested in creating designs that can connect with users. Hence, studies have investigated the experience of design consumption according to users' memory-based perceptions of the design. Specifically, the perception of the design is the key factor for creating connections and bonding. Nevertheless, not all designs could successfully connect with users and consequently create a valuable design experience. Therefore, researchers in the discipline of user experience have proposed that design connection could be generated through human-design interactions. Additional investigations have been conducted on user experience mechanisms including the roles of human needs, affective concerns, thoughts, and actions. Different senses such as audio and visual influence users' experience during design consumption. Such experiences generally influence users' satisfaction with the designs. This could thus provide an alternative to the existing design methods, which focus on satisfying design func-

tions and often ignore the resulting user experience. Therefore, a shift in design focus, from function to experience, has been proposed. Studies have revealed that at the heart of experience, affective concerns have become a promising aspect and enhanced the influence of experience on an individual's memory. Consequently, affective concerns are a critical factor of experience perception. In this study, design and affective concerns were investigated to determine how designed solutions could intentionally elicit the affective concerns of users. A critical literature review was also undertaken to understand the state-of-the-art strategies in user experience design and to analyze, compare, and enhance existing knowledge. A set of guidelines for generating user experience with affective concerns was proposed.

Rather than designing to generate attractive outcomes, the focus was placed on providing proper design solutions for satisfying users' needs, further contributing to experience shaping. Designers are facing more difficulties than before. This study is the first to consider and apply affective concerns in experience design. The findings contribute primarily to developing affective concerns as the leading element in experience design. The proposed model was the preliminary concept to illustrate how affective concerns influence the users' responses. Further exploration on how affective concerns actually influence the users' decision making and responses with their physical expressions during the design experience in experience design field is needed. Also, as most of the participants in this study were Asian, it was limited to generalise the research result of this study to the worldwide users under the potential influence of cultural differences. Here is a need to conduct further investigation among the worldwide users about their affective concerns during their consumption in experience design.

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Eye Space: An Analytical Framework for the Screen-Mediated Relationship in Video Games

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Abstract

This article explores the connections between players and game worlds through the screen-mediated space in games—i.e., eye space. Eye space is the crucial link between players and the game world; it's the decisive area where the gameplay takes place. However, the concept of eye space is not attention to and is frequently confused with game space because the two are closely connected and sometimes they can even interchange with each other. Thus, the study focuses on the basic building blocks and the structure of eye space in games. An analytical framework based on the existing literature and practice is proposed with special attention on the interactive nature of video games in order to examine the interplay between players and game spaces. The framework encompasses three aspects: the visual elements within the eye space, the relation of eye space to the players, and the interaction of eye space with the game space. This study aims to establish a common language to describe the screen-mediated space in games and provide further insight into game design.

Keywords

Video Games, Eye Space, Gameplay, Game Design, Game Space

1. Introduction

"Video game worlds are navigable spaces that offer a full range of interactions, but they are also spaces told to us using certain forms of presentation." (Nitsche, 2008) In other words, video game worlds are confined to a screen space, monitor, or even augmented reality (AR) glasses; through the screen-mediated spaces, they begin to emerge and communicate with players. Therefore, certain cameras have to be set in game spaces, and certain selections have to be made by game designers. The complexity, richness, and quality of the virtual game world—infused with a viewpoint through design and framing—build connections between players and the game world. Generally, the viewpoint comes from a virtual cam-

era, or, as Manovich (2001) states, "an arbitrary point of view—a picture of a virtual world recorded by a virtual camera." Despite early or two-dimensional (2D) games, it is not necessary to use any kind of virtual camera or even have the concept of a camera. Game designers still need to scheme all gameplay components for the presentation of the visual screen in order to communicate with players. When eye space has been sketched out, players can experience its perception, and the connections between players and game worlds can be built. This is an indispensable process of game design as well as an underdeveloped research area.

The term "eye space" is employed in this article for the more active participatory nature of games as well as to distinguish from the cinematic "on- and off-screen space" as well as "camera space", which generally indicates the virtual camera systems in games. The notion of eye space has often been mentioned in discussions related to game space and user interface, but it has rarely been looked at closely, nor does eye space have a common language and understanding. Game space is manifold, from basic rule-based systems to fictional narratives and all the way to the real social sphere. Wolf (2001) has examined screen-based game space and set different representations and particularities into relation. "However, in an attempt to formulate a spatial taxonomy, Wolf mixes qualities of game spaces such as depth of space and point of view or traversability/navigation and representation of space." (Walz, 2010) That is, the concepts of eye space and game space are frequently confused with each other because they are tightly connected. Eye space is the graphical entrance for game players. In a broad sense, eye space is a part of user interface, which is the central component of any video game, and "mediates between the core mechanics of the game and the player" (Adams, 2009). Nitsche (2008) identifies five analytical planes for the analysis of game space: rule-based space, mediated space, fictional space, play space and social space. Eye space mostly resembles mediated space, which is defined by the presentation; nonetheless, at the same time, it stretches out to rule-based and play spaces, which are not merely visual. In other words, eye space defines not only the appearance of game space but also the ways in which players engage during gameplay. As Wood (2012) stated: "While cameras do not affect the action, when associated with the moving viewpoint of an avatar, the camera defines both the space of the game and the way in which the viewer is embedded in that game. The camera is more than an element through which a gamer enters into the game world, it mediates as the input of the gamer is translated into the reconfigurations of space."

To this end, the theoretical concern of this research is to delve into eye space as the vital linkage between players and game spaces as shown in **Figure 1**. The analytical perspective of screen-mediated eye space is addressed in three aspects. First, we extend the concept of photographic composition as the building blocks of design elements inside eye space and discuss their functionalities, visual purposes and effects on gameplay. Second, eye space must be derived from a distinct standpoint that significantly affects the degree of identification and gameplay

Figure 1. The analytical framework of Eye Space.

experience of players. Flynn (2004) argues that the discussions of spatiality in video games need to be taken into account, for "the participatory and embodied positions of the player". Therefore, it is necessary to describe the different presentations of eye space regarding the players' locus of manipulation with more detail. Last, we address the interplay between eye space and game space—in terms of eye space as the interface of the game world—that not only open up players' participation, communication and experience, but also sculpt the appearance of game space. The research focuses on these three aspects within the scope of game design in order to establish a common language for eye space and attempts to construct an analytical framework.

2. Inside Eye Space

As an entertainment medium, a video game, "although rich with unique potential of its own, shares elements in common with other arts", (Rollings & Morris, 2003) namely, the idea of composition in visual communication design, which is the deliberate manipulation and arrangement of lines, shapes, colors, focus, tones, etc., in a work of art. Based on these visual ingredients, films add the element of time and use cameras to create unique visual grammar, the "invisible technique" (Ward, 2002), or the concept of mise-en-scène. According to Nitsche (2005), "framing, mise-en-scène and montage are part of the video game world". Additionally, Logas and Muller (2005) contend that "examining the ways mise-en-scène is used in films will help designers adapt a holistic approach to their own discipline and create deeper resonance with the player", except their main topic is about the effects of space composition on emotion and atmosphere in the horror genre.

In the meantime, scholars have pointed out that "digital games are fundamentally different to 'traditional' media forms due to their 'interactive' nature" (Gosling & Crawford, 2011). Because of their participatory nature, games become unique for offering players a rule-based combination of challenge, exploration, and reward mechanisms while being limited by the capacity of the screen, which is similar to the camera frames in films, but one has to allow more consideration for the practical purposes of gameplay. As Nitsche (2008) stated, "functionality refers to the interactive access and underlying rules determining what the player can do in the game space and what space can do to adjust that". Visual presentation in a game should always take the functional intent into account; "any concentration on either presentation or functionality but not both would destroy the holistic principle of spatial experience".

To this degree, while referencing the cinematography principles of visual composition, the placement of foreground, background, and mise-en-scène, functional design also brings eye space configuration into analysis. Four basic design components have been defined in this manner. The following discussion is devoted chiefly to the four specific design components of eye space and will be explained individually in terms of its representation, purpose, and mutual relations with players.

A. Primary Subject:

In the field of painting and photography, centers of interest are the theme of the image, the core of the composition, and the most interesting part for viewers. In eye space games, the primary subject is akin to the center of interest. It usually has noticeable features to grab players' eyes and attention and also provides necessary information for gameplay. Diverse primary subjects are used for different purposes within different game genres and goals, but they share the same goal: to maintain the flow of a game. In other words, most of the primary subjects can affect the winning and losing of a game. Games also rely on the concentration of players and directly reflect their input and manipulation on action controls. For example, Mario is the player-controlled character in Super Mario Bros. (1985) who constantly sticks around the middle of the screen as the prominent part of the image, whereas Pac-Man (1980) is also a player-controlled character—with bright yellow corresponding to the dark background—who rambles all over the place and collects points while avoiding ghosts. As these two examples imply, elements such as position and color can emphasize the primary subject within the frame, while immediate control and manipulation—the most familiar linkages between players and games—are the critical factors when deciding who the main subject is. There are exceptional cases, though, like the one in Pinball (1980), where players pay much more attention to the ball rather than the player-controlled flippers. It is worth it to mention that control and manipulation still have the most significance on the primary subject because player-controlled flippers impact the rebound angles and movements of the ball.

Mobility and player alternatives are also features of the primary subject, especially when there are more than one controllable objects, or potential primary subjects. Tetris (1984) is the obvious example, as players have to manipulate the randomly popping up tetriminos one by one with the aim of creating a horizontal line without gaps; every tetrimino becomes the primary subject for a time (from the time it appears until it reaches the ground). As another example, in Warcraft (1994), players are busy constructing architectures for defense while gathering resources, developing technologies, and commanding orders for troops. As shown in **Figure 2**, each time the player makes a selection, the unit currently selected is marked with a light green box, which immediately becomes the primary subject, and its details appear in the status panel; until the player selects a different unit and the primary subject shifts. A bunch of armies might be the selected unit; this shows that the primary subject could be multiple, or more than one object. As mentioned previously, different game genres and goals have an influence on the quality of the primary subject.

Figure 2. Screenshot from Warcraft (Blizzard, 1994).

A picture without a dominant center of interest, or one with more than one, is puzzling to a viewer; namely, a conspicuous theme is essential for painting and photography that clearly conveys the context and meaning. Nevertheless, it is creative and rule breaking, which is what a game design element can do. Some games deliberately bury the primary subject or place it somewhere that players have to try hard to find. When there is nothing particular on the screen to draw attention to it, the eyes wander throughout the screen space. Hidden object games use this strategy to challenge players to search screen after screen for the assigned items. First-person shooter games, at the other extreme, give players full power to decide where to perceive and which part to lay eyes on. In this situation, eye space itself becomes the primary subject and gives players a different way to interact and experience the game space in a way that also increases the difficulty of gameplay.

B. Distractions

To a large extent, distractions—the secondary subjects—are what players ought to pay attention to most of the time, except for the primary subject; this is a key factor for maintaining gameplay. Distractions can be various kinds of things, including barriers, enemies, exits, event trigger objects, or anything that matters to players and makes games more abundant in many aspect, such as providing challenges, selections, rewards, and fulfillment for players. Every now and then distractions might convert into primary subjects for a while when they occupy more space or players need to focus better. A boss battle is the classic reverse case. For instance, in the normal gameplay of the Raiden series, players control the fighter—who is the primary subject—to avoid bullets, get power-ups, collect medals, and shoot every enemy fly-in from everywhere on the screen. All of these things are distractions. However, when the boss battle begins, as shown in Figure 3, the scrolling screen now stops and presents as a duel scene, and the boss, who is usually huge compared to other enemies, becomes a primary subject along with the player-controlled fighter.

Figure 3. One of the boss mission in Raiden V (MOSS, 2016).

It is not necessary to directly link distractions, player control, and manipulation. In general, players cannot directly control distractions. In terms of game mechanics, distractions are not indispensable; they play different roles in different games and genres. While players may sometimes devote all their attention to distractions, others may dismiss them as trivial decorations. Yet, distractions have a degree of effect and interference in gameplay. For players, these things are meaningful, functional, and necessary for their immersion experience. In addition, the design and arrangement of distractions has to consider affordances, which "refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (Norman, 2002). Affordances may suggest strong clues with their appearances or other attributes to their operations. "An artifact's perceived affordances have the ability to improve players' progression through the game" (Bacher, 2008); that is, in the right context and with proper indication, distractions can be critical linkages that connect players with immersive gameplay.

C. Backdrop

Assuming that primary subjects and distractions are in the foreground (although they are not necessarily situated in the front of a scene), the backdrop constructs the background and environmental details, although it is not necessarily situated in the back. While backdrop seems to have nothing to do with gameplay other than merely acting as visual decoration, it in fact has a lot to do with it. The backdrop fills out the blanks and increases the authenticity of eye space so the primary subjects and distractions can be more persuasive. "The primary purpose of architecture is to control a person's experience." (Schell, 2008) This provides a consistent experience for the player as well as the ambiance of the game, which is "everything that contributes to the innate look and feel of the game" (Rollings & Morris, 2003). Take Silent Hill (1999) for example. Without the dark and narrow corridors, rusty and blood-stained walls, and disturbing and nasty bathrooms, it would not be successful because it would lack

the horror and suspense atmosphere. The backdrop can be perfectly helpful when establishing the game theme and storyline.

The abundant visual details of the backdrop create the ambiance and atmosphere of eye space and also provide a context for players to better immerse themselves in games, even though players do not have any power to change or intervene in the backdrop. On the contrary, the backdrop could have a say in gameplay due to the nature of the game design. Everything can be a part of an interactive trigger, from simple lines, such as the ones in Snake games that define the boundaries (**Figure 4**), to more complicated objects like stairs, trees, buildings, and water surfaces, which have their own functionalities aside from their appearances. Objects in games generally have one or more attributes, which are "categories of information about an object" (Schell, 2008). Take Excitebike (1984) for instance. The backdrop use distinct colors to separate audience bleachers, racing tracks, and the speed-lowering grass (**Figure 5**). Therefore, not only does the backdrop define the main space for gameplay, but it also affects gameplay on different aspects.

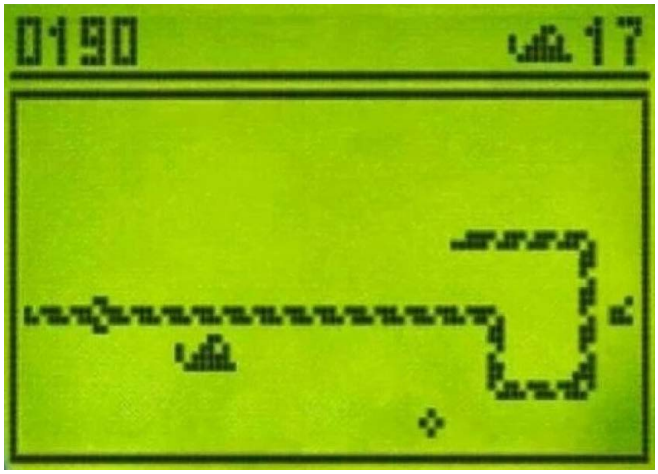

Figure 4. Snake (Nokia, 1998).

Figure 5. Excitebike (Nintendo, 1984).

D. Guiding information

Guiding information is the visual instructions and cues in eye space distributed to players; for example, the light green box in Warcraft, that marks the selected unit, the judgments in Dance Dance Revolution (1998) that rate players' timing when hitting the arrows, and the predicted trajectory path in the dotted lines in Angry Birds (2009). Generally speaking, it is part of the graphical user interface (GUI) and clear evidence of data visualization in games (Bowman, Elmqvist, & Jankun-Kelly, 2012), such as the status bar and the heads-up display commonly used in point of view games. This guiding information can be long term or short term depending on its type and purpose. Most of the heads-up displays are static onscreen, so they stay visible during gameplay. However, immediate messages and responses can give practical support to players most of the time. Besides, it is crucial to use the right technique to design the data that will be noticed but not interfere with the players. Fagerholt and Lorentzon (2009) introduced six categories for different types of user interface elements depending on how they linked to the narrative (diegesis) and game geometry (spatiality). These various on-screen displays are like layers on the game screen; they do not only inform players of their current progress and achievements, but also help create a more immersive game space.

These components are not fixed, but may vary and transition with each other in relation to the progress of gameplay. In addition, the components inside eye space define the basic architecture of the screen-mediated space and make sure the core mechanics are well designed and presented in the eye space; at the same time, they bridge the real and virtual worlds. Through eye space, players are able to communicate with the game space. However, there are two segments that can be further discussed that relate to the process that raises issues Behind eye space and beyond eye space, which implies eye space in relation to players as well as to game space.

3. Behind Eye Space: Players

Viewpoint derives from a particular line of sight and describes the position of the subject (the avatar) to the viewer, the player, and the vanishing point of space in games, merging "spectatorship and participation in ways that fundamentally change both activities" (Rehak, 2003). When serving as a narrative technique, viewpoint can be defined as the angle from which the story is seen and recounted; that is, the point of view of the narrator, such as first person, third-person limited and third-person omniscient. However, the game narrator and player are not necessarily the same person, nor do all games have stories. Therefore, traditional literary narrative forms need to have some modifications in order to answer the particular needs in games. Nitsche (2008) has discussed three types of player positioning in games; he argued, "players ['you'] are not directly projected into the fictional world of a video game space. Instead, they [you] get access to distinct elements (e.g., an avatar) within it and from that, a feeling of presence can emerge". That is, the eye space to which players are

guided in order to immerse themselves in games with their consciousness and identities will not be deprived but rather transferred into the game; it will become a distinct standpoint regarding the feature of the gameplay and background stories for which players may become engaged. Based on the above analyses, our research emphasis is placed on the locus of manipulation as well as visual representation. Symbolization of self is the fundamental purpose of viewpoint in games, as well as the representation of players and what they can take control of during gameplay. In other words, this section analyzes player participation regarding eye space at two levels as shown in **Figure 6**: the locus of manipulation and the ways of presentation.

Sherry Turkle pointed out that when a player plays a game, "you have to do more than identify with a character on the screen. You must act for it." (Turkle, 2005, first published in 1984) Likewise, Meldgaard (2008) holds that "the understanding of the role of perception in game space, must be viewed in correlation with the actions made possible". Thus, the notion of locus of manipulation arose, a description of "the in-game position of the player's ability to assert control over the game world" (Lankes, Mirlacher, Wagner, & Hochleitner, 2014). From this standpoint, many articles study player identification, functional representation, and game immersion in various degrees (Bayliss, 2007; Gazzard, 2013; Lankes et al., 2014; Linderoth, 2005). In contrast, eye space examines ways to present viewpoint perspectives and focuses on design metaphors; game space projects a certain controlling perspective that players take on in games with a dynamic nature of engagement and embodiment. Among the various manifestations of interactive modes for players, there are four possible solutions for design metaphors: protagonist, commander, invisible man, and observer.

The protagonist metaphor is one-to-one. A player takes on the role of one certain character at a time; the actions the player makes and its inputs are directly channeled through this particular character, such as Sonic in Sonic the Hedgehog (1991). A similar concept is the common trope of player-character, or when "players experience games through the exclusive intermediary of another—the avatar—the 'eyes', 'ears', and 'body' of which are components of a complex technological and psychological apparatus" (Rehak, 2003). Under this circumstance, the objective of eye space is to convey everything players need to

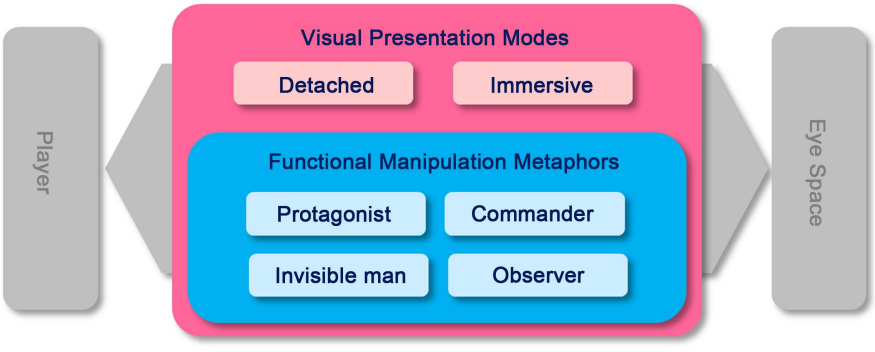

Figure 6. Two levels of the player participation structure behind eye space.

know about the role and character of which they are in control, including the actions they make, circumstances surrounded, basic status of the character, and even the character progression tree. Players tend to be more inclined toward the character they control; however, players do not necessarily identify themselves with the character or role they are assigned when considering the psychological variables and varying natures of the viewpoint. The distinct linkage can be made by a certain locus of manipulation that was precisely schemed by game designers. Humans or mechanics, living or nonliving things—the connections based on actual entities with intuitive operations and narratives often play a supportive role.

The commander metaphor is one-to-many; players take control of multiple entities. When preparing for the role the player must take on, the standpoint evolves into a higher level, and multitasking conditions ensue. For example, in Starcraft (1998), players serve as the ruler of a distinct race whose goal is to survive and conquer its enemies; thus, they have to train armies to fight against others and protect the terrain while upgrading their defense and developing technologies. Players cannot be confined by the concern of performing the right moves for a single character with the controller; they have to have a broad and comprehensive sight instead. This relates to the notion of God view: "Gameplay in these games is based on the concept that the player is a force that acts upon the world of the game, rather than a force within the game that then acts on the objects and actors of the game from within" (Taylor, 2002). The difference is that commander mode has a more clear and definite existence and authority; it prevails in construction and management simulation (CMS) (Adams, 2009) and eXplore, eXpand, eXploit, and eXterminate (4X) games (Emrich, 1993). The exertion of player control is not direct but more indirect because the target subjects are a number of individuals. As a result, instructs and orders need to be transformed and pointed to specific spheres or groups. Accordingly, these games always incorporate numerous and diverse visual representations in eye space, which can deliver a more immersive experience to the players.

The invisible man metaphor does not have a particular corresponding state. It is a rather vague and ambiguous force, such as the invisible hand in Lemmings (1991). Its common form of player-character is the cursor, "the minimal form of third-person avatars" (Klevjer, 2012). Players may not know what role they are taking on or have, any clues as to the context—it is an implied role as the Supreme Being. In some games, there is even "no avatar in the game space. Instead, the player represents him- or herself" (Brathwaite & Schreiber, 2008). Compared to the former modes, the lack of a clear identification has a more familiar and intimate manner of viewing. Moreover, the core game mechanics can be revealed more directly to players. In Tetris, for example, there are no clues regarding the positions of the players, only controllable blocks in space that plainly point out the methods designed for interaction in which players can be as engaged as other games. The invisible manners also leave greater room for players to have imaginations and develop feelings.

The observer metaphor is different from the formers; players mainly do not have actual control, but just watch. In this case, players have minimal gameplay; for example, interactive fiction games, cut scenes, and scoring screens. The interactions between players and games are mostly one-way or straight to the players as receivers. For instance, in Heavy Rain (2010) and The Walking Dead (2012), which are interactive fiction games, the gameplay is more like reading a graphic novel or watching a story unfold in front of players. The interactions consist of clicking and making decisions to keep the story moving forward.

These different metaphors of eye space coupled with the narratives construct the multiple identities for players that result in the unique charm of human-computer interaction in games; the connections between the two are inseparable. An equally important issue is how to describe these metaphors. The traditional first- and third-person point of views have now become ambiguous; popular games such as World of Warcraft (2004), Minecraft (2010), or Grand Theft Auto V (2013) all support players to willingly change between the two perspectives and even the viewing distance. As Thon (2009) noted, "many contemporary computer games allow their players an ever greater amount of control over the spatial perspective(s) used in the presentation of the game space." As a result, presentation of the viewpoint should roughly be redefined into two modes:

Immersive mode: Eye space creates a surrounding virtual environment where the player is immersed in the act of the gameplay experience. This can often be found in shooter games. Despite the first-person point of view that aligns to match the viewpoints between the character and the player, or the third-person point of view where the character can be seen in the viewpoint, the actions that players make can promptly respond onscreen with a great deal of virtual reality and visual impact. Apart from that, predefined narrative viewpoints, such as the one in Heavy Rain—which has many movie shooting and editing techniques, particularly cinematic montage—result in increased tension along with the storyline and audiovisual spectacle. Players can be visually enriched with a great and powerful sense of immersive gaming experiences.

Detached mode: This is a quite objective and plain view. Players take a relatively distant position to the subject and game space, so they can barely experience the impacts from the visual environment. However, more and better information is available to them. Game series like Civilization and Age of Empires are always presented this way in order to show broad fields and a lot of objects. On the other hand, for certain gameplay mechanics, keeping the visual fields as simple as possible is needed in order for players to focus on more important things; for example, the moves and actions in the Street Fighter series, or the obstacles and enemies in side-scrolling games such as Super Mario Bros.

4. Beyond Eye Space: Game Space

Eye space is a small part of game space that peeps into the game and shows a specific area of the whole game world. This is typically the case in most games,

apart from the earliest games and some specific game types such as puzzle games, in which the complete game space is condensed onto one single screen. In fact, eye space has become diverse with the ever-increasing technology innovations and complexities of game spaces. The most related topic is the term of the virtual camera in three-dimensional (3D) games, which is exactly the concrete representation of eye space. There are many studies on the technical improvements and automations of virtual camera systems concerning the convenience and accuracy of viewpoint manipulation in games, or bringing in the skills of cinematography from film productions for a more expressive composition (Burelli, 2013; Kneafsey, 2006; Lin, Shih, & Tsai, 2004). However, it is not always necessary for games to have a camera, especially in 2D games. Some of them use the techniques in 3D game engines, such as the camera projection in Unity that renders an isometric view. Other games apply multilayer parallax scrolling effects to create a sense of depth; for instance, ActRaiser (1990), Shovel Knight (2014), or Pole Position (1982), which is said to be the first realistic racing game with 3D graphics. In fact, the simple scaling road sprites give the illusion of 3D effects. Despite the approaches in 2D or 3D games, it can be said that there is a very clear difference between eye space and game space. Game space itself remains unchanged most of the time; what changes is the way it is framed in the eye space. Therefore, the way these two communicate is delicate and has a strong impact on player gameplay.

Generally speaking, in contrast to constant game space, eye space is fluid and reveals the game in a mobile way. As game mechanics grow various and game space becomes complicated, a single game space could contain one or more different forms of eye space but not be limited to one particular type. Besides, the varied forms can operate with each other in different situations to create a more flexible and immersive world. The focus here is on the underlying connections between game space and eye space, which has been divided into two aspects as shown in Figure 7: visual and interactive.

First of all, the visual relations between game space and eye space are primarily determined by the viewing angles and viewpoint fields, which can refer to the

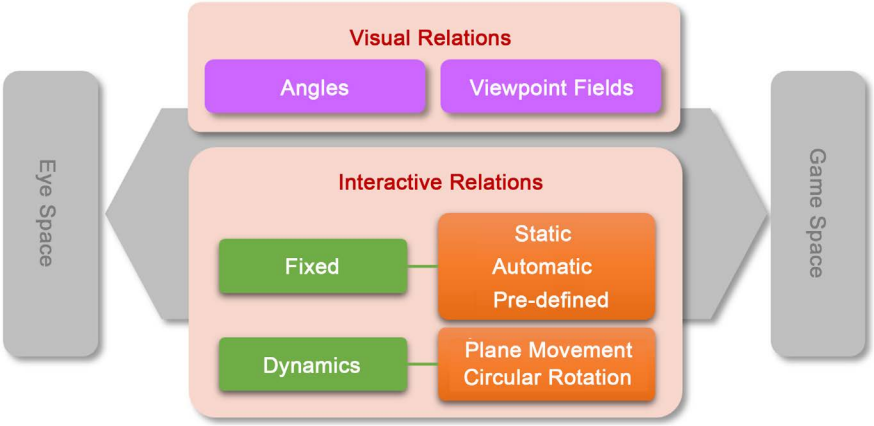

Figure 7. The structural relations beyond eye space.

concept of camera language in cinema. Different viewing angles can affect players' perceptions of space, perspectives, and senses. Choosing the most advantageous angle to show the important details is of great importance and is closely related to the game's genre. Normally, viewing angles can be divided into three types: high, eye level, and low angles. High angles are usually associated with the top-down genre of many strategy games, simulation games, and some role-playing games like Diablo (1996) and the Final Fantasy series. Looking down from a high angle can make the scene more dramatic and also give players a wider view; therefore, it can deliver more information on the surroundings in gameplay so players can make timely responses. High-angle shots, as a cinematic technique, tend to emphasize the smallness or insignificance of an object and imply a more powerful and predominant force behind the camera, which is similar to the positions of the players who hold the power and controller behind the screen.

Eye-level angle is the most common view that people are used to seeing in everyday life. With different game mechanics, genres, and gameplay, the need for a variety of visual presentations will arise. An eye-level angle creates a fairly neutral impact and dispassionate space so players can concentrate more on the actions they make in games. Hence, most action games, fighting games, and battle themes in role-playing games are presented at the eye-level angle. In famous game series, such as Street Fighter and Mortal Kombat, the need for space is simply a platform where game characters can have fair competition. Even though the technology of computer graphics is advancing rapidly toward more gorgeous and complex content, the eye-level angle displays an impartial view of the match and adequately shows the physical actions.

The low angle, which viewed from below the eye level of the subject, makes the subject appear dominant, impressive, or in charge. There is not much gameplay viewing from a low angle—only a few shots from narrative cut scenes, or when encountering giant enemies or getting into steep surroundings. These situations only take place when it is required to look upward at specific objects or events temporarily, not throughout the entire gameplay. From a visual psychology point of view, in the low-angle view, the primary subject is amplified for its details and importance while the relatively more important information about the surrounding circumstances are weakened. That is, there are more functional considerations regarding the actual gameplay design of the viewing angles.

On the other hand, viewpoint fields can be discussed in two aspects: the field of view and the depth of field. Each represents the breadth and focus range of eye space. In fact, nowadays players can alter the two values according to their habits or the hardware performance in most games. The field of view, or the extent of the observable area, determines what players can see in games; in other words, it defines the boundaries of eye space. Within this field, players communicate with the primary subject with reference to the information they can get as a result of the distance to the subjected conditions of the viewing area, which decides how much information the players can acquire. In addition, it has a close

correlation with viewing angles, especially the high-angle view. In the top-down style, strategy games usually have a wide field of view in order to observe a wide contact area so players can gain control over territories by thoroughly recognizing the circumstances they are in; accordingly, the visual details of each object may be reduced or simplified. Role-playing games, on the other hand, often display a closer perspective with a limited field of view. Players can only see the character and a certain area of the surroundings, yet physical actions and reactions can be made immediately for players when exploring in games with a more immersive approach. Therefore, the field of view has more to do with gameplay than graphics.

Regarding the depth of field, the view distance—in the same measure—determines how far into the distance players can see in games. Because depth perception is the visual ability of the human eye to perceive the 3D world, game design, likewise, attempts to represent 3D depth within the 2D plane in a variety of ways. Wolf (2008) has discussed the Z-axis development in video games from a historical viewpoint and mapped out several strategies. He asserts that creating a sense of depth will "fill the player's viewpoint with a larger and more detailed world of interconnected locations, encouraging involvement and giving players a virtual space to enter into where their attention is held and contained". Therefore, the depth of field in games richens the visual sense and provides depth clues for players during gameplay.

The interactive relations between game space and eye space should also be considered. Deciding which viewpoint to use and how to optimize it is a major topic. Viewpoint control is an essential part of the gameplay experience as well as the main issue between eye space and game space. In online gaming discussion forums, it is often found that players complain about problems caused by the in-game camera for reasons like it got stuck in the wall, the character disappears in the frame, the camera controls are too complicated, or it is causing dizziness and nausea. Those situations absolutely diminish the pleasure and interrupt the immersive playing experience. Attention, interaction, and comfort are the fundamental elements of an adaptive scrolling camera (Keren, 2015) and can be applied to the design of eye space as well. "Camera placement in games is usually directly controlled by the player or statically pre-defined by designers. Direct control of the camera by the player increases the complexity of the interaction and reduces the designer's control on game storytelling. A completely designer-driven camera releases the player from the burden of controlling the point of view, but might generate undesired camera behaviors." (Burelli, 2012) There are roughly two types of interactions between eye space and game space; game content and goals decide the suitable approaches with which to present the gameplay.

When reviewing articles related to viewpoint control, the more systematic discussions and organizations are mostly regarding computer graphics and concern virtual camera systems. For example, the four metaphors in viewpoint manipulation—eyeball in hand, world in hand, flying vehicle, and walking meta-

phor (Christie, Olivier, & Normand, 2008)—are based on the results of several studies (Ware & Osborne, 1990). Analysis regarding the game camera is mainly made by Nitsche (2008)—he identifies five dominant camera behaviors in 3D games that are used within gameplay: following camera, overhead view, first-person point of view, predefined viewing frames and free camera. Based on his results, Colistra (2013) added the 2D legacy side-scrolling camera. In this paper, a different approach is proposed based on eye space. We place more stress on the importance of the participatory player and lessen the emphasis on the virtual camera system or issues of dimensionality, hoping to meet the actual playing experience of players and fit the variety of games. The analysis has been divided into two forms: fixed eye space and dynamic eye space.

Fixed eye space is non-controllable for players. It comprises three types: static, automatic, and predefined. Static means the eye space is constant and the information players need to know can be presented within one single frame. It can be found mostly in the games' early stages or with rather simpler mechanics. Some games might not seem static because they have elements such as moving lines, changing shapes, or even shifting backgrounds; however, the eye space is still unchanged. Static eye space provides a less disturbing viewpoint. Automatic eye space is made with programming and uses scripts or compiled languages to automatically control the movement of eye space. A common example is the following viewpoint, which tracks the main subjects and players who do not have the direct power to manipulate it. Most of the time, they can indirectly change the viewpoint of their controllable main subject. As a result, this relies upon the efficient and robust program design. Static and following viewpoints "play a large role in establishing a focal point and visually separating regions" (Milam, El-Nasr, Moura, & Bartram, 2011). Predefined eye space is more concerned with the editing and presentation of the atmosphere from a functional aspect, such as changing different views not only for smooth gameplay but also for an expressive narrative.

On the other hand, dynamic eye space is adjustable and controllable for players, which means that players might have more involvement in the game space as well as predominance and freedom. At the same time, it might cause the focus to scatter, increase the complexity of control, cause more difficulty playing, and produce a longer gameplay adjustment time. To decrease the problems it might cause, some games implement supporting measures such as game tutorials, instruction pages, or the flexibility of customizing control settings. Dynamic viewpoint is dominated by two types: those that move along a single plane and those that rotate circularly around a central axis. The former allows players to pan and zoom in and out of the game space to observe certain areas or objects; it is better with broad space or numerous objects that cannot be displayed all at once. Visually, it is flat and distancing, as if looking through a microscope. The latter has a rotating center and is usually the main subject. The players can spin around to check their surroundings as though they are in the game space; the action of spinning the eye space is a way of creating a sense of perspective and immersion.

5. Conclusion and Future Work

In this article, an original analytical framework of eye space is proposed with special attention placed on the significant interrelationships between players and game worlds. As a part of the human-computer interaction in a broad sense, eye space is the place where players and games meet and interact. In a way, it presents core game mechanics, reveals various game spaces, and shapes the players' experiences. While level design can be defined as "the container for gameplay" (Byrne, 2005), eye space, likewise, is the threshold for gameplay. A well-designed eye space should bring out the richness of visual content and meet the needs for functional gameplay, and more importantly, specify the standpoint in games for players. The discussions and results in this paper could be extended to other studies and, hopefully, be applicable to game design and development. Two major routes may be followed in future works. The first is to demonstrate and verify the framework with practical case studies and further discussions on eye space. The second is to delve into the relationships between game genres and different design strategies of eye space on players' experiences for gameplay.

"Video games vary greatly in terms of their construction and presentation, and video games need to be analyzed on all levels so that a critical vocabulary and analytical method can be developed as a starting point for the exploration of video games." (Taylor, 2002) Eye space, in its nature, also has a wide range of forms with the ability to sculpt different appearances of a game, which makes the analysis very hard to perform. In this study, the most fundamental elements and general situations are considered for building the framework in order to apply it to most of the games. The three aspects of this framework are closely related to each other, and each aspect has its own different qualities and defining elements. However, in order to provide a visually fluent gaming experience, they all have to work in combination. With the progress of a variety of technologies and creativities, the game has been a continual renewing medium. AR—for example, recently emerging technology—generates a whole new level of composite eye space by combining the real and virtual worlds, which creates a very different player experience. Further research should be done to contribute to this area. The relationship between players and games is very delicate and contains many possible factors. What is the unique language of presenting a game, and how does it work to keep players immersed? This research seeks to take the first step in this direction.

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