An Exploration of Needs for Connotative Messages during Image Search Process

JungWon Yoon
School of Library and Information Science, University of South Florida, Tampa, FL 33620 jwyoon@lis.admin.unt.edu

This study aims to provide an understanding of the information seeking process for image documents by focusing on needs for connotative messages. For this purpose, this study attempted to investigate and compare three stages of the image search process in terms of use of image attributes. The three stages of the image search process are identified as initiation, representation and selection, and image attribute levels are defined as color, denotative, and connotative attributes. Data was collected from a survey questionnaire composed of Likert scales, open questionnaires, and Semantic Differential scales. The study found that while color, denotative, and connotative attributes were all considered important by users, color itself did not have critical impact during the representing and selecting stages. Denotative and connotative attributes were important across the overall search process and users employed diverse denotative and connotative terms for finding a satisfactory image under a given task. This study also demonstrated that affective attributes of an image can be represented with reduced dimensions using Semantic Differential scales, and that reduced dimensions can be used to indicate more meaningful and relevant images.

Introduction

A connotative meaning is an inherent and essential feature of an image. Although they have been performed in various disciplines and used different terminologies, studies of image attributes have identified the features of connotative meanings of an image (Panofsky, 1962; Barthes, 1964/1977; Shatford, 986; Markey, 1988; Krause, 1988). Some studies investigating image viewers' behaviors also have provided evidence that connotative meanings are significant in the perception and understanding of images (Keister, 1994; O'Connor, O'Connor & Abbas, 1999; Greisdorf & O'Connor, 2002). However, in spite of the significance of connotative meanings, current image retrieval systems provide limited support for connotative meanings. The text-based approach is limited by inconsistency and subjectivity in assigning connotative meanings (Markey, 1986), while the content-based approach had moderate success in representing denotative meanings but shows its limitations in indexing connotative meanings (Eakins & Graham, 1999). In addition, although understandings of the nature of user needs and behaviors should guide designing and developing image retrieval system, little is known about how needs for connotative messages are initiated, represented, and satisfied during the image search process.

Thus, this study aims to provide an understanding of the information seeking process with image documents by focusing on needs for connotative messages. With this purpose in mind, this study attempts to investigate and compare three stages of the image search process in terms of use of image attributes. Three levels of image attributes are defined as low-level, denotative, and connotative based on previous work (Eakins & Graham, 1999; Greisdorf & O'Connor, 2002). The three stages of the image search process are identified from the work of Nicholas (1996). He defined stages of information needs as information wants, information demands, and information use. Information wants are what the users would like to have, whereas information demands are the actual requests for the information wants. Information use is the stage where the users actually utilize information. Based on Nicholas'

stages, this study identified three stages as Initiation, Representation and Selection. Initiation refers to the stage where the users have some needs in mind before a search, whereas the representation stage is where users represent their needs through "search terms" which would be processed by an image retrieval system (or an image search engine). At the selection stage, the users select an image from a set of images returned by the image retrieval system in order to fulfill their initial needs.

Three research questions explore the characteristics of needs for connotative messages during image search behavior:

1. Which image attributes are considered important for connotative needs before starting a search?
2. Which image attributes are frequently used as queries for representing the connotative needs for images? What are the differences in usage of image attributes between the initiation stage and the representation stage?
3. Which image attributes are significant in the selection of images? What are the differences in usage of image attributes between the initiation stage and the selection stage?

   These three research questions were explored using survey questionnaires composed of closed questions with responses on Likert scales and open questionnaires asking users to provide verbal descriptions. Although verbal descriptions are a traditional and convenient way to explore user needs, words have some limitations in describing images (O'Connor, O'Connor & Abbas, 1999). Specifically, the affective attribute, an important portion of the connotative attribute, is difficult to articulate with verbal descriptions. Thus, this study adopted the Semantic Differential method in order to complement the limitations of word-based analysis. The fourth research question is designed to examine the functions of the affective attribute during the image search process.

4. How does the affective attribute function at the initial stage and the selection stage?

Connotative Messages of an Image

There are inherent differences in the way messages are conveyed in image documents and text documents (Shatford-Layne, 1994). Therefore, in order to reflect essential and unique features of image documents in their representation in retrieval systems, it would be a worthwhile endeavor to examine the nature of meanings contained in an image. Panofsky (1962), an art historian, suggested three levels of messages of an art image, Pre-Iconography, Iconography, and Iconology, and subdivided the pre-iconographical level into factual and expressional. Panofsky explained that at the pre-iconographical level, a viewer links visible forms to their corresponding objects, events, and expressional quality based on "everyday familiarity". The iconographical meanings are acquired through conventional and cultural knowledge as well as the prior identification of the pre-iconographical meaning. For example, recognizing an image of a mother holding a baby is the pre-iconographical (factual) level, and sensing the love is a pre-iconographical (expressional) level because this impression can be acquired by everyday familiarity and not by specific knowledge. However, to identify the baby and mother as baby Christ and Mary and to link them to the concept of God's love requires western conventional and cultural knowledge. Thus, it corresponds to the iconographical meaning of an image. The third level meaning, iconological meaning, is generated by a synthesis of the multiple backgrounds of a nation, a period, a class and a religious or philosophical attitude. That is, if the image of baby Christ and Mary gives additional messages or meanings to viewers having specific periodical or national background, those specific meanings correspond to the iconological meaning.

Panofsky's discussion of the meanings of art images has provided a theoretical foundation underlying subject analysis of images (Choi & Rasmussen, 2003). Shatford (1986) investigated image attributes by applying concepts of *Ofness* and *Aboutness* to Panofsky's pre-iconography and iconography levels in order to suggest the theoretical basis for subject analysis of an image. The iconological level was excluded from her image attribute analysis,

because she thought that the meaning of iconological level cannot be indexed with any degree of consistency. She explained that the Of aspect covers the generic description of objects and events at the pre-iconographical level and specific appellations of those objects and events at the iconographical level. The About aspect is the mood of an image at the pre-iconographical level, and includes mythical, abstract, symbolic concepts at the iconographical level.

Meanings of an image also have been explored from a semiotics perspective. Considering an image as a type of sign, Roland Barthes analyzed the messages contained in an image. Barthes (1964/1977) explained the messages of an image using the concepts of denotation and connotation. He asserted that a denotative message corresponds to identifiable objects which can be recognized based on perceptual knowledge and a connotative message is derived from the arrangement of denotative messages based on the cultural knowledge of the user. With an image of "a young Negro in a French uniform saluting, with his eyes uplifted, probably fixed on a fold of the tricolour" (Barthes, 1957/1972, p. 116), Barthes explained that the identified things, such as people, objects, and action, function as denotative messages, and French Imperiality or Militarism can be possible connotative message which emerge from these denotations. He insisted on the significance of connotative messages by asserting that people are impacted by connotative messages whenever they see the images. It needs to be noted that Barthes (1961/1977) indicated that the recognition of specific objects is a particular mode of connotation which he referred to as 'cognitive connotation.' His concerns of connotation mostly correspond to 'ideological/ethical' connotation.

Table 1 presents three researchers' views on meanings of an image. Although these researchers analyzed meanings of an image in somewhat different ways, they distinguish between denotative (objective) attributes based on visual perception and connotative (subjective, affective) attributes based on socio-cultural background.

Table 1. Messages of an Image

Panofsky (Art History)	Shatford(Library & Information Science)	Barthes(Semiotics)
Pre-iconography (factual level)	Generic – *Of*	Denotation
Pre-iconography (expressional level)	*About*	Connotation
Iconography	Specific – *Of*	Cognitive Connotation
	About	Connotation
Iconology	-	Connotation

As discussed above, it has been conceptually addressed that an image contains multiple levels of meanings and the researchers examining image meanings considered connotative messages as inherent features of images. However, the studies on user query analysis, which have been performed for understanding user needs (Choi & Rasmussen, 2003), have demonstrated that the Ofness (Generic-Of or Specific Of) of an image dominates a large percentage of user queries (Enser & McGregor, 1992; Jörgensen, 1995; Turner, 1995; Armitage & Enser, 1997; Collins, 1998; Chen, 2000; Choi & Rasmussen, 2003). The seeming discrepancy between analysis of image meanings and analysis of user queries raises some questions; 1) Are connotative messages important for users looking for images?, and 2) If connotative messages are important for users searching images, how do they express and process their needs for connotative messages during the image search process? There are some studies discussing these issues directly or indirectly.

O'Connor, O'Connor and Abbas (1999) and Greisdorf and O'Connor (2002) imparted the important roles of connotative messages for image users. O'Connor, O'Connor and Abbas (1999) analyzed the user-generated verbal reactions to images, and the results showed that a large portion of user reactions are directly related to connotative messages of an image. Greisdorf and O'Connor (2002) asked participants to assign given terms to images as well as to generate descriptive terms on their own for the images. The results of both tasks demonstrated that connotative messages are important characteristics of an image. Some studies demonstrated that users have difficulties in expressing connotative messages with a specific search statement. Batley (1988) explored the relationship between types of user needs (specific, general, abstract, and subjective) and search strategies

(keyword search, specific browsing, and serendipitous browsing). The experiment's results indicated that when users have connotative needs (abstract and subjective), users employ serendipitous browsing rather than keyword search. Keister (1994) identified a particular query type, named the "image construct query" based on the reference interaction logs. For example, the queries "people racing in wheelchairs" or "surgeons standing" were used by a surgeon trying to illustrate an occupational hazard for the profession. She explained that although individual terms of the query are topical, the concepts behind them are visual constructs. According to her analysis, this type of query comprised one-third to one-half of requests.

Jörgensen's (1995; 1998) and Fidel's (1997) research demonstrate more directly why connotative messages are used less frequently than denotative messages. Jörgensen (1995) categorized image attributes into twelve classes, and then compared the usage of classes in three different tasks: 1) In describing tasks, participants wrote descriptions of six images, 2) In searching tasks, each participant was given two query terms representing abstract concepts, and then browsed 77 images to find images relevant to the abstract concepts, and 3) In sorting tasks, participants sorted the 77 images into groups for their own use as if the images were their personal collection. Regarding the results of Jörgensen's research, Fidel (1997) asserted that among these three tasks, the sorting task resembled most closely the retrieval process, because even though participants did not create search terms, they were asked to organize images for future usage. Then, Fidel (1997) compared the results of the sorting task with her own experimental results which analyzed 100 actual requests using Jörgensen's attribute classes. The Jörgensen and Fidel results showed that over half of the attributes used in Jörgensen's sorting task and in Fidel's actual requests were abstract (interpretive) attributes. From this research, Fidel concluded that users prefer to use abstract attributes for image retrieval. According to Jörgensen's research, in describing and searching tasks perceptual attributes were used more often than abstract attributes. However, when Jörgensen (1998) asked participants to describe images using a template which includes both perceptual and abstract attributes, the usage of perceptual attributes decreased and that of abstract attributes increased. From this result Jörgensen concluded that when participants are presented with options of attributes, they choose abstract terms to describe images. This probably implies that in spite of the importance of abstract attributes in image retrieval, users do not use abstract attributes since they are not familiar with retrieving images with this kind of attribute.

These lines of research support the idea that connotative messages could be one of key elements in enhancing user satisfaction in image retrieval. Because of the concerns about inconsistency and technological limitations, current image retrieval (or representation) systems provide connotative access point in a limited way. However, if connotative messages are a factor in improved image retrieval, there should be an effort to find a better way of supporting connotative messages based on the studies of user behaviors with image documents. In this context, this study is designed to investigate how users' connotative needs are processed during the image search process in terms of types of image attributes. Whereas the research on image attributes focused on denotative and connotative meanings, the research on user query analysis has demonstrated that low-level features, especially color, are useful image attributes in addition to denotative and connotative features (Jörgensen, 1995; Eakins & Graham, 1999; Greisdorf & O'Connor, 2002). Thus, this study defined three image attributes for characterizing connotative needs in each search stage: color, denotative components, and connotative components.

Research Design

Participants for this study were graduate students at the School of Library and Information Science, University of North Texas. Once pre-tested, the survey was sent to 26 participants and 21 sets of responses were completed and returned. Although all participants are Library and Information Science majors, they represent diverse ethnic and educational backgrounds. A detailed description of the participant pool follows under results.

The questionnaire instrument was developed to explore users needs for connotative messages during the image search process in terms of three levels of image attributes. The instrument begins with the following instruction which was designed for the task causing connotative needs.

Based on Nicholas' (1996) stages of information needs, this study defined three stages of the image searching process: Initiation, Representation, and Selection. The initiation stage is investigated by asking participants to assume that they would select the images for the given task from a set of images. Then, a set of questions were presented to participants which asked them to rate the importance of image attributes (color, denotation and connotation) using a Likert scale of 1-7. Then, they were asked to provide terms describing the image attribute which they had evaluated as important. The participants were also asked to rate the Semantic Differential scales for the expected image (more information on the Semantic Differential will be discussed below). For investigating the representation stage, participants were asked to list 2-4 search terms which would be used for finding appropriate images through an image search engine. For the selection stage, participants were shown five images which were collected from websites advocating "peace." For selecting these five images, the author searched Google with the search term "peace" and collected images located on the first page (main homepage) of the retrieved websites, but excluded the images associated with any specific news article or events. The five images selected through this process were considered as "potentially relevant" images for the given task. The participants were asked to answer a set of questions for each potentially-relevant image. A set of questions asked participants to rate the overall appropriateness for the given task, the appropriateness in terms of image attributes (color, denotation, and connotation), and the Semantic Differential scales for each image. After answering a set of questions for five images, the participants were asked to select the most appropriate image among the five images and to describe the reason for selecting the image.

This study adopted the Semantic Differential scale as an instrument of measuring affective reactions. The Semantic Differential measures people's affective reactions or attitudes to stimulus words or concepts in terms of ratings on bipolar scales defined with contrasting adjectives at each end (Heise, 1970). Since the time that Osgood, Suci, and Tannenbaym (1957) created this method, the Semantic Differential has been used as a scaled measurement of affective reactions or attitudes towards various objects, including images and paintings. One of the distinctive features of the Semantic Differential is that it can reveal stimulus with the reduced dimensions of various scales. There have been a number of studies performing experimentations to identify the dimensions, and three dimensions, which have been labeled Evaluation, Potency, and Activity (EPA), have been evidently verified in a variety of studies. The EPA structure holds up with a wide variety of subjects, stimulus, and scales.

This study constructed a 12-scale form of the Semantic Differential based on two criteria, scale relevance and factorial composition. Scale relevance means that scales should be related meaningfully to the stimulus, so that participants easily judge the stimulus using those scales. Factorial composition means that appropriate scales should measure the EPA dimensions, because the basic goal of the Semantic Differential study is to obtain measurements on the EPA dimensions (Heise, 1970). In order to meet the factorial composition criteria, this study selects 28 scales representing EPA dimensions according to the Osgood, Suci and Tannenbaym (1957) thesaurus study which has been used as a standard source of factor analytic information on the Semantic Differential scales. Then, for choosing relevant scales, 12 of 28 scales are selected based the previous research results which used paintings and images as stimulus (Tucker, 1955; Polzella, Roten, & Parker, 1998). The developed Semantic Differential tool is used for measuring the affective reactions at the initiation and selection stages.

Results

A total of 21 graduate students of Library and Information Science at University of North Texas served as participants. 65% of the participants were female and 35% were male, and 85% of the participants ranged in age from 26 to 45. Their undergraduate majors include Art (12.5%), Humanities (25%), Social Science (18.8%), Science/Technology (18.8%), and Library and Information Science (25%). Their national origins vary including Africa (15%), Asia (25%) and Europe (15%) as well as North America (45%). 85% of the participants use the computer over 20 hours per week. All participants have experience using image retrieval systems (or search engines), and 50% of the participants use image retrieval systems (or search engines) more than one time per week.

RQ1. Which image attributes are considered important for connotative needs before starting a search?

Using the scale of 1-7 (1 = extremely unimportant, 7 = extremely important) , the importance of three attributes was rated under the assumption that they would select an image for the given task from a set of images. As presented in Table 2, almost every participant (19 among 20 participants) considered connotation as an extremely or quite important attribute for the given task, whereas the importance of denotation dispersed from slightly unimportant to extremely important, although 16 among 20 rated the importance of denotation quite or extremely important. The color attribute was ranked from extremely unimportant to extremely important, although 12 among 20 participants considered color extremely or quite important. This result shows that when people have a connotative need, denotation and color are also regarded as important attributes but not so much as connotative attributes.

Table 3 presents the descriptive terms identified by users who regarded each component as important. The description shows that some colors ('blue', 'white' and 'green') were expressed by more than one third of participants. Among the denotative component, 'diverse groups of people', 'dove or pigeon', and 'olive branch' were identified by more than approximately one third of participants. On one hand there are some dominant descriptive terms which were provided by large portions of participants, on the other the result also shows that participants employed diverse and numerous denotative terms for describing the image in their mind. Symbols of peace ('dove', 'olive branch', etc.), diverse objects or activities presenting concepts of harmony or cooperation ('handshaking', 'diverse groups of people', etc,), and specific events, people, organization and locations ('Olympics', 'Nelson', 'Mandela', 'United Nations', 'Iraq', etc.) were provided by the participants. Another remarkable finding is that six participants used negative concepts for the given task, such as 'broken building', 'dead body', 'gun', 'war', 'Saddam' and so on. Connotative attributes also demonstrated the diversity. However it is not difficult to find the common denominator among those connotative descriptions, although it is hard to describe with one word. It also shows that although connotative attributes were considered most important among the three attributes (Table 2), the number of connotative descriptions given by users (25) was less than the number of denotative descriptions (66). This result can be interpreted as an indirect demonstration of the idea that connotations are more difficult to represent with words than denotations. Some negative concepts ('conflict', 'sad/grief') were also provided as connotative attributes.

Table 2. The Importance of Attributes at the Initiation Stage

Attribute	Extremely Unimportant	QuiteUnimportant	SlightlyUnimportant	Neutral	SlightlyImportant	Quite Important	ExtremelyImportant	Mean	S.D.
Color	1	1	0	0	6	11	1	5.30	1.41
Denotation	0	0	1	1	2	11	5	5.90	1.02
Connotation	0	0	0	1	0	10	9	6.35	.745

Table 3. User Descriptive Terms at the Initiation Stage

Attribute	Category	Frequency†	Descriptive Term (Frequency) ‡
Color	Color	36	Blue (9) White (8) Green (7) Red (6) Black (4) Gray (2)

	Color Value	9	Neutral (2) Soft (1) Multi-colored (1) Nice (1) Calm (1) Contrast (1) Soothing (1) Vivid (1)
	Sub-Total	45	
Denotation	Objects	21	Dove or Pigeon (6) Olive branch or leaf (6) Globe (2) Bird (1), Leaves (1) Green grass (1) Flags of nations (1) Nature (1) Broken building (1)* Gun (1)*
	People	19	Diverse groups of people (7) Child (4) Baby (1) People (2) People face (1) Notable persons, like Nelson, Mandela, Gandhi, Martin Luther King (1) Troubled people (1)* Dead body (1)* Saddam (1)*
	Activities	13	Handshaking (3) Play (1) Laugh (1) Smile (1) Negotiation process – People in the room (1) Activity indicating resolution, accord or cooperation (2) marches (1) People working together (1) Cry/Tear (2)*
	Organizations	2	United Nation's logo (2)
	Others	11	Peace symbols (5) Images of community (1) Images depicting real events (1) Sport events like Olympics (1) Team environment (1) Archetypal images (1) Iraq (1)* War (1)*
	Sub-Total	66	
Connotation	Abstract	17	Peace (6) Agreement (1) Cooperation (2) Harmony (2) Unity (1) Inclusiveness (1) Friendship (1) Innocent (1) Youth (1) Conflict (1)*
	Atmosphere	5	Tranquil (1) Serenity / Calm (3) Natural and Real (1)
	Emotional	3	Happiness (1) Sad/Grieve (2)*
	Sub-Total	25	
Total		136	

† The sum of frequencies of the fourth column

‡ The occurrence of the descriptions. When participants identified one concept more than one time, it was regarded as one occurrence.

* The indication of negative concepts

RQ2. Which image attributes are frequently used as queries for representing the connotative needs for images? What are the differences in image attributes usages between the Initiation stage and the Representation stage?

The participants were asked to identify 2-4 search terms they would use with a search engine or an image retrieval system for performing a given task. The distribution of search terms by attribute indicated that connotative attributes (36 occurrences) were more frequently used than denotative attributes (24 occurrences). Although color was recognized as important at the initiation stage, it was rarely used as a search term. One occurrence of color was used for illustrating denotative search term, e.g. 'blue sky'. Compared to the descriptions used at the initiation stage, it can be found that the terms which might more directly articulate the given connotative needs were used as search terms. Peace was employed by 14 participants as a search term. 'Dove' or 'Pigeon' and 'Olive branch', and the concepts of international, world, or multicultural were also used by several participants. The concepts frequently used as search terms were also often used at the initiation stage. One noticeable difference is that at the initiation stage many participants described diverse groups of people but at the representation stage participants used conceptual terms, such as 'international', 'world', or 'multicultural', instead of terms describing diverse groups of people. The tendency of participants to adopt more directly related terms or concepts as search terms might be explained by a well known phenomenon, which is, people convert their initial needs into the search terms which they think image retrieval systems can handle (Jörgensen, 2003). As found at the initiation stage, the negative concepts ('weapon', 'war', 'famine', 'conflict', etc.) were also used as search terms.

Table 4. Search Terms at the Search Stage

Attribute	Category	Frequency	Keywords (Frequency)
Color	Color	1	Blue (1)
	Color Value	0	
	Sub-Total	1	
Denotation	Objects	13	Dove / Pigeon (5) Olive branch (3) Sky (1) Globe (1) Flower (1) Weapon (1)* Dead soldiers (1)*
	People	0	
	Activities	4	Handshake (1) Negotiate (1) International peace initiatives (1) Cease Fire (1)*
	Organizations	3	UN (1) PAX (1) World peace organization (1)
	Others	4	War (3)* Anti-war (1)
	Sub-Total	24	
Connotation	Abstract	34	Peace (14) World Peace (2) International/World/Multicultural (6) Harmony (1) Cooperation (1) Utopia (1) Conflict resolution (1) peaceful resolution (1) Globalization (1) Famine (1)* Conflict (1)* International Conflict (3)* Military aggression (1)
	Atmosphere	2	Quiet (1) Calm (1)
	Emotional	0	
	Sub-Total	36	
Total		61	

RQ3. Which image attributes are significant in the selection of images? What are the differences in usage of image attributes between the Initiation stage and the selection stage?

Participants were asked to indicate overall appropriateness as well as appropriateness of color, denotative, and connotative attributes against five potentially relevant images using a scale of 1 - 7 (1 = extremely inappropriate, 7 = extremely appropriate). Since 21 participants rated five images, the total number of evaluation sets would be 105. Among them, the number of sets where overall appropriateness was rated 6-7 was 51 (these are regarded as highly appropriate) and the number of sets having an overall rating of 1-2 was 19 (these are regarded as not appropriate). That is, approximately 50% of total evaluative sets were regarded as highly appropriate and 18% were regarded as not appropriate, even though five images were all selected from related websites with potentially relevant images. Table 5 and Figure 1 compare the mean of appropriateness of color, denotation and connotation for three different groups. The results demonstrate that color is not directly related to overall appropriateness, because the mean of color appropriateness for the highly appropriate group is relatively low and the mean of color appropriateness for the not appropriate group is relatively high. Compared to color, denotation and connotation more closely match the overall appropriateness.

Table 5. Distribution of Attributes by Rated Appropriateness

Attribute	All(106 evaluation sets)		Highly Appropriate (51 evaluation sets of which overall appropriateness is 6-7)		Not Appropriate (19 evaluation sets of which overall appropriateness is 1-2)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Overall	4.83	1.914	6.39	.493	1.53	.513
Color	4.65	1.783	5.52	1.474	3.42	1.677
Denotation	5.03	1.632	6.15	.684	3.06	1.731
Connotation	5.12	1.713	6.23	.778	3.37	2.060

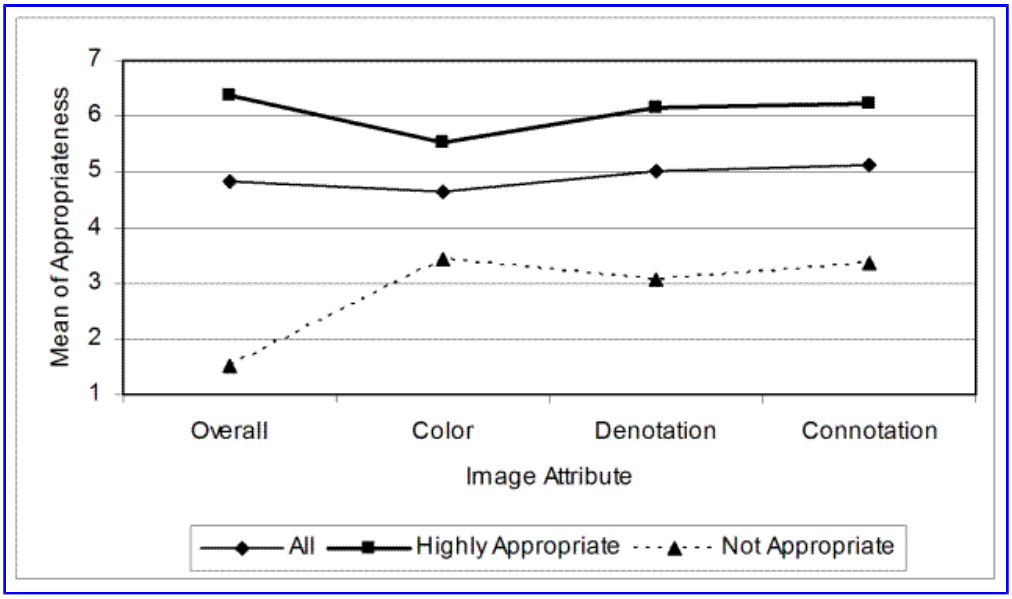

Figure 1. Distribution of attributes by rated appropriateness

Table 6 and Figure 2 demonstrate another approach examining the selection stages by investigating the average appropriateness of each image. According to overall appropriateness, one image (Image 1) was evaluated as highly appropriate (average score is 6.57 on a 7 point scale), two images (Images 2 & 3) were slightly appropriate, and two (Images 4 & 5) were neutral or slightly inappropriate. This result also demonstrated that color is not directly related to selecting images for the connotative need. Image 1 and Image 2 have a relatively low score in color, whereas Image 4 and Image 5, which are neutral or slightly inappropriate images, have relatively high scores in color. However, denotative and connotative attributes show parallel patterns with overall appropriateness.

Table 6. Distribution of Rated Attributes' Appropriateness among Five Images

Attribute	Image 1		Image 2		Image 3		Image 4		Image 5	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Overall	6.57	.507	5.05	1.465	4.76	2.022	4.19	1.662	3.57	2.111
Color	5.40	1.429	3.57	1.938	5.05	1.431	5.00	1.483	4.29	2.053
Denotation	6.25	.716	5.05	1.146	5.37	1.571	4.55	1.146	3.95	2.259
Connotation	6.40	.821	5.10	1.294	5.50	1.395	4.80	1.322	3.80	2.331

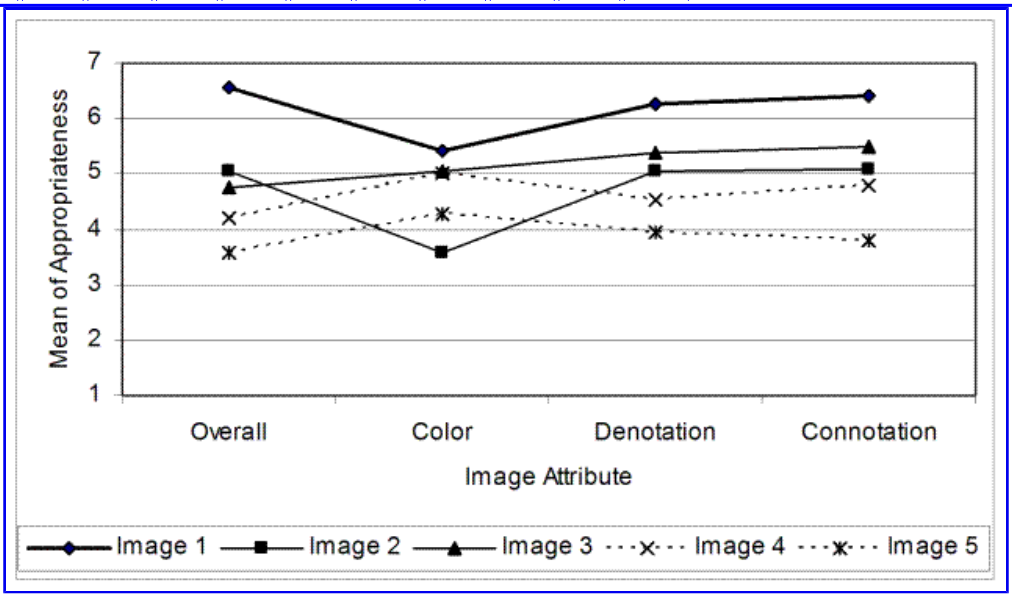

Figure 2. Distribution of rated attributes' appropriateness among five images.

The importance of each image attribute was compared at the selection stage and at the initiation stage. For the comparison, the evaluation sets having high appropriateness scores (overall appropriateness of 6-7) were considered and evaluation sets having low appropriateness were excluded from this comparison analysis. As shown in Table 7, no significant differences were found in the three attributes between the two stages.

Table 7. t-Test for Equality of Means of Rated Appropriateness between Initiation and Selection Stages

Attribute	Initiation Stage		Selection Stage		*t*-test	
	Mean	S.D.	Mean	S.D.	*t*	*p*
Color	5.30	1.418	5.52	1.474	-.570	.571
Denotation	5.90	1.021	6.15	.684	-1.161	.250
Connotation	6.35	.745	6.23	.778	.590	.557

RQ 4. How does the affective attribute function at the initial stage and the selection stage?

The Semantic Differential scale was used for six stimuli. An expected image was used at the initiation stage and five images were used at the selection stage. Participants used a seven-point scale to indicate their responses for each Semantic Differential scale. In accord with Osgood, Suci and Tannenbaym (1957), a principal component factor analysis with varimax rotation was performed for examining the prominent dimension. The result extracted three factors labeled Evaluation, Potency, and Activity (Table 8).

Table 8. Factor Loadings

	Dimension		
Scale	1 Evaluation	2Potency	3 Activity
active – passive***	.441	.215	.621
beautiful – ugly*	.873	-.130	.035
good – bad*	.909	-.234	-.027
happy – sad*	.726	-.492	.095
hard – soft**	-.204	.754	.122
large – small	.016	.424	.366
rough – smooth**	-.386	.710	-.013
sharp – dull**	.164	.584	.342
dynamic – static***	-.107	-.039	.938
strong – weak***	.185	.459	.584
tense – relaxed**	-.306	.852	.038
valuable – worthless*	.665	.065	.451

* scales of Evaluation dimension; ** scales of Potency dimension; *** scales of Active dimension

Participants' answers were coded as a partial interval scale (Osgood , Suci & Tannenbaym, 1957), -3, -2, -1, 0, +1, +2, +3, with the negative values assigned to the semantically negative adjective and the positive values to the positive adjective. Thus, these mean scores could range between +3 and -3 in value, and as the absolute value is greater, the dimension is meaningful for that item. Table 9 presents the means and standard deviations for the three dimensions by six items. The results show that participants' reactions to the expected image at the initial stage are more meaningful in the Evaluation dimension in a positive direction, and the other three dimensions were

closer to neutral. Image 1, evaluated as highly appropriate (refer to Table 6), also presented a positive direction in the Evaluation dimension, whereas Images 4 and 5, evaluated as slightly inappropriate, presented negative or neutral directions in the same dimension. Figure 3 illustrates the agreement patterns between the expected images at the initial stage and three groups of images. The first image group contains an image judged as most appropriate for the given task (Image 1), the second group contains the next two images (Images 2 and 3), and the third group contains two images judged as least appropriate for the given task (Images 4 and 5). The results of the comparison demonstrate the distinctive differences in the Evaluative dimension depending on the degree of appropriateness. That is, considering the Evaluative dimension, the image judged as highly appropriate has higher agreement patterns with the expected image at the initial stage, and the images judged as not appropriate shows lower agreement patterns with the expected image. An interpretation of this result is that under the given task of this study, the Evaluation dimension can be a critical factor in selecting the appropriate images.

Table 9. Semantic Differential Factor Means

	Factor					
	1. Evaluation		2. Potency		3. Activity	
Item	Mean	S.D.	Mean	S.D.	Mean	S.D.
Initiation	1.80	1.073	-0.51	1.401	0.98	1.591
Image 1	1.74	1.066	0.32	1.043	1.23	1.093
Image 2	0.62	1.260	-0.55	.974	0.00	1.403
Image 3	1.64	1.002	-0.85	1.135	1.16	1.285
Image 4	0.21	1.354	0.44	1.022	0.27	1.334
Image 5	-0.87	1.663	1.24	1.411	1.40	1.622

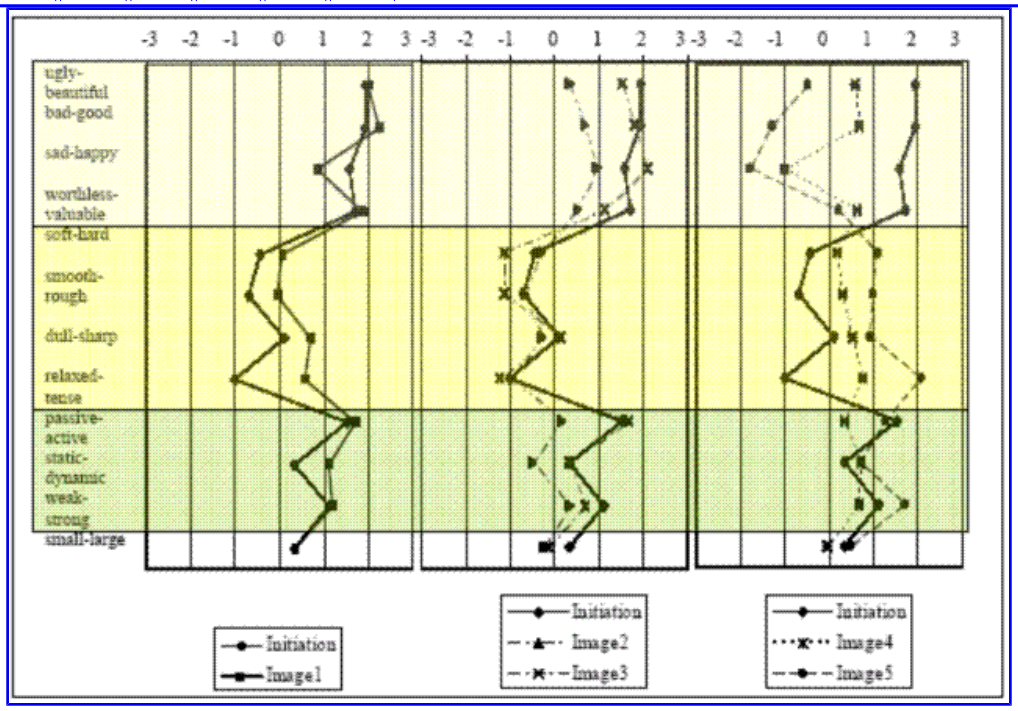

Figure 3. Mean profiles for three groups of images

Discussions & Implications

This study investigated three stages of the image search process in terms of image attributes. When participants were asked if three attributes, color, denotative and connotative attributes, were important, participants considered all of them as important, both at the initiation stage and selecting stage. However, in spite of participants'

perceptions of the color attribute, it was found that color was rarely used to represent needs and there were discrepancies between overall appropriateness of an image and appropriateness of color for the image. This result supports the recognition of the limitations of low-level oriented image retrieval (Rui, Huang & Chang, 1999) by demonstrating that in some image search tasks color alone may not be a significant attribute for achieving satisfactory image retrieval results but should be integrated with other semantic attributes of an image.

Compared to color, denotative and connotative attributes were frequently employed as search terms and demonstrated consistency between overall appropriateness of an image and their own appropriateness for the image. Both descriptive terms given at the initiation stage and search terms at the representation stage demonstrated that diverse concepts were employed by users to perform a given task. Participants provided not only objects representing peace symbols, activities demonstrating peaceful or harmonious gestures, and abstract concepts related to peace or unity amongst diversity, but they also provided specific organizations, people, or events related with peace movements and even negative concepts opposing peace. The only noticeable difference between descriptions at the initiation stage and search terms at the representation stage was that words which could more directly articulate participants' needs were selected as search terms. The diversity of search terms or descriptive terms employed for a given task lend support to those researchers who discussed the "recall of browsing sets" (Fidel, 1997; Yoon, 2006) and the "most-informative display update scheme" (Cox, Miller, Minka, Papathomas & Yianilos, 2000). As Fidel (1997) discussed, a user sending peace as a query term would be interested in diverse sets of images representing peace rather than fifty dove images or fifty images of an olive branch. Even when a user sends dove as a query term, the display of diverse images would increase potential for user satisfaction by giving the user a chance to browse diversely related images.

This study examined the affective attribute by adopting the Semantic Differential Scale. As Greisdorf and O'Connor (2002) mentioned, if one of the purposes of an image is to express emotion, the affect of the image should be available for achieving more meaningful retrieval results. However, while there is increasing interest in affective attributes of an image, incorporating this attribute into image retrieval systems seems to be difficult (Jörgensen, 2003). Although this study is based on a small set of data, it suggests that in accordance with the Semantic Differential, it is possible to represent complex affective attributes of an image in the reduced dimensions. In addition, it also demonstrates the possibility that those reduced dimensions of the affective attribute could be used to indicate more meaningful and relevant images.

Acknowledgements

I would like to thank Dr. Brian O'Connor for his valuable comments that helped me to improve this paper. I thank the survey participants for their contributions and Amy Eklund for editing this paper. I also thank the anonymous reviewers for their helpful comments.

References

Armitage, L. H. & Enser, P. G. B. (1997) Analysis of user need in image archives *Journal of Information Science* 23(4), 287-299

Barthes, R. (1972) *Mythologies (A. Lavers, Trans.)* NY: Hill and Wang. (Original work published 1957)

Barthes, R. (1977) The photographic message In S. Heath (Ed. & Trans.) *Image, Music, Text* pp. 15 - 31. London: Fontana. (Original work published 1961)

Barthes, R. (1977) Rhetoric of the image In S. Heath (Ed. & Trans.) *Image, Music, Text* pp. 32 - 51. London: Fontana. (Original work published 1964)

Batley, S. (1988) Visual information retrieval: browsing strategies in pictorial databases *Proceedings of the 12th International Online Information Meeting* 373-381

Chen, H. (2000) An analysis of image queries in the field of art history *Journal of the American Society for Information Science and Technology* 52(3), 260-273

Choi, Y. & Rasmussen, E. (2003) Searching for images: the analysis of users' queries for image retrieval in American history *Journal of the American Society for Information Science and Technology* 54(6), 498-511

Collins, K. (1998) Providing subject access to images: a study of user queries *The American Archivist* 61, 36-55

Cox, I. J., Miller, et al. (2000) The Bayesian image retrieval system, PicHunter: theory, implementation, and psychophysical experiments [Electronic version] *IEEE Transactions on Image Processing* 9(1), 20-37

Eakins, J., & Graham, M. (1999) *Content-Based Image Retrieval: A Report to the JISC Technology Application Program* University of Northuinbria at Newcastle). Retrieved April 22, 2001, from http://www.unn.ac.uk/iidr/research/cbir/report.html

Enser, P. G. B. & McGregor, C. G. (1992) Analysis of Visual Information retrieval Queries *British Library research and Development Report, no. 6104*

Fidel, R. (1997) The image retrieval task: implications for the design and evaluation of image databases *New Review of Hypermedia and Multimedia* 3, 181-199

Greisdorf, H. & O'Connor, B. (2002) Modeling what users see when they look at images: a cognitive viewpoint *Journal of Documentation* 58(1), 1-24

Heise, D. (1970) The Semantic Differential and attitude research In G. F. Summers (Ed.) *Attitude Measurement* pp. 235-253. Chicago: Rand McNally & Company

Keiser, L. (1994) User types and queries: impact on image access systems In R. Fidel (Ed.) *Challenges in Indexing Electronic Text and Images* pp. 7-19. Medford, NJ: Learned Information, Inc

Krause, M. G. (1988) Intellectual problems of indexing picture collections *Audiovisual Librarian* 14(2), 73-81

Jörgensen, C. (1995) Classifying images: criteria for grouping as revealed in a sorting task *Proceedings of the 6th ASIS SIG/CR Classification Research Workshop* 32, 65-78

Jörgensen, C. (1998) Attributes of images in describing tasks *Information Processing & Management* 34(2/3), 161-174

Jörgensen, C. (2003) *Image Retrieval: Theory and Research* Lanham: The Scarecrow Press, Inc.

Markey, K. (1986) *Subject Access to Visual Resources Collections: A Model for Computer Construction of Thematic Catalogs* New York: Greenwood Press

Markey, K. (1988) Access to iconographical research collections *Library Trends* 37(2), 154-174

Nicholas, D. (1996) *Assessing Information Need: Tools and Techniques* London: ASLIB, The Association for Information Management

O'Connor, B., O'Connor, M., & Abbas, J. (1999) User reactions as access mechanism: an exploration based on captions for images *Journal of the American Society for Information Science* 50(8), 681-697

Osgood, C. E., Suci, G. J., &Tannenbaym, P. H. (1957) *The Measurement of Meaning* Urbana: University of Illinois Press

Panofsky, E. (1962) *Studies in Iconology: Humanistic Themes in the Art of the Renaissance* NY: Harper & Rowe

Polzella, D. J., Roten, J. G., & Parker, C. W. P. (1998) Image of Mary: effects of style and content on reactions to

The 10th Annual Convention of the American Psychological Society, May 21-24, 1998, Washington, DC Retrieved November 29, 2005, from http://www.udayton.edu/mary/respub/reactions.html

Rui, Y., Huang, T., & Chang, S-F. (1999) Image retrieval: current techniques, promising directions, and open issues *Journal of Visual Communication and Image Representation* 10(4), 39-62

Shatford, S. (1986) Analyzing the subject of a picture: a theoretical approach *Cataloging & Classification Quarterly* 6(3), 39-62

Shatford-Layne. S. (1994) Some issues in the indexing of images *Journal of the American Society for Information Science* 45(8), 583-588

Tucker (1955) *Experiments in Aesthetic Communications* Unpublished doctoral dissertation, University of Illinois

Turner, J. M. (1995) Comparing user-assigned terms with indexer-assigned terms for storage and retrieval of moving images: research results *Proceedings of the 58th Annual Meeting of the American Society for Information Science* 32, 9-12

Yoon, J. (2006) *Improving recall of browsing sets in image retrieval: from a semiotics perspective* Unpublished doctoral dissertation, University of North Texas