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Interindexer Consistency, Term Usage, and Indexer Experience Levels in the Application of Image Descriptors

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This study concerns image indexing and the affect of indexer experience levels on interindexer consistency and the choice of indexing terms. Owing to the importance of concept-based indexing for images, this investigation will provide information for the development of basic criteria for image indexing practices. Four groups of participants with varying degrees of image indexing and subject expertise will be studied through an interactive Web site. A questionnaire will gather information on indexer experience levels and basic demographic data, and an image component of the study will gather indexing terms applied by the participants. Quantitative analysis will be conducted on the data resulting from the questionnaire, while qualitative methods will be employed for analyzing the indexing terms assigned by the participants. The study will examine the multiplicity of term types applied to images (generic description, identification, and interpretation) and the degree of indexing difficulty due to the accessibility of representation and subject content of the image. It is hoped that this study will lead to a deeper understanding of the role of indexer experience in image indexing, which in turn can inform the processes utilized to enhance access to digital collections of visual materials.

Introduction

Concept-based image indexing, the application of textural concepts gotten via natural language or controlled vocabularies to visual materials, is a topic which has seen relatively little research to date. This is a surprising situation given the rapid development of techniques and technologies associated with digital content and systems. While much effort has been expended in the creation of content and systems for visual materials, only limited research has been undertaken into the unique issues surrounding

content representation, information retrieval, and user needs of visual materials. Unlike text-based media, which can be accessed through full-text searches, the application of textural descriptors for images remains vital to their retrieval in an online environment. While recent developments in the area of image retrieval by visual content are promising, in most contexts this retrieval method will fall short of meeting user needs. Because of this situation there is a continued reliance on text for the retrieval of images, and so the application and use of indexing terms is critical to the development of useful systems of visual materials.

The question of how concept-based indexing is best undertaken for visual materials is not well understood. This study examines indexer experience and subject expertise and how these affect the application of indexing terms. In addition, an investigation into what type of indexing terms (generic description, identification, and interpretive) exhibit the highest interindexer consistency will be carried out. Finally, the study will explore the legibility of images and the impact of this on indexing term types and interindexer consistency. It is hoped the study will provide an increased understanding of image indexing, and that this in turn will assist in the development of new techniques and systems for visual materials. Research in this area is critical in order to provide functional access to visual materials in a manner that attempts to mirror the techniques in place for printed matter. Visual materials offer a wealth of information that until recently was hidden due to limitations of physical access; the now nearly universal availability of images over the Web underlines their importance. Hopefully, as their numbers continue to grow in the digital environment useful methods of image indexing can be discovered to ensure future access.

Background

Chen and Rasmussen (1999) performed a review of the relatively limited research completed on image indexing in their article titled "Intellectual access to images." The dearth of research on this topic is at least due in part to the complex nature of indexing visual materials. A difficulty in image indexing that is often overlooked and typically not well-understood is the gap between seeing and "reading" visual materials. There is a perceived equality in the degree of literacy among all individuals when images are being investigated, and yet observation is clearly not akin to an in-depth analysis of visual information (Panofsky, 1939; Shatford, 1986;

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Turner, 1993; Layne, 1994; Layne, 2002).

Beyond the difficulties found in “reading” an image, there is no general agreement about what constitutes an adequate set of terms to be applied to images (Attig, 2004). According to Chen’s study of art history students, the types of terms applied to images that are most frequently used in retrievals are those considered unique, i.e. specific person, object, location, rather than general terms (Chen, 2001). This finding was countered by Jorgensen and Jorgensen’s (2005) study of professionals searching a Web-based commercial image database. These users performed fewer unique term searches and more thematic and descriptive queries (Jorgensen and Jorgensen, 2005). The difference in concept types used to access images in these two studies appear to be the result of the dissimilar user needs and contexts (students completing an academic art history term project vs. professional searchers fulfilling commercial picture requests). Further studies of image use are needed before this hypothesis can be supported, however.

A few studies concerning interindexer consistency of images have been conducted to date, and these are those of Markey (1984), and Wells-Angerer (2005). These studies offer conflicting results concerning the degree of overlap between the terms chosen by indexers. Markey studied the indexing terms of 39 individuals applied to 100 medieval works of art on three categories (objects, expressional, events). Her study reports a low percentage of agreement of terms with an average of seven percent for exact term matches, and thirteen percent for concept matches in indexing terms. Additional statistics created by this study show a range of zero percent to eighteen percent for exact term matches and six percent to twenty-one percent for concept matches among the indexers (Markey, 1984). Wells-Angerer studied the image indexing terms applied to ten works of art by thirty participants falling into three categories of image indexers (expert, knowledgeable, novice). The influence of the experience level of indexers on image retrieval rates of online museum collections was the principal question addressed in her study. She found that the indexing terms applied by indexers with the highest level of knowledge about the objects in the collections (scholars, curators and collection staff) had retrieval success rates of approximately sixteen percent. Novice indexer retrieval rates were considerably lower, at approximately five percent (Wells-Angerer, 2005).

The study by Wells-Angerer offers an indication that indexer

experience and subject expertise ought to be considered in discussions of interindexer consistency. Markey's study has been used to support the hypothesis that image indexing will produce low returns for the effort. This is remarkable considering Markey herself notes that "[t]he use of inexperienced indexers and non-subject specialists in this study may have diminished interindexer consistency scores," (Markey, 1984). Wells-Angerer's study (2005), which showed expert terms to be over three times more effective in retrievals when compared to terms applied by novice indexers, provides some support to the argument that more experienced or knowledgeable indexers will produce a higher percentage of interindexer consistency. Kennedy, too, found in her study of image professionals that their "... training may provide consistency in image description... regardless of the content or concept of the image," (Kennedy, 2005).

Another aspect of image indexing discussed in the literature is how the overall complexity of the images themselves influences the degree to which interindexer consistency is achieved. Wells-Angerer (2005) posits the overall low retrieval success rates in her study are due in part to the fact that "... the interpretation of art works is highly subjective by nature..." Markey (1984) too wondered if the Medieval works of art chosen for use in her study were themselves responsible for the low interindexer consistency scores due to their inaccessible or difficult nature. Image legibility can be thought of as following two dimensions. The first dimension relies on how accessible the representation is, while the second dimension is based upon the accessibility of the subject matter. The variable legibility for visual materials is an area that has yet to be investigated alongside interindexer consistency.

Research Questions

Three related research questions form the basis of this study:

1. How does image indexer experience and subject expertise affect interindexer consistency?
2. What types of terms (generic description, identification, interpretive) exhibit the highest interindexer consistency among image indexers?
3. What affect does image legibility have on interindexer consistency?

Methodology

Participants

While participants in this study are expected to have varied backgrounds, four discrete groups have been identified as being crucial to the methodology of this study. The primary characteristics of importance here are the levels of subject knowledge and image experience of participants. The four groups of participants included in this study are, in order of least to most experience, Novice--individuals with little or no previous subject knowledge or image indexing experience; Moderate--individuals who have undergone a minimum of five courses in visually oriented fields; Faculty--faculty and graduate students with a high level of subject knowledge and limited image indexing experience; and Professional--image professionals with a high level of subject knowledge and image indexing experience. The number of participants in the study cannot be noted with any accuracy at this stage, but the minimum number of participants to be recruited for each group will be twenty-five.

Participants are recruited for this study utilizing several methods. One recruitment method involves sending an announcement of the study's interactive Web site to listservs utilized by the Faculty and Professional groups outlined above. A second method of recruitment of participants is the distribution of printed flyers. This method is geared toward recruiting participants in the Novice and Moderate groups. An additional method of reaching participants is the distribution of flyers via the United States postal service alongside a letter of explanation about the study. This method is geared toward recruiting participants in the faculty group who may not belong to the listservs noted above. A final method of participant recruitment consists of an email notification with a hyperlink to the web survey site for the study. This method is geared toward individuals outside of any of the above outlined communities.

Research Procedure

The study consists of an interactive Web site which presents participants with a questionnaire and a series of images to gather their responses. The questionnaire, consisting of a series of ten questions, collects information about participants' image indexing experience, subject expertise and demographics. The indexing portion of the study consists of eight separate pages, each with a single image alongside an area for participant

provided indexing terms. Participants are prompted to supply conceptual terms they feel might be used to retrieve the image they are viewing. Data from questionnaire responses and applied image terms are collected through the Web interface and stored in a database.

Data Analysis

The data collected for this study will be analyzed quantitatively in order to identify significant factors affecting interindexer consistency levels. Responses to the questionnaire will be coded numerically as a first step in the data analysis. The indexing terms supplied by the participants will be analyzed according to percentages of exact matches, conceptual matches, and non-matches between indexers. Questionnaire responses surrounding indexing experience and subject expertise will be analyzed alongside the percentages of interindexer consistency in order to discover possible factors influencing exact term matches and conceptual agreement. If the study indicates there is a significant correlation between experience, and or subject expertise and effective indexing, as seen in higher percentages of interindexer consistency scores, one condition for successful image indexing will be discovered. By investigating both image indexing experience and subject expertise, the specific required proficiencies needed to complete the work effectively will be clarified. Considering the labor-intensive nature of indexing visual materials it would be prudent to ensure the usefulness of the work.

Further quantitative analyses will be undertaken through a coding of term types and image types. Term types will be numerically coded according to generic description, identification, and interpretive categories, while image types will be coded for categories of legibility. A distribution of term types will clarify what the typical indexing term coverage is overall. This distribution of term types will be further analyzed according to indexing experience, subject expertise and image type in order to discover possible factors at work in the description of visual materials. An analysis of image types alongside percentages of interindexer consistency will be completed in order to examine what role, if any, image legibility plays in affecting exact term matches and conceptual agreement. Finally, due to the fact that term consistency may be influenced by experience, subject expertise, term type and image legibility, a multiple regression analysis will be used to analyze the data.

Expected Results

The study has just begun and so at this early date no results are available. Preliminary results are expected to be available at the conference. There are several expected results, and these are:

1. Increased indexing experience and subject expertise will be reflected in an increase in interindexer term consistency.
2. Image descriptor types will be most numerous at the generic description level, and least numerous at the interpretation level.
3. The greatest interindexer consistency will be found at the generic description level, and the least at the interpretation level.
4. Image legibility will influence the number and type of descriptors used, as well as interindexer consistency.

Discussion

The wealth of information images have to offer hasn't been broadly appreciated until recently. Historically, access to images had been restricted by the physical nature of the materials. With the explosive growth of the Web and the development of common imaging technologies over the past decade, exchanging visual information has become a quick and relatively easy process. While images are readily recognized for their power to persuade us, inform us, and give us pause to contemplate, problems inherent in accessing the media have yet to be fully comprehended. This study sets out to investigate image indexing in an attempt to increase access to these rich materials. While two studies have been conducted to date on interindexer consistency for images, there was no attempt to discover the reasons behind the results. It is hoped that by investigating the various factors surrounding image indexing our future ability to provide access to images will show far more promise.

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