Tagging, Folksonomy and Art Museums: Early Experiments and Ongoing Research

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Abstract

Tagging has proven attractive to art museums as a means of enhancing the indexing of on-line collections. This paper examines the state of the art in tagging within museums and introduces the steve.museum research project, and its study of tagging behaviour and the relationship of the resulting folksonomy to professionally created museum documentation. A variety of research questions are proposed and methods for answering them discussed. Experiments implemented in the steve.museum research collaboration are discussed, preliminary results suggested, and further work described.

Keywords: Tagging, folksonomy, art museums, vocabulary analysis, research agenda, user generated content

1. Introduction

This paper reviews current implementations of tagging in museums and in the context of research about access to art museum collections. The challenge of creating and organizing personal collections of networked information resources is not unique to the users of on-line art museum information. Others who actively use Web-based resources have developed tools to enable the creation of personal collections of 'bookmarks' or pointers to networked resources, that are described or 'tagged' with words that identify and categorize them (Golder & Huberman, 2005; Hammond et al., 2005; Lund et al., 2005; Mathes, 2004; Quintarelli, 2005) (Pennsylvania State University Library, 2005-). "Social

Tagging" is the public labeling or categorizing of resources
in a shared environment. The resulting aggregation of tags
form a "folksonomy": a conflation of the worlds 'folk' and
'taxonomy' used to refer to an informal, organic assemblage
of related terminology (Vander Wal, 2005). When shared with
others, or viewed in the context of what others have tagged,
these collections of resource identifiers, tags and people
may take on additional value through network effects. It has
been theorized that searching tags could enable the
discovery of relevant resources, and the social
relationships that develop among taggers become a means of
information discovery in and of themselves (Marlow et al.,
2006). Museums have been interested in social tagging, in
part because of the success of tagging environments such as
the ESPgame [http://www.espgame.org] (Ahn & Dabbish, 2004;
Bearman & Trant, 2005).

2 The State of Research

2.1   Tagging, Folksonomy and Museums

A general survey of the social tagging and folksonomy
literature (published separately) points to a number of ways
that social tagging and folksonomy could enhance access to
museum collections on-line. Preliminary studies within
museums – discussed here in detail (section 2.1) – have
framed issues in tagging and folksonomy within a
museological context, and modeled methods for their
exploration. These studies provide direct context for the
research described in Section 3.

2.1.1 A Model of Tagging Works of Art

We have developed a model that positions tagging between
users and objects (*Figure 1*), in contrast to museum
documentation, which sits between museums and objects. When
museums document objects they compile records according to
internal standards and guidelines. Curatorial involvement
ensures that works of art are researched and information is
presented in a scholarly manner. A single, authoritative
record is created describing the works of art, and this
record represents the work in a collections database.
However, when users tag works of art, they respond to

different aspects of it, often influenced by personal
interests. Their tags may be highly idiosyncratic, or may
overlap with those of other users.
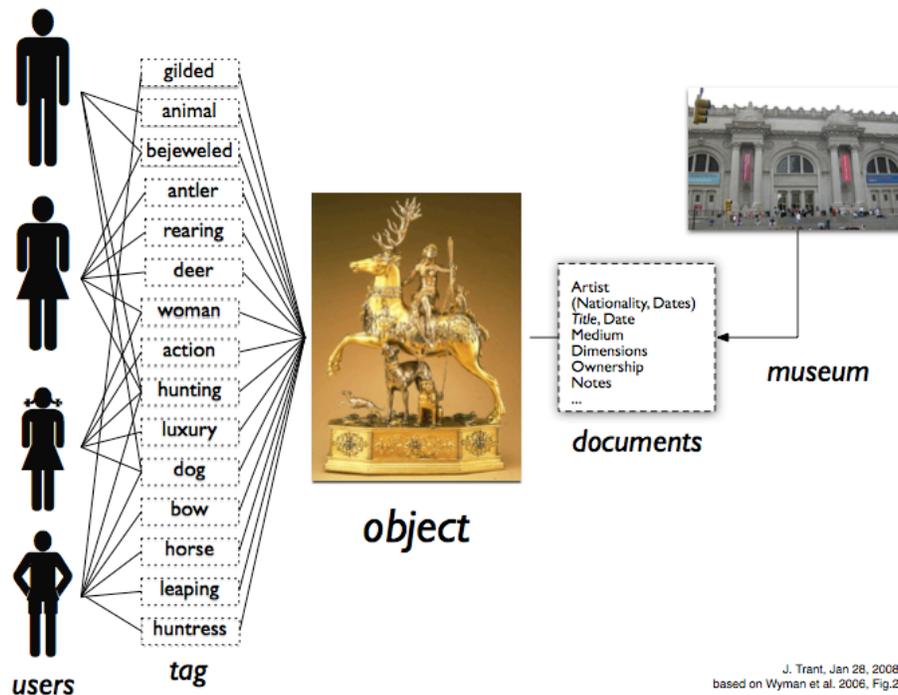
Figure 1. Differing views on object documentation: while users tag from
multiple perspectives,
the museum documents from a single, institutional point of view.

Further study is needed to understand the differences
between tags and museum documentation.

2.1.2 Enhancing Curatorial Documentation

User tags could provide additional points of view to that in
existing museums records. Museum documentation is known to
address works of art from a perspective different than that
of the public. Within the context of art museums, user
contributed tags might help reflect the breadth of
approaches to works of art, and offer access to alternative
points of view. Tags could offer another layer that
supplements and complements the documentation provided by
professional cataloguers. Proof-of concept studies at The
Metropolitan Museum of Art solicited tags for works of art,
and showed the potential contribution that social tagging

might make to improving access to art collections, through an analysis of the contributed tags and their comparison to documentation created by the museum (Trant, 2006a). Curatorial staff may not be able to provide access points of relevance to the public. As a curator at The Metropolitan Museum of Art said, "everything I know is *not* in the picture" (Jenkins, 2006).

In a study of tags contributed during prototype steve.museum data collection, tags for works of art were compared to museum documentation, to explore the actual contributions made by naïve users. Surprisingly large proportions (in one case > 90%) of tags represented terms not found in museum records. A comparison of tags assigned to the four most-tagged works in the steve.museum tagger prototype, with their documentation on the Web site of The Metropolitan Museum of Art, confirmed the distinction between public and professional vocabularies pointed to by the Proof of Concept studies (Trant, 2006b). For example, the subject matter of a work of art is often taken as given – unless it is problematic – as the work is assumed to be present and visible. [As a point of reference, genres of curatorial discourse are explored in the templates created for the Pachyderm project (Samis & Johnson, 2005).] When the role of these texts is changed from their original purpose of offering interpretation to the support of information retrieval, they may not be as effective. Social tagging seems a promising way to supplement museum records with terminology to support some kinds of queries, but a large scale, multi-museum study comparing tags and terms found in museum documentation is needed to determine this.

In a somewhat related study, van Hooland reports a content analysis of comments made about a digital collection in the National Archive of the Netherlands (~500,000 photographs a core of news photography). The study was premised on the idea that comments provided more value than simple tags: "as comments are not restrained to a chain of one-word descriptors, they can offer a higher semantic value and have more potential use for implementation within cultural heritage databases" (p. 4). Van Hooland uses what he calls Shatford's classifications (that is a combination of Panofsky's pre-iconography, iconography and iconology and a Ranganathan-inspired who, what, where, when) to characterise

queries, and user comments [also used by (Armitage & Enser, 1997)], to assist in evaluating the *quality* [his word] of user comments. Queries were collected from 5/4/2004 - 1/3/2006 (465,124 searches), and a sample (384) was analysed (confidence interval of 5% and confidence level of 95%). Distribution was: 57% iconography/where; 17.5% iconography/who; 9% pre-iconography/who; 8.5% pre-iconography/what; 5.5 % iconography/what; 2.5% iconography/when. No queries were made for pre-iconography/where, pre-iconography/when, or any iconological (who/what/when/where) terms. User comments analysed were from a set of 4,647 comments from between April 4, 2004 and March 1 2006; a sample of 355 comments was selected (interval of 5% and level of 95%, but the interval was really too large for the size of some small categories). Comments broke down into "metadata corrections: 34.13%, storytelling: 18.87%, personal biography: 4.29%, image quality (accuracy): 3.14%, opinions/judgments: 2.86%, and queries/questions: 1.15% (p. 8-9) (van Hooland, 2006). While related, through its content analysis of user contributions, this study does not address questions of access *per se*. Nor does it provide insight into the possible role of tagging or folksonomy.

The Cleveland Museum of Art has been experimenting with tagging, soliciting terms with the invitation to "help others find this object" (Cleveland Museum of Art, 2005). They surfaced a distinction between user behaviour when commenting (in a large text box), and when tagging (in a small text box) (Chun et al., 2006). Any study of tagging must take care to distinguish it from user commenting.

User tags might help bridge the gap between professional and public discourse by providing a source of terms not in museum documentation (Trant, 2006b); empirical study of the nature of user tagging, and its comparison to documentation created in museums is needed to establish this.

2.1.3 Improved Access to Collections

User tags could enhance the number and kind of access points for works of art, and therefore improve recall through the presence of more index terms. The folksonomy derived from user tags might serve as another layer, augmenting existing

description and indexing tools, but not replacing them
(Trant & Wyman, 2006). This broadens the scope of indexing
vocabulary beyond that of professional cataloguers or
indexers (Honigsbaum, 2005; Kipp, 2006a, 2007; Trant, 2006a,
2006b). This has certainly been the experience of the
Library of Congress in their early experiments with the
Commons on Flickr (Oates, 2008), echoed in that of the
Powerhouse Museum (Chan, 2008a, 2008b) and was the
motivation for tagging at the Philadelphia Museum of Art
(Philadelphia Museum of Art, 2007) and Smithsonian
Photography (Smithsonian Institution, 2006).

Searching based on tagging has been implemented in a number
of on-line museum collections. The Powerhouse in Sydney is
the best documented (Chan, 2006a, 2006b, 2007a, 2007b). Chan
reports strong user participation in tagging and significant
increases in use of the on-line public access catalogue. He
also shows how tagging surfaced a popular object – a dress
worn by Australian pop star Delta Goodrem – that had never
been on display in the museum (Chan, 2007b). But the unique
contribution of user contributed tags cannot be determined
in this context, as a number of different system
enhancements were deployed together, including tagging, the
seeding of indexes with terms derived from collection
documentation, and the creation of a Web of related objects
derived from co-occurrence of index terms. Most recently,
the Powerhouse has been experimenting with machine-generated
tags, using Open Calais (Chan, 2008c), further exploring
hybrid solutions to improved access to collections.

The relationship between user tags and searches of art
museum collections remains un-determined. A preliminary
study of art museum searching showed a broad range of
searches, many of which were unsuccessful (Trant, 2006c).
But the concordance between tagging and collections
description has not been established. Larger comparisons of
search terms to tags assigned to a broader range of objects
from multiple museums are necessary to determine how user
tags relate to searching of museum collections, and identify
if including tags in search indexes might offer improved
results. The relationship of user-assigned tags to user-
provided search terms that produced no results when
searching the same art collections would be of particular
interest.

2.1.4 Understanding Audiences and Building Community

New perspectives in museum documentation might engage new communities of users and improve museums' understanding of them. For example, specialist design and textile historians provided user descriptions of swatches in a series of electronic swatchbooks of fabrics in the collection of the Powerhouse Museum (Powerhouse Museum & Chan, 2005), both making this previously inaccessible content searchable, and supporting their specific uses of it. Tagging and folksonomy may also offer new ways for museums to engage user communities and assist them in their use of collections (Coldicutt & Streten, 2005). This could be the general public tagging works in the Powerhouse Collection (Chan, 2007b) or 19th century scholars as part of The NINES Consortium (2005). They could be geographically connected, as in the Taggin' Tallinn project (Kaipainen & Pata, 2007). Or they could be in the context of a game, as at the McCord Museum of Canadian History (McCord Museum, 2007), or personal collections, as with Collection X at the Art Gallery of Ontario (Art Gallery of Ontario, 2007; Rubenzahl et al., 2008).

Krystyna (2006) looks at examples of social classification (primarily Flickr) as models of the ways that user generated tags could encourage user involvement with digital image collections. Museums might take advantage of the subjective nature of tags, particularly when tags become annotations, like they do in the PennTags application, an academic social bookmarking (annotation) tool for use on the Penn State campus (Pennsylvania State University Library, 2005-). Museum-related entries in tag-driven environments like Flickr (2006) and del.icio.us (2006), provide another window into audience interests, behaviours and attitudes that might help further understanding of how the museum and its collections are perceived. But the public tagging of museum content in Flickr and del.icio.us is now quite extensive, and difficult to sample and study.

The relationship between user tags and museum education and interpretation also remains to be established. Kellogg Smith (2006) tries to analyse on-line tagging from a frame of in-gallery visitor studies, confusing the goals and purposes of on-line information access and in-museum art education.

Tagging needs to be approached with a robust model of the
museum, its social and educational objectives, and its many
types of interactions with users. The tagging activity needs
to be positioned within a context of on-line information
retrieval and use, and distinguished from possible studies
of in-gallery applications.

Tagging is a highly personal activity (Golder & Huberman,
2005). Tags exist in a liminal space between a user and an
information resource, and as such represent a critical facet
of personal meaning-making. The subjective nature of tagging
might reveal something of how art collections are perceived
by a broad public. As there are few tools to directly gather
this kind of feedback from museum visitors, the social side
of social tagging merits exploration within the context of
other museum-based community development and user-
contributed content initiatives (Trant & Wyman, 2006). As
museums strive to be more relevant to their communities,
comparison of results obtained by different methods of
encouraging engagement with collections should be
systematically analysed. Studies of tagging behaviour could
make a contribution here.

As these preliminary studies show, there are many
outstanding questions about how social tagging and
folksonomy might function in the museum context. Further
research is dependent upon developing a basic understanding
of how users tag works of art, the kinds of terminology they
use, and how that relates to documentation created in
museums.

3. A Research Question: Can Social Tagging and Folksonomy Improve On-line Access to Art Museum Collections?

While early studies point to the possibilities, a number of
outstanding questions remain. Understanding the contribution
that social tagging and folksonomy might make to on-line
access to art museum collections requires a empirical study
of real tags applied to different works of art by a broad
range of users: i.e. a larger, longer duration study than
the prototypes mentioned, that involves multiple museums,
and gathers thousand of tags from a large number of users
over many months.

This section proposes methods to address a set of related research questions, each of which contributes to an understanding of the broader contribution of social tagging and folksonomy to on-line access to art museum collections. Three of these narrower questions are tag-related, and one relates to the social tagging system environment:

Tag-Related Questions:
* *Do user tags differ from terms in professional museum documentation? If so, how?*
  If user tags differ from terms in professional museum documentation they can be said to provide additional access points and thus improve recall when collections are searched.
* *Do museum staff find user tags useful for searching art collections?*
  The usefulness of user tags for searching – i.e. the ability of naïve users to provide helpful descriptions – has been called into question by professionals. If museum staff review tags assigned to works of art, and find them useful for searching, this criticism of user tagging can be addressed.
* *Do user tags correspond to terms used to search on-line art museum collections, i.e. could their presence in indices improve retrieval?*
  It has been widely hypothesized in the tagging literature that tags will improve searching. This assertion can be tested by comparing tags to the terms used to search museum collections. If the tags and search terms match, then tagging could improve searching. How much tagging could improve searching cannot be established without also comparing search terms to museum documentation. The match between search terms and museum documentation reflects the *status quo*. Any increase in matching when tags are introduced can be considered an improvement.

Tagging Environment Question:
* *Does the tagging interface influence tags assigned?*
  The literature on vocabulary normalization suggests that variations in the tagging interface might influence the tags assigned. Museums interested in maximizing the utility of tags for searching might wish to tailor interfaces for certain circumstances

(to produce more, varied tags for instance, rather
than to validate particular tags already assigned).
A series of controlled interfaces to the tagging
software makes it possible to test the effect of
simple variations.

A pragmatic approach to this research is proposed, employing
a variety of methods to describe the tags collected, compare
them to documentation created for works of art, review them
in conjunction with museum staff, compare tags with evidence
of searching (found in search logs), and compare tags
assigned across interfaces.

3.1   Introducing steve.museum

The rest of this paper reports on how these research
questions are being addressed within the steve.museum
collaboration. Steve.museum is a group of art museums (and
the professionals who support them) formed in 2006 to
explore the role user-contributed descriptions can play in
improving on-line access to works of art. Participants
include: Denver Art Museum; Guggenheim Museum; The Cleveland
Museum of Art; Indianapolis Museum of Art; Los Angeles
County Museum of Art; The Metropolitan Museum of Art;
Minneapolis Institute of Arts; The Rubin Museum of Art; San
Francisco Museum of Modern Art, Archives & Museum
Informatics; and Think Design (Bearman & Trant, 2005; Chun
et al., 2006; Trant et al., 2007; Trant & Wyman, 2006). The
group is funded in part by the U.S. Institute of Museum and
Library Services through a National Leadership Grant that
runs from October 2006 through September 2008 (The
Metropolitan Museum of Art et al., 2006).

Linking the research proposed here with the activities of
steve.museum also satisfies Markey's recommendation for
'real world' studies (Markey, 2007).

3.1.1 Test collection for tagging

Any study of tagging art museum collections requires a test
collection of digital representations of museum objects that
can be made available for users to tag. In order to be
reflective of the actual documentation available in art
museums, such a collection should be drawn from readily

accessible, existing digital materials, created and used by art museums. The data set for tagging should not be artificially created. New documentation should not be compiled for this research. Nor should new digitization take place.

Images used for the study should be gathered from existing collections, and be of the size and resolution that museum professionals have actually made available, or are comfortable releasing freely on the Web for broad use. They should be captured according to procedures in-use in participating museums. Textual documentation should reflect standards in-place, and content readily available. New research should not be conducted in order to improve museum documentation prior to release of works for tagging. In this way, the information about works of art encountered in an experimental tagging environment will be representative of that encountered on a museum Web site.

A limited range of subject matter is important in order to limit the number of variables at play in a tagging study. Tagging of art museum collections might differ from tagging of other kinds of museum collections. However, there is already a large range of variation in the informational content of different kinds of works of art. Prototypical tests (reported in Trant, 2006a) showed that tagging activity differed depending on the type of work presented – e.g. a medieval manuscript vs. an Impressionist painting – so the test collection should include a broad range of works, and strive to avoid over-concentration in particular areas (beyond what is reflective of art museum collections generally).

But if all the works presented to tag could be said to belong to the same 'discipline', then this defined subject scope will facilitate analysis. For example, discipline-specific content standards, such as the *Categories for the Description of Works of Art* (Art Information Task Force (AITF), 1995; Baca & Harpring, 2006), and vocabulary sources, such at the *Art and Architecture Thesaurus* (J. Paul Getty Trust, 2000a) and the *Union List of Artists' Names (ULAN)* (J. Paul Getty Trust, 2000b) could be used as benchmarks of professional vocabulary. For the purposes of this study, it is assumed that the language of the

documentation and tagging will be English, though some specialist terminology of foreign derivation, such as "chiaroscuro" is likely to be present.

Steve.museum has assembled a test set of works of 1,784 works of art, with contributions from all participating museums, and a number of interested, but less active museums. The breakdown between institutions is shown in *Table 1*.

Boston Museum of Fine Arts	237
Cleveland Museum of Art	117
Denver Art Museum	20
Indianapolis Museum of Art	250
Los Angeles County Museum of Art	191
The Metropolitan Museum of Art	251
Minneapolis Institute of Arts	243
Rubin	111
San Francisco Museum of Modern Art	161
Skirball	153
Tate Modern	50
	1784

Table 1. Final number of works in the steve.museum test data set, by institution

3.1.2 Tagging environment

To enable broad tagging of these works of art, a tagging tool – or tagger – needs to be made available on the Web, and the tags recorded in a structured way. Steve.museum has created an open source tagging tool, available at http://tagger.steve.museum, and downloadable from sourceforge.net. The tagger tracks detailed data about registered and anonymous taggers and the tags they assign, linking tags both to works and to the system environment in which they were given. Data is recorded in a MySql database, and is readily available for analysis. See *Figure 2* for a simplified schematic of the data structure.
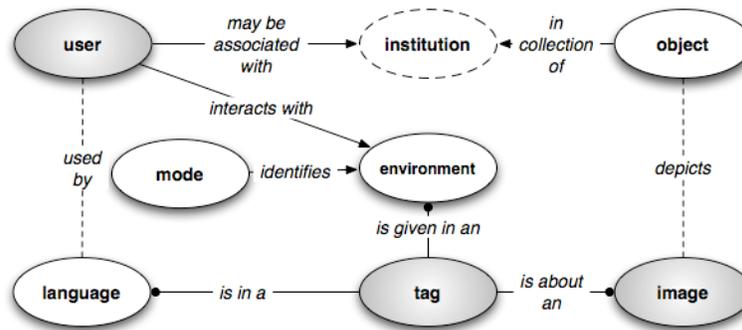
Figure 2. A simplified version of the steve.museum data model.
(Published as Figure 6 in Wyman, B., et al., 2006)

3.1.3 Recruiting taggers

Taggers need to be recruited from the broad Internet community, and asked to tag works of art. Within steve.museum, taggers have been recruited through general museum electronic mailing list requests (e.g. MUSEUM-L), subject-specific lists (such as H-ArtHistory and CAAH), the popular press (including coverage in *The New York Times* (Pink, 2005); (O'Connell, 2007) and local press in cities like Indianapolis (Elig, 2007)), blog postings (149 tracked to the end of March 2008), and volunteer requests on craigslist.org.

This varied strategy has been successful. Between March 2007 and March 2008, 931 users have registered at tagger.steve.museum and there have been an additional 3,949 sessions by unregistered / anonymous users. A large volume of terms has been entered: 42,622; 25,182 from registered users and 17,256 from unregistered users [these figures are as of March 27, 2008 and will change].

3.1.4 Search log data available

The literature of tagging assumes that tags assigned are similar to the terms used to search. However, this has not been proven. A comparison of tags assigned to works of art and the terms used to search for them in on-line museum catalogues should help answer this question. A sample of search log data from some of the same museums that provided the test works of art for tagging is required to conduct this analysis.

To date, steve.museum has assembled search log data from the Guggenheim Museum, The Metropolitan Museum of Art, the Minneapolis Institute of Arts and San Francisco Museum of Modern Art as outlined in *Table 2*.

Museum	Start Date	End Date	No. of Searches
Guggenheim Museum	01-Sep-05	31-Aug-06	126,999
The Metropolitan Museum of Art	02-Aug-05	19-Mar-06	2,514,063
Minneapolis Institute of Arts	01-Sep-05	31-Aug-06	251,918
San Francisco Museum of Modern Art *	01-Jan-04	31-Dec-05	151,102

*top 10,000 search terms for each year

Table 2. Search log data available as of March 2008 from steve.museum participants

For each museum, the date and time of the search, and term searched is available. Only the Guggenheim reports whether the search was successful. While search volume varies (as some museums' catalogues are searched more than others), breadth of coverage and a similar representation of institutions are important. It is not going to be possible, however, to include log data from all museums that contribute works to be tagged, as not all at museums have searchable databases of their collections on-line.

3.1.5 Museum collaboration

The close involvement of museum staff in the research ensures access to documentation, images of works from museum collections, and logs of searches made of museum Web sites. In addition, assessment of the contribution of tags requires museum input. As many barriers to change in institutions are cultural, museum staff involvement is essential to assess cultural barriers to the inclusion of user-contributed index terms in museum on-line documentation. Museum staff involvement also helps place the research in an appropriate museological content.

3.2   Tag-Related Questions

The first set of research questions about the role of tagging and folksonomy in enabling access to art museum collections can be answered by studying the tags assigned to the test collection of works of art. Tags will be compared to documentation of works of art to see if they add new terms (or represent new concepts), in a multi-faceted

analysis of tag vocabulary. Tags will be compared to search
terms to see if their presence in indexes would have
improved the results of simple searches of on-line
collections – in a quantitative assessment of their
contribution. Tags will be reviewed by museum professionals
to see if they accurately reflect the work of art – a
qualitative judgment of their efficacy. The results of all
these reviews will be compared, quantitatively, to see if
there are areas where tagging makes a particular
contribution. Each of these studies is discussed in more
detail below.

3.2.1 Do user tags differ from museum documentation?

User-supplied tags may differ from museum documentation. The
reflection of a different point of view – of the individual
perspective of the tagger rather than the institutional
perspective of the museum – is hypothesized to be one of the
critical contributions of social tagging in the museum
context (Chun et al., 2006). But this can only be
established with a broad study of tags assigned to works of
art. Prototypical tests at The Metropolitan Museum of Art
(reported in Trant, 2006a) defined a methodology for
establishing the contribution of tagging to the description
of works of art. Tags collected from a range of users for a
number of works were compared to museum documentation for
those same works. Analysis of data gathered in this
prototype showed a strong difference between user tags and
curatorial documentation (Chun et al., 2006; Trant, 2006a;
Trant & Wyman, 2006). This approach to tag analysis is also
used by Kipp in her studies comparing user tags with
professionally created metadata (Kipp, 2006a, 2006b).

Tags assigned to all works will be described in basic
descriptive statistics, by calculating and plotting a range
of characteristics shown in *Table 3*, including the total
number of tags assigned for each work, the total number of
distinct tags, the number of taggers, and the number of tags
per tagger (high, low, average [mean] and standard deviation
[to show the range in tagging activity]). *Tagger Velocity*
(the number of tags per tagger assigned per work) and *Tag
Variation* (the diversity of tags assigned per work) will be
compared across object type.

Tags per work

	# of tags		# of taggers	# tags per tagger							
	total	distinct	total	total tags				distinct tags			
				high	low	average	std. dev.	high	low	average	std. dev.
all works											
work 1											
work 2											
work 3											

Table 3. Simple descriptive statistics profile the number of tags assigned to each work.

Tags will then be compared to the documentation supplied by museums, listed in
Table 4 and chosen because of its ready availability and its use for in deployed on-line search systems.

Museum Data	Definition	Req.	Example
Institution	The display version of your museum's name	y	The Metropolitan Museum of Art
Image filename	The name of the image file that matches this object.	y	aps854.jpg
Institution ObjectID	An identifying number assigned to the object in your institution, other than an accession number (e.g. the record number from your collections management system).	n	11479
Title/Object Name	The display for of the work's preferred Title or Name.	y	The Gulf Stream
Date	The display form of the work's date.	y	1899
Maker/Culture	The display form of the creator's [or creators'] name[s] (and dates if desired)	y	Winslow Homer, 1836–1910
Medium	The display form of the material, support and/or techniques used to make the work	y	oil on canvas
Dimensions	The display form of the work's dimensions	y	28 1/8 x 49 1/8 in. (71.4 x 124.8 cm)
Object Type	The type of work, e.g. painting, sculpture, installation	y	painting
Credit Line	The display form of any credit to be shown with the work of art.	y	Catharine Lorillard Wolfe Collection, Wolfe Fund, 1906
Copyright	The Display form of any copyright statement for the work of art.	n	© Jasper Johns/Licensed by VAGA, New York, NY
Accession Number	The accession number assigned to the work of art in your museum	y	06.1234
Notes	curatorial or other notes about the work.	n	*The Gulf Stream* was based upon studies made during Homer's two winter trips to the Bahamas in 1884–85 and 1898–99. First exhibited at the Pennsylvania Academy of the Fine Arts in Philadelphia in 1900, the picture was subsequently reworked and "improved" by the artist. Early photographs show changes to the sea and to the back of the ship, making the composition more dramatic and vivid. The painting was shown in this state at the Carnegie Institute in Pittsburgh in 1900–1901, and then at M. Knoedler and Co. in New York, where the artist placed on the picture the record-asking price of $4,000. There were problems selling the work because of either its high price or its unpleasant subject matter. Homer may have reworked the painting again in the face of this criticism in order to add the rigger on the horizon that signals hope and rescue from the perils of the sea.

Table 4. steve.museum Guidelines. Documentation for works of art submitted to be tagged was requested from participating museums in a format comparable to that of CDWA lite. A simple CSV format was used for

data transfer, and files were accompanied by a digital image file (1024 x 768 pixels) for each work.

Searching in museum on-line catalogues is supported on basic data fields, often prosaically referred to as 'tombstone data', that are likely to be present for most works.

Artist (nationality birthdate-deathdate)
Title, date
medium, support
dimensions
Acquisition details (accession number).

These are the data that are commonly used to identify and describe the work of art inside the museum, and are presented on in-gallery labels ("label copy"). This data is present for all works in the steve.museum data set. Extended Curatorial Notes may or may not be available.

The first comparison between tags and museum object data will be a simple truncated character-string compare, with all data shifted into lower case. *Table 5* shows a subset of the terms that match the example given in *Table 4* above).

Count of term_id				
filename_orig	TermInObjectData	term	Total	Unique
ap06.1234.L.jpg	yes	sea	26	
		Homer	4	
		ship	3	
		winslow homer	2	
		see	2	
		painting	1	
		dramatic	1	
		nature	1	
	yes Total		40	8
	no	boat	52	
		storm	41	
		sharks	26	
		ocean	24	
		blue	15	
		waves	14	
		water	8	
		shark	8	
		fisherman	8	
		seascape	6	
		man	5	
		danger	4	
		tornado	3	
		struggle	3	

Table 5. Tags and Museum Documentation: Prototype data analysis

This simple match will be employed because it reflects the way in which the majority of museum catalogues are searched on-line: single term is entered, and matched against a keyword index. The results of this matching will identify –

at a basic level – if tagging contributes new terms and
where it duplicates museum documentation *(Figure 3)*.

In preliminary analyses (through March 2008) about 70% of
tags do not match any part of museum documentation.
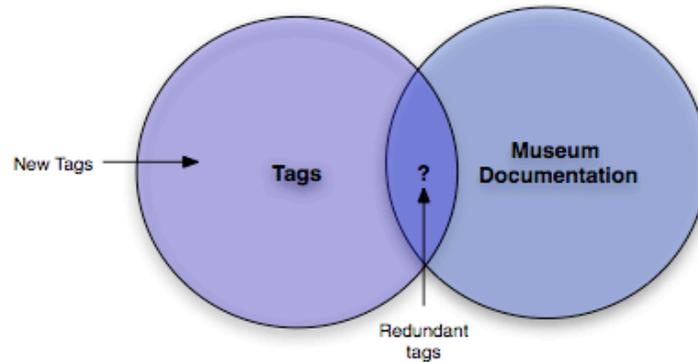
Figure 3. Comparing Tags to Museum Documentation

Results will be presented as a percentage. In prototype
tests, between 86.9% and 92.4% of tags where not found in
museum documentation (Trant, 2006b); the overlap between the
two data sets was very small. Results of the larger test
will be compared to those of the prototype analysis, and to
those from other studies (such Kipp's) that compare tagging
vocabulary to professional cataloguing.

In addition, a sample of works will be studied in more
detail, using qualitative methods. A sub-set of 50 highly
tagged works will be selected at random from the broader
steve.museum experimental tag data set. This selection will
be balanced to reflect different object types and time
periods.

The frequency with which tags were assigned to this sub-set
of works will be studied in further depth. Tag frequencies
will be calculated and plotted for each work in this sample,
as shown in *Figure 4*. A Zipf distribution with a long tail
is expected (the tail is cropped on this graph), showing a
strong inter-tagger agreement on a small number of terms,
with a long tail of divergence. This inter-tagger agreement
is evidence of vocabulary stabilization, one of the
characteristics of all tagging systems. This curve will be
compared across works, to see if there is more agreement on
particular kinds of works.
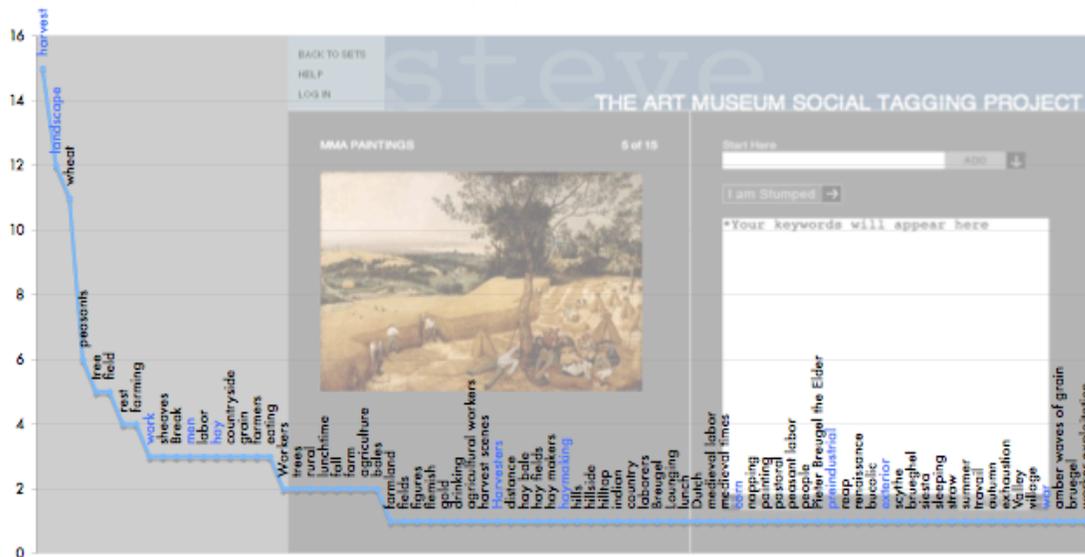
*Figure 4. Terms assigned to the fourth most tagged object in the steve
tagger prototype: Pieter Bruegel the Elder (Netherlandish, active by
1551, died 1569) The Harvesters, 1565. The Metropolitan Museum of Art,
New York, Rogers Fund, 1919 (19.164) (First published in Trant, 2006b).*

The relationship between frequently assigned tags and
presence in museum documentation will be explored. Are the
most commonly occurring tags redundant? Or do common tags
represent new terminology not found in museum documentation?
This analysis will add to our understanding of the
contribution of tagging. For example, if, as is the case in
Figure 4 above, many of the more common terms are not found
in museum documentation, then the contribution of tagging
may be more immediately noticeable than if the new terms
were predominantly found in the 'long tail'.

A smaller sample will also make it possible to explore some
of the criticisms of folksonomy in the information retrieval
focused literature (for example Spiteri, 2007). Tags will be
reviewed on a work-by-work basis to identify the presence
of:
• Synonomy (multiple words for the same concept)
• Polysemy or Homography (use of same word for
  different meanings)
• Orthography (spelling and multi-word concatenation
  conventions, use of the singular or plural;
  homophones; variations in part of speech)
• Ambiguity (uncertain meaning)

- Hierarchy (inconsistent granularity in concept identification)

By studying the set of tags assigned to a smaller group of works it will be possible to determine how widespread these problems are. The impact of this analysis on the results of matching against museum documentation will also be assessed. For example, identifying the presence of synonyms and variations in orthography will determine if tags often represent alternative forms of terminology already present in the museum documentation.

Nuance could be added by further studying tags that are – or are not – represented in museum documentation for this sub-set of works. Tags that are represented in museum documentation could be profiled based on the part of the museum record where they were found. For example, it could be established if users do or do not offer tags related to the major AITF Categories (Baca & Harpring, 2006), such as Creator, Nationality, Object Type, Date, or Subject Matter. This parallels the methods of the Catechism project and the CIMI Access Points work (Janney & Sledge, 1995a, 1995b; McCorry & Morrison, 1993, 1995; Sledge, 1995).

Tags could also be compared to common vocabulary sources, such as the *Art and Architecture Thesaurus* (AAT) (J. Paul Getty Trust, 2000a) and the *Union List of Artists Names* (ULAN) (J. Paul Getty Trust, 2000b) to identify if they reflect the professional vocabulary of the museum or a different vernacular vocabulary of the user. AAT hierarchies could be noted, and compared to the AITF/CDWA category analysis.

Visualizations will be developed to illustrate inter-relationships between these analyses and compare results across type of work and time period. For example, when frequency of use of a tag is plotted with its relation to museum documentation it is possible to see whether popular tags are also new tags. *Figure 5* shows an example from prototype data analysis, with blue terms representing tags that were also found in the museum documentation. When compared with the curve on *Figure 4* above, we can see from prototype data that some works attract more terms, and that the distribution of terms that match museum documentation is

not identical. It may be possible to determine patterns in a
larger study with more tags and more works.
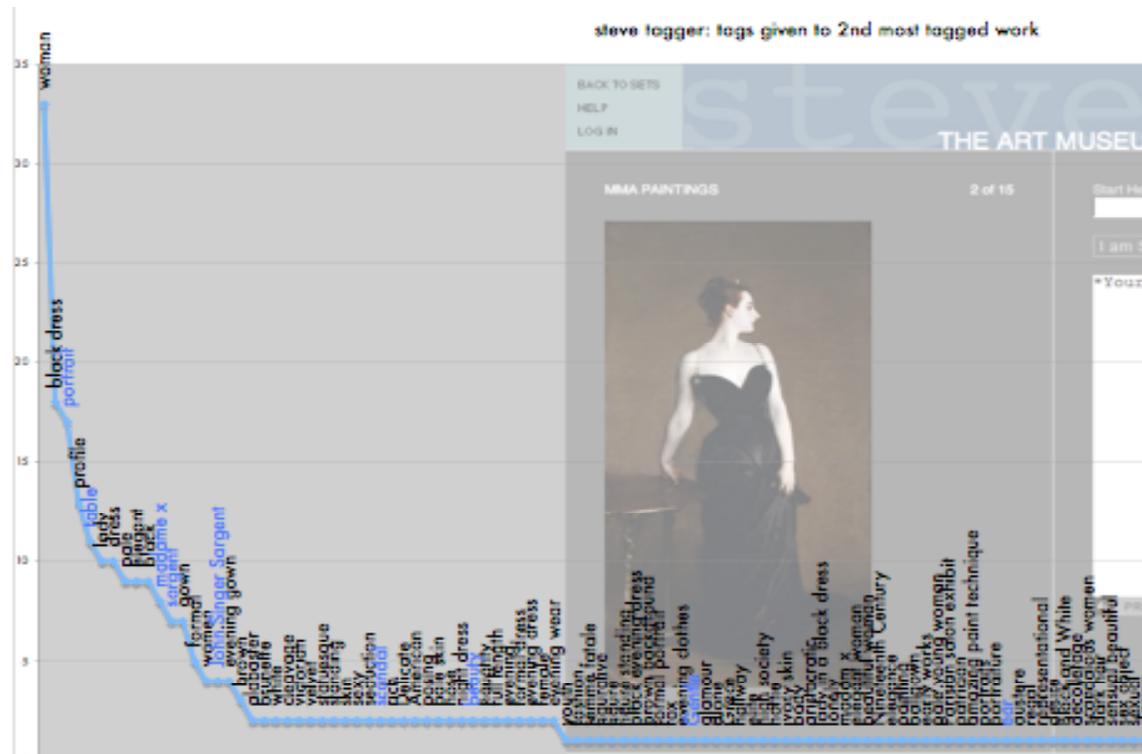
*Figure 5. Terms assigned to the second most tagged object in the steve
tagger prototype: John Singer Sargent (1856–1925), Madame X (Madame
Pierre Gautreau), 1883–84, Oil on canvas; 82 1/8 x 43 1/4 in. (208.6 x
109.9 cm), The Metropolitan Museum of Art, New York, Arthur Hoppock
Hearn Fund, 1916 (16.53). Overlap between tags and museum documentation
are terms shown in blue. (First published in Trant, 2006b).*

3.2.2 Do museum professional staff find folksonomic terminology useful?

Skepticism exists in the professional cataloguing community
about the value of social tagging. In a survey of attitudes
conducted within steve.museum, one respondent noted: "if
well managed, this could be useful. if not, utter chaos"
(Trant et al., 2007). In order to establish if user-
contributed tags are relevant to the work of art tagged,
tags need to be reviewed by professional museum staff and
compared to the works of art themselves. Tag by tag review
is the only way to establish whether – in the minds of the
museum staff responsible for implementing on-line access to
collections – tagging could improve searching.

Using a method similar to that of Von Ahn and Dabbish
(2004), museum staff will review all tags collected in the
experimental data set and assess whether they would find the
term helpful in finding the work. They will be asked to
consider the question:

> *if you found **this work** using **this term** in a **query**,*
would you be surprised?

If you are not surprised, then the term can be considered
useful. If you are surprised, then the term would be flagged
as not useful.

Reviews are taking place at each of the museums, conducted
by one or more people (depending on available staff and
resources). The circumstances of the review is documented in
a questionnaire. Each museum group will review all tags
assigned to works from their collection according to common
guidelines (steve.museum, 2007 / 2008).

Results of the review are being collected using an on-line
tool. Museum staff can approach the review either from a
display of works that have been tagged (which shows the
number of unique terms assigned and reviewed for each work)
or from a display of terms assigned (which then displays the
works which have been tagged with that term). They then see
an image of the work of art, and a list of the terms
assigned to it (*Figure 6*).
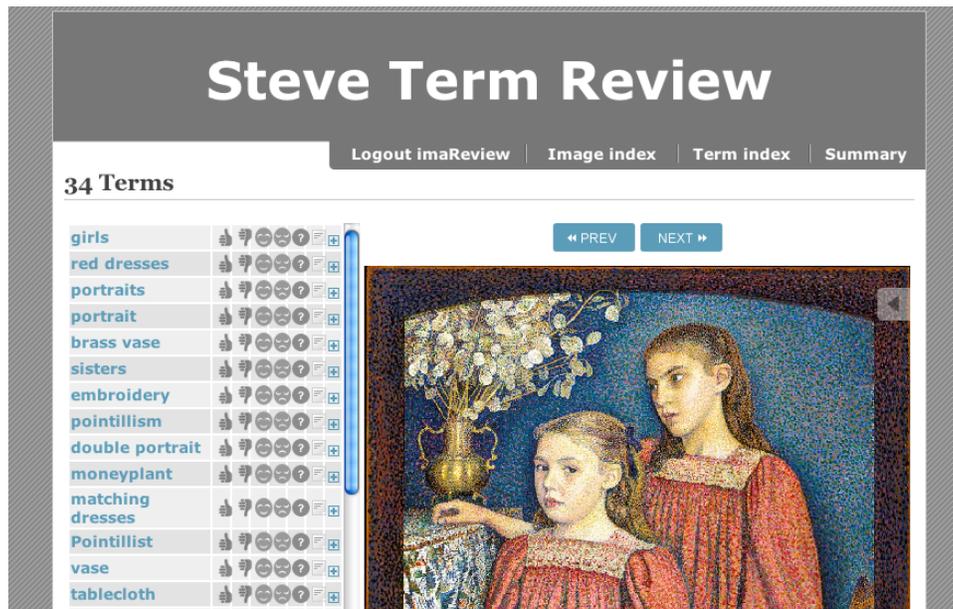
Figure 6. steve tagger term review: unique tags assigned to works of art are presented for review by museum staff

Museum staff are indicating – based on the above question – whether the tags could be *Useful* or *Not-Useful*.

In addition, based on discussions of the steve project team, nuance has been built into the review of tags. They may be optionally identified as *judgmental*, representing a personal assessment of the work in a *positive* or *negative* way, e.g. "fantastic" or "ugly"; as the result of a *mis-perception*, e.g. a mis-identification of iconography; as a *misspelling* or typo, e.g. "gilrs"; as a reflection of a *personal point of view* or category that the museum can't judge, e.g. "mg2x"; and as a *foreign language* term, e.g. "vert". With this input, it will be possible to determine not only the utility of tags assigned to works of art – as seen from the perspective of a museum staff person – but to qualify the places where tags might be seen to be not useful. The goal here is not censorship, but to develop understanding of the nature of tags and the role they could play in improving accessibility of on-line collections.

The results of this qualitative review will be analysed quantitatively, and summarized in a number of ways. Raw numbers and percentages of tags found *Useful* and *Not-Useful* will be presented. *Not-Useful* tags will be described with a

breakdown of the reasons tags where seen as *Not-Useful* (in
percentages and with examples discussed). The *Not-Useful*
list will also be supplemented with the tags that matched
the blacklist in place in the tag-collection environment.
This will ensure we have a comprehensive number of spurious,
malicious or obscene tags identified, and can then assess
the risk of misbehaviour in this kind of environment. So
far, this is minimal: of the 42,622 tags collected to the
end of March, 2008, 26 matched the blacklist.

Finally, tags seen as *Useful* and *Not-Useful* will be compared
to the Found in Museum Documentation analysis. Are any terms
found in museum documentation judged "not useful"? Why?

The assessment of terms by museum staff may not be fully
consistent across institutions. The overall results of each
institution will be profiled to see if some groups were
'harder' in their assessments of usefulness than others. If
necessary, institutional results could be weighted, but some
difference between museums is to be expected, given their
distinct corporate cultures.

This qualitative analysis is designed to address museum-
based concerns about the appropriateness of tags assigned by
the general public, and contribute to understanding the
contribution of tagging.

3.2.3 Could tagging improve on-line searching of works of art?

The third tag-based study examines whether tags might
improve searching: would including tagging terms in indexes
improve search results? It may be possible to get better
results when searching on-line for works of art, if
folksonomic terminology was included in search systems. To
determine this, search terms (gathered from logs of searches
of museum Web sites) will be compared to tags to determine
if there is an overlap from between terms assigned when
tagging and terms used when searching (*Figure* 7).
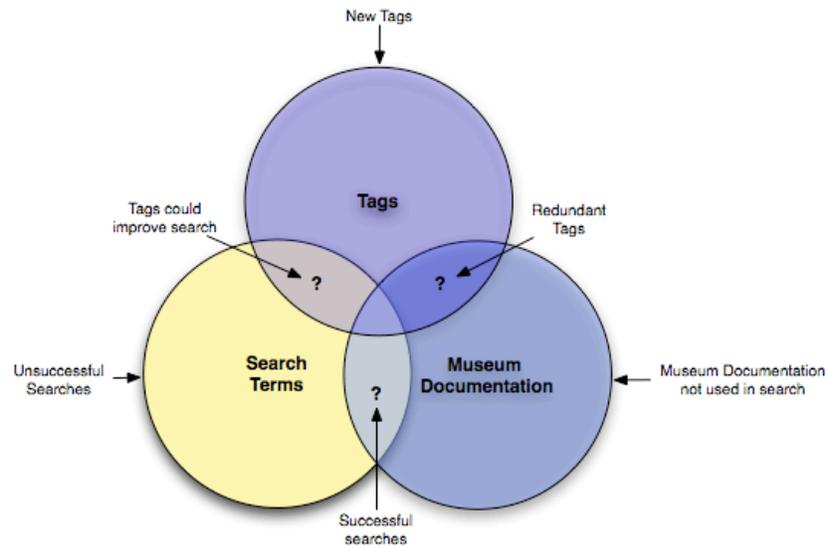
*Figure 7. What are the relationships between the terms used for searching (found in logs),
the tags assigned to works of art, and the words in museum documentation?*

A preliminary study of art museum search logs has been conducted; this method draws upon that experience (Trant, 2006c). Search logs have been collected from the same museums that supplied works of art for tagging and museum documentation for comparative analysis as described above in section 3.1.4.

The prototype analysis showed that searching of a contemporary museum collection may have some particular characteristics, including a strong reliance on artists' names. However, it is not known if these are shared with other types of art museums. Search log data will be described by institution: time period, number of searches, number of distinct terms, and number of searches per term. If necessary, frequency of search will be weighted by institution, and calculated as the number of times a term was searched divided by the number of searches of that institution. This weighting would ensure that the large number of searches from The Metropolitan Museum of Art does not skew the results. Other weightings, or samplings might be necessary to ensure parity between these data sets before comparison takes place.

The tags assigned to the test collection will be compared to the terms used to search on-line collections (recorded in the logs). Again, because most on-line collections catalogues use simple, truncated, character-string matching, the comparison will be made by matching lower-case character-strings, truncated at the end. Punctuation will be removed.

A high degree of overlap between tags assigned and search terms will indicate that tags could be useful for searching collections. A low degree of overlap will question whether the same terms are used to search as tag. Nuance in the analysis could come from seeing if tags match search terms that are used more or less frequently.

The results of the comparison of search terms to tags will be compared with results of the previous two analyses, comparing tags to museum documentation and assessing their usefulness:

- Were search terms also in museum documentation (in which case more effective indexing could be a solution, as well as tagging)?
- What percentage of search terms was only in museum documentation and not in tags, i.e. what percentage of searches could only be met by professional cataloguing?
- What percentage of search terms was in both tags and documentation, i.e. how redundant was tagging to professional documentation?
- Were search terms that were also tags found to be 'useful' in museum review? If not, can a reason be determined for the difference between museum attitudes to utility, and public assertions of interest (as reflected in their search terms)? It is possible, for example, that misspellings will be judged as not useful, but be found in search terms.

It is likely that some Search Terms will not be found in either Museum Documentation or Tags. But, because the universe of museum documentation is not complete in this study, we cannot make any inferences about search terms that do not match tags or museum documentation.

3.2.4 Summary: Tag-Related Questions

Study of multiple aspects of the relationship between tags,
searches, and museum documentation is necessary to determine
how the parts inter-relate (*Figure 8*). Studies of the tags
assigned make it possible to determine if tags add to the
professional documentation of works of art, answering the
question "Do user tags differ from terms in professional
museum documentation?" A study of the kinds of tags assigned
helps provide further detail. An tag-by-tag review by museum
staff will answer the question "Do museum staff find user
tags useful for searching art collections?", and establish
if the contribution of the public can improve on-line
searching. A comparison of tags assigned to searches of on-
line collections, can answer the question, "Do user tags
differ from terms used to search on-line art museum
collections?". If there is correspondence between tags and
search terms, and those tags that match search terms are not
found in museum documentation, then their presence could
improve retrieval.
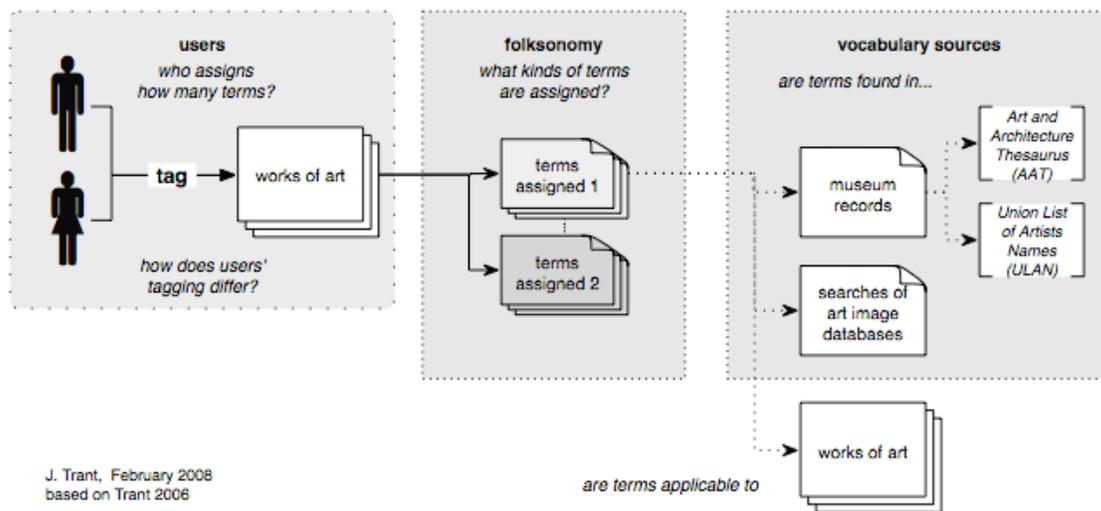
*Figure 8. Studying social tagging and folksonomy in art museums:
Interactions between Users, Tags, Tagging Environments and Institutional
Perspectives*

3.3   Tagging Environment Questions

User interfaces differ in popular tagging tools, such as
Flickr and del.icio.us. Before decisions can be made about
deploying tagging on museum sites, the impact of interface
variables on tagger behaviour should be established. The
steve.museum research project is also exploring the
questions: How does the tagging interface influence tags
assigned? (Trant et al., 2007)

The literature of vocabulary evolution (see the author's
separate study of folksonomy research) suggests that
variations in the tagging interface should influence tagging
behaviour and the tags assigned. As a number of different
user tagging scenarios can be envisioned, understanding the
variables at play in an art museum tagger would increase the
likelihood of a successful implementation. For example, if a
museum's goal was to collect as many tags as possible for a
work of art, then reducing factors that might limit the
number of tags assigned would be important. But if an
institution would like to gather new terms, then an
environment that reduces tag redundancy would be more
desirable. This section explores three questions:
- What are the interface variables at play in tagging
  systems?
- How does the tagger interface influence tagging (as
  shown by tags assigned)?
- What interface characteristics facilitate certain
  kinds tagging?

A series of experimental interfaces to the steve tagger will
be deployed, each with the same content to be tagged (as
outlined in section 3.1.1 above). In discussion the steve
team agreed that the most basic interface variables related
to whether or not the tagger had seen museum metadata or
other tags (Cataloguing by Crowd Working Group & Bearman,
2005). It might also be useful to explore how showing groups
of works or allowing users to choosing works to tag effects
tagging (these concepts are explored in Trant et al., 2007).
Each collection of variables could be considered a tagging
environment.

The following interfaces are being tested in the
steve.museum tagging experiments, and will provide data for
analysis in this study. Test interfaces show:
- No Tags, No Metadata
- Metadata Only
- Tags Only
- Metadata and Tags

Tags assigned by users are linked to a record of environment
variables, so that it is possible to analyze accumulated tag
data on a per-environment basis and determine the
influences, if any, of seeing metadata and existing tags on
users' tagging behaviour.

The analyses of the influence of interface take advantage of
the tag analyses discussed previously, particularly measures
of *tagger velocity* (the number of tags per work), *tag
variation* (the range of tags per work), correspondence with
museum documentation, and *usefulness* as judged by museum
review.

3.3.1 No Tags, No Metadata

The simplest environment, one that could be considered a
baseline against which to measure others, would be a simple
configuration, showing only an image of a work and a box to
collect tags (*Figure 9*). No other data is shown on the
screen.
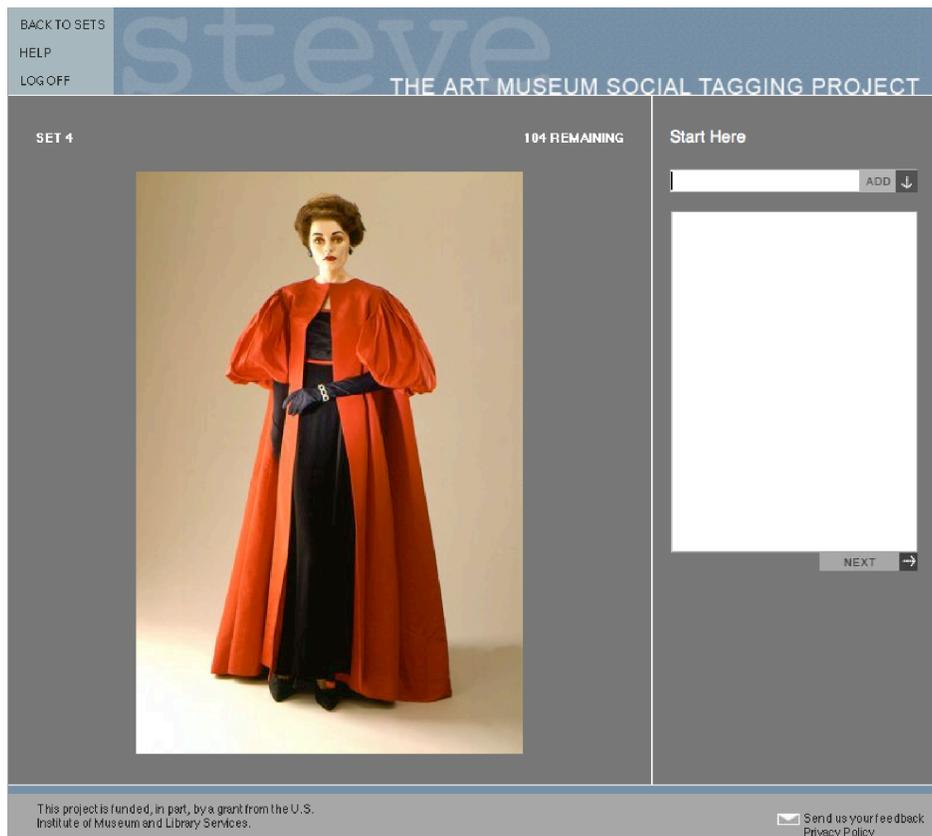
*Figure 9. steve tagger: Do users tag differently when they don't see
others' tags or museum metadata?*

3.3.2 Metadata Only

The second test environment (*Figure 10*) shows only museum-
supplied metadata. Does the display of museum documentation
for a work of art influence the tags assigned? Do users
mimic a museum label, or do they contribute new, different
tags? An environment that adds museum metadata, formatted as
'traditional label copy' to the tagger interface, enables
comparison of tags assigned to the same work with and
without metadata showing.

Figure 10. steve tagger: show museum documentation. Do the tags supplied by users vary when they can see museum documentation (metadata)?

Questions that can be answered by studying tags assigned in this interface include:
- Do users duplicate museum documentation in their tags? Are more tags assigned in the 'show metadata' environment found in museum documentation?
- Inversely, are users prompted to contribute new tags when museum documentation is shown? (Fewer tags assigned in the 'show metadata' environment are found in museum documentation.)
- Are more useful tags assigned when museum documentation is shown?

3.3.3 Tags Only

Does user behaviour change when they see the tags that
others assign? We can hypothesize two possibilities: that
users mimic what is presented to them, or that they strive
to be different. Understanding this is critical to future
deployments of tagging on museum sites, particularly if
statistical thresholding is considered as a way of assessing
tags contributed. If a tag is considered useful after it has
been assigned *n* times, then an interface that impedes the
assignment of tags perturbs this equation.

An experimental interface that shows tags previously
assigned (*Figure 11*) makes it possible to assess if user
tagging is encouraged, dissuaded or otherwise influenced by
the presence or absence of pre-existing tags for works of
art.

Figure 11. steve tagger: show tags. Do the tags supplied by users vary when they can see what others have done?

 Questions that can be answered by studying tags assigned in this interface include:
* Do users assign different tags when they are shown tags assigned by others?
* Do users assign tags that are not in museum documentation when they are shown others tags? Does this differ from when they are not shown tags or metadata?
* Do users assign more useful tags when they are shown tags assigned by others?
* Do users mimic what others have already said (enter duplicate tags) when they can see others' tags?

3.3.4 Metadata and Tags

Exploring the relationships between user-supplied tags, and the presence or absence of museum metadata and others' tags raises questions about interaction effects between metadata and tags. Do tags vary when both museum metadata and user supplied tags are shown (*Figure 12*)? Users might just 'give up' at this point, thinking there was nothing else to say. It might also be possible that that tags contributed in this environment might be the most useful, as they may add the most to the description of the work of art.

*Figure 12. steve tagger: show tags and metadata. Do the tags supplied by
users vary when they can see user tags and museum documentation?*

 Questions that can be answered by studying tags assigned in
this interface include:
- Does the volume of tags decrease when users are
  shown both museum metadata and other's tags?
- Do users assign different tags when they are shown
  tags assigned by others and museum metadata?
- Do users assign unique tags that are not in others
  tags or in museum documentation when they are shown
  both? Does this differ from when they are not shown
  tags or metadata or only shown one or the other?
- Do users assign more useful tags when they are shown
  tags assigned by others and metadata from the
  museum?
- Do users mimic what others have already said (enter
  duplicate tags) when they can see others' tags? Are
  the tags entered already in the tag set?

3.3.5 Works In Sets

One final scenario for deploying tagging (Cataloguing by
Crowd Working Group & Trant, 2005) envisioned users
volunteering to tag works of art as their contribution to a
museum. Here, creating an environment that effectively
stimulates tagging would be important. It may be likely that
users 'get in the groove' when tagging similar works, and
that their tagging of sets of like-works might be more
useful than tags assigned to randomly presented, diverse
works (as in *Figure 13*). Grouping works in sets by medium –
providing some continuity between one work and the next and
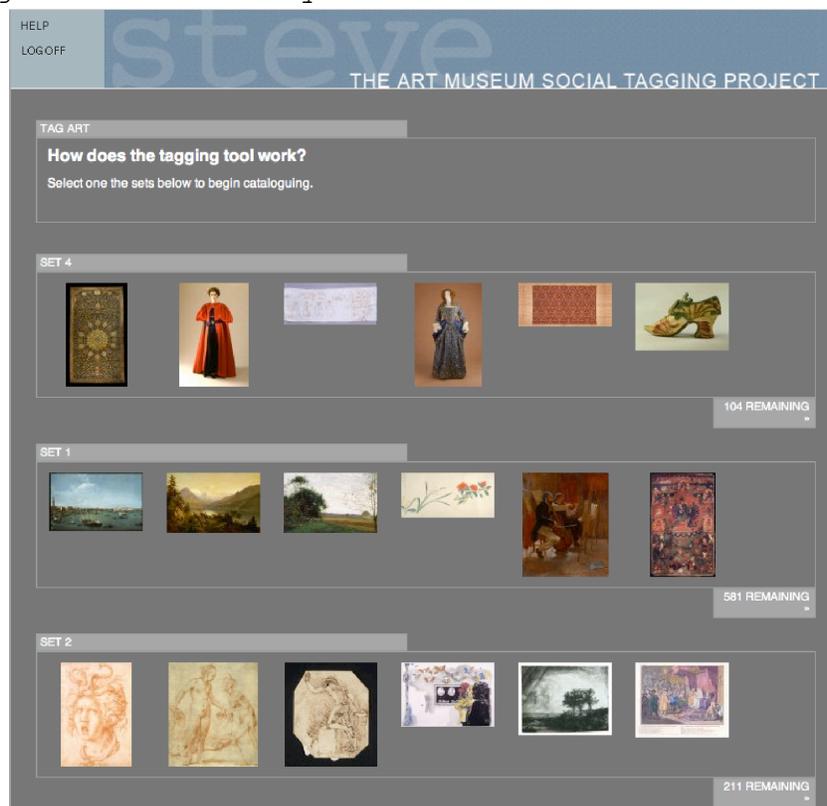
preventing the jarring sense of seeing a non-
representational contemporary painting right after a
classical sculpture – would test this hypotheses.

*Figure 13. steve tagger: show sets Does users 'get in the groove' when
they tag groups of like works?*

Questions that can be answered by studying tags assigned in
this interface include:

- Are more tags assigned when users are shown works in sets?
- Are more useful tags assigned when users are shown works in sets?
- Are users more likely to return for subsequent tagging sessions when they are shown works in sets?

3.3.5.1   Summary: Interface-Related Questions

Understanding the influence of the data shown to a tagger on the tags assigned is critical prior to implementing tagging on museum Web sites. Testing these simple variables – whether or not users see others' tags, and the museum's metadata – will provide insight into how live tagging environments might be optimized for particular effect.

There are many other choices to make when deploying a tagging system, including those around requiring user-registration, enabling user profiles and personal collections, including just one institution's works or many institutions' works, and using gaming or description metaphors. All of these build on the basic research questions outlined here.

3.4   User Affiliation Question

Motivations for tagging are often unclear. While the literature of tagging and folksonomy points initially to a selfish motivation for personal information management, the members of the steve.museum team have posited another, more altruistic motivation for tagging museum collections. People may just want to "help out" museums (Trant & Wyman, 2006). As well as distributing questionnaires to taggers to ask them about their motivations for tagging, we are testing the relationship of institutional ties to tagger activity.

The steve tagger has been implemented in two separate instances. The first, as described previously, is presents a collection of works drawn from a range of museums. It is branded with the name of the research project. Recruiting is being done broadly, and relatively anonymously.

A second instance of the steve tagger has been launched by The Metropolitan Museum of Art. It presents only works from

The Met's collection, and access is by personal invitation
only. Invitations are being distributed to people who have
registered on the MMA's site, or purchased something in
their gift shop.

The differences in tagger behaviour in these two
implementations – and differences in questionnaire responses
from those who tagged in each context– may provide some
insight into taggers' motivations.

3.5   Future Studies

The dataset collected by steve.museum could provide material
for many further studies. One, in planning now, is to look
at the relationships between tagging vocabulary and the
vocabularies of other genres of museum communication,
including education-driven materials, publicity copy and
press releases, exhibition catalogues, and other
interpretive texts. We wish to see if tags are more like
certain kinds of documents than others.

The data collected by steve.museum is to be deposited with
ICPSR/CPANDA and will be available for further study.

4. Conclusions

Efforts to improve access to visual collections often focus
on establishing vocabulary and authority control (Harpring,
2002; Shubert, 1996). But even when – or particularly when –
terminology is rigorously controlled, the concepts
represented by museums may not match the interests of museum
users. Studies of questions asked of museums (McCorry &
Morrison, 1993) and queries of museum information resources
(Janney & Sledge, 1995b) reveal gaps between the
professional framework of museum documentation and the
perspective of users of museum collections. Studies that
begin with user needs (such as (Elinich, 2004; Reich &
Lindgren-Streicher, 2006; Samis et al., 2005; Schaller et
al., 2003; Stephenson & McClung, 1998) surface differences
between what museums have available and what users expect or
want.

Acknowledging that people are "searching for meaning, not
just records" (Doolan et al., 2004), museums provide may

ways to encounter collections on-line, including exhibitions, in-depth features, publications, games, and educational materials for teachers (Reilly, 2000). There is an irony that for some kinds of users, making collections databases available on-line may not make collections themselves more accessible. This research will also build our understanding of the way that people search art museum collections, and show where the terminology used by non-specialists to describe works of art differs from that of professional cataloguers. The 'semantic gap' between these museum professionals and the general public appears to be a significant one that museums may not be able to bridge themselves (Trant, 2006a, 2006b). User-generated tags could serve as stepping stones across this chasm.

Museums are also increasingly interested in engaging their visitors in a dialogue, and encouraging community participation with collections (Anderson, 2004; H.S. Hein, 2000; Vergo, 1989). Tagging may have a role to play in institutions that are adopting individuated learning and constructivist educational philosophies that emphasize personal meaning-making and user-centered on-line and in-gallery experiences (G.E. Hein, 1998). Rather than being documentation written by and for museums, tagging is user-generated, user-initiated content, representative of points of engagement between people and collections. It has a role to play in a suite of on-line strategies that encourage user generated content (Bernstein, 2008; Farber & Radensky, 2008; Oates, 2008; Samis, 2008), offering a quick, low-investment, way for visitors to make contact with collections. These points of contact are critical for museums, for they offer a direct indication of visitor interests, visitor perceptions, and perhaps, mis-perceptions. Museums can learn from watching what and how people tag, perhaps surfacing points of interest or 'teachable moments' where additional interpretation is necessary. Just as search terms are a direct trace of a trajectory of interest, so too can tags offer a window into the objects that engage users.

The research described here looks at museum collections documentation and searching as a continuum. User tagging may form a bridge between two previously separate areas of activity. As there are no studies of information retrieval using on-line museum catalogues, this study will provide a

baseline for future work. Studying tags and their relationship to searching and documenting collections will help determine if tagging could indeed improve search results. Social tagging and folksonomy could make a positive contribution to the accessibility of on-line art museum collections

Understanding social tagging and folksonomy in the context of the art museum will add to our understanding of their roles in information management and retrieval more broadly. The exploration of the relationships between public and professional vocabularies could prove useful in other disciplines – such as health information or horticultural information – where the language of the specialist differs from that of the general information user. Improved understanding of the relationships between tags and search terms could also prove useful for the design of information retrieval systems in any discipline. Discoveries about the relationships between tagging and interfaces should apply to interface design broadly. We hope to contribute to a growing, in-depth understanding of the many, diverse roles of user-generated content in a complex networked information landscape.

5. Acknowledgements

6. References Cited

Ahn, L. v., & Dabbish, L. (2004). Labeling Images with a Computer Game. CHI 2004, Vienna, Austria.

Anderson, G. (Ed.). (2004). *Reinventing the Museum: Historical and Contemporary Perspectives on the Paradigm Shift*. Walnut Creek, CA: Altamira Press.

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

Art Gallery of Ontario. (2007). Collection X.   from http://www.collectionx.museum/

Art Information Task Force (AITF). (1995). *Categories for the Description of Works of Art (CDWA)*: J. Paul Getty Trust

Baca, M., & Harpring, P. (2006). *Categories for the Description of Works of Art (CDWA)*: J. Paul Getty Trust from http://www.getty.edu/research/conducting_research/standards/cdwa/

Bearman, D., & Trant, J. (2005). Social Terminology Enhancement through Vernacular Engagement: Exploring Collaborative Annotation to Encourage Interaction with Museum Collections. *D-Lib Magazine, 11*(9). Retrieved September 11, 2006 from http://www.dlib.org/dlib/september05/bearman/09bearman.html

Bernstein, S. (2008). *Where Do We Go From Here?: Continuing with Web 2.0.* Museums and the Web 2008. Proceedings, Toronto, Ontario, Canada. J. Trant & D. Bearman (Eds.). Retrieved March 31, 2008 from http://www.archimuse.com/mw2008/papers/bernstein/bernstein.html.

Cataloguing by Crowd Working Group, & Bearman, D. (2005, July). A Matrix of Environmental Variables to be Tested in a Museum-Based Folksonomic Tool. Retrieved 2005 from http://www.steve.museum/reference/CCA-environmentMatrix20050.pdf

Cataloguing by Crowd Working Group, & Trant, J. (2005, July 23). Research Questions: A Summary of Issues Raised in Discussion. Retrieved May 2 from http://www.steve.museum/reference/ComCatResearchQ050723.pdf

Chan, S. (2006a, August 10). Initial impacts of OPAC2.0 on Powerhouse Museum online visitation. *fresh + new [blog]* from http://www.powerhousemuseum.com/dmsblog/index.php/2006/08/10/initial-impacts-of-opac20-on-powerhouse-museum-online-visitation/

Chan, S. (2006b, August 29th, 2006). OPAC2.0 Quick log charting of object popularity. *fresh + new [blog]* from http://www.powerhousemuseum.com/dmsblog/index.php/2006/08/10/initial-impacts-of-opac20-on-powerhouse-museum-online-visitation/

Chan, S. (2007a). OPAC2.0 - latest tag statistics and trends for simple comparison with Steve project, *fresh + new(er) [blog]*. Sydney: Powerhouse Museum. Retrieved October 16 from http://www.powerhousemuseum.com/dmsblog/index.php/2007/10/15/opac20-latest-tag-statistics-and-trends-for-simple-comparison-with-steve-project/.

Chan, S. (2007b). *Tagging and Searching – serendipity and museum collection databases.* Museums and the Web 2007. Proceedings, Toronto, Canada. J. Trant & D. Bearman (Eds.). Retrieved October 15 from http://www.archimuse.com/mw2007/papers/chan/chan.html

Chan, S. (2008a). 24 hours later - Powerhouse on the Commons on Flickr, *fresh + new [blog]*. Retrieved April 22, 2008 from

http://www.powerhousemuseum.com/dmsblog/index.php/2008/
04/09/24-hours-later-powerhouse-on-the-commons-on-
flickr/.

Chan, S. (2008b). Powerhouse Museum joins the Commons on
Flickr - the what, why and how, *fresh + new [blog]*.
Retrieved April 22, 2008 from
http://www.powerhousemuseum.com/dmsblog/index.php/2008/
04/08/powerhouse-museum-joins-the-commons-on-flickr-
the-what-why-and-how/.

Chan, S. (2008c). *Uniting the shanty towns – data combining
across multiple institutions.* Museums and the Web 2008.
Proceedings, Toronto, Ontario, Canada. J. Trant & D.
Bearman (Eds.). Retrieved March 31, 2008 from
http://www.archimuse.com/mw2008/papers/chan/chan.html.

Chun, S., Cherry, R., Hiwiller, D., Trant, J., & Wyman, B.
(2006). Steve.museum: An Ongoing Experiment in Social
Tagging, Folksonomy, and Museums. Museums and the Web
2006: selected papers from an international conference,
Albuquerque, NM. J. Trant & D. Bearman (Eds.).
Retrieved September 11, 2006 from
http://www.archimuse.com/mw2006/papers/wyman/wyman.html
.

Cleveland Museum of Art. (2005). Help others find this
object. Cleveland, Ohio. Retrieved January 31, 2008
from linked from
http://www.clevelandart.org/Explore/departmentWork.asp?
deptgroup=20&recNo=1&display=.

Coldicutt, R., & Streten, K. (2005). Democratize And
Distribute: Achieving A Many-To-Many Content Model.
Museums and the Web 2005: Proceedings, Vancouver. J.
Trant & D. Bearman (Eds.). Retrieved January 31, 2008
from
http://www.archimuse.com/mw2005/papers/coldicutt/coldic
utt.html.

del.ico.us. (2006). Museum tag in del.icio.us. In delicious-
museum060123.jpg (Ed.). Retrieved January 31, 2008 from
http://del.icio.us/search/?all=museum.

Doolan, J., Peacock, D., & Ellis, D. (2004). Searching For
      Meaning, Not Just Records. Museums and the Web 2004:
      Proceedings, Washington DC / Arlington VA, USA. D.
      Bearman & J. Trant (Eds.). Retrieved January 31, 2008
      from
      http://www.archimuse.com/mw2004/papers/peacock/peacock.
      html

Elig, J. (2007, October 3). 'Your art' online. *indy.com*
      Retrieved April 22, 2008 from
      http://www.indy.com/posts/144.

Elinich, K. (2004). One Wright Way: From Collections to
      Classrooms. Museums and the Web 2004: Proceedings,
      Washington DC / Arlington VA, USA. D. Bearman & J.
      Trant (Eds.). from
      http://www.archimuse.com/mw2004/papers/elinich/elinich.
      html

Farber, A., & Radensky, P. (2008). *The Living Museum:
      Supporting the Creation of Quality User-Generated
      Content*. Museums and the Web 2008. Proceedings,
      Toronto, Ontario, Canada. J. Trant & D. Bearman (Eds.).
      Retrieved March 31, 2008 from
      http://www.archimuse.com/mw2008/papers/farber/farber.ht
      ml.

flickr.com. (2006). flickr Tags / museum / clusters. In
      flickr-museum060123.jpg (Ed.). Retrieved January 23,
      2006 from
      http://www.flickr.com/photos/tags/museum/clusters/.

Golder, S. A., & Huberman, B. A. (2005). The Structure of
      Collaborative Tagging Systems. *Journal of Information
      Science [preprint]*([preprint Sept 8, 2005]). from
      http://www.hpl.hp.com/research/idl/papers/tags/tags.pdf

Hammond, T., Hannay, T., Lund, B., & Scott, J. (2005).
      Social Bookmarking Tools (I): A General Review. *D-Lib
      Magazine, 11*(4). Retrieved December 12, 2005 from
      http://www.dlib.org/dlib/april05/hammond/04hammond.html

Harpring, P. (2002). The Language of Images: Enhancing
      Access to Images by Applying Metadata Schemas and

Structured Vocabularies. In M. Baca (Ed.), *Introduction to Art Image Access: Issues, Tools, Standards and Strategies*. Los Angeles: J. Paul Getty Trust.

Hein, G. E. (1998). *Learning in the Museum*. New York: Routledge.

Hein, H. S. (2000). *The Museum in Transition: A Philosophical Perspective*: Smithsonian Institution.

Honigsbaum, M. (2005, December 12). Search for gay history to create 'virtual museum'. *Guardian Unlimited / EducationGuardian.co.uk*   from http://education.guardian.co.uk/elearning/story/0,,1665 299,00.html.

J. Paul Getty Trust. (2000a). Art and Architecture Thesaurus (AAT). Los Angeles, CA: J. Paul Getty Trust from http://www.getty.edu/research/conducting_research/vocab ularies/aat/.

J. Paul Getty Trust. (2000b). Union List of Artists Names (ULAN). Los Angeles, CA: J. Paul Getty Trust from http://www.getty.edu/research/conducting_research/vocab ularies/ulan/.

Janney, K., & Sledge, J. (1995a, September). A User Model for CIMI Z39.50 Application Profile.   Retrieved May 3, 2006 from http://www.cimi.org/old_site/documents/Z3950_app_profil e_0995.html

Janney, K., & Sledge, J. (1995b, September). 'Formulating Typical Questions' in "A User Model for CIMI Z39.50 Application Profile".   Retrieved May 3 from http://www.cimi.org/old_site/documents/Z3950_app_profil e_0995.html

Jenkins, M. (2006). Email Message: "everything i know isn't in the picture". to J. Trant. Tue, 10 Jan 2006 08:56:49 -0500.

Kaipainen, M., & Pata, K. (2007). *Taggin' Tallinn. Piloting Meaning-Building with Locative Content.* Weblogs and

Social Media, Boulder, Colorado, USA. Retrieved December 5, 2007 from http://www.icwsm.org/papers/4--Kaipainen-Pata.pdf.

Kellogg Smith, M. (2006). Viewer tagging in art museums: Comparisons to concepts and vocabularies of art museum visitors. Advances in Classification Research, Volume 17; Proceedings of the 17th ASIS&T Classification Research Workshop, Austin, Texas, USA. J. Furner & J. T. Tennis (Eds.). Retrieved December 5, 2007 from http://dlist.sir.arizona.edu/1853/02/smith.pdf.

Kipp, M. E. (2006a). Complementary or Discrete Contexts in Online Indexing: A Comparison of User, Creator and Intermediary Keywords. Canadian Association for Information Science, Toronto, Ontario, Canada Retrieved January 31, 2008 from http://dlist.sir.arizona.edu/1533/01/mkipp-caispaper.pdf.

Kipp, M. E. (2006b). Exploring the context of user, creator and intermediate tagging. IA Summit 2006, Vancouver, BC Retrieved January 31, 2008 from http://www.iasummit.org/2006/files/109_Presentation_Desc.pdf.

Kipp, M. E. (2007). Tagging Practices on Research Oriented Social Bookmarking Sites. Canadian Association for Information Science, Montreal, Quebec, Canada Retrieved January 31, 2008 from http://dlist.sir.arizona.edu/2027/01/kipp%5F2007.pdf.

Lund, B., Hammond, T., Flack, M., & Hannay, T. (2005). Social Bookmarking Tools (II): A Case Study - Connotea. *D-Lib Magazine, 11*(4). Retrieved April 22, 2008 from http://www.dlib.org/dlib/april05/lund/04lund.html

Markey, K. (2007). Twenty-five years of end-user searching, Part 2: Future research directions. *Journal of the American Society for Information Science and Technology, 58*(8), 1123-1130. from http://www3.interscience.wiley.com.myaccess.library.utoronto.ca/cgi-bin/fulltext/114210853/PDFSTART

Marlow, C., Naaman, M., boyd, d., & Davis, M. (2006). *HT06, Tagging Paper, Taxonomy, Flickr, Academic Article, ToRead.* Proceedings of the seventeenth conference on Hypertext and Hypermedia Odense, Denmark. Retrieved December 7, 2008 from http://doi.acm.org/10.1145/1149941.1149949.

Mathes, A. (2004, December). Folksonomies - Cooperative Classification and Communication through Shared Metadata. Retrieved August 6 from http://www.adammathes.com/academic/computer-mediated-communication/folksonomies.html

Matusiak, K. K. (2006). Towards user-centered indexing in digital image collections. *OCLC Systems & Services: International digital library perspectives, 22*(4), 283-298.

McCord Museum. (2007). Tag! - Keyword Matching.   Retrieved December 7, 2007 from http://www.mccord-museum.qc.ca/en/keys/games/24

McCorry, H., & Morrison, I. O. (1993). *report on the catechism project*: National Museums of Scotland Retrieved September 11, 2006 from http://www.iomorrison.pwp.blueyonder.co.uk/catec.htm

McCorry, H., & Morrison, I. O. (1995). *report on the catechism project*: National Museums of Scotland

O'Connell, P. L. (2007). "One Picture, 1,000 Tags". *New York Times, Museums Section.* from http://www.nytimes.com/2007/03/28/arts/artsspecial/28social.html?_r=2&oref=slogin&oref=slogin

Oates, G. (2008). *The Commons on Flickr: A Primer.* Museums and the Web 2008. Proceedings, Toronto, Ontario, Canada. J. Trant & D. Bearman (Eds.). Retrieved March 31, 2008 from http://www.archimuse.com/mw2008/papers/oates/oates.html.

Pennsylvania State University Library. (2005-). PennTags.
    Retrieved April 15, 2006 from
    http://tags.library.upenn.edu/

Philadelphia Museum of Art. (2007). What is Social Tagging?
    Retrieved December 7, 2007 from
    http://www.philamuseum.org/collections/socialTagging.ht
    ml

Pink, D. (2005). Year in Ideas: Folksonomy. *The New York
    Times Magazine*. Retrieved January 31, 2008 from
    http://select.nytimes.com/search/restricted/article?res
    =F10914F938550C728DDDAB0994DD404482

Powerhouse Museum, & Chan, S. (2005, ongoing). Electronic
    Swatchbook.   Retrieved January 10 from
    http://www.powerhousemuseum.com/electronicswatchbook/

Quintarelli, E. (2005). Folksonomies: power to the people.
    ISKO Italy – UniMIB Meeting, Milan Retrieved December
    13, 2005 from
    http://www.iskoi.org/doc/folksonomies.htm.

Reich, C., & Lindgren-Streicher, A. (2006). Visitor
    Interactions with Digitized Artifacts. Museums and the
    Web 2006: Proceedings, Albuquerque, New Mexico, USA. D.
    Bearman & J. Trant (Eds.). from
    http://www.archimuse.com/mw2006/papers/lindgren/lindgre
    n.html

Reilly, B. (Ed.). (2000). *Collections: Museum Collections
    Online*: Council on Library and Information Resources.

Rubenzahl, I., Wiginton, C., McIntyre, G., & Lajoie, M.
    (2008). *Getting 'In Your Face': Strategies for
    Encouraging Creativity, Engagement and Investment When
    the Museum is Offline.* Museums and the Web 2008.
    Proceedings, Toronto, Ontario, Canada. J. Trant & D.
    Bearman (Eds.). Retrieved March 31, 2008 from
    http://www.archimuse.com/mw2008/papers/mcintyre/mcintyr
    e.html.

Samis, P. (2008). *Who has the responsibility for saying what
    we see? mashing up Museum and Visitor voices, on-site*

and online. Museums and the Web 2008. Proceedings, Toronto, Ontario, Canada. J. Trant & D. Bearman (Eds.). Retrieved March 31, 2008 from http://www.archimuse.com/mw2008/papers/samis/samis.html .

Samis, P., & Johnson, L. (2005). Taking Teaching by the Tusks: Introducing Pachyderm 2.0. Museums and the Web 2005: Proceedings, Vancouver, British Columbia, Canada. D. Bearman & J. Trant (Eds.). from http://www.archimuse.com/mw2005/papers/samis/samis.html

Samis, P., Mitroff, D., & Johnson, T. (2005). Of Ansel and Atomz: Surfacing Deep Content On-line and On-Site at SFMOMA. Museums and the Web 2005: Proceedings, Vancouver, British Columbia, Canada. D. Bearman & J. Trant (Eds.). from http://www.archimuse.com/mw2005/papers/johnson/johnson.html

Schaller, D., Cannon, E., Beaumont, L., & Burrough, L. A. (2003). A Rolling Evaluation Gathers No Moss. Museums and the Web 2003: Proceedings, Charlotte, North Carolina, USA. J. Trant & D. Bearman (Eds.). from http://www.archimuse.com/mw2003/papers/burrough/burrough.html

Shubert, S. B. (1996). *Subject Access to Museum Objects : Applying the Principles of the Subject Approach to Information from Library and Information Science to the Documentation of Humanities Museum Collections.* Unpublished PhD, University of Toronto, Toronto.

Sledge, J. (1995). Points of View. In D. Bearman (Ed.), *Multimedia Computing and Museums, Selected papers from the Third International Conference on Hypermedia and Interactivity in Museums (ICHIM95/MCN95)* (pp. 335-346). Pittsburgh: Archives & Museum Informatics.

Smithsonian Institution. (2006). Smithsonian Photography. Retrieved October 10 from http://photography.si.edu/

Spiteri, L. F. (2007). Structure and form of folksonomy tags: The road to the public library catalogue.

Webology, 4(2). Retrieved November 24, 2007 from
http://www.webology.ir/2007/v4n2/a41.html

Stephenson, C., & McClung, P. (Eds.). (1998). *Delivering
Digital Images: Cultural Heritage Resources for
Education*. Los Angeles, CA: Getty Research Institute.

steve.museum. (2007 / 2008). *Guide to Term Review:
instructions for steve Term Reviewers*

The Metropolitan Museum of Art, Indianapolis Museum of Art,
Chun, S., Stein, R., & Trant, J. (2006). Researching
Social Tagging and Folksonomy in Art Museums: U.S.
Institute of Museum and Library Services (IMLS).
Retrieved January 31, 2008 from
http://www.imls.gov/applicants/samples/NLG%20RD%20Sampl
e%20The%20Met.pdf.

The NINES Consortium. (2005). NINES, a federated model for
integrating digital scholarship.   Retrieved December
27 from http://www.nines.org/about/9swhitepaper.pdf

Trant, J. (2006a). Exploring the potential for social
tagging and folksonomy in art museums: proof of
concept. *New Review of Hypermedia and Multimedia,
12*(1), 83-105. from
http://www.archimuse.com/papers/steve-nrhm-
0605preprint.pdf

Trant, J. (2006b). Social Classification and Folksonomy in
Art Museums: early data from the steve.museum tagger
prototype. Advances in Classification Research, Volume
17; Proceedings of the 17th ASIS&T Classification
Research Workshop, Austin, TX. J. Furner & J. T. Tennis
(Eds.). Retrieved January 31, 2008 from
http://www.archimuse.com/papers/asist-CR-steve-
0611.pdf.

Trant, J. (2006c). Understanding Searches of an On-line
Contemporary Art Museum Catalogue. A Preliminary Study:
Fall 2006. Retrieved October 10, 2007 from
http://conference.archimuse.com/system/files/trantSearc
hTermAnalysis061220a.pdf.

Trant, J., Bearman, D., & Chun, S. (2007). *The eye of the beholder: steve.museum and social tagging of museum collections.* International Cultural Heritage Informatics Meeting - ICHIM07: Proceedings, Toronto, Ontario, Canada. J. Trant & D. Bearman (Eds.). Retrieved January 31, 2008 from http://www.archimuse.com/ichim07/trant/trant.html

Trant, J., & Wyman, B. (2006). Investigating social tagging and folksonomy in art museums with steve.museum. World Wide Web 2006 (WWW2006): Collaborative Web Tagging Workshop, Edinburgh, Scotland Retrieved January 31, 2008 from http://www.archimuse.com/research/www2006-tagging-steve.pdf.

van Hooland, S. (2006). *Spectator becomes annotator: possibilities offered by user-generated metadata for image databases.* Immaculate Catalogues: Taxonomy, Metadata and Resource Discovery in the 21st Century, Proceedings of CILIP Conference, University of East Anglia, UK. Retrieved January 31, 2008 from http://eprints.rclis.org/archive/00007156/01/Usergenera tedmetadata.pdf.

Vander Wal, T. (2005). Folksonomy Definition and Wikipedia. *Off the Top [blog]*   from http://www.vanderwal.net/random/entrysel.php?blog=1750

Vergo, P. (Ed.). (1989). *The New Museology*. London: Reaktion Books.