Introduction

One important component to the public's understanding of science is the need for collaborative efforts in science discovery and environmental recovery. This task is becoming increasingly easier to facilitate as web 2.0 applications allow for increasing engagement with materials and individuals are connecting on a global scale (Lievrouw, 2012). This paper is the initiation of a study of the utility of the *science and nature* category of Pinterest for the purpose of citizen science collaborations. The research explores how individuals are already engaging in science content curation while using Pinterest, facilitating an understanding of how this type of activity can be applied to citizen science research practices. Using a theoretical framework of Virtual Transactive Memory Systems, the study content analysis to explore the utility and the collaborative nature of contributions to the *science and nature* category of Pinterest over a period of time. The goal for the study is to understand the nature of Pinterest as it applies to scientific communication that includes the public sphere.

Review of the Literature

What is Pinterest?

Pinterest's mission is to, "Connect everyone in the world with the things they find interesting" (Pinterest, 2012, p. about). The social media start-up is the fastest growing site in history. For example, between May 2011 and May 2012 comScore's analysis of Pinterest reported a growth rate of 4377% (Perez, 2012) and in October of 2012 the site reached 25 million unique visitors (Tate, 2012). Creators Paul Sciarra, Evan Sharpe, and Ben Silbermann achieved this status while still in the beta phase of development and having invitation-only membership (Constine, 2012; Engauge, 2012). The concept of Pinterest is for each user to have a personal account pinning images gathered from other resources to create visual idea displays that

are arranged into subjects by "boards." The boards are user-defined, giving unique meaning to each created collection of images. Images can be repinned by any user. Users follow the boards of others and are invited to join collaborative boards. ComScore reported that 80% of the images on Pinterest are actually repinned content rather than new material (Internet Marketing Inc., 2012). Sharing and tagging features support Pinterest's role as a search engine for visual content (Engauge, 2012).

Users are developing diverse ways of employing Pinterest in their lives as a collaborative tool. Four common tasks include: brainstorming ideas for work and recreational activities, making wish lists to remember goals and desires, organizing concepts, and sharing inspirational visuals with other users (Mitchell, 2012). Science organizations and agencies are also beginning to use Pinterest. For example, the Indianapolis Zoo has multiple shared boards. One board is *Wildlife Livecams and Videos,* which invites contributors to pin their favorite live camera and videos of endangered species. NASA Edge's account administrator pins pictures from the Mars Rover. Additionally, many museums are creating accounts.

Information science literature is delving into the use of Pinterest as a tool for content curation (Dudenhoffer, 2012; Thornton, 2012; Zarro & Hall 2012). A recent survey found that most libraries are just starting to use Pinterest (Thornton, 2012). Zarro and Hall (2012, p. 2) to begin a discussion of the "characterization of activities of patron-curators" by looking at characteristics of social collections in relation to traditional library services. The authors define the unique capabilities of sites like Pinterest as social collecting sites because they combine two areas of other social media applications: the annotation features of bookmarking sites such as *de.li.cious* with the visually descriptive properties of blogs and photo-sharing sites such as *Flicker*.

Content curation communities

This paper extends the definition of patron-collaborators in library Pinterest sites to citizen collaborators in the *science and nature* category of Pinterest. Evidence for this connection appears in the perspective of Rotman, Procita, Hansen, Sims Parr, & Preece (2012) in defining a content curation community. Pinterest creates a network of content curation communities. These are "distributed communities of volunteers who work together to curate data from disparate resources into coherent, validated, and oftentimes freely available repositories" (Rotman et al., 2012 b, p.1092). The individual who actively participates on Pinterest becomes a member of many content curation communities. The goal of the individual may not be explicit, but the voluntary and enjoyable aspects of the curation process should not go unacknowledged. The users' participation in pinning applies to the act of citizens engaged in collecting as a sensory experience. Morabito (2012) suggests that what makes Pinterest different from other social media sites is that it relies on the visual experience. Thus, eye-catching content creates a heightened sense of experience making the content curation application a rich avenue for citizen science.

Citizen Science

The term citizen science is defined in myriad ways to characterize activities and reasons researchers facilitate public participation in scientific data collection and problem solving. The modern work of citizen science is different from past endeavors because of the increased ability for the majority of the public to be involved in these initiatives due to the rise of social media applications. Three reasons that citizen science has emerged include the following: the software and technology to disseminate information via the Internet is easy and available, there is

increased realization of the value of crowdsourcing, and research funding institutions are beginning to mandate public outreach in the form of research projects (Silvertown, 2009).

Citizen science literature recognizes several benefits to participatory projects. For the research teams it allows for greater avenues of labor, potentially over a larger scale or geographic area, with more funding and diverse skill sets (Cohn, 2008). As a tool for outreach, it is both an avenue to educate the public sphere about the concepts and a link across the expert and citizen gap that often occurs between scientists and community stakeholders (Silvertown, 2009; Weckel, et.al., 2010). It is from this understanding of the utilitarian aspects of participatory projects that this study finds a conceptual definition of citizen science. For the purpose of this exploration citizen science projects are defined as *research teams that collaborate with individuals in the public sphere with goals of increased productivity and access to distributed resources. These goals are combined with a recognized need for educational outreach and to bridge gaps between community stakeholders and research experts.*

The design of on-line knowledge sharing environments must address the information needs of the involved contributors (Rotman, Preece, Hammock, Procita, Hansen, Parr, Lewis, & Jacobs, 2012). Citizen science projects can increase the knowledge of the participants, but participants' attitudes toward science are often unchanging, demonstrating an ambivalence in attitude toward science and the environment (Brossard, et.al., 2005). While pinning activity may appear recreational, citizens are engaging in sharing material in distributed collaboration. An interesting component of the user-defined structure is the potential to gather trends in labeling that can help the scientist and the citizen science researcher understand different user views of science content. Boards and the comments on the pins give the researcher clues to the motivation behind the pinner.

Looking at social media technologies and the requirements needed by scientists for useful collaboration (Schleyer et al., 2008) found five main themes of system requirements. They require compatibility, the ability to search efficiently using descriptive information, the ability to connect effectively, a system that is easy to update, and usage properties that are a natural part of the individual's workflow. Pinterest's design provides this requirement of ease within the workflow. The act of pinning an image is unobtrusive through the push of a button on the browser interface, yet effective with the immediate creation of a metadata record. The acts of repinning and following allow for connections based on shared ideas regardless of the individual's background. These aspects of Pinterest's design align with theories of collaborative systems such as the virtual TMS.

Virtual Transactive Memory Systems

Transactive memory system (TMS) theory, developed by Daniel Wegner in the 1980s, is a way of understanding the group mind beyond the synthesis of similar thinking. It addresses diversification of knowledge across a network of members with different skill sets. The theory looks at behavior and performance outcomes of the group and the individual based on how the system constructs and uses the collective knowledge base (Wegner, 1986). Pinterest by design allows for shared construction of knowledge from diverse spaces. The naming and organization of boards on both an individual and group level provide an avenue for understanding the construction of what Wegner (1986) describes as *external metamemory*. External metamemory frees the individual to process new information while accessing the collective knowledge of the system.

TMS systems utilize differentiated knowledge, they require transactive encoding, storage, and retrieval processes, plus they involve constant change within the system (Lewis & Herndon,

2011). Pinterest social networks allow for these distinctions. First, individuals bring images from disparate sources. Users repin and bring new external images from web pages. Second, the act of pinning creates a record. The user records or encodes the image with its metadata and stores it in his or her external memory (e.g. collection of boards). This memory record is freely available to all. Users are able to access other's distinct record construction and repin according to his or her own understanding, create a dialogue by commenting, and search among the system for other similar representations to create a personalized metamemory space. Third, the asynchronous and personally available web-based and mobile integrated accounts on Pinterest create a dynamic flow inherent in a TMS. New material is constantly being processed and shared.

Keel (2007) introduces the *EWall* application as a tool that fosters thinking that is focused on an object. This type of thinking centers on a standardized information format that is non-descript in design yet has the ability to represent content from many sources with many formats. This is similar to the function of a pin on a board. The act of pinning plucks the image from the source and standardizes it for consideration among other pins in a user-organized structure. Keel asserts that *EWall* demonstrates a virtual version of the TMS construction because it is not stored in the minds of the individual collaborators and is created, shared, and used within the website. Pinterest aligns with this definition of criteria that constitute a virtual TMS. The user account and the boards are displays of working knowledge, expertise, and foci. The Pinterest interface allows for individuals acting within that system to discover and access this information by following, repinning, liking, and commenting. Thus, in Pinterest networks users are developing a shared understanding of content and using the individual participant's object-focused thinking to reach common goals.

Pinterest's popularity and the network capability of the visual content curation application make it a vehicle for future research on collaborations. To date, no known studies are looking at the utility of the Pinterest type Website to citizen science endeavors. By highlighting the links between TMS and Pinterest's functionality, this paper builds support that research in this area will provide insight into the development of citizen science visual content curation applications. This study informs the continued structural development of virtual TMS as a theory to frame the collaborative work process. Building on this literature the study asks the following research questions.

Research Questions

RQ1: *To what extent does each science domain (as defined by the USGS Thesaurus) use Pinterest?*

RQ 2: *To what extent does each science domain use collaboration on Pinterest?*

RQ3: *What is the relationship between the activity in a domain and the collaborative nature of the domain on Pinterest?*

Method

In a similar method to a database search engine or a library's OPAC, Pinterest allows for search by user-defined criteria or image exploration and discovery by choosing from a list of subjects pre-defined by the content administrators. The researcher accessed these categories by going to the main Pinterest page. The option to search categories appears as the second in five options. Categories are listed in the form of a dropdown menu. Clicking on *science and nature* retrieved the most recent pin activity that the pinner categorizes as such by pinning to user created boards that have been labeled accordingly. From this retrieval and analysis of content, the researcher categorized the images according to science domain.

Science Domain Definitions

For categorization purposes, the need arose for a standardized definition of the areas of science. The researcher looked to the thesaurus constructed by the United States Geological Survey (USGS) library database (USGS thesaurus, 2012).The domain definitions offer several initial features that create authoritative definitions for the categorization of the materials. First, the source is readily available via the Web. Also, the definitions are based on the standard elements used in classification of science literature and digital archiving of research data. Third, the authority of the USGS as a governing body of science in the United States adds an element of applicability to the fields of science research as these definitions are from a source that works in concert with other government agencies to fund research.

Activity Level

The activity level of the science domains in the *science and nature* category of Pinterest is operationalized as *the number of pins per domain that occur over the collection of the pin records*. This content creation is an ongoing process that takes place whether or not it comes through a collaborative channel or from an individual who is sharing the image for the first time. The study recognized activity as measured by categorization of the pin records into domains and by counting the frequency of pin occurrences for each domain. The researcher assigned categories based on cues from the pin's caption and pinner's classification in a board as well as comments from viewers in relation to the researcher's perception of the image and the USGS thesaurus definitions. Upon discovery of the amount of content per domain, the researcher then sought to understand the level of collaboration that exists among those who pin. To do this, the researcher developed an understanding of collaboration within the Pinterest structure.

Levels of Collaboration

Collaboration relates to the sharing of knowledge between individuals in the progress to reach a common goal or set of goals (Rotman et al., 2012 b.) From the point of view of the TMS, collaboration involves the interplay between the activities of the individuals and the activities of the group (Lewis & Herndon, 2011). Associated with this are the unique components of the individual and how they store and utilize both a common metamemory and an individual memory in concert. Virtual TMS allows for collaboration to occur by creating a space in the virtual environment of the Web (Keel, 2007). Thus, in the interest of this research, collaboration refers to *the active interplay between shared memory space and unique metamemory systems in a process toward a common goal*. To move beyond the concept of collaboration to the process of measuring collaboration requires explanation about the two actions that Pinterest users take to contribute collaboratively.

1. *Repinning*: The act of repinning is performed when the user sees an image on Pinterest that he or she wishes to pin to a board and captures it by clicking the repin icon option located on the original pin.
2. *Participating in a shared board*: Users have an option to invite other users to pin to board in their collection. The user controls the invitation and sharing process through email and has the option of getting an email message when users contribute to the shared board. Boards are identified as shared with an icon representing a group of people.

Collaborative pins represent collaborative activity and are defined as *repinned pins, pins from collaborative boards, or both*. TMS theory suggests that more pinning activity will occur in domains where a greater level of collaboration takes place. Collaboration level can only be measured in the instance of pin activity. The term is operationalized as *the frequency in the daily*

sample that a pin is: a.) a repin, b.) from a collaborative board, or c.) both a repin and from a collaborative board.

Data Collection

In the process for data collection, the researcher used the following steps: starting on a specific date and recorded time for the month of December the researcher accessed the Pinterest home page from his account and selected *Science and Nature* from the drop down categories menu. The first 50 pins were captured using a screen shot application. All recording units as defined in Table 1 were recorded in spreadsheet. The process was repeated for seven total unique days of the week and times of the day through the month of December 2012 and January 2013.

Table 1. Recording Units

Unit	Definition	Code
Pin Title	The user created caption underneath the image in the record.	Full text record- dependent on user creation. Can be left as NA**
Domain	Science category as defined by the USGS thesaurus that corresponds to the image.	See the appendix for domain categories and definitions. May not be left NA
Number of Repins	If repinned- the number of times the action took place. This is found underneath the pin source. See appendix for anatomy of a pin record.	0, 1, 2…N
Number of Likes	The number of times that users have clicked the like button for the image. This measure is found under the number of repins. See Appendix for anatomy of a pin record.	0, 1, 2…N
Number of comments	The number of comments that users have made about the image. Found directly under the image caption. See Appendix for the anatomy of a pin record.	0, 1, 2…N
Board Name	The user created organizational category in which the pin record is stored.	Full text record- dependent on user creation. Cannot be left as NA
Collaborative Board	The board is shared and more than one person contributes. An icon on the user interface designates shared boards. See the Appendix for icon and icon location.	0=Not Collaborative 1=Collaborative
Pinner Name*	The pinner's chosen user profile. See Appendix for anatomy of a pin record.	Full text record- dependent on user creation. Cannot be left as NA

*NA= Not Applicable

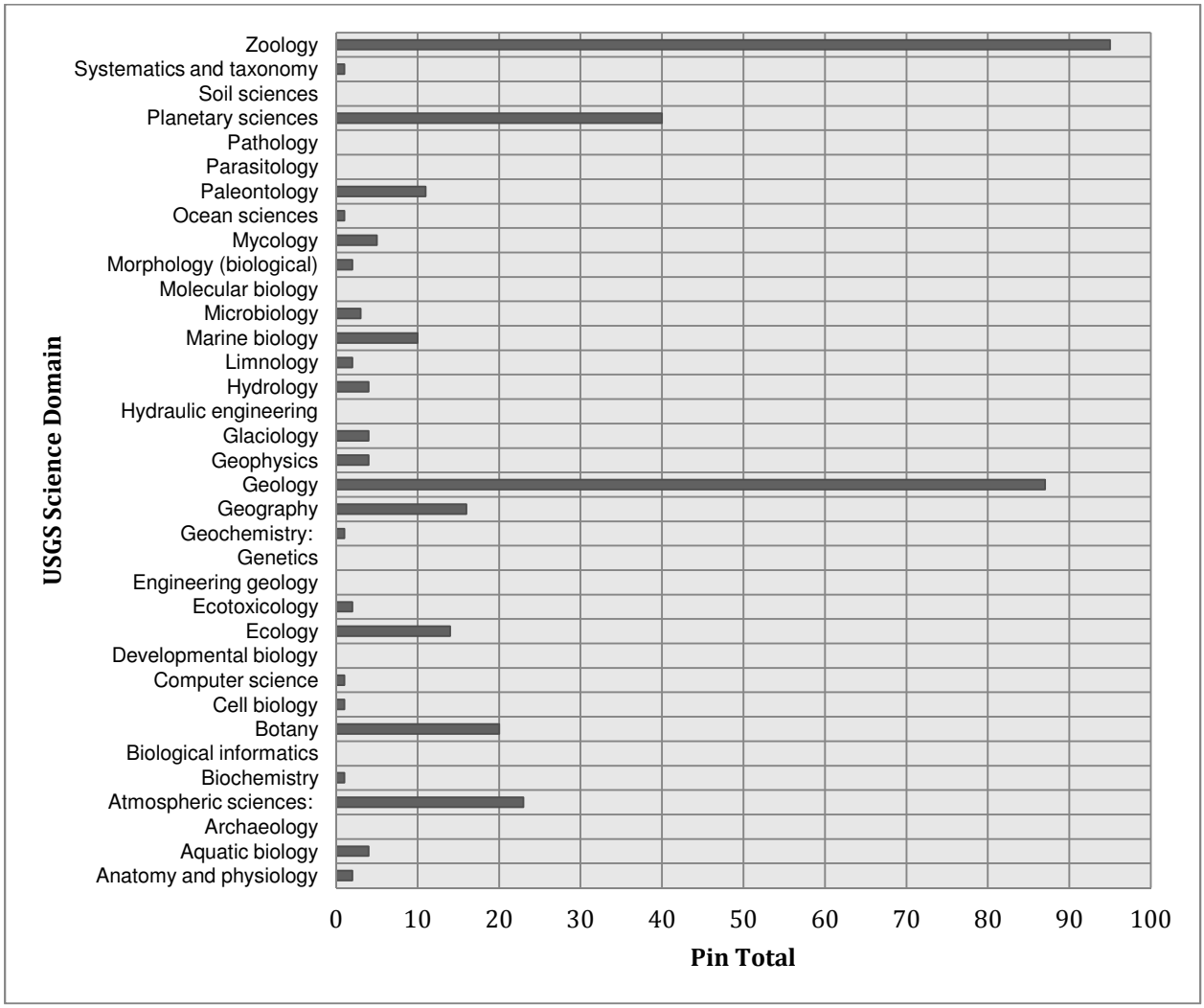
** Further data is collected for future research based on this initial exploration. See the Appendix for the expanded sample frame.

Results

To what extent does each science domain (as defined by the USGS Thesaurus) use Pinterest?

The sample results showed that the five most active pinning science domains were Botany with 20, Atmospheric Sciences with 23, Planetary Sciences with 40, Geology with 87, and Zoology had the greatest activity with 95 total pins. Twenty of the science domains did have some activity, all fewer than 20 pins total. Ten of the 34 different domains had no related pin activity. Figure 1 shows the total extent for sample period.

Figure 1. Total Pin Activity for all USGS domains December 2012- January 2013



To what extent does each science domain use collaboration on Pinterest?

Collaboration is defined in this study using the previously mentioned elements number of repins and number or collaborative boards. Looking at the five science domains with the greatest level activity on Pinterest, zoology had the most repins, followed by atmospheric sciences, then geology, planetary sciences and botany. Collaborative boards were significantly less frequent and distributed differently among the top active domains. The domain with the most collaborative boards was planetary sciences, followed by botany, geology and zoology each had one instance of a collaborative board and atmospheric science did not have any in the sample. Figures 2 and 3 show the breakdown of the two elements of collaboration.

Figure 2. Repins per domain.

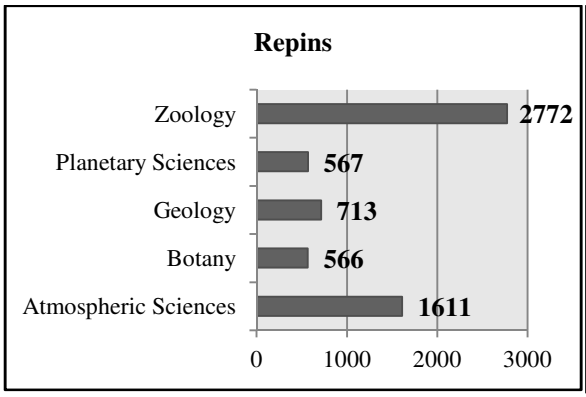
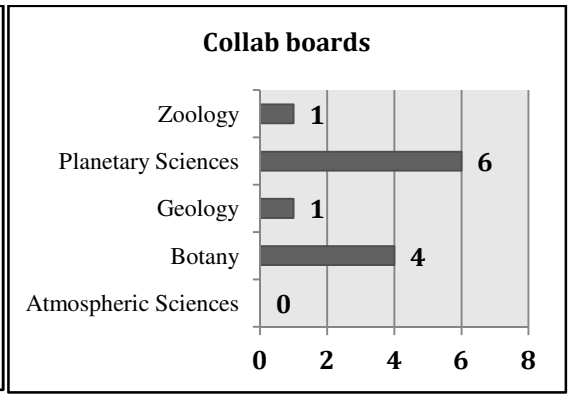


Figure 3. Collaborative boards per domain

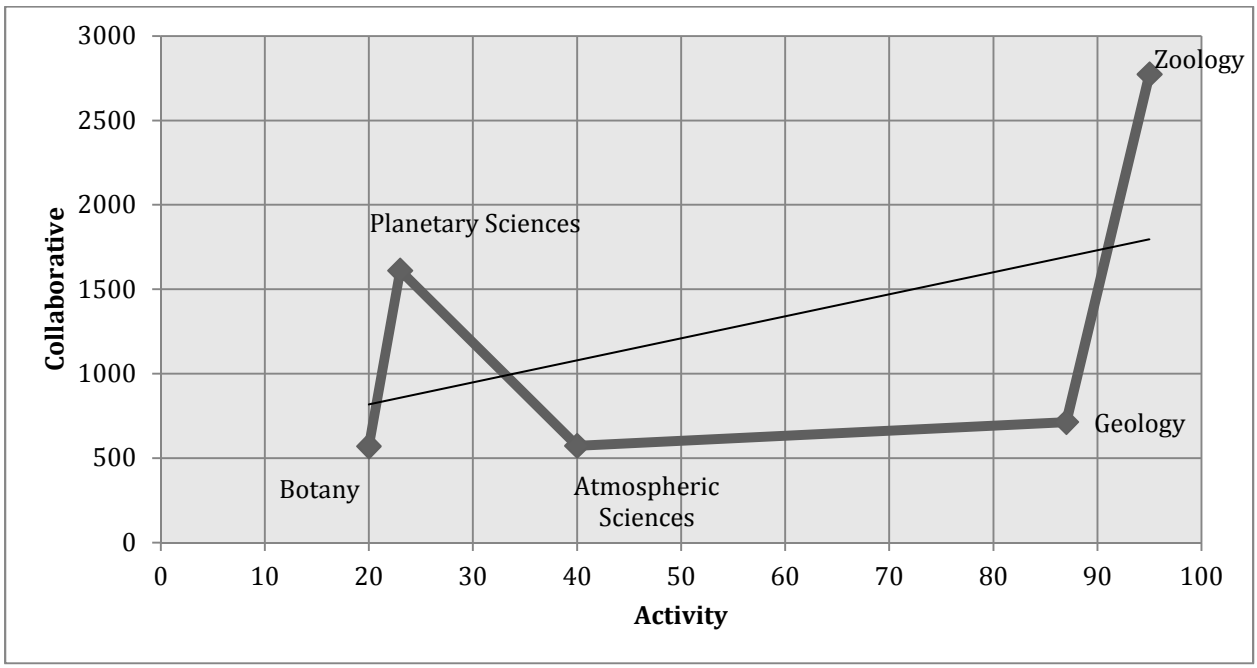


What is the relationship between the activity in a domain and the collaborative nature of the domain on Pinterest?

Comparing the level of overall activity of the five most active science domains pinning on Pinterest with the levels of collaborativeness of the pinning activity shows that the most active domain of zoology was the most collaborative and in most cases the more active the domain, the more collaborative the activity. There is one exception to this in the data. It is important to note that the number of collaborative boards for the pinning activity of the planetary sciences contributed to the much higher score of collaboration than the other science domains

that exhibited a similar level of activity. Figure 4 shows the relationship between the activity of the domain and the collaborative nature of that activity.

Figure 4. Relationship between the activity and the collaborativeness of the activity per domain



Discussion

The research finding that the planetary sciences are more collaborative in comparison to other domains that have similar levels of activity brings up new questions. Why is there more collaboration in planetary science? Can one attribute this finding to the history of citizen science endeavors in planetary science and in zoology? Are the issues in these areas more popular among populations in general? More exploration in these areas: the boards, the pins, and the profiles of pinners involved, are needed. In this case the results do provide a preliminary understanding of the subject matter of the pins and the collaborative nature of the activity. Repinning is a much more popular form of collaboration than the collaborative boards. This could be partly due to the newness of the collaborative board concept and the sharing of the board with other users takes

control out of the single user and distributes it beyond the personal collection level. Additionally there may be other reasons, such as the ease with which a user can execute repins.

Pinterest is in its infancy as a social media application and while growing faster than any other application has in the past, the future is uncertain (Mellow, 2012). Therefore this exploratory study takes a look at the current instances that science collaborations are occurring. The time span of the data collection process is limited. The researcher notes that the activity levels may change by domain depending on the season and other external factors that are beyond the scope of the study. This initial study lays groundwork for future content analysis expanding the sample further. Another limitation is the lack of intercoder reliability when categorizing the pins. With a measure of intercoder reliability the results of the study could be considered more externally valid and in turn transferrable to other virtual TMS type collaborations. Additionally the potential appearance of unrelated pins creates a problem with gathering an accurate and complete sample. Unrelated pins will not be coded. Increased understanding of the effect of these activities needs to be addressed in future research.

Lewis and Herndon (2011) warn against ascribing TMS theory to other forms of shared social cognition as it can lead to an oversimplification of TMS and result in incongruent evaluation of a system. However, Pinterest is an exemplary candidate for the theory of TMS. It applies a new perspective to the utility of Pinterest where initially the site is characterized as devoted solely to recreational use among young women particularly those who reside in the Midwest region of the United States (Engauge, 2012). Lewis and Herndon (2011) discuss the need for future research of TMS that use the social network approach and suggest that, "information technology has the potential to offer many benefits of a TMS across a large number of collocated or geographically distributed workers simultaneously" (p.1262). Taking this into

account, future research will need to delve further into the analysis of the distributed collaboration networks. Data collected during this initial exploration is considered an integral part to finding out more about citizen science collaboration efforts in social media.

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