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**Motivations for Self-Archiving on an Academic Social Networking Site:
A Study on ResearchGate**

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Abstract

This study investigates motivations for self-archiving research items on academic social networking sites (ASNSs). A model of these motivations was developed based on two existing motivation models: motivation for self-archiving in academia and motivations for information sharing in social media. The proposed model is composed of 18 factors drawn from personal, social, professional, and external contexts, including *enjoyment, personal/professional gain, reputation, learning, self-efficacy, altruism, reciprocity, trust, community interest, social engagement, publicity, accessibility, self-archiving culture, influence of external actors, credibility, system stability, copyright concerns, additional time, and effort*. Two hundred and twenty-six ResearchGate users participated in the survey. *Accessibility* was the most highly rated factor, followed by *altruism, reciprocity, trust, self-efficacy, reputation, publicity*, and more. Personal, social, and professional factors were also highly rated, while external factors were rated relatively low. Motivations were correlated with one another, demonstrating that RG motivations for self-archiving could increase or decrease based on several factors, in combination with motivations from the personal, social, professional, and external contexts. We believe the findings from this study could increase our understanding of users' motivations to share their research and provide useful implications for the development and improvement of ASNS services, which could attract more active users.

Keywords: Self-archiving, Motivation, Academic Social Networking Site, ResearchGate

Introduction

Academic social networking sites (ASNSs) are social media platforms designed to support the dissemination of research and social interactions among researchers (Jordan, 2014; Williams & Woodacre, 2016). The development of information and communication technologies have affected the ways in which researchers produce, disseminate, and access their work, and collaborate with others (Bergman, 2006; Liu, 2003). Recently, researchers have begun to use social networking sites (SNSs) to share their thoughts and ideas on research, to disseminate their publication information, and to keep up with recent trends in research (Gu & Widén-Wulff, 2011). Researchers use SNSs to create their research and professional experience profiles, connect with other researchers, share connections, and distribute their publication information (e.g., bibliographic information or full texts) (boyd & Ellison, 2008; Lupton, 2014; Nández & Borrego, 2013; Williams & Woodacre, 2016). Previous studies have reported the academic reasons and benefits of using SNSs (Donelan, 2016; Lupton, 2014); researchers also benefit from sharing their papers on social media because doing so facilitates communication with other researchers, improves publicity, and increases citation impact (e.g., Mas-Bleda, Thelwall, Kousha, & Aguillo, 2014; Thelwall & Kousha, 2015).

ASNSs are social networking sites for academics only (Williams & Woodacre, 2016). Their success may be due to the numbers of regular users and academic resources shared on such sites (Ortega, 2015). ResearchGate (RG) and Academia.edu are the two most popular ASNSs (Elsayed, 2016; Lupton, 2014; Thelwall & Kousha, 2014, 2015; Van Noorden, 2014). As of December 2017, RG had about 14 million subscribed users from 193 countries, and more than 100 million publications had been shared on the site (ResearchGate, 2017). Academia.edu has about 58 million users and 19 million papers (Academia.edu, 2017). According to Alexa.com, the global website traffic statistics site (Alexa, 2018), RG and Academia.edu were ranked 259 and 581 among the world's websites, respectively, as of December 2017.

One of the key factors that attracts new users to and maintains the loyalty of ASNS users is that these platforms make a substantial number of publications (such as pre-print journal articles, technical reports, and conference papers) available for free. "Self-archiving" refers to the action of uploading any kind of academic work, material, or research data to personal websites or institutional or subject repositories to make them freely available to and accessible by the public online (Laakso, 2014; Lee, Burnett, Vandegrift, Baeg, & Morris, 2015; Swan & Brown, 2005; Xia, 2008). Previous studies have focused on authors' awareness of or attitudes toward self-archiving (Swan & Brown, 2005), self-archiving practices (Antelman, 2006), motivation (Kim, 2010), advantages (Harnad, Carr, Swan, Sale, & Bosc, 2009), and policies (Xia et al., 2012).

In this study, we investigated researchers' motivations for self-archiving work on RG to understand their perceptions and willingness to use RG as a personal repository for their research. Self-archiving, in our study, is defined as the act of uploading research items on RG, which could include information or full-texts of refereed/non-referred journal articles, conference papers, raw data, full-texts, bibliographic information, or any kinds of materials produced in the process of research. We proposed three research questions, as follows:

- RQ 1: What are the personal, social, professional, and external factors of motivations for researchers that lead them to self-archive their research work on ASNSs?
- RQ 2: How do these motivational factors correlate with each other?
- RQ 3: How do researchers' motivations differ according to their demographic and background information and how often they use ASNSs?

We developed our motivational framework based on the two models of motivation: motivation for self-archiving in academia (Kim, 2010) and motivation for sharing information via social media (Oh & Syn, 2015; Syn & Oh, 2015). The personal, social, and professional motivations, as well as external factors for self-archiving, were identified and proposed in the current study. We used RG as a test case due to its popularity with academics. We contacted RG users who had uploaded their research items from various disciplines to RG at least once, distributed our survey questionnaires, and investigated their motivations for self-archiving. Our findings reveal researchers' perceptions of participating in ASNSs, the factors that encourage them to actively distribute their research materials via such networks, and to voluntarily share their research findings to promote professional development and community in academia. The motivational framework proposed in this study could also be implemented in investigations of users' motivations for sharing information sharing in various contexts.

Background

ASNSs are effective social media platforms for promoting researchers' professional stances in various ways, especially for scholarly communication. Thus, in this section, we first present the uses of SNSs/ASNSs for scholarly communication. We then provide a literature review of previous studies on the motivations for using SNSs/ASNSs in academia, most of which focus on the functional reasons for using SNSs/ASNSs. We also focus on the perceptual and behavioral aspects of motivations that could encourage self-archiving in ASNSs, and explain our motivational framework for self-archiving in this section.

SNSs/ASNSs for Scholarly Communication

SNSs/ASNSs have been frequently used by researchers (Gruzd, 2012; Nández & Borrego, 2013; Sugimoto, Work, Larivière, & Haustein, 2017; Van Noorden, 2014) as a “new addition to the scholarly communication infrastructure” (Thelwall & Kousha, 2014, p. 877), supporting the *dissemination, interaction, evaluation, and creation* of research.

Dissemination is the most common basic function provided by all SNSs/ASNSs, as a tool for spreading scientific messages during academic conferences (Letierce, Passant, Breslin, & Decker, 2010). ASNSs greatly boost the access of academic papers, although copyright concerns have been an issue (Van Noorden, 2014). RG also supports the sharing of research data and approximately 700 sets of research data were uploaded each day in 2014 (Van Noorden, 2014).

Interaction among researchers has improved their professional stance thanks to many of the built-in functions and interfaces in SNSs/ASNSs (Jeng, He, Jiang, & Zhang, 2012; Jeng, He & Jiang, 2015; Jordan, 2017). The constant updates on ASNS interfaces such as RG and Mendeley successfully support informal scholarly communication and information exchange on Q&A, enabling a multidisciplinary comparison in the fields of library and information services, history of art, and astrophysics (Goodwin, Jeng, & He, 2014; Jeng, DesAutels, He, & Li, 2017).

Evaluation, namely altmetrics, a new family of research indicators, has emerged from social media services that support social networking, social data sharing, and (micro-) blogging (Sugimoto et al., 2017). Recent studies have tested the validity and impact of metrics offered in ASNSs, including various metrics at the institutional (country), user, and resource levels. At the institutional level, metrics such as total number of publications, total impact points, downloads, views, and (total) RG scores were assessed and compared to

traditional rankings of universities (Thelwall & Kousha, 2015, p. 877). Studies discussed the reliability of users' RG scores as a measure of scientific reputation (Jordan, 2015; Kraker & Lex, 2015) and its relation to other common metrics (Orduna-Malea, Martín-Martín, Thelwall, & López-Cózar, 2017). Altmetrics, including RG citation index, RG view counts, and Mendeley view counts, were tested by comparing them to other more conventional metrics such as Google Scholar, Scopus, and Web of Science (for citations) (Thelwall & Kousha, 2017a, 2017b).

Studies have examined the functions of SNSs/ASNSs for the collaborative *creation* of academic knowledge. In ASNSs, some functions of Web 2.0 technologies are specifically geared to researchers' collaboration and creation (Sugimoto et al., 2017), such as groups in Mendeley that foster multidisciplinary collaboration (Oh & Jeng, 2011) and open review in RG (Van Noorden, 2014). Through the open processes of disseminating, evaluating, and creating scientific knowledge, SNSs/ASNSs not only benefit the entire research cycle, but could also lead to an open science environment by supporting open access and open review (Ponte & Simon, 2011). It is therefore appropriate that Jeng, He, and Jiang (2015) conceptualized ASNS as a generalized online service tool or platform facilitating network-building, communication, and various other activities in conducting research.

Motivations for Using SNSs in Academic Contexts

Researchers mainly use SNSs/ASNSs for academic purposes, promoting research and professional development (Donelan, 2016; Manca & Ranieri, 2017). Lupton (2014) conducted an international survey of the academic use of SNSs/ASNSs to build social networks, share information, promote research, and get emotional and professional support. Donelan (2016) examined the motivations of Science, Technology, Engineering and Mathematics (STEM) academics to use SNSs and found four types of motivation, namely "externally driven," "self-development," "maintaining networks," and "widening networks." Manca and Ranieri (2017) conducted a large-scale study on the motivations of Italian university scholars for using SNSs/ASNSs to extend their networks, interact with their colleagues and professional communities, share professional interests, and promote their work.

Nández and Borrego (2013) explored the reasons for using an ASNS through a survey of Academia.edu users affiliated with Catalan universities; more than half of the 293 survey participants stated that they wanted to communicate with other researchers, disseminate their research work, and keep up with other researchers' activities in Academia.edu. Other reasons included "to disseminate curriculum vitae," "no specific aim, signed up because other researchers from the department/faculty are there," "find collaborators for research projects," and "disseminate teaching material." Elsayed (2016) studied Arab researchers' attitudes toward and perceptions of ASNSs, and found that RG was the most frequently used service across six Arab universities. This study further revealed that ASNSs were used most often to communicate with other researchers, share research, increase citation counts of research, and obtain statistics about research.

Motivational Framework for Self-Archiving on ASNSs

Previous studies have looked at researchers' functional motivations for using SNSs/ASNSs rather than examining their perceptual or behavioral aspects of motivations. Furthermore, few studies have focused on the act of self-archiving in particular, uploading publications and research materials to SNSs/ASNSs.

To build our research framework of motivation for self-archiving in ASNSs, we adapted two models of motivations: motivations for self-archiving in academia (Kim, 2010) and motivations for sharing information in social media (Lee, Oh, Dong, Wang, & Burnett, 2017; Oh & Syn, 2015; Syn & Oh, 2015). Kim (2010) defined self-archiving as an act of uploading pre-refereed, refereed, or un-refereed research articles, book chapters, and data sets on a variety of venues (personal, research group, and departmental websites, as well as disciplinary/institutional repositories). Kim (2010) developed a framework for self-archiving based on the socio-technical interaction networks (STIN) model and the social exchange theory. The STIN model was used to understand the roles of social and technological factors, and social exchange theory was adopted to grasp knowledge sharing in self-archiving. Kim's (2010) model consists of 11 factors, divided into four categories: (a) costs (*copyright concerns* and *additional time and effort*), (b) extrinsic benefits (*accessibility, publicity, trustworthiness, academic reward, and professional recognition*), (c) intrinsic benefits (*altruism*), and (d) contextual factors (*trust, self-archiving culture, and influence of external actors*). Kim (2010) tested her framework, surveying faculty members from 17 universities, and found that copyright concerns, additional time and effort, and age were negatively associated, while altruism, academic reward, self-archiving culture, and technical skills were positively related.

Oh and Syn (2015) investigated social media users' motivations for sharing information on social media platforms, such as Facebook, Twitter, Delicious, Flickr, and YouTube. Oh and Syn (2015) based their framework of motivation on a comprehensive literature review of studies on motivations for sharing information in online communities and other user-generated content platforms (e.g., Wikipedia), as well as social media. They adapted social exchange theory and social cognitive theory to their proposed model, and redefined ten motivational factors from a study of information-sharing in social contexts (Oh, 2012) (*enjoyment, self-efficacy, learning, personal gain, altruism, empathy, community interest, social engagement, reputation, and reciprocity*) and applied these to their study. Syn and Oh (2015) reported that learning and social engagement were the most influential motivations to encourage SNS users to share their information with those in their networks. Learning and reciprocity were strongly correlated with other factors, which indicate that SNS users share information as a pay-it-forward to others in their networks; this could cause a synergetic effect when these motivations are combined with other factors, such as reputation. Altruism was strongly correlated with empathy and community interest, which shows that SNS users want to share information for the benefit of others.

We combine Kim's (2010) and Oh and Syn's (2015) models because they were developed in different contexts helped us identify researchers' diverse points of view in self-archiving; Kim (2010) emphasized the social, professional, and external contexts that affect self-archiving in academia, while Oh and Syn (2015) focused more on the personal and social contexts that motivate users to share information. We integrate the two models, resolving the issues of overlap and ambiguity in the theoretical constructs, and propose an enhanced framework of motivations, including a total of 18 motivational factors in the personal, social, and professional motivations as well as external factors. Figure 1 is a graphic representation of the current model of motivations for self-archiving in ASNSs.

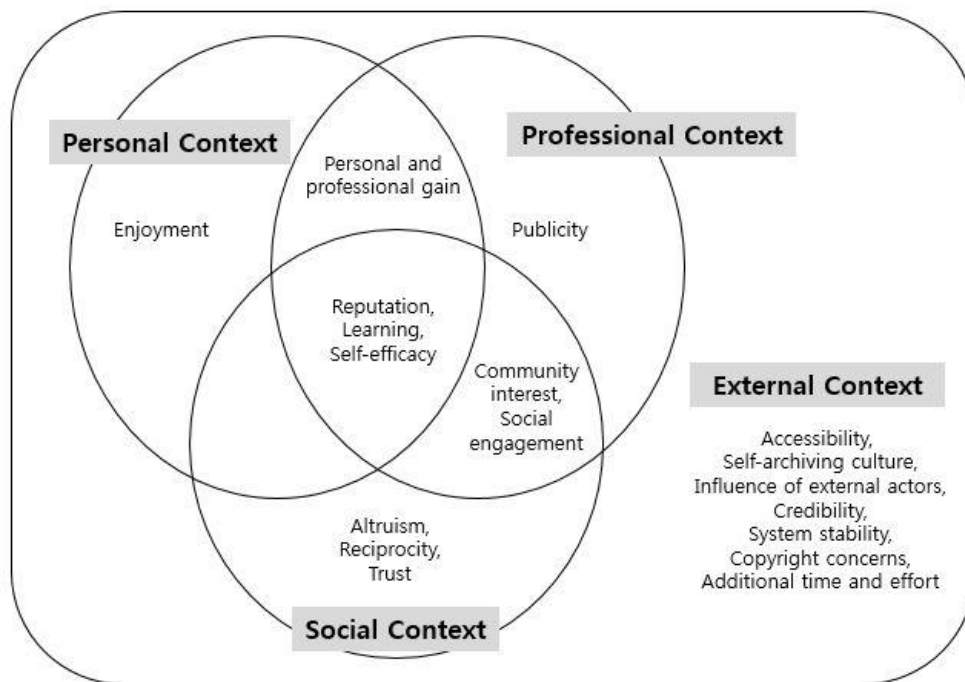


Figure 1. Motivations for Self-Archiving

The personal context represents researchers’ personal preferences or perceptions that they believe are important in self-archiving on ASNSs; factors related to professional context reveal the contributions researchers feel they are making to the professional community and the goals they would like to achieve in academia. Social context refers to factors related to the broader impact on society—for example, to promote altruism, reciprocity, or trust among researchers in the networks. These categories of contexts may not mutually exclusive, but they do overlap in two or three dimensions—e.g., reputation, learning, and self-efficacy could be motivations related to all three contexts. The Venn diagram in Figure 1 shows how these factors overlap. Finally, external context refers to the factors that researchers may not be able to control but which could encourage or discourage them from self-archiving their work on ASNSs. Table 1 presents definitions of the 18 motivational factors tested in the current study.

Table 1
Definitions of the 18 motivational factors

Categories	Factors	Definitions
Personal Factors	Enjoyment	Users self-archive their research on ResearchGate (RG) for pleasure.
Personal & Professional Factors	Personal/ Professional gain	Users self-archive their research on RG to advance their personal/professional interests, such as promoting work or gaining academic tenure/promotion.
Personal, Professional & Social Factors	Reputation	Users self-archive their research on RG to increase their personal, social and professional recognition in their communities.
	Learning	Users self-archive their research on RG because they want to gain new information and enhance their current stage of knowledge and skills in research.
	Self-efficacy	Users self-archive their research on RG because they have confidence in quality of their work and feel it merits being shared with others.
Social Factors	Altruism	Users self-archive their research on RG because it helps others and is the right thing to do.

	Reciprocity	Users self-archive their research on RG because they believe everyone benefits through the open exchange of research.
	Trust	Users self-archive their research on RG because they believe in other users' good intentions.
Social & Professional Factors	Community interest	Users self-archive their research on RG in order to support the goals and values of their communities.
	Social engagement	Users self-archive their research on RG as a way to connect to and communicate with other users. They perceive self-archiving as a way to feel a sense of belonging in their communities.
Professional Factors	Publicity	Users self-archive their research on RG because they want to see increases in the usage and citation counts of their research.
External Factors	Accessibility	Users self-archive their research on RG because they believe it will make their work more widely and more easily available.
	Self-archiving culture	Users self-archive their research on RG because it is common and expected practice in their communities.
	Influence of external actors	Users self-archive their research on RG because they are influenced to do so by others including coauthors, funding agencies, and academic institutions.
	Credibility	Users self-archive their research on RG because they believe that the overall quality of materials stored there is high.
	System stability	Users self-archive their research on RG because they trust the security and stability of RG.
	Copyright concerns	Users do not self-archive their research on RG because they believe doing so would violate the copyrights of the work.
	Additional time and effort	Users do not self-archive their research on RG because of the time and effort required.

Methods

Test Case: ResearchGate

ResearchGate (RG) is the most popular ASNS (ResearchGate, 2017). Upon registration, users are given a profile page where they can post their brief biography, research interests, research items, etc. (see Figure 2). They can network with other users, follow other users' accounts, ask questions, and answer other users' questions. Statistical information is available, such as data on readership, citations, recommendation counts for research items, and the numbers of questions and answers. In particular, an RG score is given to each user that measures his or her scientific reputation by counting how many peers follow that person's profile, how many questions/answers from peers he or she has responded to, and how many of his or her publications are available on RG. It also provides statistical information on institutions. On the institution page, it is possible to check the total RG score, statistics for publications, departments, and members of the institution(s) an individual is affiliated with (see Figure 2).

Figure 2. An example profile page in ResearchGate

Sampling of Survey Participants

The target population of the study was defined as RG users who have at least one research item on their profile page.

First, we chose the top eight U.S. universities based on their total RG Score as of Spring 2016: the University of Michigan (UM), the University of Washington-Seattle (UW), Stanford University (SU), the University of California-Los Angeles (UCLA), the University of California-San Diego (UCSD), the University of Pennsylvania (UP), the University of Wisconsin-Madison (UWM), and the University of Florida (UF). We then sampled participants who had at least one research item on their profile pages from various departments of the universities, such as Mathematics, Chemistry, Psychology, Sociology, Electronic Engineering, Mechanical Engineering, Economics, Communications, and Education. We purposefully sampled participants from these disciplines according to the categories of hard/soft and pure/applied sciences suggested by Laird, Shoup, Kuh, and Schwarz (2008), and investigated and reported participants' motivations for self-archiving regardless of discipline. An examination of motivations across these disciplines is continuing and will be reported in a later paper.

Survey Questionnaire and Administration

An online survey was used to identify RG users' motivations for self-archiving. A survey questionnaire was developed using Qualtrics, consisting of four parts: 1) informed consent, 2) participants' background information; 3) their RG usage; and 4) their self-archiving motivations. The background questions asked participants' gender, age, race and/or ethnicity, education level, job position, research experience. The questions about the usage of RG included respondents' account history and how often they used RG. To examine 18 self-archiving motivations, respondents were asked to rate 51 statements on a 5-point Likert scale, ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Each factor was tested with three to four statements. We developed these measurement items/statements based on the online surveys used to test the motivation models by Kim (2010) and Oh and Syn (2016). We revised the original statements according to our own definitions of each factor shown in Table

1. We conducted pilot testing of these statements with ten researchers and made some revisions prior to the survey distribution (the statements are available on the ResearchGate project site, <https://goo.gl/jhpCk2>).

We sent an email invitation with a link to our online survey to the randomly selected RG users from the eight universities. Because RG does not make users' contact information public, we gathered the public email addresses of the users by searching with their name and affiliation (department and institution) information.

We sent email invitations to 2,655 users, and a total of 226 users completed the survey questions. The survey response rate was about 8.5%. We recruited the survey participants using email addresses available from their published journal articles or websites. We might not be able to reach them properly because their affiliation and email addresses have been changed but not updated on these sources. Recent studies with online surveys about ResearchGate or Mendeley have shown a similar rate of response about 10% (Elasyed, 2016; Mohammadi, Thelwall, Koush, Elasyed, 2016; Manca & Ranieri, 2017)

After collecting the survey data, the internal consistency of the statements for each motivational factor was measured using Cronbach's alpha (see Table 2). The scores ranged from 0.569 to 0.837. A rule-of-thumb scale for evaluating alpha coefficients was that a score of .70 or higher was rated acceptable to excellent (Nunnally, 1978). Most of the alpha values of the motivational and constraint factors were .70 or higher, or close to .70, except for the two constraint factors—self-archiving culture (alpha = .569) and influence of the external actors (alpha = .616)—so we interpret the data values of those two factors with caution.

Table 2
Cronbach's alpha coefficient for 18 categories

Motivations	Alpha coefficient
Enjoyment	0.751
Personal/Professional gain	0.728
Publicity	0.759
Reputation	0.830
Learning	0.837
Self-efficacy	0.686
Community interest	0.763
Social engagement	0.801
Altruism	0.690
Reciprocity	0.699
Trust	0.819
Accessibility	0.821
Self-archiving culture	0.569
Influence of external actors	0.616
Credibility	0.740
System stability	0.732
Copyright concerns	0.833
Additional time and effort	0.679

Findings

Participants' Background Information and RG Usage

Table 3 shows the demographic information of all participants ($N=226$). Of all the participants, 46.9 percent ($n=106$) were females and 52.7 percent ($n=119$) were males. The participants' mean age was 37.8 years ($SD=15.11$, range 18–94). The majority were Caucasian ($n=140$, 61.9 percent); The remainder were Asian/Pacific Islander ($n=59$, 26.1 percent), Hispanic or Latino ($n=15$, 6.6 percent), African American ($n=6$, 2.7%), other ($n=4$, 1.8 percent), or Native American/American Indian ($n=1$, 0.4 percent). One participant declined to reveal his/her ethnicity. The level of education was quite high; all of the participants had at least a bachelor's degree, while 62.4 percent ($n=141$) had a doctorate and 29.6 percent ($n=67$) had a master's degree.

Table 3.
Demographic Information of Participants

Variables	Scales	n	%
Gender	Female	106	46.9
	Male	119	52.7
	Other	1	0.4
	Total	226	100
Age	Under 30	79	35.0
	30-39	86	38.1
	40-49	17	7.5
	50-59	18	8.0
	Over 60	26	11.5
	Total	226	100
Ethnicity	Caucasian	140	61.9
	African American	6	2.7
	Native American or American Indian	1	0.4
	Asian/Pacific Islander	59	26.1
	Hispanic or Latino	15	6.6
	Prefer not to answer	1	0.4
	Other	4	1.8
	Total	226	100
Highest degree	Bachelor's degree	14	6.2
	Master's degree	67	29.6
	Doctorate degree	141	62.4
	Professional degree (MD, JD, etc.)	3	1.3
	Other	1	0.4
	Total	226	100
Job title	Undergraduate Student	1	0.4
	Graduate Student	80	35.4
	Post-doctoral Researcher	54	23.9
	Researcher	19	8.4
	Tenure track Faculty	48	21.2
	Non-tenure track Faculty	7	3.1
	Others	17	7.5
	Total	226	100

With respect to job title, 35.4 percent ($n=80$) described themselves as graduate students, followed by 23.9 percent ($n=54$) as post-doctoral researchers, 21.2 percent ($n=48$) as tenure-track faculty, 8.4 percent ($n=19$) as researchers, 7.5 percent ($n=17$) as other (e.g.,

professors emeritus, librarians, post-baccalaureate students), and 3.1 percent ($n=7$) as non-tenure-track faculty. One respondent (0.4 percent, $n=1$) reported being an undergraduate student.

Table 4 presents the distribution of participants' usage information of RG. On average, participants had had their RG accounts for 2.6 years ($SD=1.3$ years) at the time of the survey. Two hundred and twenty-four participants indicated that they checked their account 8.4 times ($SD=15.8$ times) on average over the past three months.

Table 4
ResearchGate Usage Information of Participants

Variables	Scales	n	%
RG account history	Less than a year	1	0.4
	1-1.9 years	44	19.5
	2-2.9 years	64	28.3
	3-3.9 years	66	29.2
	4-4.9 years	23	10.2
	More than 5 years	19	8.4
	No answer	9	4.0
	Total	226	100
RG usage frequency (Times visited in the past 3 months)	None	43	19
	1-2 times	43	19
	3-4 times	e	19.5
	5-6 times	35	15.5
	7-10 times	21	9.3
	More than 10 times	38	16.8
	No answer	2	0.9
	Total	226	100

General Distribution of Participants' Motivations for Self-Archiving

Table 5 shows the general distribution of mean scores of motivations on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). On average, the overall mean value was 3.54 ($SD=0.47$). Accessibility was the most highly rated motivation. All of the social factors—altruism, reciprocity, and trust—were the second most highly rated group of motivations, followed by self-efficacy and reputation, the two personal, professional, and social factors. The external factors, except accessibility, ranked relatively low, between eleven and eighteen.

Table 5.
Mean scores of motivations

Rank	Motivations	Categories	Mean	SD
1	Accessibility (ACC)	External	4.28	0.73
2	Altruism (ALT)	Social	4.13	0.65
3	Reciprocity (RCP)	Social	3.98	0.67
4	Trust (TRS)	Social	3.92	0.72
5	Self-efficacy (SEF)	Personal, Professional, and Social	3.90	0.69
6	Reputation (REP)	Personal, Professional, and Social	3.85	0.77
7	Publicity (PUB)	Professional	3.82	0.71
8	Community interest (COI)	Social and Professional	3.81	0.76
9	Social engagement (SOE)	Social and Professional	3.79	0.83
10	Learning (LRN)	Personal, Professional, and Social	3.65	0.93
11	Self-archiving culture (CUL)	External	3.58	0.79
12	System stability (SYS)	External	3.39	0.77

13	Credibility (CRD)	External	3.37	0.72
14	Copyright concerns (COPY)	External	3.11	1.04
15	Personal/Professional gain (GAIN)	Personal and Professional	3.01	0.82
16	Enjoyment (ENJ)	Personal	2.83	0.88
17	Influence of external actors (EXT)	External	2.72	0.87
18	Additional time and effort (TIME)	External	2.63	0.82

Correlation analyses were conducted to check the bivariate associations among the 18 motivations (Table 6). Overall, 153 different associations were measured; 116 had statistically significant positive associations at the level of .01 (ranging from .175 to .732) and two associations were positively correlated at the level of .05 (.142 and .149 respectively). In particular, according to Dancey and Reidy's (2004) categorization of correlation, strong correlations ($r > 0.7$) were observed between reputation and publicity, reputation, and accessibility, and between altruism and accessibility. That is, personal, social, and professional recognition is closely related to the increase of the usage and citation count of research and with the effort of making research available. The act of helping others is also closely related to providing access to research.

However, seven associations had negative correlations at the level of .01 (ranging from -.302 to -.177), and the factor of additional time and effort was negatively correlated with the factors of publicity, reputation, self-efficacy, social engagement, altruism, reciprocity, and accessibility. The factor of additional time and effort was also negatively correlated with the factors of learning, community interest, and trust at the level of .05 (ranging from -.163 to 0.133). These findings suggest that self-archivers do not consider the act of self-archiving to consume time or effort. Furthermore, there were 25 associations that had no statistically significant associations.

Table 6.
Correlations among the 18 Motivations

	ENJ	GAIN	PUB	REP	LRN	SEF	COI	SOE	ALT	RCP	TRS	ACC	CUL	EXT	CRD	SYS	COPY	TIME
ENJ	1																	
GAIN	.323**																	
PUB	.276**	.509**	1															
REP	.319**	.461**	.719**	1														
LRN	.438**	.400**	.474**	.521**	1													
SEF	.419**	.372**	.633**	.688**	.496**	1												
COI	.359**	.377**	.627**	.571**	.574**	.617**	1											
SOE	.470**	.445**	.633**	.675**	.692**	.624**	.639**	1										
ALT	.245**	.332**	.578**	.576**	.503**	.655**	.686**	.568**	1									
RCP	.330**	.317**	.541**	.553**	.598**	.626**	.655**	.628**	.732**	1								
TRS	.413**	.298**	.399**	.454**	.502**	.587**	.495**	.462**	.561**	.658**	1							
ACC	.245**	.314**	.682**	.712**	.534**	.671**	.673**	.652**	.678**	.657**	.543**	1						
CUL	.263**	.300**	.322**	.286**	.278**	.388**	.390**	.328**	.299**	.351**	.363**	.354**	1					
EXT	.359**	.290**	.051	.057	.190**	.149*	.184**	.188**	.066	.129	.175**	-.079	.366**	1				
CRD	.493**	.368**	.411**	.447**	.576**	.545**	.565**	.489**	.500**	.541**	.557**	.436**	.277**	.252**	1			
SYS	.442**	.338**	.451**	.451**	.454**	.567**	.537**	.445**	.472**	.560**	.596**	.406**	.365**	.278**	.673**	1		
COPY	.037	.142*	-.026	.030	.053	.052	.035	.080	.049	-.070	.006	-.005	-.044	.048	.049	-.077	1	
TIME	-.050	.061	-.208**	-.228**	-.156*	-.178**	-.133*	-.183**	-.177**	-.239**	-.163*	-.302**	.090	.322**	-.127	-.130	.266**	1

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

* . Correlation is significant at the 0.05 level (2-tailed)

Demographic and RG Usage Characteristics and Motivations

We tested the statistical differences in motivation across the demographic factors and found significant differences across certain motivations in relation to all demographic factors, such as gender, age, ethnicity, most advanced degree, and job positions.

A Mann-Whitney U test was used to explore differences in the distribution of the agreement scores between the male and female groups; the distribution of motivations was statistically significantly different at the .05 level for two factors only, professional/personal gain ($U=4,647.50$, $z=-3.43$, $p=.001$) and reciprocity ($U=5,329$, $z=-2.04$, $p=.041$). Female participants ($M=3.21$) were more likely to self-archive their research to advance their personal/professional interests than male participants ($M=2.82$), and were more strongly motivated by reciprocity ($M=4.07$) than male participants ($M=3.90$).

Kendall's tau- b correlation coefficient was used to identify whether any association exists between age and motivations. The associations were statistically significant for personal/professional gain ($\tau_b = -.227$, $p < .001$) and additional time and effort ($\tau_b = .126$, $p = .008$). In other words, age was negatively associated with professional/personal gain, although it was positively associated with additional time and effort. That is, older RG users were not motivated to self-archive their papers by professional or personal interests; rather, their self-archiving motivations were inhibited by time and effort.

We compared differences in motivation scores between the groups of Caucasian and Asian/Pacific Islander. Other ethnic groups were excluded from the analysis because they each represented less than 10 percent of all participants. The comparisons revealed that Asian/Pacific Islander participants were more highly motivated by enjoyment ($U=5,005.50$, $z=2.376$, $p=.018$), professional/personal gain ($U=5,105.50$, $z=2.648$, $p=.008$), community interest ($U=5,037.50$, $z=2.491$, $p=.013$), and system stability ($U=5,015.50$, $z=2.411$, $p=.016$) than Caucasian participants, and these differences were statistically significant.

Statistical differences in motivations between those with master's degrees ($n=67$) and those with doctorates ($n=141$) were checked, and there were statistically significant differences in personal/professional gain ($U=3,846$, $z=-2.181$, $p=.29$) and in additional time and effort ($U=5,776.50$, $z=2.618$, $p=.009$) at the .05 level. In other words, participants with master's degrees ($M=3.20$, $SD=0.79$) were more highly motivated by personal/professional gain than those who had doctorates ($M=2.92$, $SD=0.83$), while participants with doctorates ($M=2.74$, $SD=0.77$) perceived self-archiving as more time- and effort-consuming than those with master's degrees ($M=2.47$, $SD=0.88$).

We performed a Kruskal-Wallis test to check for differences in the distribution of the agreement scores across job positions. We only compared the motivations of three groups—graduate students ($n=80$), post-doc researchers ($n=54$), and tenure-track faculty ($n=48$)—as other groups had small numbers of participants. We found statistically significant differences in three dimensions across the groups: personal/professional gain, self-archiving culture, and additional time and effort. Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Post hoc analysis revealed that statistically significant differences exist in the agreement scores in personal/professional gain ($\chi^2= 9.03$, $p=.01$) and self-archiving culture ($\chi^2= 7.00$, $p=.03$) between graduate students and tenure-track faculty. Furthermore, although post-doc researchers and faculty participants appear to be less motivated by time and effort than graduate students, post hoc analysis did not show any significant difference. Overall, graduate students were more likely to self-archive their work in

RG for personal/professional gain than faculty members, although faculty members' self-archiving was more influenced by culture than that of graduate students.

To examine relationships between RG usage information (account history and usage frequency) and motivation, we ran a series of Kendall's tau-*b* correlations. These results showed that the participants' account histories were not statistically significantly related to their motivations. However, there were statistically significant relationships between participants' usage frequency and their motivations at the .05 level. That is, there were positive relationships between RG usage frequency and the 15 motivational factors of learning ($\tau_b = .274$), social engagement ($\tau_b = .230$), community interest ($\tau_b = .224$), enjoyment ($\tau_b = .182$), reciprocity ($\tau_b = .175$), accessibility ($\tau_b = .168$), reputation ($\tau_b = .163$), credibility ($\tau_b = .161$), self-efficacy ($\tau_b = .150$), publicity ($\tau_b = .149$), trust ($\tau_b = .148$), system stability ($\tau_b = .148$), influence of external actors ($\tau_b = .118$), altruism ($\tau_b = .106$), and personal/professional gain ($\tau_b = .099$). These results indicated that more frequent users have a variety of strong motivations. A statistically significant negative relationship was observed between RG usage and additional time and effort, meaning that frequent RG users did not perceive self-archiving in RG time or effort consuming. Two other dimensions (copyright concerns and self-archiving culture) were not statistically significantly related to RG usage.

Discussion

We discovered that the most highly rated motivation for self-archiving was *accessibility*; RG users believe that it allows them to widely distribute their research materials and outputs, and that it makes their work easily discoverable and accessible by other researchers in the community through RG. The social factors, such as *altruism*, *reciprocity*, and *trust*, were followed by *accessibility*, indicating that RG users self-archive their own materials to help others, benefit society, and promote a social culture of information-sharing. Simultaneously, they are confident that the research materials they share in RG will be used appropriately and fairly by other researchers. The rest of the personal, professional, and social factors, such as *self-efficacy*, *reputation*, *publicity*, *community interest*, *social engagement*, and *learning* were rated highly, compared to the external factors, such as *self-archiving culture*, *system stability*, *credibility*, *copyright concerns*, *influence of external actors*, and *additional time and effort*. RG users may have concerns about these external and constraining factors for self-archiving, although they gave these factors relatively low ratings. RG users' perception of these factors could influence their active participation in self-archiving and the sustainability of the site's membership in the future.

We also found that motivations for self-archiving are not influenced by a single factor but a combination of personal, professional, and social motivations, with strong correlations evident among *social engagement*, *altruism*, *reciprocity*, *publicity*, *reputation*, *learning*, *trust*, and *self-efficacy*. In particular, *altruism* and *reciprocity* are correlated with one another the most strongly; RG users who are motivated by altruistic reasons believe that self-archiving their own work could benefit others and that others self-archived their research work to share it with the public. Two other strong correlations were observed between *reputation* and *accessibility* and *reputation* and *publicity*. RG users eager to build a good reputation in the field self-archive their research because they strongly believe that RG's accessibility and publicity can increase readership of their work and the impact of their work on the research community. The external factors were not strongly correlated with other factors, except *accessibility*, *credibility*, and *system stability*. RG users who participate in self-archiving motivated by *self-efficacy*, *community interest*,

altruism, reciprocity, and trust consider RG a place for sharing credible resources and providing stable connections. One of the external factors, *additional time and effort*, showed a weak correlation with most of the factors; RG users have few concerns about spending their time and effort on self-archiving their work on RG.

We related participants' demographic and background characteristics to their motivations. The *personal/professional gains* factor was used to test whether RG users seek to obtain academic gains or benefits from self-archiving, such as getting jobs or attaining tenure/promotion. Overall, participants give this factor a low rating, but when comparing groups by demographic characteristics, it was found that RG users who are female, younger, Asian/Pacific Islander, graduate students, or have master's degrees rate *personal and professional gains* higher than RG users who are male, older, Caucasian, tenured faculty, or have doctorates. In addition, female RG users are more strongly motivated by *reciprocity* than male RG users. Older RG users are more likely to be discouraged by the time and effort needed to learn about RG culture and usage than younger RG users. Asian/Pacific Islander RG users are more strongly encouraged by *enjoyment, community interest, and system stability* than Caucasian RG users.

Those who use RG more frequently are influenced by almost all the motivational factors, unlike those who have visited RG less over the preceding three months. Those who are highly motivated by personal, social, professional, and external factors visit RG more often and actively use the service for self-archiving, as well as (possibly) other services that RG provides that were assessed in previous studies (Donelan, 2016; Manca & Ranieri, 2017), such as networking, social engagement, and distributing research for promotional purposes and professional development.

The distribution of self-archiving motivations of RG users is different from that of other user groups in other venues; for example, when Kim (2010) investigated university professors' motivations for self-archiving in open access venues (i.e., personal homepages, university repositories, etc.), *altruism* was the most highly recognized motivation, followed by *self-archiving culture* and peer pressure. RG users, however, rate *accessibility* higher than *altruism* because they wish to benefit from the ubiquitous access to RG through the advanced technology of the information and communication that is reachable from anywhere. RG users are less influenced by *self-archiving culture* or peer pressure than university professors, possibly because RG users include a wide range of people in academia, including students and post-doctoral researchers as well as university professors. The level of peer pressure for self-achieving may differ from group to group, although this was not observed in the current study.

For social media users, *learning* was the most highly rated motivation for sharing information online (Oh & Syn, 2015), although this motivation may not be as strong for RG users. Instead, RG users rate *reputation* and *publicity* highly while social media users gave them relatively low ratings. Social media users who participated in sharing information for fun rated *enjoyment* highly, but this factor was one of the lowest-rated motivations for RG users. RG users' motivations to self-archive may increase or decrease according to the level of benefits they obtain in a social or professional context, while social media users enjoy information sharing for altruistic reasons without being strongly influenced by personal gains or professional benefits.

Conclusions

Self-archiving research on RG is a way to promote open science that makes scientific results accessible to and reusable by a wider audience; this will create an era of networked science, thus accelerating the progress of science, which will be beneficial to our society (Scheliga & Friesike, 2014). In this sense, the findings of this study could be interesting to communities of scholarly communication that promote open science and open access repositories. There is still plenty of room for improvement in open access repositories, although it appears that they are growing dramatically in terms of usage (Björk, Laako, Welling & Paetau, 2014; Lee et al., 2015). Open access venues should be designed to encourage user motivations for *accessibility*, *altruism*, *reciprocity*, *trust* or other factors that were observed from the current study; external factors such *system stability*, *credibility*, and *copyright concerns*, while obviously important for system functionality and reputation, may not have a strong impact on users' decisions to use open access repositories. Furthermore, this study's findings provide useful implications for the development and improvement of ASNSs that could potentially attract more (active) users.

This study also has theoretical implications for building a motivational framework for self-archiving, based on a comprehensive literature review regarding motivation for self-archiving in academia as well as on other social media platforms. The layers of contexts with overlapping personal, social, professional, and external factors can be applied to identify the motivations for self-archiving as well as information sharing in open access repositories and other digital environments, which may contribute to promoting self-achieving behaviors.

This study has a few limitations. First, RG was chosen because it is the most popular ASNS, but it may not represent all other ASNS usage; it may not be possible to generalize the motivations of RG users to the self-archiving motivations of all ASNSs. Second, we recruited RG users who had at least one research items available on their RG profile pages. RG users' motivation could differ according to the number of research items available on their RG profile pages, but we did not specify the level of self-archiving behaviors. RG users who did not upload any research papers to their profile page may have different motivations for using the site, but these individuals were not included in our study.

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