



INFLUENCE OF TITLE CHARACTERISTICS IN SCIENTIFIC LITERATURE ON TWEETING BEHAVIOUR

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Abstract

This study investigates the societal impact of Finnish arts and humanities research mentioned on the microblogging site Twitter. The impact is examined by analysing similarities between the titles of scientific articles and the contents of tweets. To establish a background for the study, different kinds of metrics for research evaluation are reviewed before discussing different aspects of science tweeting and features of academic titles such as length, type, and amusement. This study mainly uses exploratory methods and analyses Twitter data collected by the Research Unit for the Sociology of Education (RUSE) at the University of Turku. The results show a weak connection between the number of retweets and the level of lexical difficulty of scientific titles. In addition, more than half of the number of tweets include summaries of the titles or contain personal comments instead of only quoting the titles. Moreover, this study reveals that Finnish family matters represent the most popular topic in the interdisciplinary field of arts and humanities. In spite of limitations in methodology, this study concludes by the discussions including the implications, similarities as well as differences with previous studies, to present potential evidence for approaching advanced research of scholarly communication.

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Chapter 1. Introduction

The motivation of this research initially comes from the author's personal interest in how scientific publications in the field of arts and humanities impact society. The author later had a chance to obtain data from a project called "Measuring the societal impact of open science", by collaboration between researchers from the Research Unit for the Sociology of Education at the University of Turku and from Information Studies at the University of Oulu. The project aims to map the online attention of Finnish research and develop an open system to collect and detect mentions of research outputs in Finland from various open sources.

Research assessment has become increasingly essential partly due to the growth in the number of researchers and research products. Assessments based on peer review or citations are two methods that have been widely used for evaluating the scientific impact of research, even though both approaches have disadvantages. Peer review is still an irreplaceable method used in order to decide whether a manuscript is good enough to be published in scientific journals. Citations are used not only for intellectual protection (Moed, De Bruin, & Van Leeuwen, 1995; Borgman, 2000; Cole, 2000; Holmberg & Thelwall, 2014) but also as part of the scientific reward system (Merton, 1968). It is assumed that a researcher who has many highly-cited publications is more influential. However, traditional metrics such as citations and peer review only focus on the scientific impact of research, whereas funders are increasingly curious about the societal impact and how academic research proves valuable to society (Bornmann, 2014).

Open science has brought the scholarly community to the open web, where anyone can read scientific research, share articles and discuss their own opinions. Many open access journals were created to allow researchers to publish their manuscripts without a strict peer review process, and to allow wider audiences to access these publications for free (e.g., Dynich and Wang, 2016). Open science is not only about free access to scientific manuscripts, but also about discussing and sharing scientific ideas on online and social media platforms. Altmetrics were created as a potential approach to reflect the impact of research on the online community. Whereas citations and peer review have been used to measure scientific impact of research, altmetrics have been investigated to trace these

scholarly activities and conversations on social media, in order to understand what societal impact a scientific research creates. Although altmetrics are still in their infancy and not widely accepted, altmetrics have shown a potential to trace online attention towards research products, and have been studied to further investigate their uses as metrics for research evaluation outside of academia (Holmberg, 2015).

Among social-media sites for research discussion, Twitter is the most popular platform for distributing scientific products (Thelwall, Haustein, et al., 2013). While Mendeley is mainly used by researchers, Twitter has been reaching different audiences widely. Twitter is also the second largest source after Mendeley in terms of providing altmetrics data (Haustein et al., 2014). However, these traces of scientific publications on Twitter are still being investigated, especially in the field of arts and humanities. According to Thelwall and Delgado (2015), due to the transparent impacts in the field of arts and humanities, contextual data should be used as impact evidence instead of evaluating research impact by using any kinds of metrics. The data in this research are Twitter mentions about Finnish research in the discipline of arts and humanities.

With an interest in exploring how people on Twitter react to scientific research in the field of arts and humanities, the author started to analyse the given data and recognised that the contents of tweets related to scientific articles mostly include the title of the article or a short summary of the article. The shortness is perhaps due to the limit of 140 characters for each tweet. This raises the following question: if the title is too difficult to understand, will it affect the number of retweets? In other words, would the Twitter users be less attracted because of the difficulty of the title? This research aims to explore two broad research questions:

- (1) Is there a connection between the difficulty of the title of scientific articles and number of tweets?
- (2) How do audiences on Twitter react to Finnish research in the field of arts and humanities?

To answer the first question, the VocabProfile tool was used to analyse the difficulty of each research title and examine the correlation between the difficulty and number of tweets, with separation based on the previous coding scheme.

The second question attempts to explore the tweeting behaviour regarding arts and humanities research. The codebook was built to classify the tweets in order to clarify how the users tweet and how they make conversation on Twitter.

To sum up the structure of the study: the theoretical part includes an introduction and theoretical background, the empirical part comprises methodology, results and discussions before the conclusion. The theoretical sections will discuss relevant previous research about scholarly communication, open science, metrics for research evaluation, the potential of using altmetrics in evaluating arts and humanities research, tweeting behaviour among scientists and the importance of titles in academic research. The empirical research starts by explaining the research methodology including an overview of data and the used methods to conduct the study. After this, the findings of the study are presented based on the analysis of the difficulty as well as length of title and its correlation with the number of tweets. In the discussion chapter, all results will be discussed and compared to the theoretical framework. Furthermore, the research questions of this thesis will be answered. In addition, the contribution of the thesis as well as some limitations and a need for further research are also discussed before finalising the study.

Chapter 2. Theoretical framework

In this chapter, the literature is reviewed. The first three parts offer an overview of Finnish research, definitions and activities within scholarly communication, and the open science movement. The fourth section explains four metrics that are used to evaluate research impact and this section also introduces the concept of altmetrics. Next, the potential of using altmetrics in evaluating arts and humanities research is introduced. The following section discusses how scholars use Twitter and reviews the correlation between the presence of research on Twitter and citation counts in various disciplines. Finally, four aspects of title which are considered as influencing factors on citation counts are given, such as length, type, specific markers such as colons, and the level of amusement.

2.1 Scholarly communication

Scholarly communication is the system of creating, evaluating, disseminating and preserving the value of research and other scholarly writings for future use (Principles and strategies for the reform of scholarly communication 1, 1996). Scholarly communication includes both formal and informal contributions. Formal contributions include researcher's scientific publications in following formats: journal articles, conference proceedings, book chapters and books. Informal contributions happen during the conversation at conferences, or during communication via Twitter and other social media channels (Holmberg, 2015). In general, scholarly communication is a process starting with a new research idea or an idea that builds on previous research. After analysing and writing, these manuscripts will be assessed by peer review and published if they are considered to be good enough to make a contribution to science. These publications continue to inspire other researchers and become a source of literature for future research. As a part of this formal scholarly communication, citations are used as an indication of intellectual debt or connection to prior work and as contributing to the academic reward system. It is assumed that if a study is frequently referred to, it reflects higher value and contributes more to science. For this reason, its author could be considered as a productive researcher who is more influential than those with less-cited papers.



Figure 1. The cycle of scholarly communication (Holmberg, 2015)

The dissemination, availability and accessibility of research outputs have been significantly affected by the development of the internet and the electronic format of research products (Walsh et al., 2000). Scholarly communication has also shifted to social-media platforms. As such, many researchers are interested in using available tools and services on social media in order to productively support the online presence of their research (Thorin, 2006; Gu and Widén-Wulff, 2011).

2.2 Open science

The advent of web 2.0 and social-networking sites has changed the way of publishing, disseminating and sharing knowledge within the scholarly community and to people outside academia. Along with the transfer from printed academic journals to electronic publishing, the demand from society to access scientific knowledge has increased. The concept of ‘open science’ was created to encourage scientists and researchers to share scientific articles to spread knowledge to wider audiences. Open science is defined as “the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process” (Nielsen, 2011). There are still some concerns about what information should be shared, since the public could misunderstand scientific data or science might be negatively exploited (Galligan and Dyas-Correia, 2013; Ferrara et al.,

2014; Holmberg, 2015). Despite these concerns, new organisations were created to adopt the concept of open science, for example, *Public Library of Science (PLoS)* with a collection of open-access journals and scientific literature; *F1000 Research* with an open publishing platform and open peer review for life-sciences (Wikipedia, 2016). Regarding Finnish research, as stated in the reports of Ministry of Education and Culture (2014), Finland believes that open science and research under legal and ethical operating environments could increase the competitiveness and innovation by bringing surprising discoveries, creative insights, and widening the impact of research.

Along with open science, many social-networking tools are used for various purposes. Scholars use these platforms to exchange information, to build a new relationship and to interact with other people who share the same interests (Tiryakioglu & Erzurum, 2010; Chen & Bryer, 2012; Gruzd, Staves, & Wilk, 2012; Al-Aufi & Fulton, 2014). Researchers use wikis and online documents to update and to search for information, as well as to send instant messages to interact with others, and to share knowledge on other platforms (Gu & Widén-Wulff, 2011; Holmberg, 2015). Specifically, Twitter has been frequently used by the scholars to discuss their ideas, to promote individual works or to find collaboration (Letierce, Passant, Breslin, & Decker, 2010). During a scientific conference, the participants tend to discuss, to comment on and to share interesting links on Twitter (Ebner & Reinhardt, 2009; Letierce, Passant, Decker, & Breslin, 2010; Ross, Terras, Warwick, & Welsh, 2011; Weller, Dröge, & Puschmann, 2011; Weller & Puschmann, 2011; Homberg, 2015). Gu and Widen-Wulff (2011) found that the scholars in Finland are familiar with using social-networking tools in the daily life. Although not all researchers actively use these tools for scholarly activities, most of them agree that the use of social media among academics is increasing. Scholarly communication has shifted to the online world, and more communication between researchers or between researchers and audiences have occurred on these online platforms.

2.3 Metrics for research evaluation

Priem, Taraborelli, Groth and Neylon (2010) presented four methods for evaluating the impact of research, from a traditional to an emerging approach.



Figure 2. Four ways to measure impact of scholarly products (J. Priem et al. 2010)

2.3.1 Usage statistics

Usage statistics count how many times a publication was viewed or downloaded. The biggest advantage of this measure is that it immediately shows the impact of a study as soon as it is published online (Bollen, Van de Sompel, Hagberg, & Chute, 2009).

However, it is impossible to know whether the readers actually read the articles after downloading or not (Neylon & Wu, 2009). Moreover, Haustein and Siebenlist (2011) indicated that many publishers do not share their usage data, except in some cases for a specific collection of articles. However, some previous studies found a correlation between the download counts and the citations (Brody, Harnad, & Carr, 2006; Watson, 2009; Bollen et al., 2009). These authors explained that if an article is downloaded, it may receive citations later.

2.3.2 Peer review

Peer review is a process of evaluating a manuscript by the researcher's peers, who are usually the experts in the same area of research. The peers carefully check the accuracy rate of the manuscript and assess the validity of the research methodology and procedures before approving or rejecting the paper (Elsevier, 2016). Despite some criticism, peer review is still the only widely accepted method for research validation across different disciplines. It has been a formal part of scientific communication since the first scientific journals were published more than 300 years ago. There are three main types of peer review, namely single-blind review, double-blind review, and open review. Single-blind review is the most common type so far without revealing the name of reviewers; whereas

both reviewers and authors are anonymous to each other in double-blind review. Open review is completely open to other peer-reviewers. This method can prevent malevolent comments, stop plagiarism, and encourage honest reviews (Elsevier, 2016). Another opinion is that it would be less likely to be honest by using open review. For example, a junior researcher could be afraid of giving an open review as well as honest review to a work of a famous scientist in order to protect his own career and funding possibilities (Mulligan, 2005). In general, single-blind review is still the most popular method since the 1750s (Spier, 2002).

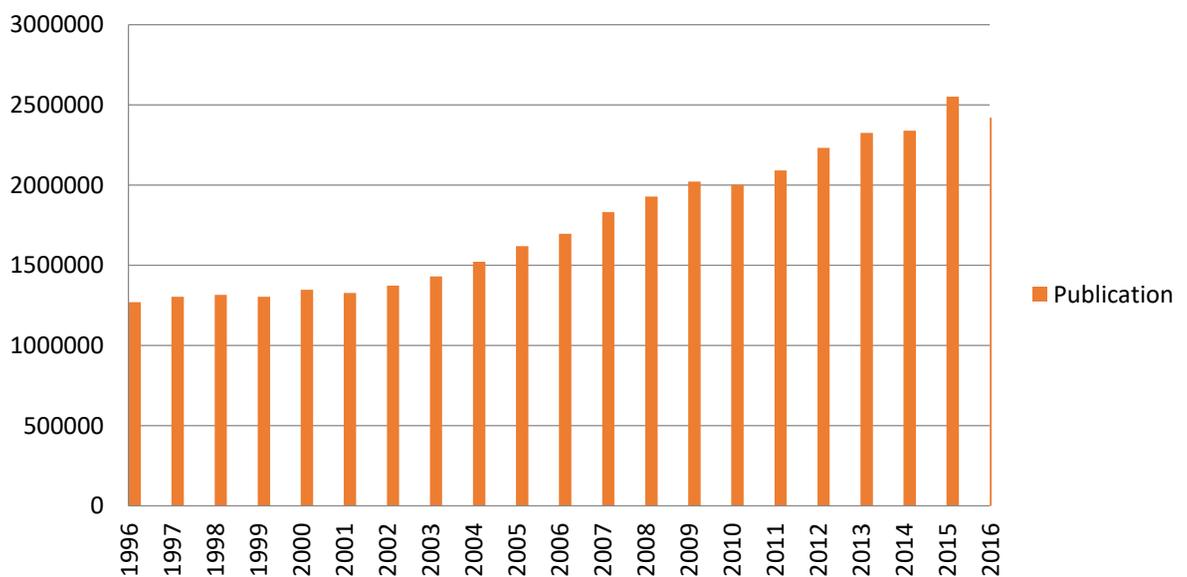


Figure 3. The increase of publication as archives by Web of Science between 1996 and 2016 (data retrieved from web of Science, February 26, 2017)

With a double increase in the number of researchers and scientific publications during the past ten years, using peer review alone to evaluate this long queue of manuscripts may be impossible. Due to the time-consuming and costly process, peer review cannot be used on a large scale (Holmberg, 2015). However, it still remains a reliable method for vetting of claiming knowledge (Lee et al., 2012). As such, a combination of using peer review and other bibliometrics indicators is necessary to evaluate the impacts of research in terms of both quality and quantity, particularly at a large scale.

2.3.3 Citation impact

Bibliometric is a statistical measurement which is used to analyse the quantity and performance of a publication. In 1969, Pritchard introduced the concept of bibliometric as “the application of mathematics and statistical methods to books and other media of communication” (p.2). Since then, bibliometrics have developed into a set of methods to assess the scientific productivity and impact (Holmberg, 2015; Yu, Wu, Alhalabi, Kao & Wu, 2016).

In the early 1960s, Eugene Garfield from the ISI (Institute for Scientific Information) created an idea of journal impact factor, by counting how many times on average an article in a specific journal has been cited in the previous two years (Garfield, 2006). Since then, this citation-based approach has become the most popular bibliometric indicator for research evaluation. However, this citation-counting metric was criticised as it ignored the differences between various fields of research and it was impossible to evaluate the quality of the publications (Seglen, 1997). In 2005, Hirsch argued that the problem of bibliometric indicators is that the research is evaluated by counting either the total number of papers or the number of citations. Both of these statistics should be used together. Hirsch therefore introduced the h-index for evaluating the scientific performance of researchers by taking both quality and quantity aspects into account. If a researcher has h number of publications which receive at least h citations each, then the h-index of this researcher is h . For example, if researcher A has published seven publications which all have more than seven citations, then his h-index is 7. A high h-index means that a researcher has published many highly-cited papers. The h-index has been widely used, studied and criticised by the scholarly community. It has become an inspiration for developing other citation-based indicators (Burrell, 2007; Abramo, D’Angelo, & Viel, 2013; Ferrara & Romero, 2013; Schreiber, 2013). Despite many arguments, citations still remain as the well-known metrics for measuring the scientific impact and even for evaluating the quality of research.

To respect and to protect the ownership of original ideas as well as to avoid plagiarism, researchers have to use references and give the credits to the prior work by citing the articles which they have used to build their own work upon. Apart from protecting the intellectual ownership, citations are used to capture the accumulated knowledge,

collaborations and the flow of ideas in science (Moed, De Bruin, & Van Leeuwen, 1995; Borgman, 2000; Cole, 2000; Holmberg & Thelwall, 2014). However, the process of turning an idea into a complete research product is slow, particularly the case of a collaboration between many researchers worldwide (Holmberg, 2015). After publishing, it takes time to recognise the value of the research and to cite it. Moreover, more time is needed to accumulate enough citations for evaluating the research. It probably takes at least a few years after the research has been published to provide a reliable evaluation of its citations. As such, the research ideas become outdated at the moment the value of research can be assessed. In other words, this citation-based approach only shows the value of a research in the past instead of the present.

Apart from protecting the intellectual ownership, citations are a part of the scientific reward system (Merton, 1968). It means that a highly-cited research is more valuable and its author is more influential. This strongly applies in choosing a candidate for an academic position. A teacher with greater publications is often considered better than those who have a better teaching quality but poor research output (Holmberg, 2015).

2.3.4 Altmetrics

Since the 1990s, as the competition for research funding has increased, funders are not only interested in the scientific impact of research but also the societal impact, which focuses on social, cultural, environmental, and economic returns (Bornmann & Marx, 2013). For instance, Finland has recently focused on the importance of the wider impact of scientific research to the society, specifically on four fields: (1) ecology, evolutionary biology and ecophysiology, (2) history, (3) material science and technology, and (4) medical engineering and health technology. Finland attempts to capture the research impact beyond academia by using surveys and group interviews to collect the information of influences, interactions and broader impact of research (State of scientific research - Academy of Finland, 2016). The societal impact evaluation, however, is still in its infancy. While scientific impact can be measured by peer review and other standard bibliometric methods, there are no established approaches for assessing the societal impact of research yet. Bornmann and Marx (2013) stated that the societal impact occurs when the contents of scientific articles are addressed outside of academia and it can be measured by tracking the

online attention related to the research. Altmetrics, a short name of alternative metrics, are an interesting option to assess the societal impact of research. Altmetrics are defined by Shema, Bar-Ilan and Thelwall (2014, p.1019) as “web-based metrics for the impact of scholarly material, with an emphasis on social-media outlets as sources of data”. In other words, altmetrics count the online attentions related to the articles, such as views, downloads, saves, tweets, likes, bookmarks, comments, blog posts and online discussions. Priem and Hemminger (2010) summarised that there are seven major platforms on social media to track the impact of research, namely bookmarking sites, reference managers, recommendation services, comments on articles, microblogs, Wikipedia, and blogs. Whereas citations or the journal impact factor take months or even years to show the value or impact of the research, altmetrics measure fast and allow researchers to observe, almost in the real time, how an article or other research outputs are used. One more potential advantage of altmetrics is that they capture the data from a variety of sources, not only in the traditional academic publication setting. In this way, they reflect a ‘real’ connection to wider audiences beyond scholarly communication.

Previous studies have found that there is a positive association between the altmetrics counts and the number of citations (Shema, Bar-Ilan & Thelwall, 2014), as well as between the altmetrics counts and the views of an article (Wang, Liu, Fang & Mao, 2014). The article views include the abstract views, HTML views and downloads, in which the pdf download counts have the most significant correlation with the citations (Wang et al., 2014). However, these studies of correlations between the citation counts and altmetrics might not be useful. The high association between them addresses the similarity of their functions for evaluating the impact of research, which is not the goal of altmetrics. Altmetrics were created to investigate the new kinds of impacts on the wider audiences. In other words, the less altmetrics indicators correlate with the citations or other bibliometrics, the more opportunities to discover the uses of altmetrics which are beyond scholarly impact (Holmberg, 2015).

There are some applications which offer the altmetrics views. Altmetric.com (<http://www.altmetric.com>) is a service that captures tweets, blog posts, news and other contents on different webs and social-media platforms which mention the research outputs. Plum Analytic (plumanalytics.com) focuses more on delivering traces of the attention to

institutions and research managers. Another service is ImpactStory (www.impactstory.org), which traces the volume of discussions (good or bad) around a research (Bornmann & Marx, 2013). There is a difference in the level of impact or level of engagement that different social-media activities can reflect. Holmberg (2015) discussed the association of the level of engagement with each online activity and he suggested that the number of tweets, retweets, likes and shares are likely to have less impacts than the number of downloads or bookmarks, while a blog post or a news story which might generate more conversations and could be considered as a stronger indicator.

Apart from the potential, there are also many critics of altmetrics. Many researchers are sceptical and afraid of changing from traditional metrics such as citations to altmetrics, as they are strongly tied to the academic reward system (Weller, M., 2011). Some have argued that altmetrics could be easily manipulated by the software robots (Galligan & Dyas-Correia, 2013; Haustein, Bowman, Holmberg, Peters, & Larivière, 2014). As such, the programs for detecting those robots are further developed to decrease the threat of manipulation (Ferrara, Varol, Davis, Menczer, & Flammini, 2014). Even lately, there was a two-phase initiative from the NISO Altmetrics Initiative which attempts to explore, to identify, and to standardise the altmetrics (Verma, 2016). However, altmetrics are still lacking in standards compared to the citation metrics or peer review. No one can guarantee that all the social bots will be detected. The situation could be even worse if the altmetrics would be standardised and be considered as an evaluating factor for the research funding, since people would probably start manipulating them (Holmberg, 2015). The other problem with altmetrics is that there is no firm understanding of what altmetrics mean and how the data collection should be interpreted. Unlike citations, altmetrics do not have an established score or a standard that applies to all altmetrics providers (e.g. altmetrics.com, plumanalytics.com, impactstory.org). The other challenge is that the data sources have a shortage of stability. The number of tweets or contents on blogposts could change or disappear by time and would be impossible to retrieve; that lead to the fluctuation of altmetrics scores (Haustein & Siebenlist, 2011). It is undeniable that there are many defunct social-media sites which are no longer widely used, such as Google Wave, Orkut, Hyves and Six Degrees. Hence, it is difficult to determine which platforms would be stable and reliable over time. It is even possible that the popular platforms such as Facebook, Twitter

or Mendeley could be replaced some day and all their data might disappear (Holmberg, 2015).

In general, altmetrics receive both interest and criticism. Altmetrics are created along with the movement of open science and the development of social-media sites. The wider audiences are able to access the scientific research for free and to share their opinions online. It has been found that the online visibility of research leads to more citation counts. This proves that altmetrics also reflect similar aspects of the research products as the citations do (Holmberg, 2015). Moreover, altmetrics can reflect other aspects of the societal impact such as the public interest or attention towards a study. In the future, although the current social-media platforms will no longer exist or will be replaced by new ones, altmetrics (alternative metrics) are still able to develop along with the advancement of the open science movement.

However, altmetrics are new and have no established standards which are widely accepted. The worldwide users are creating the tremendous amount of contents every single second regarding research products. These mentions can be the self-promotion or the automated bots which try to manipulate the altmetrics score. As such, before we fully understand the potential, altmetrics should play a role as a complement to traditional metrics in observing the public attention towards the research products, rather than as a replacement.

2.4 Potential of using altmetrics in evaluating the arts and humanities research

The definitions of arts and humanities are fuzzy. This heterogeneous domain generally covers religion, philosophy, arts, music, literature, linguistics, archaeology and history (Hellqvist, 2009).

There are many problems in evaluating the impact of arts and humanities research with the established bibliometrics methods such as citations. In the field of social science as well as arts and humanities, only the data for the psychological and cognitive science could be used for the evaluation of citations (Thelwall and Delgado, 2015). Ardanuy (2013) conducted a citation analysis in the field of humanities from 1951 to 2010 and found that the *Web of Science*, *Scopus* and even *Google Scholar* are not good at covering the social sciences or humanities research. In addition, the arts and humanities publications are mostly non-

English and non-journal. This leads to the fact that citations are difficult to use for evaluating arts and humanities research. As stated by the Research Excellence Framework (REF) in 2014, there are 34 different types of outputs in the field of arts and humanities, namely “advisory reports and evaluations, books (authored and edited), chapters in books, journal articles, published conference papers, electronic resources and publications, exhibition catalogues, translations and scholarly editions, compositions and musical scores, creative writing (libretti, film scripts, radio plays, novels, short stories, stage plays), databases, grammars, patents, digital and broadcast media, performances, films, video and media presentations, installations, designs and exhibitions, software design and development, working papers”. These research products may generate the meaning and knowledge, encourage practical applications, and contribute to happiness and democracy (Small, 2013), which influence the society at a subtle level that cannot be evaluated by the traditional measures using citations or peer review.

The impact of arts and humanities research is not transparent or as visible as other types of research, such as medical or technological innovation research. As stated by Thelwall and Delgado (2015), we should not measure the societal impact of arts and humanities research by using traditional metrics. Instead, contextualised data should be used. In order to understand the wider impact of research, the data itself should be used as an “indicator”. For example, the contextualised data could be the ‘publication and sales figures, external funding, evidence of use of educational materials, tourism data, and business growth figures, such as income, or employment, critiques or citations from users, public engagement data (including numbers and descriptions), policy engagements, independent testimony and formal evaluations’ (Thelwall & Delgado, 2015). More studies will be needed to further investigate the use of these contextualised data as an altmetrics approach that could benefit the research evaluation in the field of arts and humanities.

In general, altmetrics are the potential tools to capture the wider societal influence of research beyond academia. However, the problems of using altmetrics in arts and humanities research undeniably also relate to the issues that are already addressed in the bibliometrics approaches. The problems are, for instance, the diverse publication channels in the field of arts and humanities, the reliance on print instead of e-publication as well as

the low coverage of non-English research. However, compared to citations-based metrics, altmetrics are still more diverse and potential to capture the real-time activities related to the research. As stated by Thelwall and Delgado (2015), the altmetrics data could be used to understand how arts and humanities research reaches the public. Instead of counting the number of tweets or Mendeley readers, we should carefully observe how the scientific publications are tweeted and blogged, analyse those contents and the motivation behind.

2.5 Science tweeting

Not only do the wider audiences mention the scientific research on social media for various reasons, the researchers also promote their products online and seek collaboration by using social-media sites. It has been found that there is a relationship between the social-media visibility of scientific research and the citations, which reveals its potential as a rapid data source for analysing the research impact (Eysenbach, 2011; Shuai, Pepe, and Bollen, 2012; Bar-Ilan et al., 2012; Thelwall, Haustein, et al., 2013). It could be assumed that if an article is frequently mentioned on Twitter or receives a high number of retweets, it is more valuable and creates more societal impact compared with publications with less social-media presence. The scholarly community uses Twitter to follow discussions and post work-related contents (Holmberg, 2015), while the public updates their daily life activities, searches and shares information on Twitter 200 (Java et al., 2009; Zhao, Rosson and Beth, 2009). Twitter allows the users to choose who they want to follow and what kind of tweets they want to feed. As such, the networks on Twitter tend to be clustered around those who share the same interests. Even though not everyone is online and uses Twitter regularly, the population on Twitter keeps growing rapidly with an ease of access to the data. For these reasons, Twitter has attracted great attention as a source of data for research in many disciplines and has lately become one of the most popular social-media sites (Holmberg, 2015). Twitter may become a useful metric for measuring the attentiveness of the public towards a specific scientific publication. Additionally, via Twitter we could know which topics are popular and attract the public's attention, even if they did not receive many citations. It may support the funding organisation, journal editors, and research institutions in making the funding decision, by finding a research idea which is resonate and trendy enough to attract the public (Eysenbach, 2011).

2.5.1 Science tweeting- motivation and behaviour

Microblogging allows people to post their messages to potentially reach a large number of audiences (Mollett, Moran & Dunleavy, 2011). Twitter is one of the most popular microblogging sites that has been widely used not only for sharing information but also in promoting activist groups and online campaigns (Jansen, Zhang, Sobel, & Chowdury, 2009). Twitter has been proven to be an effective tool to spread the online campaigns during political elections (Vergeer, Hermans, & Sams, 2011) or climate activities (Bennett & Segerberg 2011). There are also studies about the use of Twitter among scholars (Priem & Costello, 2010; Weller, Dröge, & Puschmann, 2011). However, most of them found that Twitter is not considered as a popular tool for scholarly dissemination, even though the Twitter data for altmetric events are more extensive than the data from other social-media platforms (Thelwall, Haustein, Larivière, & Sugimoto, 2013). Twitter is less likely to contribute to a scholar's reputation (Cruz and Jamias, 2013). As studied by Kwak, Lee, Park, and Moon (2010), if a tweet is retweeted, it could reach more than 1000 users on average, which is a potential approach for widely disseminating information. However, despite a large population of tweeters, the connections between individuals are not as strong as on other social-media platforms, such as Facebook (Huberman, Romero, & Wu, 2008). Twitter is more information-based. For instance, during academic conferences, it is frequently used to share information about the event, comment on and share the individual conversations (Weller, Dröge, & Puschmann, 2011).

Less than 10% of researchers use microblogging (Rowlands, Nicholas, Russell, Canty, & Watkinson, 2011), while only 2.5% of scientists are active on Twitter (Priem, Costello, & Dzuba, 2011). When scholars tweet, almost 50% of the tweets are related to the scholarly communication (Chretien, Azar, & Kind, 2011; Holmberg & Thelwall, 2014). There are three kinds of special characteristics or affordances on Twitter: hashtags, directive @messages and retweets (Boy, Golder & Lotan, 2010). Hashtags combine key words to indicate the topics and label the tweet. @messages are used to send the messages directly to some specific person (e.g. @amandapalmer) or to refer to another user (e.g. "I saw@oprah's show today"). Unlike @message and hashtag, retweet is much more inconsistent. Ideally, a retweet should copy the original tweet, precede it with RT and mention the author with @. However, people usually change the contents when retweeting. This therefore leads to a

difficulty to track the retweets. Retweets are considered as the “internal citations”, while the “external citations” appear when the users link to another website or outside information (Weller & Peters, 2013). Tweets are more likely to be retweeted if they contain links. It has been shown that almost a third of academic tweets contain the URL links (Peters, Beutelspacher, Maghferat, & Terliesner, 2012), even though it could vary greatly among disciplines (Holmberg & Thelwall, 2014). These links generally connect to a blog, a mass-media channel (news or video-sharing platforms), or an open publication website (Weller, Dröge, & Puschmann, 2011; Weller & Puschmann, 2011; Peters et al., 2012; Holmberg & Thelwall, 2014).

2.5.2 Tweeting and citations

Haustein and her co-authors (2013) conducted a large-scale study and found that “less than 10% of more than 1.4 million articles in *WoS* and *PubMed* are tweeted” (p.14). When articles are tweeted, each will be tweeted two and a half times on average. The correlation between Twitter coverage and the traditional citation rates is positive. The correlation between the Twitter citations and the formal citations for all publications in 2011 is low but positive. In other words, these two indicators appear to be somewhat related, but probably measure a different kind of impact. These authors concluded that altmetrics should not be considered as an alternative to the traditional citation-based indicators, but rather a complement. The results also showed that the correlation between the number of retweets and citations is lower than the association between other metrics (the readership and mentorship) and citations. It is also lower than the correlation between the number of tweets and other scholarly metrics, such as the Google Scholar citations and downloads. The authors also concluded that the highly-tweeted articles are either related to the health topics or contain the humorous or curious contents, which means that the tweets do not necessarily reflect the intellectual impact.

In 2013, Thelwall and his co-authors conducted a content analysis study of how 270 tweets are linked to academic articles in four journals (*PLOS ONE*, *PNAS*, *Science*, and *Nature*). The authors found that the tweets mainly contain the titles (42%) or a brief summary of the article (41%). The summaries seem to be easier to understand for the wider audience. The majority of tweets do not link to the name of authors, but some do and others are self-

citations. Most of the tweets are neutral and include no comments, except some tweets which express excitement. As such, while the tweet counts might reflect the popularity of scientific articles, the contents of the tweets are unlikely to reveal the insights about the reactions of readers, except in some special cases. However, the results are concluded from a small sample of tweets, and only from articles in the four journals. There is still a shortage of studies about why the scholarly articles are mentioned on Twitter and why some articles are tweeted more than others, particularly in the field of arts and humanities.

In the field of arts and humanities, Holmberg and Thelwall (2014) found that the scholars in digital humanities use Twitter to create conversations with the wider audiences. It has been previously stated that the humanities journals are often used in conversational and negotiating manners (Hammarfelt, 2014; according to Hellqvist, 2009).

2.6 The power of title

The title is an important part of a scientific article that informs the readers about the contents of the paper and encourages them to read (Subotic and Mukherjee, 2013). It also helps to attract the public attention and affects the impact of research articles (Wang and Bai, 2007). In the computer age, for the success of searching an article among thousands of others, it is necessary to include some key words about the research into the title (Hartley, 2008). According to Ball (2009, p.668), “a title should motivate the reader to read an article, give the readers a summary of the contents, give overview of the topics and finding discussed, and introduce the way in which the reported items are looked at”. However, most titles are attractive but not informative, or vice versa, informative but not attractive (Kane, 1988).

More than 70% of researchers re-cite the articles from the lists of references without reading those articles or only skimming (Simkin and Roychowdhury, 2002). There are some previous studies (Subotic & Mukherjee, 2013; Didegah, 2014) that focus mostly on the correlation between the citation counts and the characteristics of title, such as length, type, specific markers as colon, or an extreme attention grabbing such as humour. However, these prior findings are debatable. It is not reasonable to assume that changing the title will simply attract more citations.

2.6.1 The length of titles

The title length has been investigated to discover its correlation with the citation rates; however, the findings vary in different disciplines and fields. Letchford, Moat and Preis (2015) investigated the 20,000 most highly-cited papers from 2007 to 2013 and found that the shorter titles receive more citations. However, this correlation depends on how famous the journals are. Specifically, the papers which are published in several specific journals attract more citations than in others. They explained that the shorter titles may be easier to understand and attract more readers. Additionally, many journals might have a restriction on the length of title. Sharing the same results, Subotic and Mukherjee (2013) stated that the short titles at around 10 ± 4 words receive above the median number of citations. The authors concluded that the shorter titles, at least in the psychology discipline, are easier to digest and therefore, attract more citations. Didegah and Thelwall (2013) also concluded that the title length associates with the decreased citations in biology, biochemistry and social sciences, whereas no significant association is found in chemistry and a low positive correlation is found in psychological articles. Generally, the title length is not an important factor to affect the citations.

By contrast, in another study of 9,031 articles from 22 scientific journals in the medical field, Habibzadeh and Yadollahie (2010) concluded that the longer titles seem to be associated with a higher citation rate. The authors explained that “the longer titles are mainly those which include the study methodology and/or results in more details and thus, attract more attention and citations” (p.169). They also suggested conducting more research about the contents analysis of the titles to understand what makes them longer; for instance, the result, the information about methods, the emotional expression or different types of writing styles. Yitzhaki (1994, 2002) concluded that the longer titles are cited more because they are normally bigger projects. These bigger projects create greater results which contribute more to science and deserve more citations.

2.6.2 Types of titles

The number of substantive words in the titles in the humanities research is lower than in sciences and social sciences between 1940 and 1960; even though the titles have become more and more informative in the field of humanities (Yitzhaki, 1997). Yitzhaki (1997)

supposed that a title is considered as an informative title if it helps readers to perceive the idea of what the article is about. This informative concept has been analysed based on the number of substantive words, which do not include stop words such as articles, prepositions, conjunctions, pronouns and auxiliary verbs. Yitzhaki also found in 1994 and 2002 a positive correlation between the title length, the number of authors and the length of the articles. Another study in biomedical articles found that the articles with the method-describing titles are cited less than the result-describing titles (Paiva C.E, Paiva B.S.R, and Lima, 2012).

Jamali and Nikzad (2011) investigated more than 2,000 articles in six *PLoS* journals and categorised into three types of title, namely declarative, descriptive and question-title. The declarative titles summarise the findings of articles, whereas the descriptive titles only describe the topic without adding any conclusions, and the question titles indicate the subject of the paper in a form of question. They found that even the number of articles with a question mark in titles has increased four times within the last 40 years in physics, medicine and life sciences. However, they are downloaded more but are cited less in comparison with the articles with descriptive or declarative titles. Subotic and Mukherjee (2013) supported this point by the discovering that the descriptive titles are the most common way to name psychology articles.

2.6.3 Specific markers as colons or question marks

According to Ramana, Jain, and Howlett (2013), all styles of titling depend on each individual writing style and vary among different disciplines. They added that some authors prefer to write a simple title, while others favour a complex one. Some writers use many commas, while others use both commas and colons. Sometimes the authors also use brackets for an additional explanation, or even a subtitle. Some emphasise their title with a question mark or exclamation mark to stimulate the readers. Therefore, the different individual writing styles affect their titling behaviour, and this may also affect the way the authors want to deliver their messages to the audiences. Another study mentioned that there was an increase in the title length and the use of colon from 1981 to 2001 (Lewison and Hartley, 2005). Hartley (2007) found that there was a greater use of colon in arts than in science. He concluded that even though the students and scholars often prefer to put colons

into the titles, using this particularly in the psychology discipline had no effect on the citation rates. However, in the medical and life science discipline, Jamali and Nikazad (2011) found that the titles with colon were longer and received fewer downloads and citations. They also indicated that the long titles with colon did not attract people to cite the articles or increase the usage statistics.

Ball (2009) concluded from his study of nearly 20 million scientific articles that the number of titles with question marks increased significantly between 1966 and 2005. The use of question mark in the title is considered as a marketing trick, which might appeal more to the readers and attract them to read. Overall, even though there has been a growing use of special markers such as the colon in the titles, it has little or no influence on how the research is cited later.

2.6.4 Amusement or humour of titles

Humour has been considered as an attention grabber, which is widely applied in marketing and even now in science. In a previous study, Bryant et al. (1981) found that the humorous illustration in the text book for undergraduate students is positively associated with the level of enjoyment, but negatively with the credibility of the author and the persuasiveness of the text. This finding suggested that humorous titles may harm the credibility and make the readers treat its contents less seriously. Sagi and Yechiam (2008) stated that the purpose of using humour in the scientific titles is to stimulate the audiences, but the title also has to convince the audiences. They reviewed previous research and indicated that the use of humour in scientific titles sometimes has “side-effects” that reduce the tendency to read the article or underestimate the quality of the article. Additionally, they found that in the field of psychology the number of citations is weakly associated with the pleasantness of the title which is “giving a sense of happy satisfaction or enjoyment; friendly and likeable” (p.681). Even worse, the articles titled amusingly which cause readers to laugh or smile may receive only a few citations.

However, even though the pleasantness seems to connect with the amusement, only the amusement feature is negatively associated with the article’s citations. They explained that an article with a humorous title includes less professional key words and thus does not provide enough information for the viewers. Another reason is that the humour could

destroy the credibility of the paper as the readers consider it as a signal of low quality (Bryant et al., 1981). Subotic and Mukherjee (2013) showed that the level of amusement does not influence the level of citations, but the articles with amusing titles are downloaded slightly more often. The authors concluded that the humorous titles do not necessarily contribute to the quality of articles, but could attract more attention and spark curiosity.

Chapter 3. Methodology

The aim of this study is to investigate the tweeting behaviour on scientific products by evaluating the relationship between the scientific titles and the tweets. This chapter describes the data and methods used to achieve this aim. The data section explains how the author obtains and filters the raw data, and how the sample selection is chosen. The methods section explains how title analysis and tweet analysis work and are applied in this study. The title analysis explores how difficult the titles are by using the VocabProfile program, whereas the tweet analysis classifies the contents of tweets by building a coding scheme. After that, the Spearman rank correlation function is used to examine a connection between the titles and the tweets.

3.1 Data

The data were provided by the Research Unit for the Sociology of Education (RUSE) at the University of Turku, Finland. All of the data set was extracted from their on-going research project “Measuring the societal impact of open science”. This project examines the online attention of Finnish research to develop an open system for collecting data and detecting mentions of the research outputs in Finland from various open sources. Generally, the project aims to measure societal impact of Finnish research in Finland and beyond. In addition, the research project classified their data in different sections including arts and humanities which is relevant to the research field in this study. The raw data comprised mentions of research articles written by authors of whom at least one had a Finnish affiliation on three social-media platforms: Twitter, blogs, news. However, this study only uses Twitter data. The research thus focuses on the attention of arts and humanities research in Finland on Twitter.

The Twitter data include 1023 Finnish scientific articles written in English in the field of arts and humanities. According to the data, 934 of 1023 articles were tweeted 4243 times (including retweets). In addition, the data contain information about the following aspects: DOI (Digital Object Identifier), altmetrics attention score (calculated by Altmetric.com), author, title, journal, publisher, links of tweets, contents of tweets, publication date and other citations data.

Due to the large Twitter data, only 200 articles are randomly selected as the sample for this study. These articles are mentioned on Twitter 989 times in total, in which most are in English (887 tweets), the rest are in various languages shown in Table 1.

Table 1. A summary of the language of tweets

Language of tweets	Total (989)
English	887
Japanese	28
Finnish	18
Dutch	10
French	10
German	10
Spanish	9
Swedish	6
Norwegian	5
Chinese	2
Korean	2
Italian	1
Turkish	1

Additionally, Table 2 shows a summary which reports the status of the tweet links. In general, most links are still active (around 89%), some links are no longer existing (around 9%) at the moment the author checked them. The rest are not found for different reasons stated on Twitter site such as “This account’s Tweets are protected”, or “Account suspended”. Fortunately, the contents of all 989 tweets can be still usable as the given data including all the original contents before the links are deactivated.

Table 2. Status of Twitter links

	Number of tweets	Percentage
Link not found	92	9.3%
Active link	881	89.08%
Private account	12	1.21%
Account suspended	4	0.4%
Total	989	100%

3.2 Methods

This section explains the methods used in this study. The selection of methods is based on the availability of title analysis and tweet classification to answer the research questions. It begins with the title analysis by using the VocabProfile program. The VocabProfile analyses vocabularies and grammars, especially in English texts which are based on its own data and algorithm. This free computer program executes a lexical text analysis, which shows the significance of a title in the four following groups: (1) K1 words - the percentage of most frequent 1000 words, (2) K2 words - the percentage of most frequent 2000 words, (3) AWL words - the percentage of academic words, and (4) Off-List words - the percentages of words which do not appear on the other lists.

After that, the tweets are classified into three codes 0, 1, 2 manually by the author. Code 0 is for the tweets which cite exactly the titles or contain some additional information about the authors or publishers. Code 1 is similar with code 0 but including hashtag or @ and personal comments. Code 2 is for the tweets which are completely different from titles. The purpose of conducting this analysis is to explore the similarities between the titles and the tweets.

3.2.1 Title analysis

One of the core methods in this study is to analyse the level of difficulty of the chosen titles. VocabProfile (<http://www.lex tutor.ca/vp/eng/>) created by Tom Cobb performs a lexical text analysis and breaks the texts down by word frequencies. The analysis counts the total number of words, number of different words, type-token ratio which means that the

higher number of this, the fewer times a word is re-used. For instance, type-token ratio of 0.5 means the analysed text occurred twice; similarly, the ratio of 0.25 means the word occurrences are 4. The type-token ratio is useful to determine common words, word families, common topics as well as hot topics among different titles.

In addition, VocabProfile divides a title into four categories: (1) the percentage of words in the most frequent 1,000 words in English, (2) the second most frequent 1,000 words in English (i.e. 1001 to 2000 words), (3) the percentage of academic words (in total of 550 most frequent words in English academic texts in various topics), and (4) off-list words which mean other words. Those categories are always calculated in percentage and these are the main criteria for the title analysis in this study. The calculation for all of the categories is executed, and then the results are shown and compared at the same time. However, the large texts may affect the accuracy of the results, while the shorter texts show a better performance by using this tool. Figure 3 shows a model of results after analysing texts by using VocabProfile.

	Families	Types	Tokens	Percent																											
K1 Words (1-1000):	54	58	84	72.41%	<table border="1"> <thead> <tr> <th colspan="2">Current profile</th> </tr> <tr> <th>%</th> <th>Cumul.</th> </tr> </thead> <tbody> <tr> <td>72.41</td> <td>72.41</td> </tr> <tr> <td>8.62</td> <td>81.03</td> </tr> <tr> <td>12.93</td> <td>93.96</td> </tr> <tr> <td>6.03</td> <td>100.00</td> </tr> </tbody> </table>	Current profile		%	Cumul.	72.41	72.41	8.62	81.03	12.93	93.96	6.03	100.00														
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%	Cumul.																														
72.41	72.41																														
8.62	81.03																														
12.93	93.96																														
6.03	100.00																														
Function:	(38)	(32.76%)																											
Content:	(46)	(39.66%)																											
> Anglo-Sax =Not Greco-Lat/Fr Cog:	(18)	(15.52%)																											
K2 Words (1001-2000):	7	9	10	8.62%																											
> Anglo-Sax:	(3)	(2.59%)																											
1k+2k			...	(81.03%)																											
AWL Words (academic):	11	12	15	12.93%																											
> Anglo-Sax:	()	(0.00%)																											
Off-List Words:	<u>2</u>	<u>7</u>	<u>7</u>	<u>6.03%</u>																											
	72+?	86	116	100%	<table border="1"> <tbody> <tr> <td>Words in text (tokens):</td> <td>116</td> </tr> <tr> <td>Different words (types):</td> <td>86</td> </tr> <tr> <td>Type-token ratio:</td> <td>0.74</td> </tr> <tr> <td>Tokens per type:</td> <td>1.35</td> </tr> <tr> <td>Lex density (content words/total)</td> <td>0.67</td> </tr> <tr> <td colspan="2"><i>Pertaining to onlist only</i></td> </tr> <tr> <td>Tokens:</td> <td>109</td> </tr> <tr> <td>Types:</td> <td>79</td> </tr> <tr> <td>Families:</td> <td>72</td> </tr> <tr> <td>Tokens per family:</td> <td>1.51</td> </tr> <tr> <td>Types per family:</td> <td>1.10</td> </tr> <tr> <td>Anglo-Sax Index: (A-Sax tokens + functors / onlist tokens)</td> <td>%</td> </tr> <tr> <td>Greco-Lat/Fr-Cognate Index: (Inverse of above)</td> <td>%</td> </tr> </tbody> </table>	Words in text (tokens):	116	Different words (types):	86	Type-token ratio:	0.74	Tokens per type:	1.35	Lex density (content words/total)	0.67	<i>Pertaining to onlist only</i>		Tokens:	109	Types:	79	Families:	72	Tokens per family:	1.51	Types per family:	1.10	Anglo-Sax Index: (A-Sax tokens + functors / onlist tokens)	%	Greco-Lat/Fr-Cognate Index: (Inverse of above)	%
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Figure 4. An example of vocabulary profile output for texts by VocabProfile

Because VocabProfile does not allow input of several texts at once, each title was input separately. The results are produced as shown in Figure 4 for further analysis.

3.2.2 Tweet analysis

The main idea is to find the correlation between the number of tweets and the difficulty of titles. However, the tweets are retweeted differently. For example, some tweets quote the titles; others include comments along with the hashtags or direct messages. As such, a coding scheme is developed to classify the contents of the tweets before comparing the associations with the results of title analysis by VocabProfile. After analysing the titles, the Twitter data are categorised into code 0, code 1 and code 2 as shown in Table 3. Code 0 represents the tweets as quoting the titles, possibly along with information about authors or publishers. Code 1 is similar with code 0 but including hashtag, @usernames or personal comments which mean sharing something to somebody. Code 2 represents the tweets which are completely different from the titles. The three codes are exclusive; for instance, if a tweet is codified in code 0, it cannot appear in code 1 or code 2. The coding process was preformed manually by the author. To increase the reliability of the coding results, VocabProfile was used to compare the familiarity of the common words between the tweets and the titles.

Table 3. A description of coding scheme

0	1	2
Title	Title + emoticon, opinion, comment (in English or other languages)	No title but summary of title and contents
Part of title (because tweet length is limited within 140 characters)	Title +Hashtag or @username	No title but comment
Title + info as name of author, publisher, year of publish		No title, only the link

Results in the title analysis method will be compared with the numbers of the tweets in each code. For example, an article has 10 tweets including 2 tweets as code 0, 3 tweets as code 1 and 5 tweets as code 2. The categories in title analysis such as K1, K2 will be compared

with 2 tweets in code 0, 3 tweets in code 1, and 5 tweets in code 2 separately. The result is calculated by using the Spearman rank correlation function on Microsoft Excel which outputs a decimal number between -1 and 1. For example, a correlation result of 0.75 for the number of the tweets in code 1 with the percentage of academic words in title (AWL) means a fairly high positive correlation between them, whereas a result of -0.16 means a low correlation as it is closer to 0.

Chapter 4. Results

This chapter presents the outcomes of the title analysis, the tweet analysis, and the correlation results of those analyses together. First, the title analysis shows the average results of lexical categories for each title. The titles of top 10 articles which have the largest number of tweets are also discussed. After that, the tweet analysis displays the results of the coding and the correlation between the tweets and the titles is described.

4.1 Title analysis

As described in the methods section, the title analysis outputs the findings of the length of the titles, the percentage of K1 (most 1000 frequent words), the percentage of K2 (most 2000 frequent words), the percentage of academic words and the percentage of off-list words. Table 4 shows the results of the title analysis including the average number of tweets. The length of titles is well-distributed statistically. The longest title has 23 words, while the shortest one has only 2 words. The average word counts of title is 12.03 which is very close to the average number at 12.5. By contrast, the number of tweets is not well-distributed. The largest number of tweets for one article is 82 and the minimum number is 1, while the average number of tweets is only 4.95. This shows that the distribution of tweets among the articles is highly skewed. A few of the articles receive a large number tweets, whereas the majority of articles receive only few tweets.

Table 4. A summary of title analysis

Categories	Average	Max	Min
Length of titles	12.03	23 words	2 words
Number of tweets	4.95	82 tweets	1 tweet
Percentage of K1	54.87%	90%	0%
Percentage of K2	8.18%	66.67%	0%
Percentage of academic words	14.08%	54.55%	0%
Percentage of off-list	22.87%	100%	0%

Among the 200 titles, up to 64% of the words contain the most 2000 common words (54.87% of K1 + 8.18% of K2), followed by the off-list words and academic words at

22.87% and 14.08% respectively. It is not surprising that K1 is the highest percentage, while K2 ranks at the lowest position. The natural language processing in the VocabProfile includes stop words in calculating most 1000 frequent words, while K2 removes those stop words. Stop words refer to the most common short words in a language such as *the, is, that, this, and, which, on*, etc. For instance, a title named “this is the best one and the last one” is 100 percent belongs to K1, because all the words are in the range of the most frequently used words in English. However, it is surprising that the average percentage of academic words is not high (14.08%), even though those titles are considered as the headings of the scientific articles.

Table 5. Top 10 articles and journals according to top number of tweets

Journal	Title	Number of tweets	Title length	K1 (%)	K2 (%)	Academic words (%)	Off-list (%)
Demography	Happiness: Before and After the Kids	82	6	83.33	0	0	16.67
Autism: The International Journal of Research & Practice	Investigating the cross-cultural validity of DSM-5 autism spectrum disorder: Evidence from Finnish and UK samples	61	15	35.29	5.88	23.53	35.3
Archives of Sexual Behavior	Is a Woman's Preference for Chest Hair in Men Influenced by Parasite Threat?	41	13	61.54	30.77	0	7.69
Journal of Child Psychology & Psychiatry	Predictors of developmental dyslexia in European orthographies with varying complexity	34	10	30	0	20	50
Archives of Sexual Behavior	Finnish Women and Men Who Self-Report No Sexual Attraction in the Past 12 Months: Prevalence, Relationship Status, and Sexual Behavior History	30	20	57.14	14.29	14.29	14.28
Information Systems Research	The Effect of Customers' Social Media Participation on Customer Visit Frequency and Profitability: An Empirical Investigation	26	16	50	18.75	25	6.25
Frontiers in Psychology	Interplay between singing and cortical processing of music: A longitudinal study in children with cochlear implants	22	16	62.5	0	6.25	31.25
Journal of Learning Disabilities (14690047)	Basic Auditory Processing Deficits in Dyslexia Systematic Review of the Behavioral and Event-Related Potential/Field Evidence	22	16	52.94	11.76	17.65	17.65
Animal Behaviour	No direct relationship between human female orgasm rate and number of offspring	21	12	75	8.33	0	16.67
Intelligence	Solving the puzzle of why Finns have the highest IQ, but one of the lowest number of Nobel prizes in Europe	19	21	66.67	14.29	0	19.04

Additionally, Table 5 displays the top 10 articles which are tweeted the most. The shortest title length (6 words) in this list is tweeted 82 times (including retweets), and this title also has the highest percentage in K1 among the top 10. Meanwhile the article with the highest rate of academic words (25%) in its title has smaller number of tweets (26 tweets). Top 10 titles are mostly about the social life and especially family matters between men, women,

and their kids in Finnish society. This pointed out that people are more interested in the topic and they tend to share more research about Finnish family matters as a sub-topic in the field of arts and humanities.

4.2 Tweet and title

Tweet analysis refers to classifying and codifying the types of the 989 tweets, and examining the connections with the previous results of the title analysis. Basically, the tweets are divided into three codes: code 0, code 1 and code 2. Code 0 is for the tweets as repeating the titles, probably including the names of authors and publishers. Code 1 is for the tweets which contain the titles and other symbols of sharing such as hashtag or @, and the title summary. Code 2 is for the tweets which are totally different from the titles. The codifying stage is processed manually by the author.

Table 6. A summary of code

Code	Number of tweets	Number of tweets in percent
0	193	19.51%
1	222	22.45%
2	574	58.04%
Total	989	100%

Table 7 presents the results of the coding, showing that code 2 dominates at more than 50% in the overall, followed by code 1 and code 0 at 22.45% and 19.51% respectively. This shows that the public is more likely to express their personal opinions or introduction of the scientific articles along with links rather than only mentioning the titles for sharing. Therefore, the results indicate a high level of engagement by the Twitter users towards the scientific products in the field of arts and humanities.

Moreover, the correlation between the titles and the tweets is examined based on the findings of the title analysis and the tweet analysis. Each code is tested with each of the following categories in the title analysis: length of a title, K1 words, K2 words, academic words, and off-list words. For example, a title is tweeted 15 times which include 5 tweets in

code 0, 6 tweets in code 1, and 4 tweets in code 2; then each category of the title analysis such as K1, K2 will be tested with a number of tweets in each code separately to output the final results of correlation.

Table 7. The example of data for correlation test

Title	Number of tweets	Title length	K1 (%)	K2 (%)	Academic (%)	Off-list (%)	Code
The effect of custom	21	16	50	18.75	25	6.25	2
The effect of custom	2	16	50	18.75	25	6.25	1
The effect of custom	3	16	50	18.75	25	6.25	0
Education of research	1	10	30	20	30	20	2
Education of research	1	10	30	20	30	20	0
Undergraduate mechanics	9	13	53.85	23.08	7.69	15.38	2
Undergraduate mechanics	1	13	53.85	23.08	7.69	15.38	1
Undergraduate mechanics	2	13	53.85	23.18	7.69	15.38	0

Table 7 shows the data after analysing title by using the VocabProfile and classifying as well as coding for each tweet. The data will be sorted according to the codes and the number of tweets in order to test the correlations separately.

Table 8. Correlation between title and tweet according to number of tweets

	Code 0	Code 1	Code 2	Total number of tweets
Number of tweets to length of title	0.20	0.09	0.14	0.13
Number of tweets to K1	0.02	-0.04	0.05	-0.03
Number of tweets to K2	0.00	0.08	-0.06	0.03
Number of tweets to academic words	0.01	-0.05	0.08	0.02
Number of tweets to off-list words	-0.05	0.01	-0.04	-0.04

Table 8 shows the results of correlation between the coding of the tweets and the results of lexical analysis in the titles. Overall, the results of correlation are not generally meaningful. Most of those results are close to 0 in both positive and negative cases. The strongest positive correlation is 0.20 (code 0 versus the length of title), while the correlation between code 2 and K1 is the most negative correlation (-0.06). Moreover, there are some differences between the codes in different categories. The length of title is correlated the most with code 0 at 0.20 as the largest correlation number in this table, followed by code 2 and code 1 as 0.14 and 0.09 respectively in the same context. This can be explained by the classification of each code. While code 0 means tweets, which quote the titles, or part of the title, or including information of authors and publishers, code 1 and 2 are less relevant with the title according to the mutual words between the titles and the tweets. Moreover, code 1 is strongly connected with K2 at 0.08, whereas the correlation between code 2 and K2 is negative at -0.06, and code 0 has a neutral correlation with K2. Overall, when combining all the three codes, most results of the correlation are very close to neutral, only the correlation with the length of title is different, which receives higher positive score.

Chapter 5. Discussions

In the previous chapter, this study presented the results of the title analysis and the correlations between the titles and the numbers of tweets. This chapter provides the discussions, limitations, and suggestions for future research. Additionally, it demonstrates the concrete answers to the research questions based on the results and then compares them with previous studies in the theoretical background. The chapter starts by reviewing the correlation between the contents of the tweets and the titles of the scientific articles, which reveal a limited association between these two. The second research question is discussed based on a view of the tweeting behaviour in previous research and the findings in this study. People tend to express personal comments along with linking the articles in tweets, which indicate a high level of engagement in tweeting behaviour generally. In addition, the contributions of this study to scholarly communication are also discussed, while the limitations are mostly about the limitations of methodology. Finally, the suggestions for future research are discussed based on the limitations as well as the possibilities to apply the methods to other fields of research.

5.1 Correlation between tweeting and titling

Previous studies (Haustein et al. 2013; Thelwall et al. 2013) found the positive correlation between the number of tweets and citations. This study aims to investigate another aspect of the correlation between the features of titles and the numbers of the tweets. The features of a title comprise factors such as the length and other standardised categories of VocabProfile: the most 2000 common words, academic words, and off-list words. As reported in Table 8, all correlation results are below average ($< |0.5|$) which indicate the low correlations between these features of scientific titles and the number of tweet. This answers the first research question which aims to investigate how much of a correlation there is between the scientific titles in the field of arts and humanities and the numbers of the tweets.

However, there are some differences between the codes of the tweets and the length of the titles. The tweets or retweets which quote the titles, positively correlate with the length of titles. For instance, code 0 versus the length of the titles were given a correlation number at 0.20 as the highest one. This means that the longer titles tend to be retweeted more if the

tweets quote the titles. It can be explained that the long titles clearly show the contents of the articles as well as the descriptions of what the articles aim to demonstrate. Because the readers are provided enough information, they are more likely to read and to retweet those titles later. This matches the result from a previous study by Habizadeh and Yadollahie (2010) who stated that longer titles seem to be more associated with higher citation rates. Meanwhile long titles are less frequently retweeted if the tweets include only the comments about the titles or brief summaries of the titles. By contrast, in a study by Letchford, Moat and Preis (2015), the authors concluded that within the 20,000 most highly-cited papers from 2007 to 2013, the shorter titles received more citations. They explained that the short titles are easier to understand and they tend to receive more citations and retweets. However, the correlation also depends on the reputation of the journals as well as the authors and the field of research.

Ball (2009, p.668) suggested a good way of titling: “a title should motivate the reader to read an article, give the readers a summary of the contents, give overview of the topics and finding discussed, and introduce the way in which the reported items are looked at”. However, it is not always easy to follow the rules in scientific titling, especially in an abstract field such as arts and humanities. This study found that the less academic words appear in the titles, the more chance they are retweeted. For the tweets, which summarise the titles or add comment by using academic language, this rule is even clearer. For instance, the results of correlation between code 1 and academic words is extremely negative, while code 2 shows more positive correlations with academic words because it does not contain the academic titles in the tweets. It can be explained that although the authors of the tweets rewrite the titles or summarise the contents in their own language, readers still ignore retweeting if the title is written in an academic tone or difficult to understand.

Along with the open science movement, the scientific research may be able to reach more and more audiences from any educational levels and backgrounds. Additionally, the language on social media is not the same language used in an academic context. As such, it is reasonable that the social-media users may hesitate to share a scientific article if they do not even understand the title. Academic words in the titles are the drawbacks to reaching the wider audiences, and this affects the number of tweets or retweets. Although the data

set of this research is small and the negative correlation between the number of tweets and the academic tone of titles is not highly significant, researchers should think about who the audiences are and how to write a paper which is informative but readily comprehensible to the public.

5.2 Tweeting behaviour

This study reveals different results compared with previous studies which indicated a low level of engagement of Twitter users regarding the scientific articles. For instances, in 2013, Thelwall and his co-authors conducted a content analysis study of how 270 tweets are linked to the academic articles in four journals (*PLOS ONE*, *PNAS*, *Science*, and *Nature*). The authors found that tweets mainly contain article titles (42%) or a brief summary (41%). The majority of tweets do not link to the name of authors, but some do and some are self-citations. In addition, most of the tweets are neutral and include no comments. In the humanities discipline, especially digital humanities, Holmberg and Thelwall (2014) found that many scholarly products were tweeted on Twitter to communicate with audiences. Among the 989 tweets collected in this study, more than half belonged to code 2. It means that Twitter users do not repeat the exact title, but there are summaries of the articles and additional personal comments. This showed that the public is more likely to express their personal opinions or introduction of scientific articles along with linking rather than only mentioning the titles for mere sharing. Therefore, the results indicate a high level of engagement among Twitter audiences who share their opinions regarding scientific products in the field of arts and humanities. This could be an answer to the second research question which concerns the tweeting behaviour of social information users in arts and humanities research.

As Thelwall and Delgado (2015) said: “we should not measure the social impact of arts and humanities research with traditional metrics but use contextualised data instead. In order to understand the wider impact of research, data itself should be used as an indicator”. In addition, the authors added that altmetrics data should not be used to count how many times the research has been mentioned on Twitter, Mendeley or any social-media platforms. Instead, we should carefully investigate how scholarly publications are tweeted and blogged, analyse the contents and motivation for tweeting and blogging in order to understand how arts and humanities research reaches the public. Although the average

number of tweets per article was not highly significant (average of 4.95 in a range of 82 tweets as maximum and 1 tweet as minimum per article), the distribution of tweets among all articles varied. Only a few articles attracted attention and received a high number of tweets, while the majority of articles only were mentioned in a few tweets. The findings indicated that those top attractive articles were mainly about Finnish family matters as a sub-topic in the field of arts and humanities. This showed that people were interested in this topic and tended to share more research about Finnish family troubles, whereas other sub-topics were less attractive or neglected.

5.3 Contributions, limitations and suggestions for future research

The study has contributions to the scholarly communication, specifically in the field of arts and humanities. The findings revealed that there is a high level of engagement of Twitter users in Finnish arts and humanities research. Most of the tweets would rather include personal comments or the summary of articles than only quoting or briefly summarising the titles as the findings in previous studies. In addition, Twitter users seem to be mostly interested in Finnish family matters as the articles related to this topic which receives a large number of tweets and retweets. The open scholarly discussion is communicated mostly by text, especially on social-networking platforms. Therefore, the methodology in this study could be a good example of lexical analysis for the titles of research within the scholarly communication.

There are some limitations regarding the small scale of selected data set and some disadvantages of using VocabProfile. First, the sample selection from the raw data was only a small set of Finnish arts and humanities research, which was limited to 200 random articles. Therefore, the results do not represent the entire Finnish arts and humanities research presented on Twitter. Second, the method of title analysis was executed by using the only software which uses its own database of texts, so the outcomes might not be standardised entirely. Another limitation is that VocabProfile does not allow users to input several texts at the same time and keep track of which texts are contributing to which parts of the profile. The author therefore had to extract the result manually for each title. It was time-consuming and could lead to error when trying to extend the scale, for example, from 200 to 2000 articles. Moreover, the tool seems to ignore the markers, colons or other kinds of marks in the title that may affect the meaning or the implication of the title, for example,

amusement or humour. In addition, the classification of the coding scheme in tweet analysis was sometimes subjective and the biased in analyzing the contents of tweet is inevitable, even with the assistance from VocabProfile. As such, those limitations may have affected the study's findings.

Future research might use VocabProfile in a larger scale or obtain the data from other altmetrics providers. An important contribution of this study is that it revealed in what specific sub-topics related to Finnish arts and humanities research people are mostly interested. In addition, the methodology could be applied to other fields of research or other topics that are more common than arts and humanities. In general, trending on social networking changes fast and altmetrics is a new field that needs more research to create a standard tool for evaluating scientific products on this communication platform.

Chapter 6. Conclusion

Due to the growing phenomenon of modern communication on social-media platforms nowadays, there has been much research about this to investigate the influences between the academia and public audiences. Specifically, this study focused on the Twitter platform and provided an overview of tweeting behaviour on scientific articles in the field of arts and humanities and how much those titles are connected to the contents of the tweets.

Previous studies have discussed positive results of correlations between the tweets and the citations. However, this study focused on the correlation between tweeting behaviour and the difficulty of titles, which was evidenced as weak connection generally. Nevertheless, the tweeting behaviour of Twitter users in this research was revealed. More than half of total of the tweets tended to explain the title of articles instead of quoting the titles. People were more likely to explain the mentioned articles in their own words, but if the language use in those tweets sounds less academic, the chances of retweets were increased. It is understandable that to reach a wider audience, the use of language matters. In addition, not all aspects in the field of arts and humanities were noticed. The outcomes revealed that Finnish family matters were the most attractive sub-topics. Furthermore, this study also agreed with previous studies according to which Twitter is different from other social-media platforms in the context of social interaction behaviour. The number of followers does not guarantee a person will receive a large number of retweets, while celebrities or popular people on Facebook usually receive much attention for their every post.

Despite some limitations in the methodology, this study takes an advantage of a unique circumstance in the tweeting behaviour context as well as reveals what kind of sub-topics in the field of arts and humanities people were attracted to. Moreover, with a new discovery of the correlation between the difficulty of scientific titles and tweeting behaviours, this research may contribute to sharpening similar research in this complex field in the future.

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