Education Scholars' Evolving Uses of Twitter as a

Conference Backchannel and Social Commentary Platform

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Abstract

The scholarly community faces a lack of large-scale research examining how students and professors use social media in authentic contexts and how such use changes over time. This study uses data mining methods to better understand academic Twitter use during, around, and between the 2014 and 2015 American Educational Research Association annual conferences both as a conference backchannel and as a general means of participating online. Descriptive and inferential analysis is used to explore Twitter use for 1421 academics and the more than 360 000 tweets they posted. Results demonstrate the complicated participation patterns of how Twitter is used "on the ground." In particular, we show that tweets during conferences differed significantly from tweets outside conferences. Further, students and professors used the conference backchannel somewhat equally, but students used some hashtags more frequently, while professors used other hashtags more frequently. Academics comprised the minority of participants in these backchannels, but participated at a much higher rate than their non-academic counterparts. While the number of participants in the backchannel increased between 2014 and 2015, only a small number of authors were present during both years, and the number of tweets declined from year to year. Various hashtags were used throughout the time period during which this study occurred, and some were ongoing (ie, those which tended to be stable across weeks) while others were event-based (ie, those which spiked in a particular week). Professors used event-based hashtags more often than students and students used ongoing hashtags more often than professors. Ongoing hashtags tended to exhibit positive sentiment, while event-based hashtags tended to exhibit more ambiguous or conflicting sentiments. These findings suggest that professors and students exhibit similarities and differences in how they use Twitter and backchannels and indicate the need for further research to better understand the ways that social technologies and online networks are integrated in scholars' lives.

Keywords: social media; student and professor use of online networks; conference backchannels; professionalism; Twitter; networked participatory scholarship

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The use of technology in students' and professors'[1] lives has received increased scholarly attention in recent years. While many endeavors are enacted with the support of technology (e.g., using learning management systems or bibliographic management tools), emerging technologies have introduced many opportunities for individuals to engage in public socially-oriented activities (e.g., professors connecting with diverse audiences via social media). One such activity, made possible by the availability of internet-enabled mobile devices and microblogging, is individuals' participation in conference "backchannels." A conference backchannel is described by Ross, Terras, Warwick, and Welsh (2011, p. 215) as an "irregular or unofficial means of communication...which can extend beyond the lecture room to engage with scholars across the community." This activity enables individuals to engage with networked technologies and cultures in authentic ways.

In this paper, we examine education students' and professors' use of Twitter before, during, and after the American Educational Research Association (AERA) conferences that occurred in 2014 and 2015. Our goals are to make better sense of authentic backchannel participation and students' and professors' online participation in general. In doing so, we also report changes in participation, hashtag use, and expressed sentiment over time. This research helps the scholarly community develop a more nuanced picture of the authentic use of social media by students and faculty at a time when digital technology is permeating every aspect of scholarship including research, teaching, and learning (Goodfellow & Lea, 2013; Greenhow, Robelia, & Hughes, 2009; Siemens, Gasevic, & Dawson, 2015). While some researchers have

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[1] The term professor in this paper refers profession (e.g., lecturers, assistant/associate professors, etc) as opposed to rank.

examined the use of Twitter and backchannels, the scholarly community has limited information on how backchannel participation compares to overall participation. The research that is available provides snapshots of backchannel participation at particular points in time but gives little insight as to how participation changes from one year to the next. Furthermore, little empirical research focuses on education scholars even though prior research suggests that the ways that scholars use social media vary across disciplines (Holmberg & Thelwall, 2014; Ortega, 2015). Finally, even though students and professors have been admonished and/or dismissed on the grounds of lack of civility on social media (e.g., Authors, 2015; Jaschik, 2014), we were unable to locate any studies that examine academics' expressed sentiments on social media, and in particular the degree to which academic social media interactions occurring on Twitter are positive or negative.

To help fill these gaps, this study analyzes a large data set of education scholars' Twitter posts. First, we review literature relevant to the topic. Next, we explain our research methods and present our findings. We conclude by discussing the results of this investigation and suggesting future research avenues.

Review of Relevant Literature

In a relatively short period of time, Twitter appears to have become the technology of choice for digital backchannel participation/communication and has been used in a wide array of events, ranging from sports (Highfield, 2013) to natural disasters (Bruns & Burgess, 2013), to educational settings. The attention that Twitter has received in the education literature is notable. For instance, researchers have examined its use in formal and informal learning (Elavsky, Mislan, & Elavsky, 2011; Gleason, 2013) and evaluated its impact on learner engagement, grades, and attitudes (Junco, Heiberger, & Loken, 2010; Lomicka & Lord, 2012). In a review

and analysis of the research on microblogging in education published in 2008-2011, Gao, Luo, and Zhang (2012) found that researchers were hopeful that use of Twitter was going to a) foster the development of learning communities, b) enhance participation and interaction, c) encourage reflection, and d) support collaborative learning. After analyzing this literature Gao and colleagues made two recommendations that are especially relevant to this investigation: First, they suggested that "powerful data analysis methods, such as educational data mining…may help reveal how communication and learning occur via microblogging" (p. 793). Second, they noted that the majority of the studies on the topic focused on a short period of time, and they suggested that researchers conduct studies that observe microblogging practices over a longer period of time. This study addresses both suggestions.

Researchers have also examined how scholars and faculty members use Twitter. For instance, after analyzing a sample of 4,500 tweets from 45 scholars, Author (2011) found that scholars used Twitter to share details about their teaching, research, and professional practice; provided and requested assistance to others; and contributed social commentary on a variety of topics. Large-scale surveys suggest that scholars use Twitter in both professional and personal ways, and such mixed use is more prevalent than using Twitter for distinctly personal or distinctly professional purposes (Bowman, 2015). While scholars might be apprehensive about the personal-professional boundaries that social media use entails (Authors, 2013), some research has found that a mix of personal and professional tweets posted by professors might entail benefits. For instance, Johnson (2011) found that students who viewed professors' social tweets in addition to their scholarly ones were more likely to perceive and rate those professors as credible. The finding that Twitter is used for both personal and professional purposes reflects

broader findings in the literature pertaining to social media use by scholars (Moran, Seaman, & Tinti-Kane, 2011; Moran & Tinti-Kane, 2013).

The topic of civility in online social networks is an area of research that both interacts with this investigation and is pressing. While much research has recently focused on topics such as cyberbullying and cruelty (e.g., Lenhart et al, 2011), there is much less investigation on the civility of professor and student social media posts. This topic has gained wide attention recently with the de-hiring of Professor Steven Salaita (Jaschik, 2014) and an instituted policy by the Kansas Board of Regents governing faculty and staff "improper use of social media" (Colson, 2014). Flaherty (2014, ¶1) notes that in 2014 court and university administrators raised the issue of civility numerous times, "to the dismay of many faculty members who see expectations of civility as incompatible with academic freedom" and argued that critics note that "civility can be used as grounds to squelch unpopular ideas that deserve a home in academe." Yet, little research examines the degree to which faculty (and student) updates on social media are civil or uncivil, positive or negative.

In this paper, we focus on the use of Twitter as a digital backchannel in professional conferences, an area that has received relatively little empirical attention (Ross, Terras, Warwick, & Welsh, 2011) even though conference hashtags are commonplace. Researchers have shown that Twitter backchannels are used for a variety of purposes in conferences (Reinhardt, Ebner, Beham, & Costa, 2009). Such purposes include collaborative note-taking, resource-sharing, professional network-building, and help-seeking (Li & Greenhow, 2015; Ross et al., 2011). Potential benefits of efforts to provide digital spaces for interaction in conferences may be greater conversations between conference presenters and attendees (Ebner, 2009) and the sharing of conference insights with the greater community and with individuals who were not present at

the conference. As a result, some writers have suggested ways for conference organizers to encourage and support livetweeting (e.g., Ekins & Perlstein, 2014; Shiffman, 2012). However, while conferences may be seen as ideal settings to include a backchannel (Mahrt, Weller, and Peters, 2014), the use of Twitter at conferences has also been described as encompassing multiple monologues with disjointed discussions as opposed to a fulfilling the vision of it being a place for hosting a distributed conversation amongst interested parties (Ross, Terras, Warwick, & Welch, 2011).

Two significant themes in the literature pertaining to the use of Twitter at conferences that are relevant to this research are reported by Mahrt, Weller, and Peters (2014): a) use of Twitter at conferences appears to vary by discipline and b) conference hashtags may include information unrelated to the conference as "related external events that happen independently from the actual conference can ... produce peaks in activity if they affect the scholarly interests of that community" (p. 403). These two findings are significant, because they suggest that 1) education students' and professors' participation both on Twitter and conference backchannels may be uniquely different than other disciplines and 2) digital participation may be influenced by events unrelated to conferences. Significantly for our purposes, the studies that have examined education scholars' use of Twitter are limited. In Authors (2015), we used a large data set (232 students, 237 professors, 74,814 unique hashtags, and 645,579 tweets) to examine education professors' and students' use of Twitter. We showed that significant variation exists in how education scholars participate on Twitter and how they use hashtags. We also showed that education scholars who follow more users, have tweeted more, signal themselves as professors, and have been on Twitter longer have more followers. Li and Greenhow (2015) authored the only study that we were able to identify that examined education scholars' participation at

conference backchannels via Twitter. This study focused upon individuals participating at the 2014 AERA conference, and it was novel because of its qualitative investigation of commonalities and differences between faculty member and student use of the backchannel. The researchers interviewed 11 graduate students and 9 faculty members and reported that while student use of Twitter at the conference could potentially enhance their participation in the research community, faculty members perceived Twitter as having a neutral or negative impact on community participation in the conference. Furthermore, the authors reported that "among those interviewed who had prior experience in using a Twitter-enabled conference backchannel, the graduate students conceived of it largely to gain access to others and conference-related content, while the faculty envisioned it for disseminating their scholarship, having an online digital identity tied to their profession and managing the flow of information during a presentation" (p. 12). Knight & Kaye (in press) reported similar disparities after surveying UK academics and undergraduates regarding their participation patterns on Twitter. Greenhow and Li argued that differing perspectives on how Twitter is used may reflect different roles within the conference, community, and discipline.

In the literature focusing on use of Twitter and social media by scholars, there is a tendency to report snapshots in time as opposed to shifts, changes, or trends over time. While snapshots help researchers understand a particular phenomenon at a particular point in time, it is also important to make sense of long-term trends and changes in the phenomenon over time. By examining backchannel participation over time, we can investigate how Twitter use changes over time and how time-specific events impact scholarly participation. Such an investigation will help researchers shed greater light on the persistence of backchannel events and on the use of networked technologies in students' and professors' lives.

We situate this study on the concept of Networked Participatory Scholarship (NPS). NPS refers to scholars' use of "online social networks to share, reflect upon, critique, improve, validate, and otherwise develop their scholarship" (Veletsianos & Kimmons, 2012, p. 768). NPS is an emerging sociocultural practice that is influenced by social, technological, cultural, economic, and political factors. Rather than viewing technology as deterministic of scholars' participation in networked spaces, this perspective recognizes that a wide array of forces encourage, restrict, and overall shape digital participation. For instance, peer-pressure or policy changes that advocate for public scholarship may encourage scholars to participate on social media. This perspective aligns with the social shaping of technology viewpoint (Dutton, 2013; Oliver, 2013; Selwyn, 2010). Social learning theory also underpins our perspective on networked participation on social media. In this perspective, learning and knowledge in networked spaces are situated activities that are facilitated, negotiated, and co-constructed individually and socially (cf. Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; Wenger, 1998). Finally, this investigation is situated in the concept of authentic learning enacted in digital learning environments (Herrington & Oliver, 2000). While the concept of authentic learning is most frequently associated with designed learning experiences (e.g., students challenged with a real-world task that individuals would face in their day-to-day profession), scholarly participation on Twitter is often a cognitively realistic task (Herrington, Reeves, & Oliver, 2007) because students (and faculty) learn *about* networked scholarship (and *how to be* networked scholars) via the authentic process of becoming participants in the sociocultural practice via social interaction and development of shared and non-shared practices/activities (Lave & Wenger, 1991; Wenger, 1998).

Methods

This study focused on students' and professors' (hereafter aggregately referred to as academics) and their tweets before, during, and after the AERA 2014 and 2015 conferences. The analysis focuses primarily upon 1,421 users who were identified as academics (cf. Table 1) and the 360,446 tweets they posted that pertained directly to the studied conferences in terms of timeframe. AERA 2014 conference data coincided only with the conference. However, since tweets for multiple weeks surrounding AERA 2015 could be reliably verified, 2015 conference data included the week of the conference as well as its six surrounding weeks (cf. Table 2).

Table 1. User, tweet, and retweet counts included in the study

	users	**tweets**	**retweets**
all	6,699	7,617,203	6,168,142
non-academic	78.8%	81.1%	85.5%
academics	21.2%	18.9%	14.5%
- professors	10.2%	9.3%	7.1%
- students	10.5%	8.9%	7%

Table 2. Week identifiers of tweets included in the study

Week Identifier	**Start Date**	**End Date**
AERA14	2014-04-02	2014-04-08
- 3 week	2015-03-25	2015-03-31
- 2 week	2015-04-01	2015-04-07
- 1 week	2015-04-08	2015-04-14
AERA15	2015-04-15	2015-04-21
+ 1 week	2015-04-22	2015-04-28
+ 2 week	2015-04-29	2015-05-05
+ 3 week	2015-05-06	2015-05-12

Relevant Terms

This study used a number of terms specific to the Twitter platform that may be unclear to those unfamiliar with it. Each of these terms is now provided with a brief definition.

- Tweet (noun/verb) - A short message (not exceeding 140 characters) that is posted publicly online, which may consist of text, links, mentions, and hashtags.

- Conference Tweet - Any tweet with a conference hashtag and that was created during or within one day of a conference.

- Retweet (noun/verb) - A tweet that is reposted from an earlier tweet, as when one user shares or quotes another user's tweet for others to see.

- Hashtag - A classification, tagging, and categorization mechanism, consisting of a keyword preceded by the "#" symbol.

- Mention - A reference to another user, consisting of that user's username preceded by the "@" symbol.

- Link - A web link (URL) to an external resource, such as a website or scholarly article.

- Author - A Twitter user who creates a tweet.

- Retweeter - A Twitter user who shares a retweet.

Data Collection

To gather data, this study used the Twitter (n.d.) Application Programming Interface (API), which allowed for programmatic access to user tweets. All tweets and user profiles included in this study were shared publicly and are available via public access. To collect participant tweets, researchers first used a web browser and Javascript codes to gather all the unique tweet identification numbers for each posted tweet and available retweet with conference hashtags for each year (#AERA14 and #AERA15). The API was then used to retrieve complete

information for each posted tweet. Authors of each of these tweets were identified as participants in the AERA Twitter community. User profile information was collected including user names and descriptions, and user metadata was updated with each consecutive tweet downloads, which will be explained in more detail next.

The API was then used three weeks before the AERA 2015 conference to gather all available tweets and retweets for each participant. Due to a restriction in the API, only the 3,500 most recent tweets for each user were available for collection. This meant that tweets over long periods of time could not be reliably collected. To ensure reliability of all tweets surrounding the 2015 conference, new tweets were also continuously collected for each user until three weeks after the conference (to ensure that no gaps would exist due to the restriction). As a result, all tweets from both conferences along with all tweets in the six weeks surrounding the 2015 conference were reliably collected for analysis.

Using a series of keyword searches and manual examination on user profile data, researchers then classified participants as *students* or *professors* based upon clear self-identification in their profiles. These two categories were not exclusive, and the same user could self-identify as both a student and professor. Postdocs were also identified but are not treated as a separate analysis group, given their low representation in the dataset. Any user that self-identified as a student, professor, or postdoc was also categorized in a broader category of *academic*, and any user that did not self-identify in one of these three ways was categorized as *non-academic*. Though some academics might have been included in the non-academic category (due to not self-identifying as such), this decision seemed appropriate given the aims of the study and the problematic alternative of attempting to categorize academics without clear signifiers.

Data Analysis

All data was compiled in a relational database consisting of separate tables for users, tweets, mentions, hashtags, and URLs. Descriptive results were produced via a series of queries, and, as necessary, results were compiled into flat files for import to SPSS for further analysis. Each research question in this study required a different set of queries and statistical tests to determine significance, and these will be presented in more detail in the Results section.

Each tweet was also programmatically analyzed in an attempt to detect sentiment (i.e. positive or negative). An open-source sentiment classifier called phpInsight was used for this purpose (Hennessy, 2015). Each tweet was coded based upon the dominant sentiment reflected in its choice of words as either positive, negative, or neutral, but only tweets exhibiting clear positivity or negativity are included in reported results involving sentiment.

Limitations

Results from this study may not necessarily transfer to other technologies used as backchannel tools or to other conferences. Given that AERA is a large education conference with more than 10,000 attendees per year at the time of writing, smaller conferences or conferences in other disciplines may reveal different outcomes. Future research can address these two limitations by examining the ways other backchannel tools are used and by examining scholars' participation in other conferences. Furthermore, in this research, we do not examine the content of the posted tweets or how that content may or may not change from one year to the next. These are fruitful and rich areas for future inquiry.

Finally, it is important for the reader to keep in mind that our data collection methods exclude uses of Twitter that are invisible to the data collection methods chosen. For instance, many activities that students might have undertaken in relation to the conference backchannel

might have gone undetected. These may include: reading the conference backchannel, emailing

conference tweets, and posting content on Twitter without the conference hashtag or with an

erroneous hashtag.

Results

This study sought to better understand academic Twitter use during, around, and between

the AERA annual conferences both as a conference backchannel and as a general means of

participating online. Three research questions (RQ) were asked to achieve this larger goal, and

each question is provided below with relevant descriptive and statistical results.

RQ1. What does participation in conference Twitter backchannels look like quantitatively, and

how does this vary for academics vs. others and among different academic roles?

Each AERA conference included various conference tweets from diverse participants.

Including both conferences, over 24,000 tweets and 13,000 retweets were posted (cf. Table 3),

but due to API restrictions, not all retweets could be reliably retrieved for 2014, meaning that this

result underestimates the number of retweets. At these conferences, academics created less than

half of total tweets and comprised less than one-third of all authors creating tweets and around

one-sixth of those retweeting. This means that academics represented a minority in both the

creation and sharing of conference tweets and that others, such as corporate entities (e.g.,

publishers), non-academic professionals (e.g., teachers, librarians), or anyone else that did not

identify themselves as academics in their profiles (e.g., institutional Twitter accounts), comprised

a slight to moderate majority in participation.

Table 3. Conference tweets, authors, and retweeters from both conferences.

	tweets	retweets	authors	retweeters (only)	tweets per author	retweets per retweeter

all	24,241	13,023 *	2,748	3,408 *	8.8	4.1
non-academic	59.5%	69.6%	70.6%	83.4%	7.4	3.5
academics	40.5%	30.4%	29.4%	16.6%	12.1	6.1
- professors	20.2%	16.6%	14.3%	7.9%	12.4	6.3
- students	19.3%	13.5%	14.3%	8.2%	11.9	6.1

* Note: Since retweets could not be reliably collected for 2014, retweet counts only include those from 2015.

Though academics represented a minority of participants, they were more active in both tweeting and retweeting than non-academics. Two one-way analysis of variance (ANOVA) tests revealed a significant main effect for academic status on both the number of conference backchannel tweets, $F(1, 2,746) = 13.68$, $p < .001$, and retweets, $F(1, 4,783) = 31.37$, $p < .001$. Among academics, professors and students comprised a fairly equal representation as authors and retweeters, and professors had a slightly higher number of tweets per participant. However, two one-way analysis of variance (ANOVA) tests revealed that this student vs. professor difference was not significant for both the number of conference backchannel tweets, $F(1, 781) = .04$, $p = .84$, and retweets, $F(1, 997) = .1$, $p = .75$.

Table 4 lists the 20 hashtags that were used the most within the backchannel. Popular hashtags from both conferences included examples related to sub-communities within AERA such as Special Interest Groups and Divisions (e.g., queersig, emergingscholars, divJ), topics (e.g., literacies, lgbt/lgbtq), conference locations (e.g., Chicago, Philly), and larger educational or research communities (e.g., highered, education). By examining the table one can see that (a) in most cases the popularity of a given hashtag varied between years in terms of overall rank, and (b) some hashtags were used more frequently by professors than by students, some were used more frequently by students, and some were used evenly between groups. For example, though *queersig* was the most popular hashtag each year, it was almost entirely used by professors, and

lgbt/lgbtq and *bullying* similarly exhibited professor dominance. Alternatively, hashtags like *education, edchat, literacies,* and *edresearch* (along with division-specific or student-focused hashtags like *aeradivcgrad* and *emergingscholars*) were used mostly by students. To determine significance of these differences, a series of one-way analysis of variance tests (ANOVA) were conducted on the two highest used hashtags for each year with participant role as the independent variable and tweet hashtag use as the dependent variable (retweets were excluded). Results indicated that participant role had a significant effect on tweet hashtag use in each case as follows: *queersig*, $F(1, 15{,}618) = 676.73$, $p < .001$; *emergingscholars*, $F(1, 25{,}656) = 160.56$, $p < .001$; and *literacies*, $F(1, 15{,}618) = 26.31$, $p < .001$. Similar analysis could have been conducted on each hashtag, but for brevity, it was determined that these examples were sufficient to establish that the backchannel hashtags used by academics sometimes varied significantly by role.

Table 4. Most popular hashtags of conference tweets for each year

	2014			2015		
Rank	**Hashtag**	**Prof. %**	**Stud. %**	**Hashtag**	**Prof. %**	**Stud. %**
1	queersig	97%	3%	queersig	87%	13%
2	EmergingScholars	13%	87%	literacies	25%	75%
3	divj	6%	94%	Chicago	41%	59%
4	AERAcademicSM	27%	73%	AERADivCGrad	0%	100%
5	highered	13%	87%	highered	51%	49%
6	lgbt	99%	1%	CESJSIG	73%	27%
7	Csparks	90%	10%	lgbtq	100%	0%
8	AERAPres	49%	51%	educolor	24%	76%
9	education	23%	77%	divisionk	60%	40%
10	edtech	74%	26%	AERADivC	44%	56%

11	AERAInnovate	38%	62%	education	10%	90%
12	edchat	21%	79%	Sschat	78%	22%
13	STEM	89%	11%	aeradivg	10%	90%
14	publics	58%	42%	edresearch	10%	90%
15	HipHopEd	18%	82%	AERA100th	72%	28%
16	sschat	78%	22%	edchat	36%	64%
17	bullying	97%	3%	AERAPres	47%	53%
18	teachered	87%	13%	edtech	50%	50%
19	BlackEdu	57%	43%	nolaed	7%	93%
20	Philly	37%	63%	facultycrises	20%	80%

In summary, results from RQ1 indicated that:

1. Self-identified academics comprised a minority of participants in the AERA backchannels both in terms of participation and numbers of tweets.

2. Academics who participated in the backchannel did so at a much higher rate than that of their non-academic counterparts, but professors and students participated equally.

3. Various popular hashtags were used during the conference and included identifiers referring to sub-communities within AERA, topics, locations, and larger educational or research communities.

4. Some tweet hashtags were used more frequently by students, while others were used more frequently by professors, suggesting different norms of participation between groups.

RQ2. How did tweet creation and participation change between the 2014 and 2015 conferences?

Tweet activity and authorship were compared between the two conference years to examine whether there were any discernible differences. Results (Table 5) indicated that overall

tweet creation declined in 2015 (-8.8%), and that though a reduction in tweet creation was discernible across all groups, it was most pronounced among academics (-13.0%) and professors in particular (-16.7%). On the other hand, the number of users grew overall by 8.1%, and this growth was fairly uniform across groups. This reveals that more participants were contributing to the conference hashtag in 2015 but that the number of original tweets per author declined.

Table 5. Conference tweets by academic roles between years

	2014		2015		Change	
	tweets	**authors**	**tweets**	**authors**	**tweets**	**authors**
all	13,187	1,460	11,054	1,719	-8.8%	+8.1%
non-academic	58.0%	68.6%	61.4%	69.0%	-6.0%	+ 8.4%
academics	42.0%	31.4%	38.6%	31.0%	-13.0%	+7.6%
- professors	21.6%	15.5%	18.4%	15.4%	-16.7%	+7.7%
- students	19.4%	15.1%	19.2%	14.7%	-9.5%	+7.0%

By comparing the 2014 and the 2015 authors, we discover that only 29.5% of 2014 authors returned to author another tweet in 2015, revealing an attrition rate of 70.5% (Table 6). However, academic attrition was lower than the average: 40% of 2014 academic users returned in 2015. Furthermore, the return rate for professors (43.6%) was higher than that of students (35.9%). Additionally, though less than one-third of 2014 authors returned in 2015, these return users authored around half of the tweets each year. When considered by group, roughly two-thirds of tweets by academics each year were made by this returning group, and the rate was about 15% higher for professors than it was for students. Finally, a one-way analysis of variance (ANOVA) revealed that an author's returning status had a significant effect on the number of backchannel tweets created in 2015, $F(1, 1,097) = 159.98$, $p < .001$, with returning authors tweeting much more than new authors ($M = 15.1$ vs. $M = 1.7$).

Table 6. Returning authors from 2014 to 2015 conference

	authors returning	% of authors returning	2014		2015	
			% of tweets	tweets per returning author	% of tweets	tweets per returning author
all	431	29.5%	53.8%	16.5	49.2%	12.6
non-academic	248	24.8%	42.5%	13.1	39.6%	10.8
academics	183	40.0%	69.3%	21.0	64.5%	15.1
- professors	99	43.6%	75.8%	21.8	71.2%	14.6
- students	79	35.9%	61.8%	20.1	57.0%	15.3

In summary, results from RQ2 indicated that:

1. Though the number of participants increased for each group in 2015, the number of conference backchannel tweets created by these participants declined.

2. Only a small minority of authors from 2014 returned in 2015

3. The return rate for academics was higher than that of non-academics.

4. Returning authors from 2014 tweeted at a higher rate in 2015 than did new authors.

RQ3. How do conference backchannel tweet activities compare to other tweet activities during and surrounding the conferences?

To understand how conference tweet activities differed from non-conference tweet activities, we first compared tweets during the 2015 conference with tweets three weeks before and three weeks after the conference. As expected, use of the conference hashtag in tweets increased a great deal (61-78%) to an average of one tweet per user per day during the week of the conference when compared to surrounding weeks (Table 7 & Figure 1). A one-way analysis of variance (ANOVA) revealed that week had a significant effect on a tweet's likelihood of being tagged in the conference backchannel, $F(6, 346,560) = 6,664.99$, $p < .001$, and Bonferroni

post-hoc testing confirmed that this likelihood was significantly greater in the conference week than in all other weeks ($p < .001$) but also that the -1 week was significantly greater than the -3 ($p < .01$), +2 ($p < .01$), and +3 ($p < .01$) weeks. This reveals that conference backchannel conversations predominantly occurred during the week of the conference but also that a significant number of these conversations began taking place one week prior to the conference.

Though the total number of tweets (i.e. not just those that included a hashtag) increased during the conference as well, this increase was not drastic and only showed between a 2% and 14% frequency change from surrounding weeks. Tweet-level metrics revealed that during the conference, academics mentioned others in their tweets more, included more links, and hashtagged tweets less than in surrounding weeks, but that sentiment remained steady. Though ANOVA tests with Bonferroni post-hoc testing revealed that the conference week significantly differed from other weeks in most tweet-level metrics, each other week also varied from the others, thereby reflecting no discernible pattern of impact. Thus, we conclude that these tweet-level metrics are highly variable from week-to-week and are influenced by a variety of other factors in addition to the conference (e.g., non-conference-related events).

Table 7. User tweet activities across seven weeks surrounding the AERA 2015 conference

	-3 weeks	-2 weeks	-1 week	2015 Conference	+1 week	+2 weeks	+3 weeks
Conference Tweet Frequency (#aera15)							
academics	-72.6%	-71.2%	-63.4%	1.07	-69.8%	-74.0%	-68.5%
- professors	-77.8%	-73.6%	-62.3%	1.12	-71.0%	-72.3%	-75.0%
- students	-69.1%	-69.1%	-63.8%	1.04	-70.5%	-74.8%	-61.2%
Tweet Frequency							
academics	-3.0%	-7.0%	-2.5%	3.44	-5.7%	-5.8%	-7.8%
- professors	-1.9%	-10.3%	-1.3%	3.76	-1.9%	-4.0%	-3.4%

- students	-4.5%	-3.3%	-4.7%	3.12	-10.4%	-8.3%	-14.3%

Tweet Mentioning % (percent of tweets with a mention)

academics	-5%	-2%	-1%	61%	-1%	-1%	2%
- professors	-6%	-3%	-1%	64%	0%	-1%	1%
- students	-5%	-2%	-3%	56%	-1%	-1%	2%

Tweet Linking % (percent of tweets with a link)

academics	-1%	-3%	-3%	27%	-5%	-6%	-6%
- professors	-2%	-6%	-4%	28%	-4%	-6%	-5%
- students	-1%	-1%	-3%	24%	-6%	-7%	-8%

Tweet Hashtagging % (percent of tweets with a hashtag)

academics	+1%	+1%	0%	31%	-1%	0%	+3%
- professors	+3%	+4%	0%	28%	0%	+2%	+4%
- students	-3%	-2%	-1%	33%	-3%	-2%	-1%

Positive Tweet Sentiment

academics	0%	+2%	+1%	36%	+1%	+1%	+1%
- professors	-1%	0%	0%	17%	0%	+1%	+2%
- students	2%	1%	1%	18%	2%	1%	-3%

Negative Tweet Sentiment

academics	0%	-1%	0%	14%	0%	-1%	0%
- professors	-1%	-1%	-1%	7%	-1%	-1%	2%
- students	1%	-1%	0%	7%	0%	0%	-2%
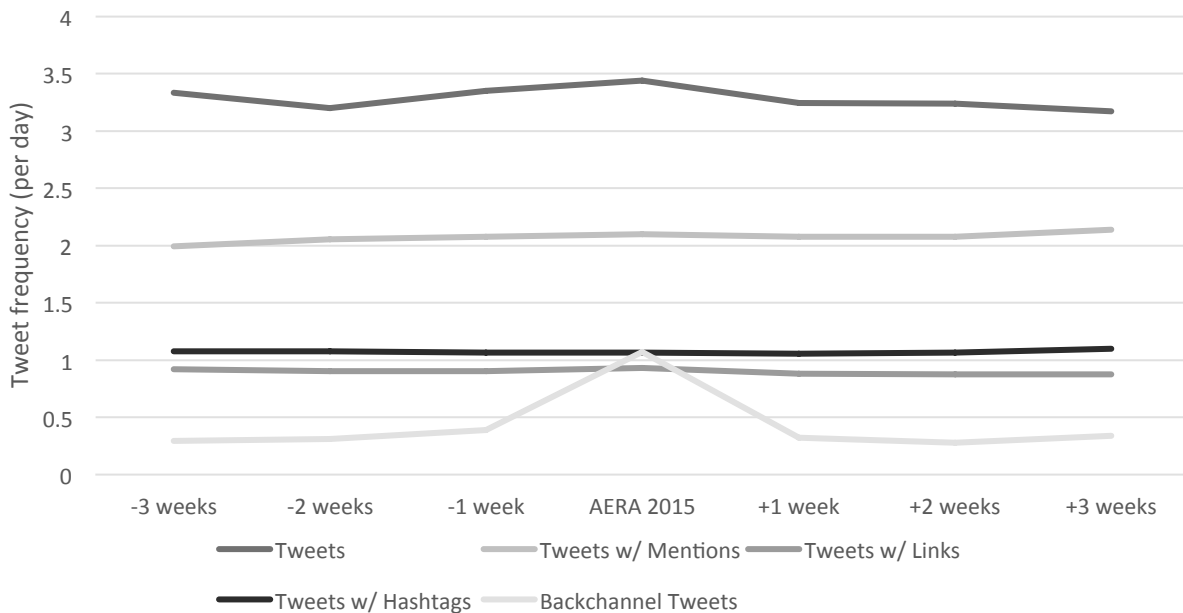
Figure 1. Academics' daily tweet frequencies by week

Next, we compared conference-hashtagged and non-conference-hashtagged tweets occurring during the 2015 conference to understand conversations happening within the conference backchannel vs. those without. One-way analysis of variance (ANOVA) results revealed that conference backchannel tweets were: (1) more likely to include a hashtag[2], $F(1, 62,306) = 675.94$, $p < .001$; (2) less likely to include a mention, $F(1, 62,306) = 524.5$, $p < .001$; and (3) less likely to include a link, $F(1, 62,306) = 2,990.49$, $p < .001$. These results are shown in Table 8 and Figure 2. Sentiment differences between conference and other tweets either were not significant or were less than 1%. In other words, though there was little overall change in frequencies of tweets and tweet sentiment associated with the conference, there were differences in the tweets themselves when compared to other tweets posted in the same week in terms of hashtagging, mentioning, and linking.

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[2] The conference hashtag was excluded from this analysis, as counting the hashtag would have overestimated the presence of hashtags in the conference tweets.

Table 8. Tweet indicators during the 2015 conference comparing conference-tagged tweets with other tweets

	Hashtagged		Mentioned		Linked	
	Conference	Other	Conference	Other	Conference	Other
academics	43%	13%	71%	81%	9%	39%
- professors	44%	10%	75%	81%	10%	40%
- student	43%	14%	66%	82%	7%	38%
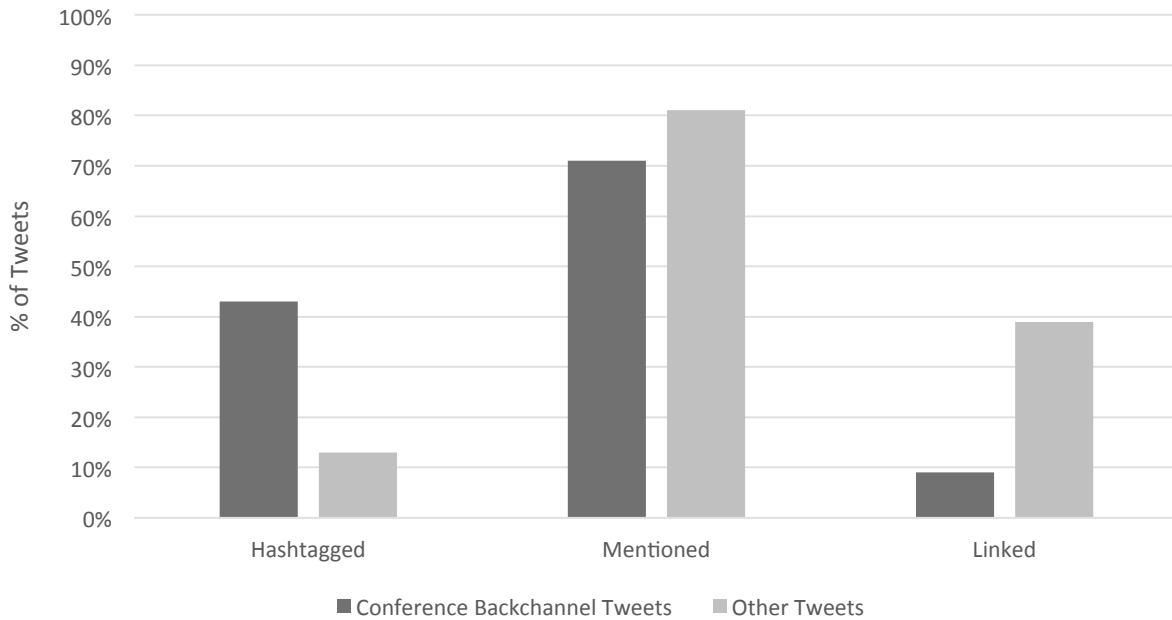
Figure 2. Conference backchannel vs. other tweets occurring during the week of the AERA 2015 conference

We then compared the hashtags that were being used in tweets during the week of the

2015 conference with the surrounding weeks to determine whether any changes were occurring

in overall hashtag use for hashtags not directly related to the conference (i.e. non-division, non-

SIG hashtags). Results (Table 9) indicated that across the seven-week span, a variety of non-

conference hashtags were used including ongoing hashtags (e.g., #education, #edchat) and event-

based hashtags (e.g., #FreddieGray, #WalterScott). Use of ongoing major hashtags was generally

stable across the seven-week span and, as anticipated, event-based hashtags seemed to have no

relationship to the conference but rather spiked in specific weeks according to the occurrence of

the event (e.g., #saskedchat in +1 week, cf. Figure 3; #WalterScott in -1 week, cf. Figure 4).

Breakdown of hashtag use by role revealed that many hashtags highly favored one group over

another (e.g., #edtherapy for professors, #saskedchat for students), and when all major hashtags

were considered together, it was found that students used the ongoing hashtags more often than

professors (67.9% to 32.1%) and that professors used the event-based hashtags more often than

students (63.4% to 36.6%).

Table 9. Major hashtags in weeks surrounding the 2015 conference by role and percent of tweets

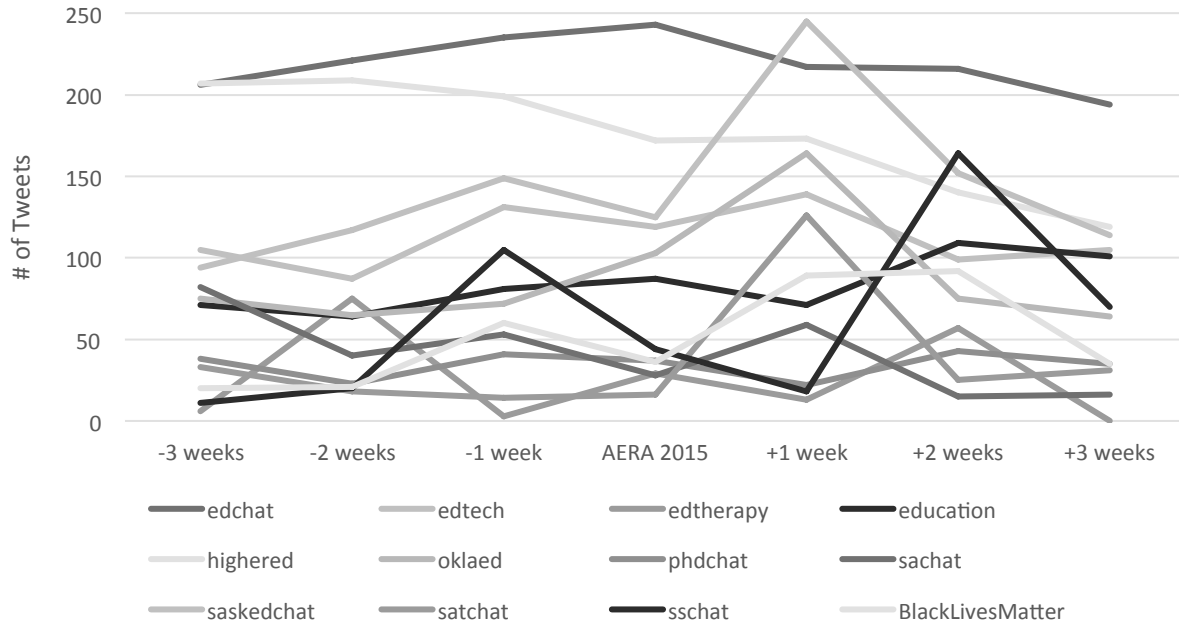| Hashtag	Professors	Students	Hashtag	Professors	Students
Baltimore	62.7%	37.3%	highered	38.9%	61.1%
BaltimoreUprising	77.8%	22.2%	oklaed	31.9%	68.1%
BlackLivesMatter	58.7%	41.3%	phdchat	31.9%	68.1%
edchat	25.1%	74.9%	sachat	14.3%	85.7%
edtech	40.9%	59.1%	saskedchat	0.8%	99.2%
edtherapy	96.7%	3.3%	satchat	57.9%	42.1%
education	30.5%	69.5%	sschat	45.1%	54.9%
FreddieGray	63.6%	36.4%	WalterScott	78.0%	22.0%

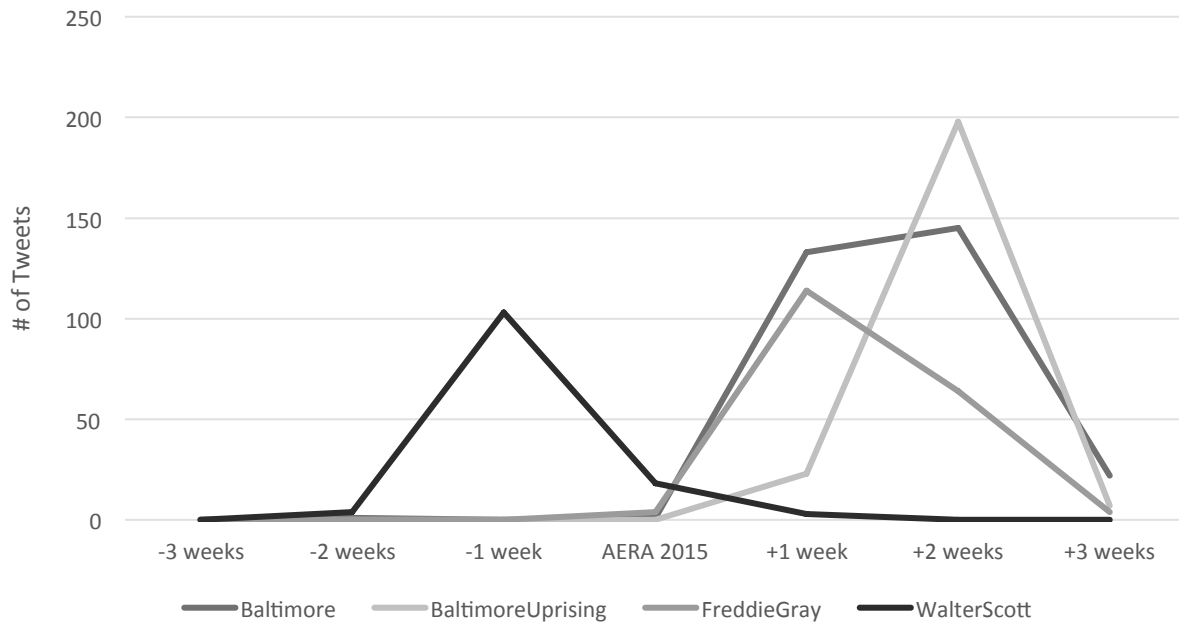Figure 3. Popular ongoing hashtag use by week

Figure 4. Popular event-based hashtag use by week

Sentiment of individual major hashtags was also considered, and it was discovered that tweet sentiment for ongoing hashtags during the seven-week span in 2015 exhibited a greater proportion of tweets expressing positive rather than negative sentiments (Figure 5). The

proportion of tweet sentiment for event-based hashtags during the same time period, however, was more evenly distributed between positive and negative (Figure 6

), thereby exhibiting more dismay, frustration, and anger. Note that the hashtags shown in

Figure 6 are related and pertain to civil rights issues, protests, and police brutality in the United

States at the time. In interpreting these results, it should be kept in mind that a positive tweet

includes consolation and support or language that connotes encouragement, whereas a negative

tweet may suggest dismay, disgust, or frustration.
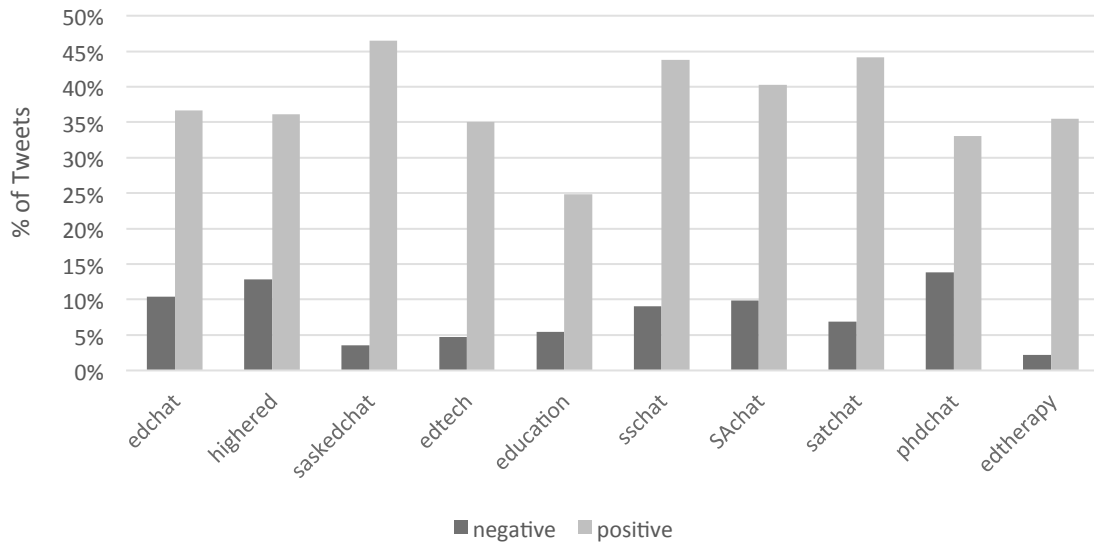
Figure 5: Sentiment of popular ongoing hashtags during the 2015 conference and surrounding
weeks
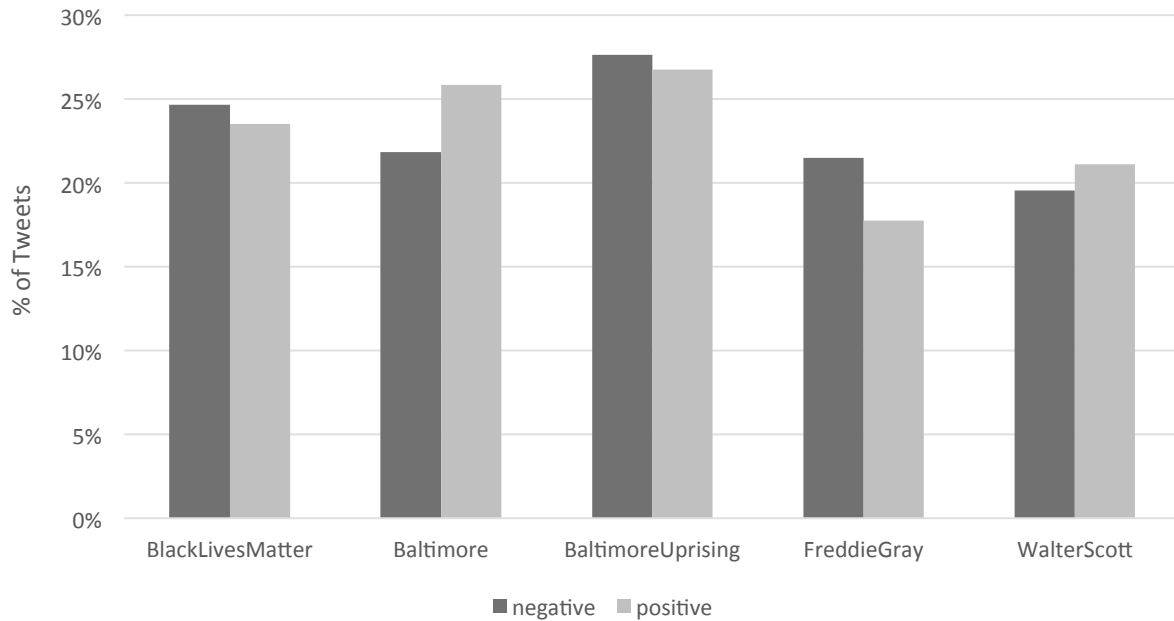
Figure 6. Sentiment of popular event-based hashtags during the 2015 conference and surrounding weeks

In summary, results from RQ3 indicated that:

1. Conference backchannel tweet frequencies increased during the conference and the week preceding the conference, but tweet-level metrics were highly variable from week-to-week, which makes it difficult to draw conclusions about the effect of the conference on these indicators for the overall week.

2. Conference backchannel tweets were more likely to include a hashtag and less likely to include a mention or link than other tweets created during the same week.

3. A variety of non-conference hashtags were used during the seven-week span, including ongoing hashtags (which tended to be stable across the weeks) and event-based hashtags (which spiked and furrowed depending upon the week).

4. Professors used popular event-based hashtags more frequently, while students used popular ongoing hashtags more frequently.

5. Sentiment of ongoing hashtags tended to be generally positive, while event-based hashtags exhibited more ambiguous or conflicting sentiments.

Discussion

Results from this study have various implications for our understanding of scholarly uses of social media and especially for our use of Twitter as a backchannel in educational conferences. These implications can be divided into four emerging areas of discussion: 1) the backchannel as a unique venue for scholarly and non-scholarly participation, 2) scholarly purposes and attitudes in using Twitter, 3) role differences between students and professors, and 4) forces impacting scholars' digital participation.

The backchannel as a unique venue for scholarly and non-scholarly participation

Previous research has shown that Twitter backchannels in conferences are used for a variety of purposes (Reinhardt, Ebner, Beham, & Costa, 2009), but this study has established that self-identified academics comprised a minority of participants in the studied educational conference. This finding suggests that use of the backchannel may not be strictly scholarly in nature (e.g., sharing and improving upon research), as the backchannel may also be used by non-academics for other purposes (e.g., marketing products).

Furthermore, academics' tweets in the 2015 backchannel differed significantly from non-backchannel tweets made by the same authors in the same week in that they included more hashtags and fewer links. This suggests that when compared to academics' general Twitter use, the backchannel was used more for commentary connected to some topic or community than is generally the case and that there was less sharing of resources or commentary on specific online artifacts (i.e. links) than is the norm for general participation.

The sheer number and diversity of hashtags used during the conference also seems to support previous research that backchannels may serve as a container for multiple monologues with disjointed discussions as opposed to places hosting distributed conversations amongst interested parties (Ross, Terras, Warwick, & Welch, 2011). If this is the case, then it seems that the backchannel may serve as an initial connector for participants to begin conversation but that as discussions become disjointed and divergent authors may naturally leave the backchannel. Results indicated that in 2015 more participants used the backchannel but that they used it less frequently and that the majority of the 2014 participants did not return to the backchannel in 2015. Furthermore, backchannel conversations did not continue after the conference or if they did they did so using different hashtags. This seems to corroborate the conclusion that a backchannel may be an initial point of contact but that meaningful conversations between scholars would naturally leave the backchannel.

It is also noteworthy, that the minority of users who returned in 2015 authored the majority of the backchannel tweets. This suggests that the backchannel may be a space driven by relatively few returning participants who are using it as a means of voicing their own monologues. It is possible that new participants have difficulty connecting into these conversations in a sustained manner and hence publish fewer tweets. This is supported by the fact that the most popular hashtags each year boast a very high tweet/person count and feature few participants that make significant contributions. For example, in 2014, the 525 backchannel tweets for #queersig were made by only 14 academics with a median tweet contribution of 2, and 91% of the tweets made for this hashtag were made by the top two authors (477). Similarly, in 2015, the 122 backchannel tweets for #literacies were made by only 5 academics with a median tweet contribution of 9, and 80% of the tweets for this hashtag were made by the top two authors

(97). This may mean that a relatively small group of academics are driving these hashtag conversations in monologue-type fashion and that the backchannel serves as a means for making monologues heard rather than fostering meaningful or sustained scholarly conversation.

Scholarly purposes and attitudes in using Twitter

These results may also be helpful for better understanding scholarly purposes for using Twitter generally. Various popular hashtags were used during the conference and included identifiers referring to sub-communities within AERA, topics, locations, and larger educational or research communities, revealing that academics are posting tweets that cover a variety of topics and connect with a number of communities via hashtags. These hashtags included both ongoing hashtags (i.e. those which tended to be stable across weeks) and event-based hashtags (i.e. those which spiked in a particular week). This result reveals that scholars are engaged in a variety of conversations on Twitter and that some of these are more sustained and formalized while others are spontaneous and reactive to current events. The finding that ongoing hashtags exhibited general positivity while event-based hashtags were more evenly distributed between positive and negative sentiment suggests that academics generally exhibit positive sentiments in their sustained conversations on Twitter, but that they also use the platform to express their dismay, frustrations, and anger within the contexts of current events. These results indicate that scholars seem to use the platform to positively promote, share, and discuss topics of interest but that they also exhibit willingness to periodically shed this positivity and express discontent.

Role differences between students and professors

Though previous research found that students believed conference Twitter use to be more useful and less problematic than did professors (Li & Greenhow 2015), results from this study showed that each group used the conference backchannel equally (or even in some cases that

professors tweeted more than did students). On the other hand, and supportive of other results reported by Li and Greenhow, professors and students exhibited different uses of the medium and seemed to play a different role within the backchannel community. Many popular hashtags were either heavily favored by one group or the other (e.g., *#queersig* by professors, *#emergingscholars* by students), which suggests that individuals' professional role in academia influences participation and perhaps the types of conversations they might be interested in having. Furthermore, this disparity may be further understood when these hashtags are categorized as either ongoing or event-based, as professors used popular event-based hashtags more frequently than did students, and students used popular ongoing hashtags more frequently than did professors. This may suggest that students are more interested in using the platform for intellectual growth and career development, while professors are more interested in using it as a vehicle for participating in contemporary events or effecting social change. The evidence does not suggest that one group uses the platform more than the other but that each group's use is nuanced and may exhibit different participation patterns, expectations, and goals.

Forces impacting digital participation

Supporting the finding of Mahrt, Weller, and Peters (2014) that external events may influence conference backchannel activity, this study found that the way academics participated on Twitter varied weekly and that though the 2015 conference influenced participation, this was just one of many factors that likely shaped participant behavior each week. Previous research has shown potential apprehension on the part of academics when navigating personal-professional boundaries online (Authors, 2013), but based on popular hashtags identified in this study, it seems that academics use both personal and professional hashtags when using Twitter or that some hashtags may not be readily categorized as one or the other (e.g., event-based hashtags like

#WalterScott). Networked Participatory Scholarship, the theoretical framework guiding this

study, recognizes that a wide array of forces encourage, restrict, and overall shape digital

participation (Authors, 2012), and given that professors and students exhibited different uses of

event-based vs. ongoing hashtags, we are led to consider whether the power dynamics associated

with these roles might influence academics' willingness to participate in particular ways. For

instance, did professors exhibit more willingness to tweet about social justice issues or politically

volatile matters as a result of their relative safety as faculty members who are given certainties

related to academic freedom? Might a student who is looking for a job be less willing to voice an

opinion on such matters out of fear of these sentiments or their perceived lack of professionalism

forming a basis of judgment by members of a hiring committee (cf. Authors, 2013)? The

findings reported in this study raise these questions for future research. In short, differences in

student and professor uses of Twitter should lead us to consider whether aspects of the

academic's role influence the individual's willingness to participate in particular ways that blur

the boundaries between professional and personal.

Conclusion

This study has sought to better understand academic Twitter use during, around, and

between the AERA annual conferences both as a conference backchannel and as a general means

of participating online. Results provide a rich representation of academic use of Twitter and

demonstrate the complicated participation patterns of how Twitter is used by academics "on the

ground." In particular, this study shows that students and professors comprised the minority of

participants in both conference backchannels but participated in the backchannel at a much

higher rate than their non-academic counterparts. While the number of participants in the

backchannel increased between 2014 and 2015, only a small number of authors were present

during both years, and the number of tweets declined from year to year. Furthermore, various hashtags were used before, during, and after the conference, and these included both ongoing hashtags and event-based hashtags. Use of ongoing hashtags tended to be stable across weeks and to exhibit positive sentiment, while use of event-based hashtags tended to spike and slump and exhibit more ambiguous or conflicting sentiments. We also showed that academics' tweets in the 2015 backchannel differed significantly from non-backchannel tweets.

A significant finding of this study is that professors and students exhibit similarities and differences in how they use Twitter: While each group used the conference backchannel somewhat equally, some hashtags were used more frequently by students, while others were used more frequently by professors, suggesting different norms of participation between groups. Combined with user-reported motivations for using conference backchannels, this result suggests that some hashtags may be perceived to be more appropriate than others to achieve desired outcomes. For example, faculty who reported that they use Twitter in order to foster a digital identity and to share their scholarship (Li & Greenhow, 2015) may use event-based hashtags more often than students (as shown in this research), because event-based hashtags allow them to demonstrate their expertise on the event. Further, students who reported that they use Twitter to consume content and network with others (Li & Greenhow) may use ongoing hashtags more often than professors (as shown in this research), because ongoing use of the medium enables them to maintain connections and gain access to content on a more frequent basis. These insights may be further explored in future research in order to understand how users are similar or dissimilar in their social network engagement and to investigate how use of social networks may or may not be tactical.

Acknowledgements

This study was partially funded by a grant from the [----] Foundation and the [----] program.

<div align="center">References</div>

Author. (2011).

Authors. (2012).

Authors. (2013).

Authors (2015).

Bowman, T. D. (2015). Differences in personal and professional tweets of scholars. *Aslib Journal of Information Management, 67*(3), 356-371.

Brown, J., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-41.

Bruns, A., & Burgess, J. (2013). Crisis communication in natural disasters: The Queensland floods and Christchurch earthquakes. In Weller, K, Bruns, A., Burgess, J., Mahrt, M., & Puschmann, C. (Eds.), *Twitter and society* (pp. 373-384). New York: Peter Lang.

Colson, D. (2014). On the ground in Kansas: Social media, academic freedom, and the fight for

    higher education. Retrieved from http://www.aaup.org/file/Colson.pdf

Dutton, W. (2013) The social shaping of digital research. *International Journal of Social*

    Research Methodology, 16(3), 177-195.

Ebner, M. (2009). Introducing live microblogging: how single presentations can be enhanced by

    the mass. *Journal of Research in Innovative Teaching, 2*(1), 91-100.

Ekins, S., & Perlstein, E. O. (2014). Ten simple rules of live tweeting at scientific conferences.

    PLoS computational biology, 10(8), e1003789.

Elavsky, C. M., Mislan, C., & Elavsky, S. (2011). When talking less is more: exploring

    outcomes of Twitter usage in the large-lecture hall. *Learning, Media and Technology,*

    36(3), 215-233.

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on

    microblogging in education published in 2008–2011. *British Journal of Educational*

    Technology, 43(5), 783-801.

Gleason, B. (2013). #OccupyWallStreet: Exploring informal learning about a social movement

    on Twitter. *American Behavioral Scientist, 57*(7), 966-982.

Greenhow, C., Robelia, B., & Hughes, J. E. (2009). Learning, teaching, and scholarship in a

    digital age: Web 2.0 and classroom research: What path should we take now?

    Educational Researcher, 38(4), 246–259.

Goodfellow, R., & Lea, M. R. (2013). *Literacy in the digital university: Critical perspectives on*

    learning, scholarship and technology. New York, NY: Routledge.

Hennessey, J. W. (2015). phpInsight – Sentiment analysis in PHP. Retrieved from

    https://github.com/JWHennessey/phpInsight

Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational technology research and development*, *48*(3), 23-48.

Herrington, J., Reeves, T.C., & Oliver, R. (2007). Immersive learning technologies: Realism and online authentic learning. *Journal of Computing in Higher Education, 19*(1), 65-84.

Highfield, T. (2013). Following the yellow jersey: Tweeting the Tour de France. In Weller, K, Bruns, A., Burgess, J., Mahrt, M., & Puschmann, C. (Eds.), *Twitter and society* (pp. 249-261). New York: Peter Lang.

Holmberg, K., & Thelwall, M. (2014). Disciplinary differences in Twitter scholarly communication. *Scientometrics, 101*, 1027-1042.

Jaschik, S. (2014, August 6th). Out of a job. *Inside Higher Ed*. Retrieved from https://www.insidehighered.com/news/2014/08/06/u-illinois-apparently-revokes-job-offercontroversial-scholar

Johnson, K. A. (2011). The effect of Twitter posts on students' perceptions of instructor credibility. *Learning, Media and Technology, 36*(1), 21-38.

Junco, R., Heiberger, G., & Loken, E. (2011). The effect of Twitter on college student engagement and grades. *Journal of Computer Assisted Learning, 27*(2), 119-132.

Knight, C. G., & Kaye, L. K. (in press). 'To tweet or not to tweet?' A comparison of academics' and students' usage of Twitter in academic contexts. *Innovations in Education and Teaching International.*

Lave J. & Wenger E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press, Cambridge, UK.

Lenhart, A., Madden, M., Smith, A., Purcell, K., Zickuhr, K., & Rainie, L. (2011). Teens, kindness and cruelty on social network sites. Pew Internet and American Life Project.

Retrieved from

http://www.cbsd.org/cms/lib010/PA01916442/Centricity/Domain/338/PIP_Teens_Kindn

ess_Cruelty_SNS_Report_Nov_2011_FINAL_110711.pdf

Li, J., & Greenhow, C. (2015). Scholars and social media: Tweeting in the conference

backchannel for professional learning. *Educational Media International, 52*(1), 1-14.

Lomicka, L., & Lord, G. (2012). A tale of tweets: Analyzing microblogging among language

learners. *System, 40*(1), 48–63.

Mahrt, M., Weller, K., & Peters, I. (2014). Twitter in scholarly communication. In K. Weller, A.

Bruns, J. Burgess, M. Mahrt, & C. Puschmann (Eds.), *Twitter and Society* (pp. 399-410).

New York, NY: Peter Lang.

Moran M., Seaman J. & Tinti-Kane H. (2011). Teaching, learning, and sharing: How today's

higher education faculty use social media for work and for play. Pearson Learning

Solutions. Retrieved from

http://www.pearsonlearningsolutions.com/blog/2011/05/09/teaching-learning-and-

sharing-how-todays-higher-education-facutly-use-social-media/

Moran M., & Tinti-Kane H. (2013). Social media for teaching and learning. Pearson Learning

Solutions. Retrieved from

http://www.pearsonlearningsolutions.com/assets/downloads/reports/social-media-for-

teaching-and-learning-2013-report.pdf

Oliver, M. (2013), Learning technology: Theorising the tools we study. *British Journal of

Educational Technology, 44*(1), 31–43.

Ortega, J.L. (2015). Disciplinary differences in the use of academic social networking sites.

Online Information, 39(4), 520-536.

Reinhardt, W., Ebner, M., Beham, G., & Costa, C. (2009). How people are using Twitter during conferences. *Creativity and Innovation Competencies on the Web. Proceedings of the 5th EduMedia*, 145-156.

Ross, C., Terras, M., Warwick, C., & Welsh, A. (2011). Enabled backchannel: conference Twitter use by digital humanists. *Journal of Documentation, 67*(2), 214-237.

Selwyn, N. (2010). Looking beyond learning: Notes towards the critical study of educational technology. *Journal of Computer-Assisted Learning, 26*(1), 65–73.

Shiffman, D. S. (2012). Twitter as a tool for conservation education and outreach: what scientific conferences can do to promote live-tweeting. *Journal of Environmental Studies and Sciences, 2*(3), 257-262.

Siemens, G., Gasevic, D., Dawson, S.(2015). Preparing for the digital university: A review of the history and current state of distance, blended, and online learning. Report Commissioned by the Bill & Melinda Gates Foundation. Retrieved on 23 August, 2015 from http://linkresearchlab.org/PreparingDigitalUniversity.pdf

Veletsianos, G. & Kimmons, R. (2012). Networked participatory scholarship: Emergent techno-cultural pessures toward open and digital scholarship in online networks. *Computers & Education, 58*(2), 766-774.

Wenger E. (1998). *Communities of practice. Learning, meaning and identity*. Cambridge University Press, Cambridge, UK.