



Relationship Between Official Twitter Ambassadors and the Number of Retweets in the Annual Congress

— “Tweet the Meeting” —

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Background: The relationship between Twitter ambassadors and retweets has not been fully evaluated for “tweet the meeting” activity.

Methods and Results: We collected data on the number of tweets and retweets during the Japanese Circulation Society’s (JCS) annual meetings in 2019, 2020, and 2021. After adjustment, JCS Twitter Ambassadors, selected by the JCS to increase the meeting’s visibility, increased the total number of retweets by 9%.

Conclusions: This is the first report on the numerical relationship between JCS Twitter Ambassadors and the total number of retweets during an annual congress. Original tweets by JCS Twitter Ambassadors increased the number of retweets, but retweets by influencers were more effective at stimulating social media engagement.

Key Words: Ambassadors; Annual congress; Twitter

The use of Twitter at annual congresses is increasing, and it is especially popular for disseminating presentation materials and related links, including published articles.¹ These activities have been described as “tweeting the meeting” and have resulted in information diffusion and the development of complex networks among Twitter users through retweeting and mutual follows.^{1,2} Several measures, such as retweets, mentions, and impressions, can be considered as metrics for the potential impact of “tweet the meeting” actions. Among these metrics, the retweet count, which is the number of times the tweet has been retweeted, is a frequently used measure of the effec-

tiveness of an individual tweet, because it gives a measure of audience size and appreciation.³ Thus, increasing the number of retweets is a key strategy to increasing the impact of “tweet the meeting”.

Prior to the annual congress of the Japanese Circulation Society (JCS), the society’s Information and Communication Committee nominated several healthcare professionals as JCS Twitter Ambassadors to purposefully engage in tweeting during the congress (**Supplementary Table 1**).² Although the relationship between allocated healthcare specialists and Twitter dissemination has been studied in the area of journal article citations, the impact of allocated Twitter

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Table 1. Baseline Comparison of Retweet Metrics (of the Original Tweet) Between Japanese Circulation Society Twitter Ambassadors and Non-Ambassadors				
	Influencer	Others	JCS Twitter Ambassador	P value
n	55	2,481	5,597	
Year				<0.001
2019	7 (12.7)	694 (28.0)	1,346 (24.0)	
2020	8 (14.5)	630 (25.4)	2,555 (45.6)	
2021	40 (72.7)	1,157 (46.6)	1,696 (30.3)	
During the congress				0.019
Day 1	13 (23.6)	683 (27.5)	1,660 (29.7)	
Day 2	29 (52.7)	950 (38.3)	2,006 (35.8)	
Day 3	13 (23.6)	848 (34.2)	1,931 (34.5)	
No. retweets for each original tweet				<0.001
Mean±SD	6.38±12.64	2.59±3.05	3.14±4.32	
Median [IQR]	2 [1–5]	2 [1–3]	2 [1–4]	
No. retweets by influencers (≥10,000 followers)				0.001
0	51 (92.7)	2,443 (98.5)	5,504 (98.3)	
1	3 (5.5)	36 (1.5)	86 (1.5)	
2	1 (1.8)	2 (0.1)	5 (0.1)	
3	0 (0.0)	0 (0.0)	2 (0.0)	
Guideline-related topic	2 (3.6)	147 (5.9)	183 (3.3)	<0.001
Twitter users' follower categories ^A				<0.001
Q1	0 (0.0)	1,308 (52.7)	1,377 (24.6)	
Q2	0 (0.0)	776 (31.3)	2,076 (37.1)	
Q3	55 (100.0)	397 (16.0)	2,144 (38.3)	

Unless indicated otherwise, data are given as n (%). ^ATwitter users were divided into tertiles based on the number of followers: Q1, <306 followers; Q2, 307–1,998 followers; Q3, ≥1999 followers. IQR, interquartile range; JCS, Japanese Circulation Society.

ambassadors has not been evaluated previously. In this study, we evaluated the relationship between JCS Twitter Ambassadors and the total number of retweets over 3 consecutive years of “tweet the meeting” experience.

Methods

Data Pull

We extracted tweets using the Twitter Archiving Google Sheet (TAGS), which accesses the Twitter application programming interface (API) and records information about tweets and retweets for up to the previous 7–10 days, to a maximum of 18,000 tweets and retweets.⁴ The extraction was defined using the specific hashtags #19JCS, #20JCS, and #21JCS for the 2019, 2020, and 2021 congresses, respectively. The information was pulled for each day of the congress and combined. We only used data from tweets that originated within the 3-day durations of the main congresses. The congress durations were defined as March 29–31, 2019, July 31–August 2, 2020, and March 26–28, 2021, Japan Standard Time (JST). Quoted tweets were not classified as retweets for the purposes of this study. Twitter IDs were grouped into 3 categories: JCS Twitter Ambassador, influencer, and other. Influencers were defined as non-JCS Twitter Ambassadors with more than 10,000 followers.

Network Model

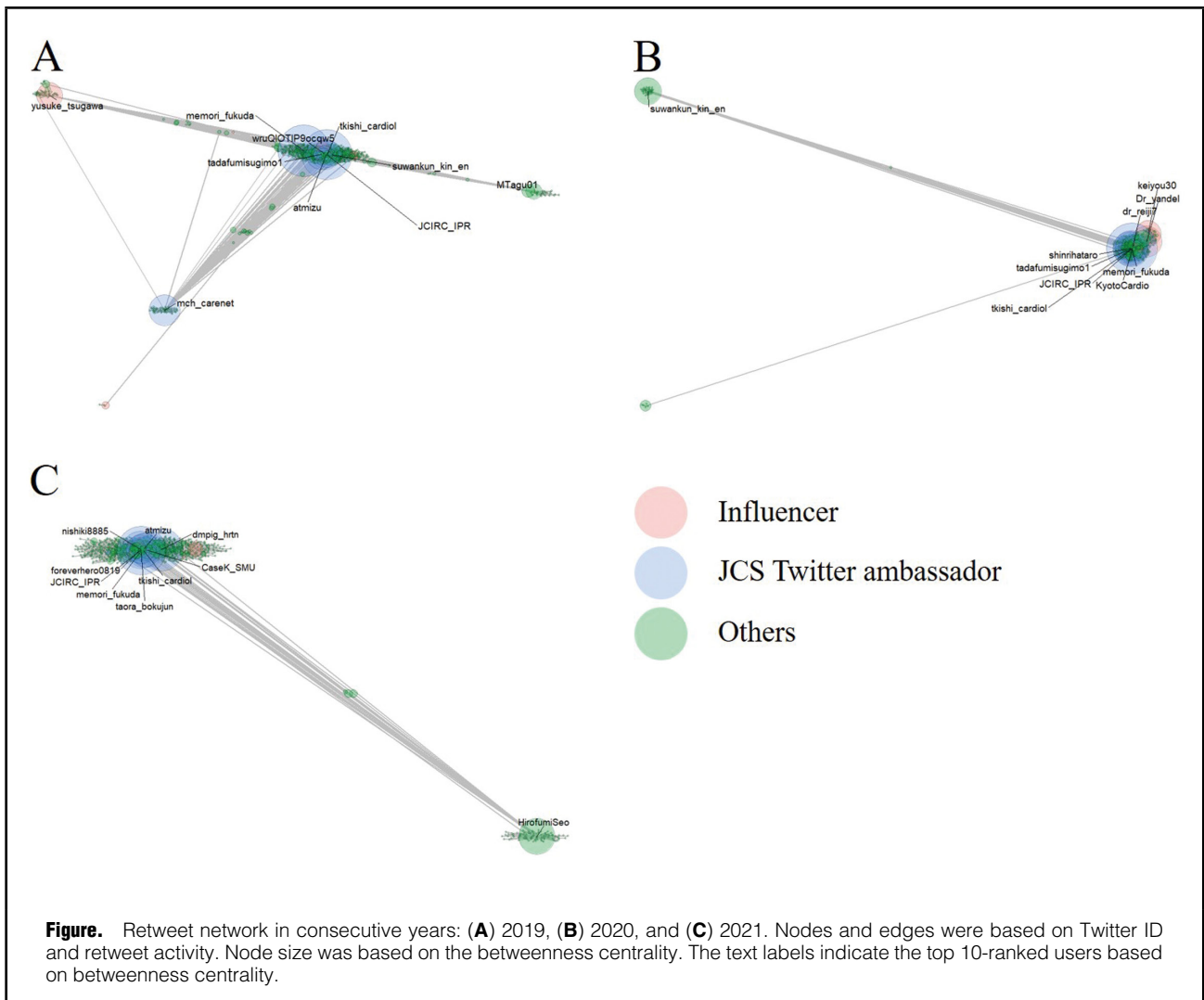
First, we focused on retweets to model networks of Twitter users. Nodes and edges were identified as Twitter users who formed mutual tweet and retweet relationships (e.g., User A retweeting User B resulted in a directed edge from

A to B). Centrality measures in each year were calculated with the *igraph* package in R (R Foundation for Statistical Computing, Vienna, Austria). We calculated 4 major centrality measures: degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality. Degree centrality, which is used to analyze interactions between users, was calculated as the number of adjacent edges of a node. Betweenness centrality is measured by computing the number of shortest paths between every pair of nodes that pass through the node of interest. This measure shows how central a node connecting any other pair of nodes into the network is, often bridging otherwise unconnected communities.⁵ Closeness centrality was measured by assigning a score to each node that was proportional to the reciprocal of the sum of all distances between that node and all the other nodes: as a node is “closer” to other nodes, on average, its closeness will increase.⁶ Eigenvector centrality expands degree centrality to incorporate not only the number of connections, but also the degree centrality of its neighbors (i.e., whether it is connected to many other central nodes or many non-central nodes), *ad infinitum*.⁷

Because we hypothesized that betweenness centrality, measuring connections to otherwise unconnected groups, would be most salient in increasing retweets, we sorted by this value. We identified the top 10 Twitter users according to betweenness centrality in each year to indicate which Twitter IDs best bridged the many distinct communities present at the annual congresses. To visualize social networks, we used the Distributive Recursive Layout, which is based on “a force-directed algorithm”.⁸ In the resulting figures, the node size was determined by betweenness cen-

Table 2. Centrality Measures Summary of the Retweet Network				
	Influencer	JCS Twitter Ambassador	Others	P value
n	51	126	3,136	
Degree centrality				<0.001
Mean±SD	9.47±19.33	61.69±80.07	3.02±6.83	
Median [IQR]	2.00 [1.00, 10.00]	32.50 [16.00, 70.75]	1.00 [1.00, 2.00]	
Closeness centrality (×1,000)				0.188
Mean±SD	0.13±0.08	0.14±0.09	0.14±0.07	
Median [IQR]	0.13 [0.06, 0.14]	0.13 [0.06, 0.15]	0.13 [0.06, 0.22]	
Betweenness centrality				<0.001
Mean±SD	4,436.11±11,430.84	20,469.81±40,185.12	494.86±2,709.98	
Median [IQR]	1.00 [0.00, 2,383.40]	5,409.64 [1,884.92, 18,078.33]	0.00 [0.00, 39.26]	
Eigenvector centrality (×1,000)				<0.001
Mean±SD	4.61±10.26	150.10±212.14	3.97±15.76	
Median [IQR]	1.70 [0.48, 4.92]	70.35 [34.33, 144.48]	0.99 [0.18, 2.58]	

IQR, interquartile range; JCS, Japanese Circulation Society.



	Log (total no. retweets)	Total no. retweets	P value
	Estimates (95% CI)	RR (95% CI)	
Original tweet by JCS Twitter Ambassadors	0.08 (0.05, 0.12)	1.09 (1.05, 1.12)	<0.001
Year 2020 vs. 2019	0.45 (0.41, 0.49)	1.58 (1.51, 1.64)	<0.001
Year 2021 vs. 2019	0.3 (0.26, 0.34)	1.35 (1.29, 1.4)	<0.001
Day 2 vs. Day 1	-0.02 (-0.06, 0.01)	0.98 (0.94, 1.01)	0.239
Day 3 vs. Day 1	-0.04 (-0.08, 0)	0.96 (0.93, 1)	0.041
No. retweets by influencers			
1 vs. 0 (reference)	1.27 (1.15, 1.39)	3.55 (3.14, 4)	<0.001
2 vs. 0 (reference)	2.22 (1.75, 2.69)	9.22 (5.75, 14.77)	<0.001
3 vs. 0 (reference)	2.85 (1.9, 3.79)	17.24 (6.71, 44.26)	<0.001
Guideline-related topic	0.3 (0.23, 0.38)	1.35 (1.25, 1.46)	<0.001
Twitter users' follower categories ^A			
Q2 vs. Q1	0.03 (-0.01, 0.06)	1.03 (0.99, 1.07)	0.167
Q3 vs. Q1	0.1 (0.06, 0.14)	1.1 (1.06, 1.15)	<0.001

^ATwitter users were divided into tertiles based on the number of followers: Q1, <306 followers; Q2, 307–1,998 followers; Q3, ≥1999 followers. CI, confidence interval; JCS, Japanese Circulation Society; RR, relative risk.

trality, and color was allocated to the Twitter ID category (JCS Twitter Ambassador, influencer, and other).

Statistical Analyses

Continuous variables are reported as the mean ± SD and/or as the median and interquartile range (IQR). Variables were compared with a Kruskal-Wallis test. Categorical variables are reported as frequency and percentage. Due to the skewness of the total number of retweets, we performed linear regression of log-transformed total retweet number to estimate the impact of JCS Twitter Ambassadors. The tweet data were adjusted by: (1) followers of the originating Twitter ID; (2) tweeted year (2019, 2020, or 2021); (3) day of the tweet during the congress (i.e., Day 1, 2, or 3); (4) tweet originating from JCS Twitter Ambassadors; (5) the presence of the word “guideline” (in English and Japanese) in the original tweet; and (6) the number of retweets by influencers. All analyses were performed using R version 4.0.2.

Results

The total number of original tweets during the congresses in 2019, 2020, and 2021 was 2,049, 3,200, and 2,896, respectively. Of these original tweets, 5,597 (68.7%) were delivered by JCS Twitter Ambassadors (Table 1). Tweets by non-ambassadors (influencers and others) were most frequent in 2021 (72.7% and 46.6%, respectively). During a congress, non-ambassador tweets occurred most frequently on Day 2 (influencer 52.7%, others 38.3%), and tweets by JCS Twitter Ambassadors were more frequently observed on Days 2 and 3 of the congress (35.8% and 34.5%, respectively) than on Day 1 (29.7%). The total number of retweets was significantly higher in the influencer group (median 2 [IQR 1–5]). Tweets concerning the topic “guidelines” were more frequently observed in the others group (5.9%).

Table 2 compares the 4 major centrality measures among influencers, JCS Twitter Ambassadors and others. Except for closeness centrality, JCS Twitter Ambassadors showed significantly higher centrality values than the other groups. As shown in the Figure, many Twitter users connected

strongly and a few influencers could make new network connections in 2019 and 2020. Supplementary Table 2 provides a list of the top-ranked users in terms of betweenness centrality. Most of the Twitter users in the ranking were JCS Twitter Ambassadors. The official Twitter account @JCIRC_IPR was consistently in the list and showed the highest eigenvector centrality scores every year.

A linear regression model revealed that JCS Twitter Ambassadors increased the total number of retweets (relative risk [RR] 1.09; 95% confidence interval [CI] 1.05–1.12; Table 3). The total number of retweets was exponentially associated with the number of retweets by influencers (RR 3.55 [95% CI 3.14–4] for 1 vs. 0; RR 9.22 [95% CI 5.75–14.77] for 2 vs. 0; and RR 17.24 [95% CI 6.71–44.26] for 3 vs. 0).

Discussion

This is the first study to evaluate the relationship between Twitter ambassadors and the total number of retweets of information pertaining to a scientific congress. Our analysis uncovered several important patterns. First, original tweets by JCS Twitter Ambassadors themselves increased the total number of retweets by 9%. Second, influencer retweets increased the total number of retweets exponentially. Third, evaluation of centrality measures showed that JCS Twitter Ambassadors played a major role in forming networks with many other users.

Models that include official supporters or that allocate ambassadors could be useful for medical associations that want to increase engagement via tweeting activity associated with annual medical congresses. Theoretically, allocating ambassadors to retweet or tweet the contents of congresses could be useful to increase the total number of engagements with the information. Our study confirmed this prediction, and further suggests the utility of targeting specific tweeting personalities to expand influence. Similar to our experience, the European Society of Cardiology also allocated Twitter ambassadors and reported an increased total engagement with social media networks.⁹

Our results showed a particularly strong impact of retweets by influencers. The theory of influential engagement

in social media has long been debated, because estimates of actual viral enhancements by influential contributors have not been consistent with predictions based on theory. In our study, we used a cut-off value of 10,000 followers to define influencers; this value has been shown to be reasonable to illustrate the impact of influencers on the number of retweets.¹⁰ Here, single retweets by influencers resulted in a 355% increase in retweets, and, if they retweeted 2 or 3 times, their actions resulted in 922% and 1,724% increases as compared with no retweets. If the chair of an annual congress aimed to increase the total number of retweets, the engagement of influencers could be one of the most effective ways to do this.

Our network visualization and centrality measures showed the effectiveness of the allocation of Twitter ambassadors. These tools demonstrate that influencers increased the total number of retweets and made new connections outside of the JCS Twitter Ambassador network. However, from the perspective of centrality, JCS Twitter Ambassadors also play major roles in a “tweet the meeting” model. Notably, in our study, the official Twitter account @JCIRC_IPR showed the highest eigenvector centrality, which meant that @JCIRC_IPR retweet activity showed a strong connection to all major Twitter IDs.

Our study has several limitations. First, we measured activities of “tweet the meeting” by using hashtag data only. Twitter users can tweet or quote tweets without using hashtags, so the total activity may be underestimated. However, hashtag analysis is the most popular strategy, and this could be easily calculated and monitored in a consecutive year. Second, in this study of network formation, we did not use other metrics, such as follows and followership and friends’ components. However, as ideas are spread continuously during a congress (e.g. tweets about a particularly exciting parallel session), the retweets are likely the most relevant measure for this phenomenon. Third, it should be noted that JCS Ambassadors and the JCS official Twitter account were highly active in their tweeting and retweeting, as these ambassadors were officially selected by Information and Communication Committee of the JCS. Such energetic engagement may not always be possible for every society.

Furthermore, the allocation strategy could affect our results. The chairman and secretariat members of the Information and Communication Committee have selected ambassadors from members of the JCS who consistently tweet academic content. However, this is a similar strategy to that of other academic associations.^{11,12} Finally, in 2020, the 84th Annual Scientific Meeting of the JCS was held entirely online, and this format may positively affect Twitter usage over a full 3-day congress.

Conclusions

This is the first report on the relationship between Twitter ambassadors and the total number of retweets during an annual scientific congress in Japan. Original tweets by Twitter ambassadors increased the number of retweets, but this effect was smaller than the retweeting by influencers.

Highlights

- JCS Twitter Ambassadors increased the total number of retweets by 9%
- Influencer retweets exponentially increased the total number of retweets
- JCS Twitter Ambassadors showed higher centrality values in retweet

networks

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Disclosures

S.S., K.N. are members of *Circulation Reports*’ Editorial Team. The remaining authors declare have no conflicts of interest to declare.

IRB Information

This study was granted an exemption from requiring ethics approval by the Ethics Committee of St. Luke’s International Hospital (20-R118) because it was a retrospective observational study.

Data Availability

The de-identified participant data will not be shared.

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Supplementary Files

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