Effect of Media Usage Selection on Social Mobilization Speed: Facebook vs Email

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Working Paper CISL# 2014-11

September 2014

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Abstract: Social mobilization is a process that enlists a large number of people to achieve a goal in limited time, especially through the use of social media. There is increasing interest in understanding the factors that affect the speed of social mobilization. Based on the Langley Knights Competition data set, we analyzed the differences in mobilization speed between users of Facebook and Email. In order to isolate the effect of other factors that may influence mobilization speed, we include those factors (gender, age, timing, and homophily of information source) in our model as control variables. We discovered that, in this experiment, although more people used Email to recruit, the mobilization speed of Facebook users was faster than that of those that used Email, and we were able to measure the degree to which Facebook users were faster. This finding could provide useful insights for future social mobilization efforts.

One Sentence Summary: We find in the experiment of Langley Knights Competition the mobilization speed of Facebook users was faster than that of those that used Email, although more people used Email to recruit other participants.

Main Text:

INTRODUCTION

Online media has the ability to mobilize a large number of people to achieve a goal in limited time (1). The process that enlists people to complete tasks has been called

social mobilization. Social mobilization with the Internet has been used to map crisis event in real time (2) and operate search-and-rescue actions (3). It is also an important way to participate in political decision-making (4, 5). In many of these social mobilization tasks, speed is a top concern (6). Because of its increasing importance, research has been done to understand the process both theoretically and practically (6). Recently, some researchers have analyzed some of the factors that influence mobilization speed (*7*). However, few have investigated the effect of different communication channels on social mobilization speed. In this paper, we explore the difference of social mobilization speed between those who used Facebook and those who used Email. The research questions to be addressed are:

- Although many have assumed that the use of Facebook would lead to faster mobilization, can we confirm that?
- Furthermore, even if Facebook was faster: How much faster?

The findings are useful for improving performance of social mobilization tasks.

Social mobilization speed is influenced by various factors. Timing is one of them. For different social media, the daily number of new posts for weekdays and weekends shows different patterns (*8*). Participants also modulate their activities following a daily cycle (daytime/night) (*9*). Meanwhile, the closer to the contest start date, the faster the mobilization speed (*7*). Gender factor has an impact on information diffusion as well and men are more likely than women to receive a given message (*10*). Meanwhile, the speed of information spread varies with the age of participants (*11*). Furthermore, information source has significant homophily influence on social mobilization (*7*). Thus, these factors might explain the difference in mobilization speed between users of Facebook and Email. In this paper, we examined the difference in social mobilization speed between users of Facebook and Email, after controlling other influencing factors (gender, age, timing, and the homophily of information source). Even after all these controls, we found that the mobilization speed of attained by users of Facebook remains significantly faster than that of Email.

RESULTS

Mobilization Speed Difference between Facebook and Email

Following Alstott et al. (*7*), the mobilization speed was defined as the interval days from the registration time of one participant to that of their recruit. The mobilization speeds of four categories of recruitees are shown in Figure 1: Those that were recruited using (i) Email, (ii) Facebook, (iii) some other media (e.g., telephone, word-of-mouth),

and (iv) those that did not report the method by which they were recruited.

As can be seen, not only are people contacted through Facebook recruited fasted, they are recruited substantially faster, with a median mobilization speed of 1.17 days for Facebook compared with 7.71 days for Email, making mobilization through using Facebook more than six times faster.

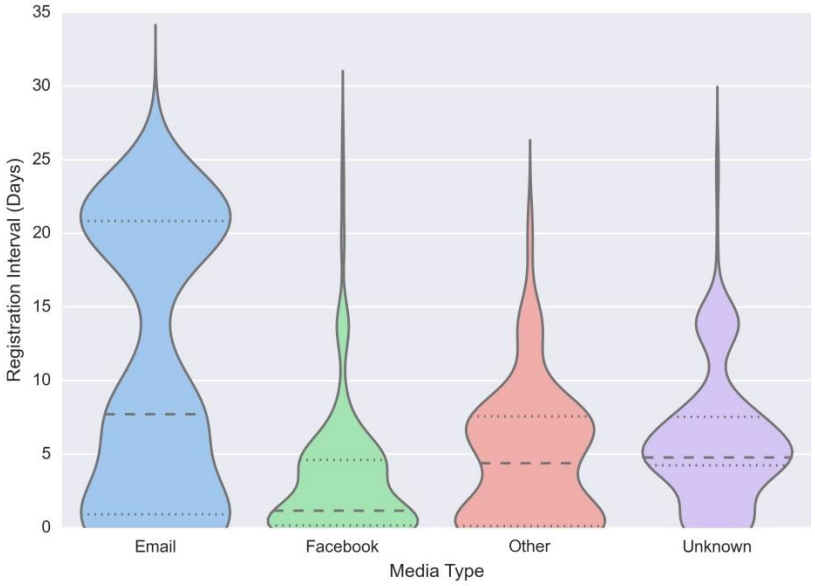

Fig. 1. The mobilization speed distribution of Email is different from that of Facebook.

In the results of normality tests, both of the Sig. values of the Shapiro-Wilk Test are below 0.05, which indicates that the data significantly deviate from a normal distribution. Since the mobilization speed values does not show a normal distribution, we used a non-parametrical test, Mann-Whitney U test, to check the difference between Email and Facebook in mobilization speed. Because the distributions of the two media have a different shape (see Figure 1), we have to compare the mean ranks of mobilization speed rather than medians. All the observations are ranked from the lowest to the highest for each group (Facebook and Email), and then the sum of those ranks is calculated for each group. The mean rank is the mean of the total rank (*12*). The results show that mobilization speed in the Facebook group was statistically significantly faster than that in the Email group ($U = 9933.5$, $p = 0.000$, $181.06 > 142.58$). However, as noted above, there are other traits influencing the mobilization speed, such as gender, age, etc. Hence, the goal of our study was to figure out the mobilization speed difference between those two media themselves, while controlling for other confounding factors.

Data

For our social mobilization analyses, we used the Langley Knights Competition data set of the original study (*7*). The competition involved locating 5 knights in shining armor — three real knights and two virtual ones. The three "real" knights wore armor and stood in their appointed venue in unspecified public parks in England from 9am to 9pm each day. The two "virtual" ones were to be found on Google Maps or Google Earth. This worldwide competition started on July 2, 2011, but the recruiting of members for teams started about a month beforehand. Participants who registered could invite their friends to join the contest as new team members through any way that they wished, though facilities were provided to make email forwarding and Facebook messaging easy – over 80% of the participants who reported how they were recruited used these methods. In particular, participants who registered using Facebook Connect could, at the end of the registration process, invite their Facebook friends to join the contest under their team. Registered participants were also provided with a URL and an email acknowledgement that they could share with others, such as via email forwarding, to register through, which would automatically put those new participants on their recruiter's team.

A total of 1,089 participants registered, with 148 starting their own team. Of the teams, 97 did not mobilize any other team members, leaving 51 teams that recruited new participants. Participants could act as both recruits (if they joined a team) and recruiters (if they mobilized others). In these teams, 152 participants acted as recruiters, mobilizing at least one other participant. These recruiters mobilized 941 recruits. The mean team size was 7.36, and the mean size of teams larger than 1 was 19.45.

For each participant, the date and time of his/her registration was recorded by the system. Demographic information (age, gender, etc.) and what media method was used to contact them were collected during the registration process. Because participants were not required to answer any question, there was some missing information in the data set. We only used those participants have provided the complete information in our analyzed below.

Of those reporting the method by which they were recruited, 46.4% of participants were recruited through Email and 35.6% were recruited through Facebook. Those two media accounted for around 82% of all the participants reporting their method of recruitment[1]. Some characteristics and differences between the users of these medias

[1] Other social media communications methods reported included: Instant messaging, phone call, text message, other social media (eg. Twitter), and word of mouth. Indirect methods reported included Langley Knights Competition web site, newspaper, television, and radio.

include:

- Among Email users, the percentage of recruits who are female (32.5%) is much smaller than that among Facebook group (62.5%).
- The percentage of recruits who were contacted through the same source as their recruiters in Email group (30.7%) is smaller than that in Facebook group (47.5%).
- The distribution of age of Email users is similar to that of Facbeook users.
- The age difference between recruits and their recruiters in Email group is not different from that in Facebook group.

The finding that users of Facebook were mobilized faster than users of Email remained even after controlling of these factors, as analyzed in the next section.

Modeling Mobilization Speed

We analyzed the influence of social media on mobilization speed with a cox regression (see Methods), which is the standard method for social contagion evaluation in sociology (*13*). We also included several control variables in the regression to isolate the effect of these variables that may influence mobilization speed. These control variables included timing (*8, 9*), gender (*10*), and age (*11*). Timing factors include workweek/weekend (*8*), daytime/night (*9*), and time left (*7*). Gender factor consists of male and female. Age factor is divided into four different age groups: youth (20 years old and under), young adults (21-40 years old), middle-aged adults (41-60 years old), and seniors (over 60 years old). Considering that information source has significant homophily influence (*7*), we involved another control variable: if the child heard through same medium as the parent (e.g., both were contacted via Email). Below we first discuss the effects of online media, and then add control variables step by step. These independent variable codes are described in Table 1.

Independent variables	Dummy variables	Definition and codes
Online media		1(Facebook), 0(Email)
Media homophily		1(yes: the recruit heard through same medium as his/her recruiter), 0(no: the recruit heard through different medium from his/her recruiter)
Workweek		1(workweek), 0(weekend)
Daytime		1(daytime), 0(night)
TimeLeft		The number of days until the competition ended.
Gender		1(female), 0(male)
Age	Age_Young	1(young adults: 21-40), 0(otherwise)
	Age_Middle	1(middle-aged adults: 41-60), 0(otherwise)
	Age_Senior	1(seniors: >60), 0(otherwise)

Table 1. Independent Variable Codes.

A hazard ratio (HR) is the ratio of the probability of an outcome event in the exposed group compared with that in the nonexposed group in a period of time (*14*). In our cases, the hazard ratio of nonexposed group (Email group) equals one. The exposed group (Facebook group) is faster at registering for the contest than the nonexposed group, if its hazard ratio is larger than one. The result shows that the social mobilization speed of Facebook is faster than that of Email. Conversely, a hazard ratio that is smaller than one reflects slower mobilization speed. Table 2 shows the effect results of social media on mobilization speed[2]. The choices of social media have a significant impact on mobilization speed (Sig. < 0.05). Moreover, the social mobilization speed of Facebook is faster than that of Email (HR > 1).

							95.0% CI for HR	
	Beta	S.E.	Wald	df	Sig.	HR	Lower	Upper
Online media	0.645	0.120	28.951	1	0.000	1.907	1.507	2.412

Table 2. Online media factor has significant influence on mobilization speed. The coefficient of online media (0.645) is larger than zero. The likelihood of registering for the competition is larger when online media is Facebook than that when the media is Email.

[2] The results include the coefficient of the estimated regression equation (B), their standard errors (SE), Wald statistics (Wald), the degree of freedom (df), Significance (Sig.), Hazard ratio (HR), and confidence intervals for the 95% significance level (95.0% CI for HR)

Isolating the effect of control variables

Some studies indicated that same information source (*7*), timing (workweek/weekend (*8*), daytime/night (*9*), and time left (*7*)), age (*11*), and gender (*10*) may influence mobilization speed. To isolate the effect of these control variables, we include them step by step. The results are reported in Table 3. It indicates that the mobilization speed of Facebook is faster than that of Email, even after controlling of those six variables in the model (all the HR values of 'online media' are larger than one). We also analyzed separate equations for each subgroup by substituting the values of category control variables and including the remaining controls. Table 4 shows the coefficients of variable 'online media' in each separate equation. As a result, no matter what values the control variables are, users of Facebook still mobilized faster than users of Email when online media does influence the mobilization speed (HR's > 1).

The mobilization speed was faster when there was media homophily, that is that the recruits heard through same medium as their recruiters (HR = 3.065 > 1).

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
	HR (Coef., S.E.)	HR (Coef., S.E.)	HR (Coef., S.E.)	HR (Coef., S.E.)	HR (Coef., S.E.)	HR (Coef., S.E.)
Online media	1.750***	1.687***	1.704***	1.743***	1.829***	1.844***
	(0.560, 0.122)	(0.523, 0.124)	(0.533, 0.125)	(0.556,0.126)	(0.604,0.130)	(0.612, 0.134)
Media homophily	2.348***	2.813***	2.801***	2.979***	3.080***	3.065***
	(0.854, 0.122)	(1.034, 0.129)	(1.030, 0.129)	(1.092, 0.130)	(1.125, 0.131)	(1.120, 0.132)
Workweek		1.962***	1.957***	2.111***	1.983***	1.984***
		(0.674, 0.164)	(0.671, 0.164)	(0.747, 0.167)	(0.685, 0.170)	(0.685, 0.170)
Daytime			1.060	1.037	1.005	1.001
			(0.059, 0.114)	(0.036, 0.114)	(0.005, 0.118)	(0.001, 0.119)
Time left				1.038***	1.040***	1.040***
				(0.037, 0.009)	(0.039, 0.009)	(0.039, 0.009)
Age_Young					1.664*	1.659*
					(0.509, 0.302)	(0.506, 0.302)
Age_Middle					2.172**	2.170**
					(0.776, 0.309)	(0.775, 0.309)
Age_Senior					1.939*	1.931*
					(0.662, 0.378)	(0.658, 0.379)
Gender						0.972
						(-0.029, 0.121)
Number of observations	323	323	323	323	323	323

Table 3. Online media has significant influence on mobilization speed in control of media homophily, workweek, daytime, time left, age, and gender factors. Dependent variable is mobilization speed. In each step, HR of online media is larger than one. It indicates that the possibility of recruiting a new participant through Facebook is higher than that through Email. In other words, Facebook has faster mobilization speed compared to Email. *p < 0.10, **p < 0.05, ***p < 0.01.

Control variables	Values	# of Obs.	Online media HR (Coef., S.E.)
Media homophily =	Yes	126	0.886 (-0.121, 0.241)
	No	197	2.300*** (0.833, 0.162)
Workweek=	Workweek	271	2.038*** (0.712, 0.148)
	Weekend	52	2.600** (0.955, 0.405)
Daytime=	Daytime	153	2.073*** (0.729, 0.197)
	Night	170	1.748*** (0.559, 0.189)
Age=	Youth	13	1.186 (0.171, 0.716)
	Young adults	162	1.887*** (0.635, 0.189)
	Middle-aged adults	129	2.154*** (0.767, 0.228)
	Seniors	19	3.583* (1.276, 0.789)
Gender=	Female	153	2.022*** (0.704, 0.222)
	Male	170	1.621*** (0.482, 0.186)

Table 4. The fact that the mobilization speed of Facebook is faster than that of Email exists when control variables take on any value. Dependent variable is mobilization speed. Facebook does significantly recruit people faster than Email when recruiter and recruitee were recruited by different media, while the difference in the mobilization speed is not significant when there is media homophily. For any value of other category control variable, the HR value of online media is larger than one. It shows that Facebook recruiting people faster than Email. *p < 0.10, **p < 0.05, ***p < 0.01.

DISCUSSION

As social media penetrates into every aspect of social life, social mobilization appears to be more and more influential. The performance of mobilization has attracted much attention because of its broad social influence. The mobilization speed is critical to

the final results. For instance, time is of the essence in a rescue movement. In order to better understand the influencing factors of mobilization speed, we examined its differences between users of Email and Facebook. Controlling the factors that may also influence the mobilization speed, we found that Facebook mobilized people significantly faster than Email**.**

There are many plausible explanations for that outcome. Compared to Email which is an example of a private source of social network information (*15*), Facebook appears to be more public. Facebook not only pushes the new status automatically to writer's friends when the status is just posted, but also allows people share opinions through giving feedback. According to Webber, people are mainly affected by others' feedback when they learn new things (*16*). In other words, the possibility of engaging the competition may increase if the feedback is positive. Furthermore, people usually login their Facebook account very frequently and a noticeable proportion of the Facebook users keep their account signed in and use the Facebook as an instant messenger (*17*). In contrast, in the study of Tan et al., only 70% users check their email daily (*18*). It seems that Facebook is checked more frequently than Email, which raises the possibility of people obtaining the information of competition sooner. Hence, the characteristics of Facebook (public, feedback attribute, and high check frequency) may contribute to the findings that social mobilization through Facebook is faster than that through Email.

It has been reported that the relationships on Facebook are built followed by the offline-to-online trend (*19*). In other words, most Facebook users know each other in real-life first and then become friends on Facebook. For email, most relationships between users are constructed in the opposite direction. The majority of them build the connection through Internet and some of them may contact offline depending on the close degree of their relationship. Moreover, people commonly use Facebook for non-professional and informal purposes and email for professional and formal reasons (*20*). Thus, Facebook seems build a more trustful and personal network compared to email and leads to faster social mobilization.

In conclusion, quantitative studies of social mobilization speed are rare and, to the best of our knowledge, the key studies in this area made no effort to measure the effects of different communication media used. Although many people may have assumed that usage of Facebook would lead to faster mobilization, this study provides concrete confirmatory evidence as well as a measure of the magnitude of the difference. By measuring such factors that predict social mobilization speed, this work advances our understanding of this important phenomenon.

ACKNOWLEDGEMENTS

The authors would like to thank Anton Phillips for operational support as the general manager at Langley Castle, Sunny Cheung for designing and implementing the web site software, and Wei Pan for insights and suggestions based on his experience with the DARPA Red Balloons Challenge experiment.

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SUPPLEMENTARY MATERIALS

Methods

Cox proportional hazard model (1972) is the popular method for analyzing information diffusion in marketing and sociology (*13*). It is also the most widely used method of survival analysis which typically explores the relationship of the survival distribution to covariates (*21*). For example, in our cases, "death" refers to the registration for the contest and covariates are the influencing factors of mobilization speed. The hazard function ($h(t)$) is a key concept of cox model. It is the probability that an object will be dead within a time interval given that the object has been alive up to the beginning of the interval (*22*). It could seem as the risk of dying at time *t*. In other words, the hazard function is the possibility of registering at time *t*. It can be evaluated using formula (1).

$$\mathbf{h(t)} = \frac{\mathbf{f(t)}}{\mathbf{S(t)}} \tag{1}$$

Here, $f(t)$ is the number of objects who dead in interval beginning at *t*, and $S(t)$ is the product of the number of objects who are alive at time *t* and the interval width. Cox proportional hazard regression model could be described as the following formula (2) (*21*).

$$\mathbf{h(t)} = \mathbf{exp}(\boldsymbol{\alpha} + \boldsymbol{\beta_1 x_{i1}} + \boldsymbol{\beta_2 x_{i2}} + \cdots + \boldsymbol{\beta_k x_{ik}}) \tag{2}$$

In formula (2), *i* is a subscript for object, and the *x*'s are the covariates. The constant α is the log-baseline hazard ($\alpha = \log(h_0(t))$). β represents the hazard ratios (HR), which is the ratio of the hazard rates corresponding to the conditions described by two levels of an independent variable. It could be presented simply as follows. $h_A(t)$ is the risk of registering in the group where independent variable equals A and $h_B(t)$ is the risk of registering in group B.

$$\mathbf{HR} = \frac{\boldsymbol{h_A(t)}}{\boldsymbol{h_B(t)}} \tag{3}$$

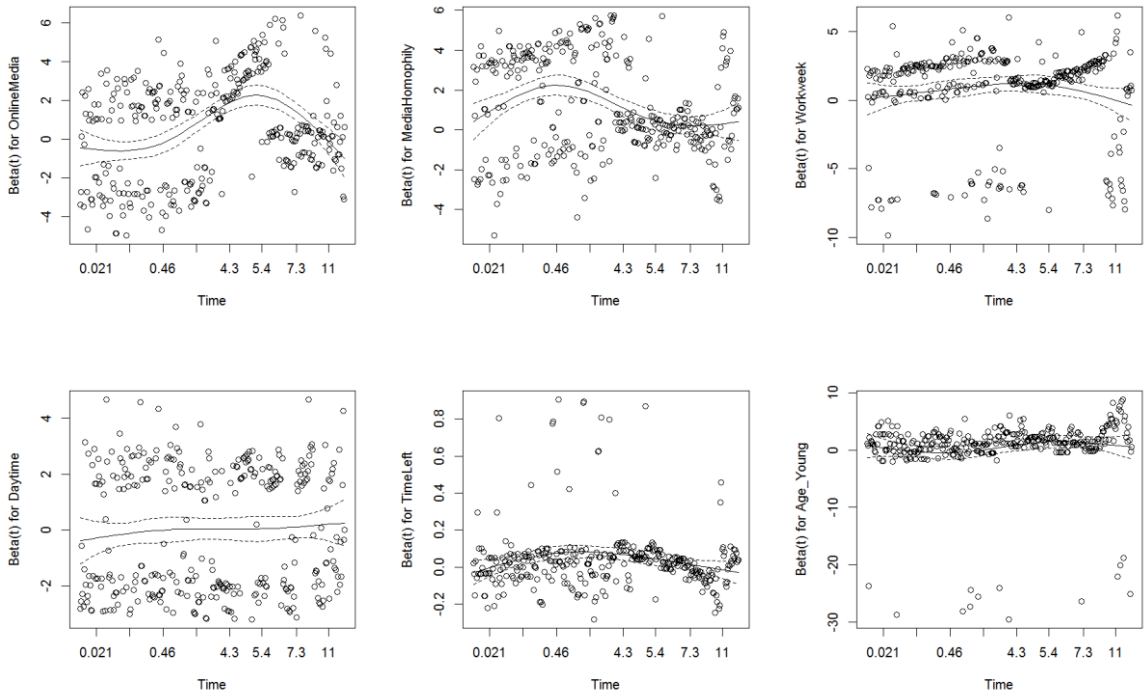
Goodness of fit

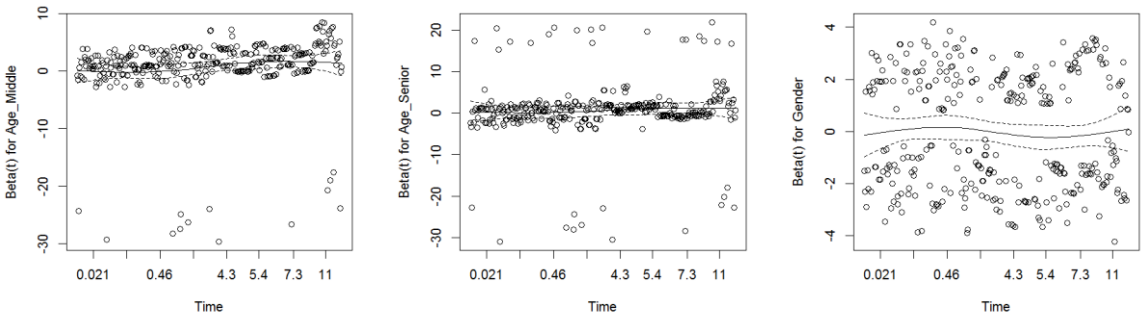
When we involve all the control variables in the model (step 6), the model fits the data well with an R-Square of 0.304. We performed several goodness-of-fit tests for the Cox proportional hazards model. The model has nine degrees of freedom. The results of all the tests show that the model fits the data better than a null model. We also calculated the concordance probability, which is used to assessing the discriminatory power and the predictive accuracy of cox proportional hazards models (*23*), the model has a good probability with 0.697.

Metric	Value
Likelihood ratio test	116.8 (p<0.0001)
Wald test	115.1 (p<0.0001)
Score (logrank) test	122 (p<0.0001)

Proportional hazards assumption testing

The Cox proportional hazards model holds an assumption that the covariates in the hazard function does not vary with time. The Scaled Schoenfeld residuals for all explanatory variables are plotted to test this assumption. The proportional hazards assumption has been supported by the lack of linear trends for any of these residuals.

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