

# Do You Know the Speaker? An Online Experiment with Authority Messages on Event Websites

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## ABSTRACT

With the widespread adoption of the Web, many companies and organizations have established websites that provide information and support online transactions (e.g., buying products or viewing content). Unfortunately, users have limited attention to spare for interacting with online sites. Hence, it is of utmost importance to design sites that attract user attention and effectively guide users to the product or content items they like. Thus, we propose a novel and scalable experimentation approach to evaluate the effectiveness of online site designs. Our case study focuses on the effects of an authority message on visitors' browsing behavior on workshop and seminar online announcement sites. An authority message emphasizes a particular prominent speaker and his/her achievements. Through dividing users into control and treatment groups and carefully tracking their online activities, we observe that the authority message influences the way users interact with page elements on the website and increases their interests in the authority speakers.

**Categories and Subject Descriptors:** H.3.4 [Information Storage and Retrieval]: Systems and Software - Performance evaluation

**Keywords:** Online Controlled Experiments, A/B Tests, Behavioral Analysis, User Interface, Authority Messages

## 1. INTRODUCTION

In recent years, many companies and organizations have established an online presence in the form of websites and social media sites. Apart from serving as information sources, these websites help to facilitate online transactions such as item purchases or event registrations. These online transactions are often a key revenue source or business function for these companies and organizations. Hence, there is an impetus for them to design websites that attract user attention and effectively guide users to complete these online transactions. However, these companies and organizations face various challenges such as: (i) users with limited attention on the web; (ii) websites cluttered with a large amount of information; and (iii) limited capability to conduct customized online experiments to evaluate different website designs.

While there are recent work on how various visual cues can encourage user activity and promote purchases, these cues were evaluated based on user studies in the form of detailed questionnaires [11, 8]. Despite the detailed insights ob-

tained from a controlled laboratory setting, such user studies are expensive to conduct and cannot be easily automated. Moreover, the user study participants are explicitly recruited and hence may not be reflective of the actual users. Ideally, these experiments should be conducted on the actual users who use the website in a real-life setting. Many researchers and large online companies have also increasingly adopted such experiments in recent years [4, 9].

In this paper, we address the above-mentioned challenges by proposing a novel and scalable experimentation approach to evaluate the effectiveness of online site designs. Our case study focuses on event websites, specifically workshop and seminar registration sites. In particular, we employ the use of an authority message that features a particular prominent speaker and his/her achievements. Through dividing users into control and treatment groups and carefully tracking their online activities (mouse events), we show how this authority message results in users being more interested in the authority speakers. In addition, we also describe an online experimentation system specially developed to manage and automate the main steps in this type of online controlled experiments. Using this system, we are able to experiment directly on the actual users and track their online activities on the actual websites, and thus obtain insights that are most applicable to real-life scenarios.

Our main contributions in this paper are as follows:

- Proposing and designing a set of experiments to measure the effect of authority messages on user browsing behavior (Section 2).
- Highlighting our key findings from the experiments, we show that the authority message positively changes the user browsing behavior on the event page (Sections 3 and 4).
- Developing an online experimentation system to manage and automate the main steps of online controlled experiments (Section 2).

For the rest of the paper, Section 5 describes some related work while Section 6 summarizes and concludes the paper.

## 2. EXPERIMENTAL DESIGN

In general, we are interested in these research questions:

- RQ1 (User Behavior): Is there any difference in web browsing behavior when a user is exposed to the authority message? Specifically, we are interested in the user's interaction with different content elements of the workshop/seminar page.
- RQ2 (Conversion Rate): Does emphasizing on an authority figure prompt more users to sign up for the workshop/seminar?

Our general experiment design is by first defining control and treatment groups. The control group is shown the

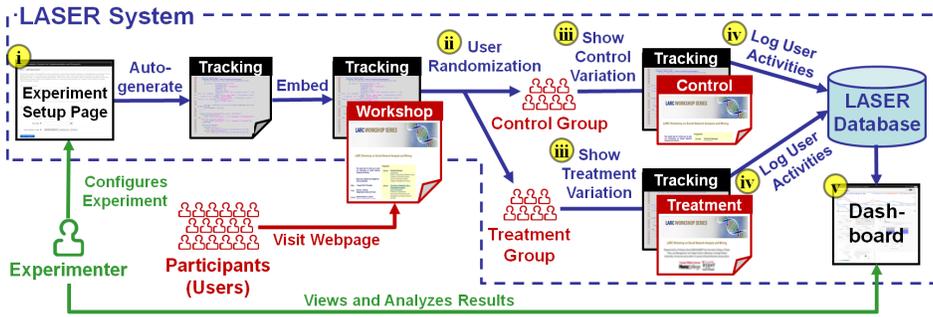


Figure 1: LASER System in Support of Experiment Design

default workshop/seminar page while the treatment group will be shown the same workshop/seminar page with an additional authority message featuring the authority speaker in the workshop/seminar (see Fig. 2).<sup>1</sup> We will then keep track of the user activities on the page until he/she registers for the workshop/seminar or leaves the page.

To support this experiment, we designed and developed the **Living AnalyticS ExpeRimentations (LASER)** system [10] to provide various functionalities to enable online controlled experiments. Fig. 1 illustrates an overview of the LASER system and its main functionalities, namely to: (i) simplify the process of experiment setup via a GUI form; (ii) automate the process of user assignment into control or treatment groups; (iii) show different web interface variations to different groups (i.e. administer treatments); (iv) monitor the activities of users in the different groups; and (v) visualize and display real-time results in an interactive dashboard.

We next elaborate on the main steps of this experiment, namely: the assignment of user grouping; administration of treatment; and tracking of user interaction.

## 2.1 Assignment of User Grouping

Visitors to the event website start as anonymous users as they are not required to log-in. Such anonymous visitors can be “uniquely” identified by a user cookie assigned to the user’s browser. This user cookie allows us to uniquely identify and track this user should he/she make multiple visits to the website. We utilize cookies to track such anonymous visitors and when they re-visit the same website. If they visit the website multiple times, these visits are tracked as different sessions if the visits are more than 30 min apart.

We assign all visitors to the website into either the control or treatment group based on randomization. This randomization is achieved through the use of a seeded random number generator where users are assigned into either the control or treatment group with equal probability. In the event of a returning visitor, the random function ensures that the same unique user is always assigned to the same group. Both groups are not assigned a maximum size but the experiment (and hence the user group assignment) terminates two weeks after the event date.

## 2.2 Administration of Treatment

As we are interested in measuring the authority effect, we designed an authority message that is shown to the treatment group. This authority message is placed directly below

<sup>1</sup>In this paper, we study the overall effects of emphasizing a speaker on user browsing behavior. As part of future work, we intend to further investigate the extent of which a speaker’s prominence affects the level of user interest.



Figure 2: Event page with the authority message (red box)

the workshop title and comprises a textual description of the authority speaker and a logo of the authority speaker’s affiliation. Fig. 2 shows an example of the authority (treatment) message and its placement on the workshop page.

As users are dynamically assigned to the control and treatment groups (Section 2.1), we dynamically insert the authority message onto the page shown to users in the treatment group. In our experiment, the two main steps of assigning the user group and showing of treatment message is performed by a client-side JavaScript code, which is auto-generated by LASER. As these steps are performed on the client-side asynchronously, the users in the treatment group would not experience any noticeable delays.

## 2.3 Tracking of User Interaction

For all visitors, we track their interaction with the various elements on the event page, using the auto-generated LASER tracking code (i.e. the client-side JavaScript code mentioned in Section 2.2). These elements include the registration buttons, workshop date/time/venue, speaker biography, abstract of talks, URL links and authority message (only for treatment group). The main types of interactions we track are the mouse-click count (cc), mouse-over count (mc) and mouse-over duration (md). We represent the user interactions on the various page elements in the form of {interaction}. {element}. For example, clicks on the biography of Tommy would be represented by “cc.bio.tommy”.

We approximate the user’s attention on the different page elements based on his/her mouse interaction with these elements. While a user’s attention is most accurately measured with an eye tracking device in a laboratory study, it is impractical to implement such devices for a larger scale online experimentation. Moreover, research have shown that a user’s eye gaze can be approximated with that of his/her mouse cursor position [3, 6].

## 3. EFFECT OF AUTHORITY MESSAGE ON USER BEHAVIOR

Our experiment was conducted on two workshops and two seminars running from Jul to Sep 2013, which attracted a total of 577 unique visitors. We further identified visitors as “active” users if they interacted with any page elements or “inactive” users if they did not. In addition, there are also “converted” users who are visitors that clicked on either the internal or external registration button for internal staff and external visitors respectively. A breakdown of the total number of unique, active and converted visitors is listed in Table 1. In this section, we focus on the effect of the authority message on user web browsing behavior, while its effect on conversion rate will be covered in the next section.

**Table 1: User Summary Statistics for Workshops and Seminars**

Total Count	Workshop A		Workshop B		Seminar A		Seminar B		Total
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	
All users	99	113	56	38	107	91	38	35	577
Active users	67 (67.7%)	79 (69.9%)	36 (64.3%)	18 (47.4%)	72 (67.3%)	51 (56.0%)	24 (63.2%)	23 (65.7%)	370 (64.1%)
Converted users	35 (35.4%)	35 (31.0%)	7 (12.5%)	8 (21.1%)	14 (13.1%)	23 (25.3%)	13 (34.2%)	8 (22.9%)	143 (24.8%)

For each distinct element on the event page, there is a set of actions that could be performed on it (e.g. click count, mouse-over count, mouse-over duration, etc). We now represent each combination of a specific action on an element as a variable. This representation resulted in each user in the control group having observations on 87, 80, 32 and 33 different variables, for Workshop A, Workshop B, Seminar A and Seminar B respectively. For the treatment group, each user has observations on three additional variables due to the three actions (click count, mouse-over count and mouse-over duration) on the authority message.

### 3.1 Analysis of Results using Original Data

Using this set of variables, we now investigate if the addition of the authority message changes the user’s behavior in terms of his/her interactions with other webpage elements.

#### 3.1.1 Multiple Tests on Variables

In this section, we want to find out if there is any difference in the observed interactions with a specific element between users in the control and treatment groups. For example, we measure if there is a difference in the observed number of clicks on the internal registration button for users in the control group compared to users in the treatment group.

For each experiment, we first compare each set of variables using Wilcoxon’s rank sum test (two-sided). Let  $k = 1, \dots, p$  where  $p$  is the number of variables (i.e. the actions on elements as described in Section 3) for a particular experiment ( $p = 87, 80, 32$  and  $33$  for Workshop A, Workshop B, Seminar A and Seminar B respectively). For each experiment, we conduct the Wilcoxon’s rank sum test (two-sided) and observe that all  $p$ -values  $> 0.05$ , with the exceptions ( $p$ -values  $< 0.05$ ) as listed in Table 2.

**Table 2: Wilcoxon’s rank sum test**

Experiment	Variable	$p$ -value	mean-value	
			Control	Treatment
Workshop A	mc.btnRegExt	0.0097	0.33	0.10
Workshop A	md.btnRegExt	0.0085	2.54	1.67
Workshop B	mc.workshopTitle	0.0087	0.11	0.39
Workshop B	md.workshopTitle	0.0079	0.21	1.26
Seminar A	cc.btnRegInt	0.0208	0.17	0.43
Seminar A	mc.btnRegInt	0.0028	0.04	0.25
Seminar A	md.btnRegInt	0.0035	1.18	3.24

The results show that there is a significant difference on the observations of some variables of Workshop A, Workshop B and Seminar A. Thus, there is evidence to suggest that the authority message changes the user’s behavior when interacting with certain set of elements.

For Seminar A, users exposed to the authority message are more likely to register for the workshop (via clicking on the internal registration button). Table 2 supports this observation where the mean click count on the internal registration button (cc.btnRegInt) of the treatment group is about 2.5 times higher than that of the control group.

We do not observe any significant difference in the variables for Seminar B (thus none is listed in Table 2). This result could also be the effect of a small sample size of 73 (control=38, treatment=35), which may not be sufficient to generate any significant difference. The results in this section suggest that users interact differently with the same element if they have been exposed to the authority message.

#### 3.1.2 Correlation Analysis on Workshop A

Next, we want to determine for the treatment group if there is a correlation in the users’ interaction on the authority message with that on other elements on the same page. We calculate the Spearman’s rank correlation coefficients for the variables related to the authority message (click count, mouse-over count and mouse-over duration on the authority message) versus other variables (actions on other elements). As we are interested in elements that have a correlation with the authority message, we use permutation test [5] to determine whether the correlation coefficients are zero.<sup>2</sup>

**Table 3: Workshop A: Correlation of Click Count, Mouse-over Count, Mouse-over Duration on Authority Message with other Elements**

Correlation with Element	cc.authMsg Coeff ( $p$ -val)	mc.authMsg Coeff ( $p$ -val)	md.authMsg Coeff ( $p$ -val)
cc.workshopTitle	0.33 (0.005)	- (-)	0.24 (0.033)
mc.workshopTitle	- (-)	0.44 (0.001)	0.41 (0.001)
md.workshopTitle	- (-)	0.44 (0.000)	0.41 (0.000)
cc.header.date	0.34 (0.026)	0.22 (0.024)	- (-)
mc.header.date	0.34 (0.021)	0.22 (0.026)	0.22 (0.041)
md.header.date	0.34 (0.023)	0.22 (0.026)	0.21 (0.046)
cc.bio.PersonWA1	0.42 (0.005)	0.33 (0.003)	0.31 (0.007)
mc.bio.PersonWA1	0.22 (0.033)	0.28 (0.007)	0.27 (0.010)
md.bio.PersonWA1	0.22 (0.040)	0.29 (0.005)	0.28 (0.010)
mc.abstract.PersonWA1	- (-)	0.27 (0.010)	0.24 (0.025)
md.abstract.PersonWA1	- (-)	0.25 (0.017)	0.22 (0.033)
cc.title.PersonWA2	0.46 (0.005)	0.25 (0.035)	- (-)
mc.title.PersonWA2	0.36 (0.019)	- (-)	- (-)
md.title.PersonWA2	0.36 (0.018)	- (-)	- (-)

Workshop A comprises five presentations/speakers and the authority message is on the keynote speaker, Person WA1. Table 3 shows that the three actions (click count, mouse-over count and duration) on bio.PersonWA1 ({cc,mc,md}.bio.PersonWA1) and the same three actions on the authority message ({cc,mc,md}.authMsg) are all positively correlated. This correlation indicates that the authority message has a positive impact on attracting users’ attention to the biography of Person WA1.

Interestingly, we found that the click count on the authority message (cc.authMsg) is also positively correlated to all three actions on the talk title of Person WA2 ({cc,mc,md}.

<sup>2</sup>All analysis in the following sections are performed using an alpha/significance level of 0.05. The exception is Section 3.1.4 which uses an alpha/significance level of 0.10 as all coefficients are not significantly non-zero at an alpha/significance level of 0.05.

title.PersonWA2). Person WA1 and Person WA2 are both social scientists, thus suggesting that the authority message not only draws the user’s attention to the authority figure but also those related to him and from the same field. On the other hand, the remaining three speakers are computer scientists presenting on data mining applications to social networks, and we observe no such correlation.

Another interesting finding is that click counts and mouse-over counts on the authority message are also positively correlated to the three actions on the “date” element (`{cc,mc,md}.header.date`). A possible explanation is that after catching the users’ attention with the authority message, the date of the workshop becomes one of the main factors for users to decide whether to register for the workshop.

### 3.1.3 Correlation Analysis on Workshop B

Workshop B comprises six presentations/speakers and the authority message is on the keynote speaker, Person WB. Like Workshop A, we observe that the authority message increases the interest in Person WB, the keynote speaker. This positive impact is illustrated by the positive correlation coefficients of `cc.authMsg` on both `mc.bio.PersonWB` and `md.bio.PersonWB` (both with coefficients of 0.43). This result indicates that the click count of the authority message is positively correlated to the mouse-over count and duration on the biography of Person WB.

While Workshop B does not show a correlation between actions on the authority message and actions on the “date” element, we can still observe that the users’ behavior on the authority message does have some impact on a subset of the remaining variables, as supported by their non-zero coefficient values.

### 3.1.4 Correlation Analysis on Seminar A

Seminar A was presented by a single speaker, Person SA. Similar to the results for Workshops A and B, we observe that the authority message is positively correlated to other elements related to the speaker (in this case, her biography and the abstract and title of her talk). As Table 4 shows, the actions on the authority message are positively correlated to similar actions on both the title and abstract of her talk. This result further supports that the authority message has a positive effect on drawing the user’s attention to details of the talk (i.e. title, abstract, speaker biography).

In addition, we observe that actions on the authority message is positively correlated with actions on other elements such as the speaker’s name, photo and internal registration button, as indicated by correlation coefficients of 0.29 to 0.51. This result shows that the authority message positively influences the user’s behavior with other elements on the page. An interesting trend is that the click count on the authority message (`cc.authMsg`) is also positively related to the click count, mouse-over count and mouse-over duration of the speaker’s photo image (`{cc,mc,md}.imgSpeaker`), as shown in Table 4.

### 3.1.5 Correlation Analysis on Seminar B

We now perform correlation analysis on Seminar B, presented by a single speaker, Person SB. Similar to Workshop A, the mouse-over duration on the authority message (`md.authMsg`) is positively correlated to the mouse-over duration on the date/time/venue element of the seminar (`md.paraVenueTime`), with a correlation coefficient of 0.38. Likewise, this trend could indicate that the users’ attention was

**Table 4: Seminar A: Correlation of Click Count, Mouse-over Count, Mouse-over Duration on Authority Message with other Elements**

Correlation with Element	cc.authMsg Coeff ( <i>p</i> -val)	mc.authMsg Coeff ( <i>p</i> -val)	md.authMsg Coeff ( <i>p</i> -val)
cc.paraTitle	0.27 (0.045)	- (-)	- (-)
mc.paraTitle	0.42 (0.020)	0.28 (0.023)	- (-)
md.paraTitle	0.42 (0.017)	0.28 (0.017)	0.37 (0.048)
cc.paraAbstract	0.31 (0.023)	- (-)	- (-)
mc.paraAbstract	0.32 (0.017)	0.34 (0.009)	0.33 (0.014)
md.paraAbstract	- (-)	0.25 (0.040)	0.25 (0.038)
cc.paraBio	0.49 (0.000)	- (-)	- (-)
mc.paraBio	0.29 (0.021)	- (-)	- (-)
md.paraBio	0.26 (0.042)	- (-)	- (-)
cc.imgSpeaker	0.51 (0.000)	- (-)	- (-)
mc.imgSpeaker	0.50 (0.004)	0.27 (0.035)	- (-)
md.imgSpeaker	0.50 (0.003)	0.27 (0.030)	- (-)

on the authority message as they spent time on it. Thereafter, they want to find out the date/time/venue of the seminar, before deciding whether to register for the seminar.

Similarly, the mouse-over count on the authority message (`mc.authMsg`) is positively correlated to the click count on the title of the talk (`cc.paraTitle`), as indicated by a correlation coefficient of 0.37. The authority message that describes the speaker might have caught the attention and interest of the user, hence the user is now also interested to find out the title of the seminar before his/her final decision.

Another common result for both Seminars A and B is that the click count on the authority message is positively correlated to the click count, mouse-over count and mouse-over duration of the speaker’s photo image. Is this a case where people want to know whether they know the speaker? Or are they are simply checking whether the speaker looks good? Unfortunately, these questions cannot be answered without conducting a detailed user survey, which is beyond the scope of this paper.

## 3.2 Analysis of Results using Binary Data

In this section, we want to study the collected data based on whether a user is active, instead of how active this user is. As such, we analyze the binarized variables by considering only the mouse click count and mouse-over count variables for the control and treatment groups, and transforming them to a binary 0-1 valued data set (i.e. all non-zero values are represented as 1). For the treatment group, we also do not consider the variables related to the authority message. This results in a total of 63, 57, 22, 23 variables for Workshop A, Workshop B, Seminar A and Seminar B respectively.

### 3.2.1 Multiple Tests on Variables

Similar to Section 3.1.1, we now compare every binarized variables between the control and treatment groups for each experiment. We conduct Fisher’s exact test (two-sided) and obtain results that are consistent with that in Section 3.1.1. As the results are similar, we shall not elaborate here.

### 3.2.2 Testing Simultaneous Marginal Homogeneity

We next investigate if there is any difference in the way users interact with the page (all elements as a whole) when they are in the control or treatment groups. In short, we are interested in comparing the overall behavioral differences between the control and treatment groups, in terms of all ac-

tivities (mouse clicks and mouse-overs) on all elements on the respective pages. This analysis complements our previous analysis presented in Sections 3.1.1 and 3.2.1 where we determine if there is any difference in the observed user interaction with the same specific element between users in the control and treatment groups.

Let  $k = 1, \dots, p$  where  $p$  is the number of variables (i.e. actions on elements as described in Section 3) for a particular experiment ( $p = 63, 57, 22$  and  $23$  for Workshops A and B, Seminars A and B respectively).  $P(k, C)$  is the probability of the  $k$ -th variable taking a value of 0 in the control group, and  $P(k, T)$  is defined similarly for the treatment group. For each experiment, we test the null hypothesis:

- *Null Hypothesis ( $H_0$ ):*  $P(k, C) = P(k, T)$ , for  $k = 1, \dots, p$

In short, we are comparing the overall user actions on page elements between the control and treatment groups (of each experiment) to determine any differences in their overall browsing behavior. We use the Wald’s Statistic (using a shrinkage estimator for the covariance matrix) [1] and obtained the results presented in Table 5.

**Table 5: Wald’s Statistic**

Experiment	chi-square	$p$ -value
Workshop A	1.79	<0.001 (left sided)
Workshop B	26.61	<0.001 (left sided)
Seminar A	131.60	0.000 (right sided)
Seminar B	1.71	<0.001 (left sided)

This result shows that there is not enough evidence for accepting the null hypothesis. In other words, there is a significant difference on the overall behavior of users between the control and treatment groups of each experiment. Thus, this result also supports the observation that the authority message changes the way users interact with other elements on the workshop/seminar page.

### 3.2.3 Correlation Coefficients Matrices

After determining that there is a significant difference in the overall user behavior between the control and treatment groups, we now proceed to compare the extent by which these user behavior differs from each other. We compare the correlation coefficients matrices (after thresholding as described in [2, 7]) for the two groups in each experiment (Workshops A and B, Seminars A and B).

For Workshop A, we observe that the click count variables are more correlated to each other in the treatment group. We also observe similar results for the mouse-over variables (i.e. treatment group has more correlated variables than the control group). This result gives some preliminary evidence that the authority message has a bigger positive impact on user browsing behavior. Another observation is that the date and time variables are more correlated to other variables in the treatment group. This observation could be due to the case where a user became interested in the workshop after reading some speaker’s biography or abstract, she then continues to check the date and time of the workshop before deciding to register or not. Also, most of these variables are either positively correlated or uncorrelated to each other. Similarly for Workshop B, we observe that the correlation structures of the control and treatment groups are distinctly

different from each other, indicating that the authority message changes the users’ behavior.

For Seminar A, we also observe that more variables are correlated to each other in the treatment group and with a higher correlation coefficient. As for the case of Workshops A and B and Seminar A, the results for Seminar B show a difference in the correlation structures of the control and treatment groups, indicating that the authority message changes the user’s web browsing behavior in all cases (i.e. for all workshops and seminars).

Based on the results obtained thus far in Section 3, we can answer RQ1 (User Behavior) and conclude that the authority message affects user browsing behavior. More specifically, the impact is a positive one where users that are exposed to the authority message are more likely to interact with other elements on the page, with an emphasis on those related to the authority speaker.

## 4. EFFECT OF AUTHORITY MESSAGE ON USER CONVERSION

As our secondary objective is to determine if the authority message results in more users registering for the event (i.e. RQ2 in Section 2), we now compare the user registration (conversion) rate between the control and treatment groups, for all users and only active users. Any user can register by either clicking on the internal or external registration button and an active user is one who has performed some activity on the page. Thus, our null hypothesis are as follows:

- *Null Hypothesis A ( $H_{A0}$ ):* There is no difference in the probability of a user being “active” in the control group and all users in treatment group.
- *Null Hypothesis B ( $H_{B0}$ ):* There is no difference in the probability of a user clicking on the registration buttons between all users in the control group and all users in treatment group.
- *Null Hypothesis C ( $H_{C0}$ ):* There is no difference in the probability of a user clicking on the registration buttons between active users in the control group and active users in treatment group.

We use Fisher’s exact test to determine whether there is any significant difference for null hypothesis A ( $H_{A0}$ ), B ( $H_{B0}$ ) and C ( $H_{C0}$ ). The  $p$ -values for null hypothesis A ( $H_{A0}$ ), B ( $H_{B0}$ ) and C ( $H_{C0}$ ) are listed in Table 6. The  $p$ -values of null hypothesis A ( $H_{A0}$ ) show that there are no significant difference for Workshops A and B, Seminars A and B. Thus, there is some evidence to suggest that our experiment is randomized such that the proportion of active users in both groups are not significantly different.

**Table 6:  $p$ -values for Conversion Rate**

Experiment	$H_{A0}$	$H_{B0}$	$H_{C0}$
Workshop A	0.767	0.559	0.406
Workshop B	0.137	0.389	0.104
Seminar A	0.109	0.043	0.003
Seminar B	1.000	0.312	0.244

For Workshops A and B and Seminar B, there is insufficient evidence to suggest that the authority effect causes more users in the treatment group to sign-up for the workshop. However, there is a significant difference in null hypothesis B ( $H_{B0}$ ) and C ( $H_{C0}$ ) for Seminar A, indicating

that the authority message helps to improve the registration (conversion) rate for this seminar. The conversion rate further supports this where 45.1% of active users in the treatment group registered compared to only 19.4% in the control group. One key reason is that Seminar A comprises only one speaker hence the effect of the authority message is stronger, compared to the workshops where this effect is “diluted” among multiple speakers (hence more variables). While Seminar B also comprises a single speaker, its sample size of 73 is too small to observe any significant difference.

## 5. RELATED WORK

As our study is on the effect of authority messages on user browsing behavior on event pages, most relevant to our work would be various studies relating to the influence of visual cues and user interface evaluation, which we discuss next.

Through detailed user studies, Sundar et. al. experimented on how authority seals and user reviews affects the likelihood of a user purchasing a product [11]. Similarly, Kim and Sundar studied how displaying the number of posts/views/replies/stars of a forum discussion encourages more participation. While [11] and [8] are closely related to our study and offer interesting insights, these earlier work are based on user studies where the experiment participants are explicitly recruited and evaluated based on questionnaires. On the other hand, our study utilizes online controlled experiments where the experiment participants are actual users of the website, being evaluated based on their activities in a real-life setting.

In [4] and [9], researchers ran online controlled experiments to evaluate the performance of different user interface designs in terms of their overall evaluation criterion. While these papers discuss interesting lessons learnt and their proposed remedies, they differ from our study mainly in the design of the control and treatment variants. For example, [9] compared six different design variations while [4] compared two design variations that have multiple different components. On the other hand, our experiment compared between two design variations with the only difference being the additional authority message for the treatment group. By comparing only a single different component, we can more succinctly and accurately evaluate its effect.

## 6. CONCLUSION AND FUTURE WORK

In this paper, we designed and conducted a set of experiments to examine the authority effect on user browsing behavior. Using a series of workshop and seminar webpages, we exposed selected visitors to an additional authority message emphasizing a particular prominent speaker and his/her achievements. We then measure their response to this authority message by carefully tracking their online activities (mouse events). Our main aim is to investigate if this authority message influences user browsing behavior, i.e. how users interact with other elements of the webpage.

Our main finding shows that including an authority message positively changes the user’s behavior on the webpage. More specifically, this authority message encourages users to interact more with other elements on the webpage, with an emphasis on those related to the authority message (i.e. an authority message on a speaker is more likely to prompt visitors to view his/her biography and talk abstract). Thus, the addition of an authority message has the positive effect of drawing the user’s attention to that particular authority.

Despite the positive influence of the authority message on user browsing behavior, it only increased the user registration rate in one (seminar) out of the four workshops/seminars. One possible explanation is that seminars (with only one speaker) have a more focused authority effect than workshops (with multiple speakers). For the seminar without an increased registration rate, this could be due to a small sample size which did not result in any significant difference in registration. As part of future work, we intend to overcome these issues by: (i) using authority messages that collectively emphasize all workshop speakers; and (ii) performing more experiments on seminars with a larger sample size.

While our experiments are conducted on event websites (a series of workshops and seminars), the results are also broadly applicable to e-commerce and related websites. For the example of an e-commerce website, instead of an authority message on a prominent speaker, it would be on a particular featured product. Thereafter, we proceed to analyze the users’ behavior on the website, particularly their interaction with other products and the conversion rate (in terms of product purchases, instead of event registration).

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