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Digital Social Visibility, Anonymity and User Content Generation: Evidence from Natural Experiments

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Abstract

This study examines how changes in digital social visibility (or conversely, anonymity) can affect the characteristics of user-generated content (volume and linguistic features). We consider natural experiments at two leading online review websites (*Yelp.com* and *TripAdvisor.com*), wherein each was integrated with *Facebook*. Constructing a unique panel dataset of online reviews for a matched set of restaurants across the two review sites, we estimate a multi-treatment difference-in-differences (DID) model to assess the impact of increased digital social visibility (decreased anonymity). We find that integration with Facebook (and thus greater digital social visibility) increased the volume of user-generated content and consumers' use of affective language processes, while simultaneously decreasing their use of cognitive language processes and controversial language (e.g., sexually explicit, negative and abrasive words). We discuss the implication of these results as they relate to the creation of a civil, sustainable online social platforms for user generated content.

Keywords: Natural experiment, text analytics, online reviews, linguistic characteristics, digital social visibility, social network integration, anonymity, difference-in-differences

"Humans are different in private than in the presence of others. While the private persona merges into the social persona in varying degrees, the union is never complete. Something is always held back."
– Brian Herbert, House Corrino, 2001

1. Introduction

There has been a growing trend toward promoting social connections on the internet over the past decade, resulting in greater 'digital social visibility' (Rhue and Sundararajan, 2013). For instance, many online platforms have sought to supplement their home-grown communities by integrating with prominent social networking sites like *Facebook*, *Twitter*, and *Google+*, a practice known as social network integration (Blanchard, 2011). Examples of social network integration include social login (Kontaxis et al., 2012) and instant personalization (Richmond, 2010). Social login allows a new user to register an account with an online platform using an existing account at a social networking service – e.g., *Facebook* (Goel et al., 2011, Frutiger et al., 2014). Once a user grants the new platform access to their existing social networking account, this enables integrated social sharing of one's activities on the platform back to the social networking site (e.g., share Yelp reviews on Facebook pages). *Facebook*'s instant personalization option enables even greater levels of integration, because it allows the partner platform to access and make use of the user's *Facebook* profile information, such as their name, geographic location and social connections, on Facebook (Rapp et al., 2013). Thus, social network integration facilitates convenient user account creation and login, provides for a more personalized user experience, and it promotes greater digital social visibility of users' behavior.

However, with increased visibility comes a loss of anonymity (Kaplan and Haenlein, 2010). Many users value their online anonymity (Awad and Krishnan, 2006), which has been

found to increase users' willingness to participate on a platform, expressing their uncensored opinions, thoughts and preferences (Suler, 2004; Leshed, 2008).

The objective of this study is to examine how increases in digital social visibility deriving from social network integration can affect the processes and characteristics of user content generation, particularly in the context of online reviews (volume and linguistic features). We propose that increases in digital social visibility lead to a greater perception of social presence (e.g., cognizance of one's audience). As a result, on the one hand, greater digital social visibility may cause users to generate more content, with the purpose of gaining social influence (Dellarocas, 2003; Lampel and Bhalla, 2007). On the other hand, it may drive users to tailor or even cease their content generation (Das and Kramer, 2013; Sleeper et al., 2013), out of fear of social disapproval. Further, digital social visibility may change users' attitude formation, which in turn can affect the content they produce. Bearing the above in mind, we seek to investigate the following research question:

How does digital social visibility (enabled by social network integration) affect user content generation (online reviews), in terms of volume, the exhibition of affective or cognitive mental processes, and use of controversial language?

Based on social presence theory, we propose several hypotheses relating digital social visibility to the quantity and linguistic characteristics of online reviews. To test our hypotheses, we analyze a unique data set comprised of online reviews for a set of matched restaurants across two leading online review websites, considering the textual features of the reviews, coded using Linguistic Inquiry and Word Count (LIWC), a tool we describe in greater detail below. Our econometric identification strategy hinges on two natural experiments: social network integration on *Yelp.com*, and then again on *TripAdvisor.com*. These natural experiments allow us to infer the

causal effect of integration via a multi-treatment difference-in-differences model (Fricke, 2015; Frohlich, 2004). We find that, while digital social visibility increases the volume of online reviews that are authored (likely due to a combination of increased convenience from social login and increased potential for reputational benefits amongst social connections), it also leads to significant changes in language use. In particular, increases in digital social visibility lead to more affective (emotional) and less cognitive language in online reviews. The negative effect of visibility on cognitive language use could be detrimental to online review platforms because cognitive language has been shown to increase the perceived helpfulness of reviews (Yin et al., 2014). Meanwhile, increases in visibility (decreases in anonymity) also lead to a reduction in the use of controversial language. This decline in controversial language might be beneficial to online review platforms, helping to create and sustain a civil online environment. In sum, our findings demonstrate that social network integration and the associated increases in digital social visibility are a double-edged sword, providing benefits in terms of review quantity, apparently at the cost of review quality.

Our study contributes to research streams on user content generation and IT system design. To the best of our knowledge, our study provides a first consideration of digital social visibility (enabled by social network integration) on the production of online reviews. Further, the findings of this study shed light on the countervailing influences of digital social visibility in the context of user content generation. On the one hand, greater visibility appears to boost the quantity of reviews and to mitigate the use of controversial language, thereby helping to overcome the well-known problems of under-provision and internet trolling (Avery et al., 1999; Hardaker, 2010). On the other hand, digital social visibility reduces users' reliance on cognitive mental processes, which may reduce the perceived quality and helpfulness of a review (Yin et al.,

2014). Given the recent trend toward promoting social connections and increasing digital social visibility amongst online platforms, it is crucial that we improve our understanding of the collateral consequences. The findings of our study thus carry important implications for the design of IT platforms that host and heavily rely upon user generated content.

The rest of the paper is organized as follows. We first present our review of the literature in which we discuss related prior work. In the methodology section, we explain the data, variable measurement, and identification strategy. The analysis and findings are then presented. Finally, we conclude with a discussion of the theoretical and managerial implications, as well as possible avenues for future research.

2. Prior Literature

2.1. Social Presence and Anonymity

First, we consider the effects of greater digital social visibility on the characteristics of online reviews, via the lens of social presence. Social presence refers to individuals' awareness of the existence of social connections in a communication interaction (Kehrwald 2008; Cobb 2009). The degree of social presence depends on the level of interpersonal interactions that a communication medium supports, with face-to-face communication having the most social presence and text-based communication bearing the least social presence (Lowenthal 2010; Cui et al. 2012). Social presence has been found to be a significant predictor of user behavior in computer-mediated interactions (Gunawardena and Zittle 1997; Richardson and Swan 2003). For example, increased social presence leads individuals to become less extreme in thinking during computer-mediated group discussions (Sia et al. 2002). Low social presence makes it difficult for individuals to interpret the depth of information while promotes the breadth of information

sharing on an electronic medium (Miranda and Saunders 2003). Greater social presence in a communication medium also leads to more socially fulfilling experiences (Jiang et al. 2013).

Prior research on digital social visibility and social presence focuses on outcomes such as trust (Animesh et al. 2010), purchase intentions (Ou et al. 2014), and choice decisions (Rhue and Sundararajan 2013). Nonetheless, this study examines users' authorship of online reviews (in terms of volume and linguistic characteristics) as novel outcomes driven by increases in digital social visibility and social presence on online platforms. Recent development in social media have created the potential to increase social presence on the internet (Kaplan and Haenlein 2010). In particular, online platforms have begun to implement social network integration (integration with social media services) to improve social interaction (Wright-Porto 2011; Kontaxis et al. 2012). Social network integration leads to increases in digital social visibility and social presence on the adopting platform (Rhue and Sundararajan 2013). In response, users are likely to change their behavior (Acquisti and Gross 2006; Daughety and Reinganum 2010; Jones and Linardi 2014).

The corollary of increased visibility is the loss of anonymity. Anonymity is an important issue in online reviews because it may lead users to feel more comfortable and secure, enabling more frequent contribution, while at the same time raising concerns around user regulation (Scotts and Orlikowski 2014). Anonymity is defined as a state in which identifying information for an acting party is unknown (Pfitzmann and Köhntopp 2001). There are two-sides to the argument about anonymity's role, in the literature. On one hand, anonymity is an important element in preserving information privacy (Ayyagari et al. 2011; Pavlou 2011; Acquisti et al. 2013). On the other hand, anonymity contributes to the incivility online, ranging from racism and

hatred (Reader 2012; Santana 2014) to Internet Trolls (Hardaker 2010; Phillips 2011) and cyber bullies (Campbell 2005).

Prior studies on anonymity indicate that its presence or absence leads individuals adjust their information sharing behavior. For instance, with the loss of anonymity, users are more likely to publicize socially desirable information (Huberman et al. 2005). When prompted to consider their anonymity, users may become self-conscious and subsequently more conservative in their information sharing (John et al. 2009; Burtch et al. 2015). Dissociative anonymity leads users to intensify their information sharing behavior, a phenomenon known as the online disinhibition effect (Suler 2004). Building on prior research, this study examines the effects of anonymity on users' engagement with online platforms and, in particular, their information sharing behavior.

2.2. Online Reviews and Social Interactions

The extensive literature of online reviews can be classified into two broad categories. One body of work has focused on the consequences of online reviews (Chevalier and Mayzlin, 2006; Dellarocas et al. 2007; Duan et al., 2008; Zhu and Zhang, 2010; Kwark et al., 2014), whereas a second has focused on the antecedents of, and processes underlying review generation (Godes and Silva 2012; Luca and Zervas, 2013; Huang et al. 2014). Our study aims to contribute to the latter category, considering the influence of social aspects on review generation.

Past work suggests that social factors significantly influence users' authorship of online reviews (Aral 2013; Wang et al., 2015). First, Wang (2010) observed that, given the opportunity to establish social image, consumers tend to write more reviews and give less extreme ratings. This suggests that users are respond to an audience. Other work, by Chen et al. (2010), tells a similar story. Those authors conducted an experiment and found that providing information about

the average rate of review authorship in the community could significantly increase a subject's own rate of authorship, if they realized they were contributing that average. At the same time, however, those authors found an opposite effect for individuals initially contributing above the average; high contributors became less engaged once they realized they were doing more than their fair share. Still other work suggests that individuals seek to maintain their social approval, once obtained. In particular, users after individuals attract subscribers (or followers), they begin to author reviews more objectively, and with greater negativity and variance in valence – features that are known to be perceived as helpful (Goes and Lin 2014).

The present study advances our understanding of the effects of digital social visibility and anonymity (enabled by social network integration) on users' authorship of online reviews. Prior work has examined the impact of social factors on contribution quantity (Huberman et al. 2009; Chen et al. 2010), rating negativity and extremity (Wang 2010; Goes and Lin 2014). Here, we consider review volume, but we go further, investigating the linguistic characteristics of review content subject to variation in digital social visibility and anonymity. Specifically, we provide a first consideration of the impact of digital social visibility (or anonymity) on review authors' psychological processes (emotional and cognitive) and their use of controversial language (sexually explicit, negative and abrasive words).

3. Hypothesis Development

In this section, we hypothesize several salient effects of digital social visibility and anonymity on online review production: volume, exhibited mental processes and inhibition in the use of controversial language. First, we focus on review volumes, noting that sustainable platforms require a healthy volume of content. Second, we consider language indicative of a reviewer's mental processes, i.e., whether they use more emotional or cognitive language. This is

important, because prior research has found that emotional reviews tend to be perceived as less helpful (Yin et al., 2014). Third, we consider individuals' willingness to employ controversial language under varying levels of visibility (anonymity). In particular, we consider the use of sexually explicit, negative and abrasive words. This last element is important, because a reduction in the use of these words generally implies a more civil online environment.

3.1. Volume Effect

Social network integration, increasing users' digital social visibility, may affect whether a user chooses to a review in multiple ways. In particular, we consider three mechanisms. First, some implementations of social network integration (e.g., social login) make platform registration and login easier, effectively improving ease of use (Davis, 1989). Second, social network integration, in the form of Facebook instant personalization, exposes a users' reviews to his or her friends and increases the perceived relevance of reviews to the audience. As such, because users are likely to be aware that their friends may benefit from their contributions to the review platform, they may believe that there is a potential for reputational gains (Zhu and Zhang, 2011). Third, and last, users may fear social disapproval, given a relative loss of anonymity (Kang et al., 2013). This mechanism suggests a countervailing mechanism, that the loss of anonymity may decrease the probability that users will share their experiences on the review platform, especially when they have had very negative experiences. This last mechanism is supported by Leshed (2008), who observed that a loss of anonymity was associated with a decline in the number of comments users made in online forums. Further, research has noted that individuals often create and maintain an alternate identity in online spaces (Froomkin, 1999). When an individual's online anonymity is compromised, they may lose the ability to maintain their alternate persona (Scott and Orlikowski, 2014).

Summarizing the above, we propose competing hypotheses around the relationship between social network integration and the volume of review authorship.

H1a: Social network integration leads to more reviews, due to ease of use and potential reputational gains.

H1b: Social network integration leads to fewer reviews, due to a loss of anonymity.

3.2. Mental Process Effects

The ability of a platform to support social connections and interactions heightens perceived social presence; users' awareness of other users – e.g., an audience for their reviews. We argue that the increased social presence, in turn, can affect how users author reviews, in terms of their reliance on affective versus cognitive mental processes. The affective (emotional) component of attitude incorporates feelings associated with the entity being evaluated, whereas the cognitive component incorporates attributes and beliefs about the entity (Millar and Tesser 1986). Ample neurophysiological evidence has shown that affective processes and cognitive processes are supported by different components of the brain, and thus are distinct and relatively independent (Finucane et al. 2003). It is natural that users will rely on either or both affective and/or cognitive mental processes when crafting their reviews. When users rely on an affective mental processes, they are likely to express their emotions in the text of the review. In contrast, when users rely on cognitive processes, they are likely to employ logic and objective thought (e.g., words like *because, therefore, think*). Because affective and cognitive processes are supported by different functional areas of the brain, when people draw on affective mental processes, they are less likely to draw on cognitive mental processes, and vice versa.

The emotional broadcaster theory of social sharing argues that individuals have an intrinsic drive to share experiences in a psychologically arousing manner (Harber and Cohen, 2005). In a social environment, individuals' emotions are activated and, therefore, they are more likely to share their feelings and emotions, whether intentionally or unintentionally. This behavior is known as emotional leakage (Kraut, 1982). Wagner and Smith (1991) and Ross et al. (1992) both found that closer social relationships (e.g., friends versus strangers) facilitate emotional expressiveness. It has also been found that, with respect to the expression of emotion, similar patterns emerge in computer mediated communication and face-to-face communication (Derks et al. 2008). In the context of online reviews, users express their opinions by authoring the reviews. An increase in social presence at the online review website can be expected to trigger an increase in emotional leakage. Users are thus more likely to draw on affective mental processes, rather than cognitive processes, when authoring their reviews. We therefore propose the following formal hypotheses:

H2a: Social network integration leads to more affective process (overall emotion, positive emotion, negative emotion) in language.

H2b: Social network integration leads to less cognitive process (logic, thinking, causation) in language.

3.3. Inhibition Effect

Social network integration reduces user anonymity, which has both benefits and pitfalls. A variety of studies in the Group Decision Support Systems (GDSS) literature have famously reported that anonymity can provide the conditions necessary for the production of innovative, creative ideas (Connolly et al., 1990), and that users may exhibit a decline in social desirability concerns, as well as higher levels of self-esteem (Joinson, 1999).

However, online anonymity has been shown to produce an “online disinhibition effect" (Suler, 2004), in which individuals exhibit a greater willingness to reveal their true, uncensored opinions, thoughts and preferences. Accordingly, individuals may become more critical, probing and argumentative when anonymous (Jessup et al., 1990). With the elimination of scrutiny, individuals may also engage in a variety of behaviors that would otherwise meet with social disapproval, ranging from free-riding (Andreoni and Bernheim, 2009) to racism (Reader, 2012; Santana, 2014), Internet trolling (Hardaker, 2010; Phillips, 2011) and cyber bullying (Campbell, 2005). A relative loss of anonymity increases the potential for a user to experience social disapproval.

In the context of online reviews, review authors may become concerned about the evaluation of their tone and prose by others, particularly in the absence of anonymity. Individuals form expectations about what constitutes appropriate language usage, based on established social norms (Burgoon et al., 2002). Violating those norms – e.g., through the use of inappropriate language – may result in a negative reaction from one’s peers (Dillard and Pfau, 2002). As an anonymous interviewee reported to Kang et al. (2013): *“I posted a very bad review [of a restaurant]. And I guess I did that [anonymously]. I live in a small town, so I certainly didn’t want to put my real name....”* As this quote suggests, we would expect a decline in the use of offensive or explicit language amongst users following a reduction in their anonymity, with social network integration. This leads us to our second hypothesis:

H3: Social network integration leads to less controversial language, including (a) sexually explicit, (b) negative and (c) abrasive words.

4. Research Methodology

4.1. Background

Our study considers two websites for online reviews: *Yelp.com* and *TripAdvisor.com*, both of which implemented a social network integration with Facebook, at different points in time. First, *Yelp.com* enabled the Facebook Connect feature on July 2, 2009 (O'Neill 2009; Holliday 2009). Facebook Connect allows users to log into a website using their Facebook account (also known as social login) and to easily share reviews with friends on Facebook. Facebook Connect is an "opt-in" feature, in that it is up to the users to decide whether he or she would like to adopt the feature. Given that the Facebook Connect feature did not enforce the sharing of reviews on Facebook, users might not make a conscious decision to adjust their behavior (though this might happen subconsciously). Users might choose to share their review with friends on Facebook, and then adjust the review content conditional on this decision. Moreover, positive reputational effects and ease of use can be expected to manifest, because individuals may opt into the feature to gain these benefits. Figure 1a shows the review page with the Facebook Connect feature enabled for a *Yelp.com* user.

Subsequently, *TripAdvisor.com* adopted Facebook's Instant Personalization feature on December 21, 2010 (Kincaid 2010). If a user visits *TripAdvisor*'s website while logged into Facebook (or having logged in at any time in the prior 30 days, with cookies enabled), the site will act like the user's personalized travel planner. Specifically, Instant Personalization presents users with personalized website content on *TripAdvisor.com* that shows their Facebook friends' visiting and reviewing activities, such as recently authored restaurant and hotel reviews, and a list of Facebook friends' most popular destinations. Instant Personalization is an "opt-out" feature, in that the feature is enabled by default and requires that users take action to disable it. Although

users can choose to opt out Instant Personalization through *Facebook's* privacy controls, this is reportedly challenging to do (Opsahl 2010). With Instant Personalization, users will be aware that their Facebook friends can read their reviews on *TripAdvisor*, and thus they are likely to modify their review content. Figure 1b illustrates the webpage with the Instant Personalization feature for a *TripAdvisor.com* user.

Both Facebook Connect and Instant Personalization can be considered different forms of social network integration. However, the "opt-out" feature (Instant Personalization) is likely to have a greater impact on user behavior than the "opt-in" feature (Facebook Connect). In each case, the integration presents as a system change that was exogenously imposed from the perspective of website users. Therefore, we consider the implementation of each social network integration as a separate natural experiment, with each site acting as the control group, at the time of the other site's integration.

Figure 1a. Review Page with Facebook Connect Feature On *Yelp.com*

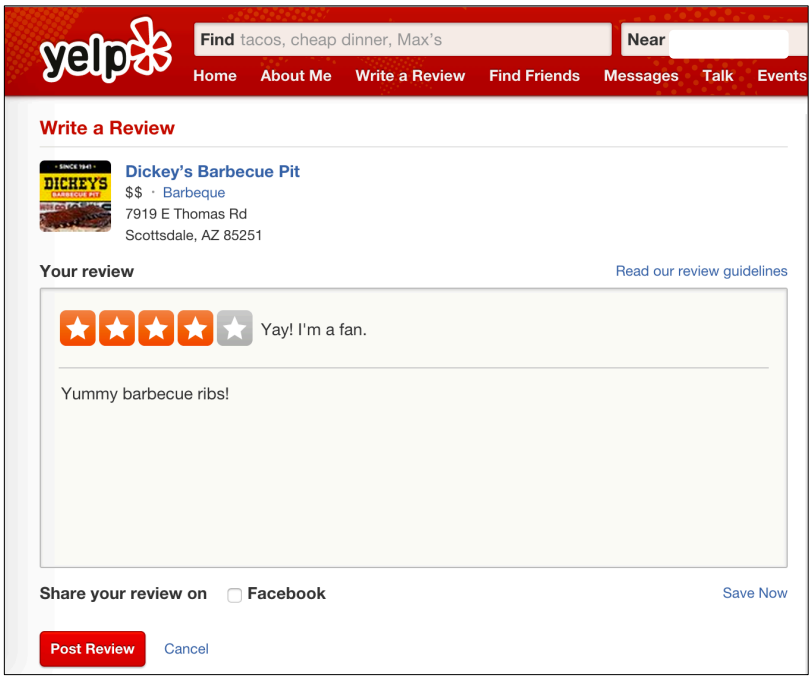
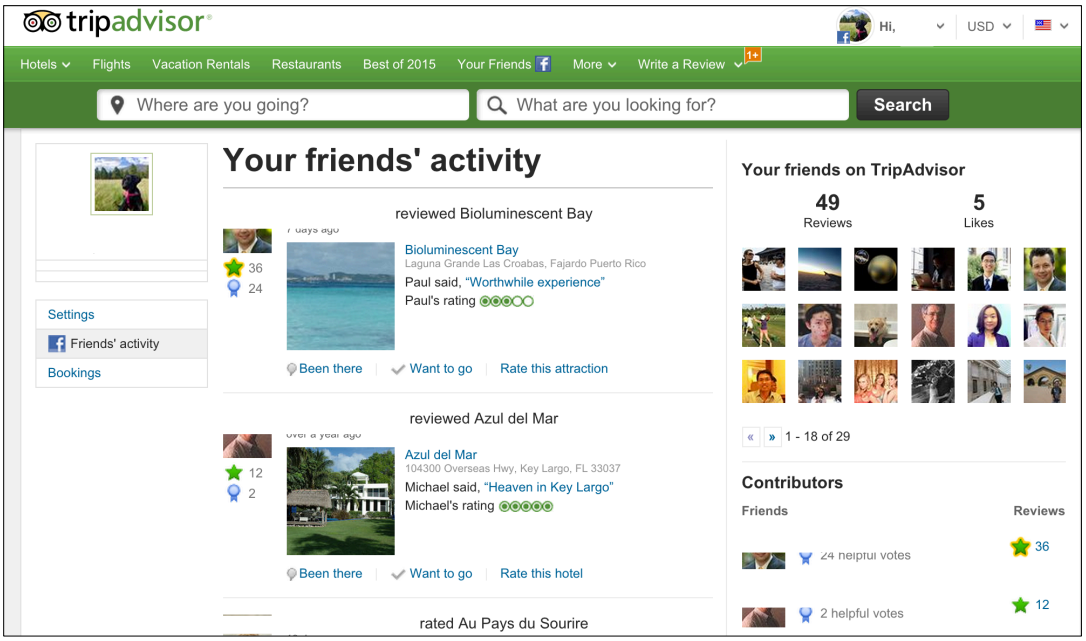


Figure 1b. Webpage with Instant Personalization Feature on *TripAdvisor.com*



4.2. Data and Measures

We collected data on restaurant reviews authored between 2005 and 2014 from *Yelp.com* and *TripAdvisor.com* for a matched set of restaurants, selected at random, which are located in five major cities across the United States (New York City, Los Angeles, Chicago, Philadelphia and Phoenix). The data contains time stamps and review content (ratings and text), in addition to reviewer profile and restaurant information. We created an indicator variable to mark reviews collected from *TripAdvisor.com* vs. those collected from *Yelp.com*, and we then pooled the data.

To construct measures of linguistic content, we leveraged the latest version of Linguistic Inquiry and Word Count (LIWC), a text analysis tool. LIWC calculates the prevalence of different categories of words (percentages of dictionary matching words) in a text document using a set of pre-defined keyword dictionaries (Pennebaker et al., 2001). LIWC has frequently been used in the psychology literature, and has also recently seen increased use in the Marketing and Information Systems literature (Burtch and Hong, 2014; Goes et al., 2014; Lurie et al., 2014; Sridhar and Srinivasan 2012; Yin et al., 2014). We focused on LIWC's measures of emotional, cognitive and controversial language (e.g., sexually explicit). These measures are normalized based on the number of words appearing in a document. Table 1 provides some examples of words in the LIWC dictionaries for the linguistic categories we consider in this study.

We averaged review characteristics for each restaurant, by month, to avoid issues of sparsity – i.e., to ensure each restaurant observation included a reasonable amount of text. Following Snefjella and Kuperman (2015), we trimmed our data, retaining observations where every review comprising the monthly observation contained at least one word that matched the word lists in the LIWC dictionaries. We then log transformed our dependent variables to address skewness in the distributions. Additionally, log transforming the dependent variables allows for

percentage interpretations of the estimates. Table 2 presents the descriptive statistics of the variables in our final sample.

Table 1: Sample Words in LIWC's Dictionaries

Linguistic Category	*Examples*	*Words in Category*
Mental Process:		
Affective processes	Happy, cried, abandon	915
Positive emotion	Love, nice, sweet	406
Negative Emotion	Hurt, ugly, nasty	499
Cognitive processes	Cause, know, ought	730
Insight	Think, know, consider	195
Causation	Because, effect, hence	108
Inappropriate Language:		
Negation	No, not, never	57
Swear words	Damn, piss, fuck	53
Sexual	Horny, love, incest	96

Notes: Table 1 is adopted from the "LIWC2007 output variable information" table, retrieved from *http://liwc.net/descriptiontable1.php*. More information on LIWC and the entire list of words that are used for matching to obtain the linguistic measures can be obtained from *http*://*www.liwc.net*.

Table 2: Descriptive Statistics

Variables	*Mean*	*STD*
Rating	3.783	0.905
Words	117.892	60.838
Mental Process:		
Affective processes	8.201	4.238
Positive emotion	7.277	4.275
Negative Emotion	1.218	1.259
Cognitive processes	15.333	3.470
Insight	1.408	0.988
Causation	1.048	0.831
Inappropriate Language:		
Negation	1.423	1.247
Swear words	0.300	0.574
Sexual	0.678	1.334

4.3. Econometric Identification

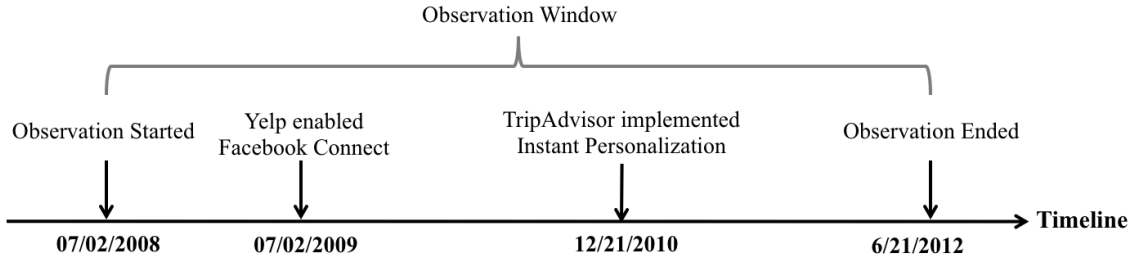
As noted above, our identification hinges on two natural experiments related to social network integrations that occurred on *Yelp.com* and *TripAdvisor.com*, which we treat as exogenous shocks. We use a multi-treatments difference-in-differences (DID) estimation to identify the effects of social network integration on the linguistic characteristics of online reviews. The DID estimator attempts to identify causal relationships by mimicking an experimental design in observational data (Angrist and Pischke 2008). DID is a common estimation approach, frequently used to establish causal relationships in data where experimental manipulation is generally difficult to implement (Card and Krueger 1994; Di Tella and Schargrodsky 2004).

Yelp.com introduced Facebook Connect on July 2, 2009, and *TripAdvisor.com* implemented Instant Personalization on December 21, 2010. A timeline of these social network integrations is presented in Figure 2. Due to the fact that Facebook Connect is an "opt-in" type feature while Instant Personalization is an "opt-out" type feature, the two social network integrations are ordered in time and potentially vary in the magnitude of their effects. The observation period spans July 2008 through July 2012. We retain a 12-month pre-treatment period, in advance of *Yelp*'s integration event. Notably, the results we present in the following sections are not sensitive to this choice; expanding the window to 18 months or 24 months produces very similar results.

We employ a two-treatment DID strategy to achieve a conservative estimate of the average treatment effect on the treated (Fricke 2015). *Yelp.com*'s integration with Facebook constitutes the first treatment, with activity on *TripAdvisor.com* at the same point in time acting as the condition. *TripAdvisor.com*'s integration constitutes the second treatment, with activity on

Yelp.com at the same point in time acting as the control group. Our work is not the first to employ a DID estimation in analyzing online reviews, however, prior research has typically employed a single-shock DID estimation (Chevalier and Mayzlin 2006; Zhang and Zhu 2011; Mayzlin et al. 2014). Our two-treatment DID provides significantly stronger identification and generally more conservative estimates (Choe et al. 2015). Nonetheless, in the robustness check section, we report the results of separate, single-shock DID analyses, to verify the main findings. In each case, the time windows are balanced.

Figure 2: Timeline of Social Network Integrations on *Yelp.com* and *TripAdvisor.com*



4.4. Estimation Model

Our study aims to identify the causal effect of digital social visibility on the volume and linguistic characteristics of online reviews. We estimate the two-treatment DID model reflected by Equation (1). Our estimation incorporates restaurant fixed effects (via a within transformation), which allow us to control for restaurant level heterogeneity.

$$\ln(Review\ Volume)_{it} = \beta_0 Yelp + \beta_1 Yelp\_Change + \beta_2 Yelp * Yelp\_Change + \beta_3 Trip\_Change + \beta_4 Trip * Trip\_Change + \beta_5 \ln(words_{it}) + \beta_6 rating_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

$$\ln(Linguistic\ Characteristic)_{it} = \beta_0 Yelp + \beta_1 Yelp\_Change + \beta_2 Yelp * Yelp\_Change + \beta_3 Trip\_Change + \beta_4 Trip * Trip\_Change + \beta_5 \ln(words_{it}) + \beta_6 rating_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

In this equation, *i* indexes restaurants and *t* indexes months. *Yelp* is a dummy variable which is equal to 1 if the observation is from *Yelp.com* and 0 if the observation is from *TripAdvisor.com*[2]. *Yelp_Change* is a dummy variable which is equal to 1 for observations following the introduction of Facebook Connect on Yelp, and 0 for observations prior. *Trip_Change* is a dummy variable that is equal to 1 for observations following the introduction of Instant Personalization on TripAdvisor, and 0 for observations prior. Because the linguistic characteristics of a review might be affected by the perceived quality of a restaurant, we also control for star rating (valence) and the number of words in the review.

4.5. Main Findings

In this section, we report the results of our main estimations. We test our hypotheses and discuss the economic significance of the key estimates. We report separate DID evaluations of each natural experiment as a robustness check, in the appendix.

4.5.1. Volume Effect

First, we conducted an analysis of the effect of social network integration on the volume of user-generated content (DV = ln(number of reviews)). Overall, our results reported in Table 3 suggest that social network integration is positively associated with the volume of user-generated content. As indicated in Table 3, both Yelp's social login feature and TripAdvisor's instant personalization feature increased review volumes. This indicates that both ease of use and reputational benefits seem to play a role in driving review volumes and that their combined impacts dominate any negative effects deriving from the relative loss of anonymity. In terms of effect sizes, based on the DID estimates, compared with their respective control groups,

[2] *Trip* is simply the reverse coding of *Yelp* – i.e., *Trip* = 1-*Yelp*.

TripAdvisor's Instant Personalization increased review volumes by 35.9% and Yelp's Facebook Connect increased review volumes by 17.6%. We thus observe support for H1a, and not H1b.

Interestingly, this result is different from that reported by Frutiger et al. (2014), who found that social login leads to decreases in user registration. This difference may be attributable to the differences in study context (Frutiger et al. studied a virtual gaming platform, and it is possible users in that setting would not want their social connections to know that they are playing games). Also, in general, having others know that you are playing games does not provide a reputational or social benefit as in the case of a review platform, where my friends may observe that I have contributed a review to help others in their purchase deliberation.

Table 3. Effect of Social Network Integration on Review Volume

DV:	ln(review volume)
Trip	-0.728***(0.020)
Trip_Change	0.248***(0.006)
Trip * Trip_Change	**0.359***(0.014)**
Yelp_Change	0.236***(0.007)
Yelp * Yelp_Change	**0.176***(0.015)**
Constant	0.865***(0.007)
Observations	139,239
R-squared	0.204
Number of restaurants	3,968
Restaurant Fixed Effect	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

4.5.2. Mental Process Effects

Table 4 reports our findings related to emotional language. We observe that social network integration leads to an increase in the use of language related to affective mental processes, supporting Hypothesis 2a. Note that while social network integration leads to more affective processes in general (more emotions), when we break the content down into different

types of emotion, we observe that integration leads to less negative emotions, yet more positive emotions. This result may be attributable to the increase in social presence following integration; users may not want their friends to perceive them as being overly negative. This is also consistent with our findings around the use of generally negative words, which we report later in our examination of Hypothesis 3.

In terms of effect sizes, the DID estimates indicate that, compared to their respective control groups, TripAdvisor's Instant Personalization increased language usage related to affective processes and positive emotion by 2.2% and 3.5%, respectively, while decreasing negative emotion by 20%. Similarly, Yelp's Facebook Connect increased language usage related to affective processes and positive emotion by 7.5% and 9.3%, respectively, while decreasing negative emotion by 12.3%.

Table 4. Affective Processes, Positive Emotion and Negative Emotion

DVs:	(1) Affective Process	(2) Positive Emotion	(3) Negative Emotion
Trip	-0.083***(0.010)	-0.102***(0.011)	0.087***(0.021)
Trip_Change	0.043***(0.002)	0.048***(0.002)	-0.045***(0.005)
Trip * Trip_Change	**0.022***(0.006)**	**0.035***(0.007)**	**-0.200***(0.014)**
Yelp_Change	-0.036***(0.011)	-0.043***(0.012)	0.061**(0.021)
Yelp * Yelp_Change	**0.075***(0.011)**	**0.093***(0.012)**	**-0.123***(0.022)**
ln(words)	-0.220***(0.002)	-0.255***(0.003)	-0.257***(0.005)
rating	0.090***(0.001)	0.183***(0.002)	-0.283***(0.003)
constant	2.651***(0.013)	2.308***(0.015)	2.248***(0.029)
Observations	137,158	136,760	109,450
R-squared	0.146	0.233	0.124
Number of restaurants	3,963	3,963	3,936
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 5 presents our findings related to cognitive processes in language. We observe that social network integration leads to: (a) less cognitive language, (b) fewer references to words related to insights, (c) and fewer references to causation, supporting Hypothesis 2b.

In terms of effect sizes, the DID estimates show that compared to their respective control groups, TripAdvisor's Instant Personalization decreased language use related to affective processes insights, and references to causation by 0.7%, 8.2% and 17.9%, respectively. Similarly, Yelp's Facebook Connect decreased language use related to cognitive processes, insights and causation by 2.3%, 12.1% and 8.8% respectively.

Table 5. Cognitive Mechanism, Insight, and Causation

DVs:	(1) Cognitive Process	(2) Insights	(3) Causation
Trip	0.026***(0.005)	0.082***(0.017)	0.139***(0.022)
Trip_Change	0.005***(0.001)	-0.067***(0.004)	-0.052***(0.005)
Trip * Trip_Change	**-0.007*(0.003)**	**-0.082***(0.011)**	**-0.179***(0.013)**
Yelp_Change	0.022***(0.006)	0.052**(0.017)	0.035(0.022)
Yelp * Yelp_Change	**-0.023***(0.006)**	**-0.121***(0.018)**	**-0.088***(0.023)**
ln(words)	0.041***(0.001)	-0.104***(0.005)	-0.205***(0.006)
rating	-0.012***(0.001)	-0.026***(0.002)	-0.023***(0.003)
constant	2.564***(0.007)	0.808***(0.027)	0.933***(0.032)
Observations	135,043	119,152	110,077
R-squared	0.016	0.021	0.029
Number of restaurants	3,958	3,949	3,943
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

4.5.1. Inhibition Effect

Finally, we consider the inhibition effect of digital social visibility on the use of controversial language, Hypothesis 3. Table 6 shows our findings. Overall, we observe that social network integration via Instant Personalization lead to: (a) fewer negations, (b) fewer swear words, and (c) fewer words related to sexuality. This provides general support for Hypothesis 3.

Notably, some inhibition effects do not show consistent significance from Yelp's Facebook Connect. We believe that this is due to the opt-in nature of the Yelp treatment, wherein users may still opt to employ controversial language and simply not share it with their Facebook connections. Clearly, because Instant Personalization automatically exposes users' reviews to their Facebook friends, it has a much stronger, more salient effect than Yelp's Facebook Connect social integration.

In terms of effect sizes, the DID estimates show that compared to their respective control groups, TripAdvisor's Instant Personalization decreased negations, swear words and sexually explicit statements by 11.3%, 56.7% and 47.6%, respectively. The effect of Yelp's Facebook Connect, on the other hand, was much smaller. It decreased negations and swear words by 10.6% and 23.9% ($p<0.1$), respectively. Notably, the effect on swear words was only marginally significant.

Table 6. Negation, Swear, and Sexual Language

DVs:	(1) negation	(2) swear	(3) sexual
Trip	0.394*** (0.015)	0.492*** (0.121)	0.376*** (0.045)
Trip_Change	-0.018***(0.005)	-0.245***(0.013)	-0.073***(0.009)
Trip * Trip_Change	**-0.113***(0.010)**	**-0.567***(0.080)**	**-0.476***(0.025)**
Yelp_Change	0.079***(0.015)	-0.009(0.132)	-0.076+(0.045)
Yelp * Yelp_Change	**-0.106***(0.017)**	**-0.239+(0.133)**	-0.044(0.046)
lnwords	-0.234***(0.005)	-0.842***(0.017)	-0.806***(0.009)
rating	-0.192***(0.002)	-0.136***(0.010)	0.186***(0.006)
Constant	1.851***(0.026)	3.100***(0.095)	2.333***(0.054)
Observations	118,205	29,759	67,162
R-squared	0.135	0.134	0.179
Number of restaurants	3,944	3,434	3,823
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.1$

5. Discussion

5.1. Key Findings

This paper aims examines the effects of social network integration on the characteristics of online reviews, via increases in users' digital social visibility. Social network integration of online platforms is typically adopted with the goal of improving convenience, promoting personalization, building social connections, and ultimately providing better services to users. That is, social login simplifies and facilitates registration and login for users, and it allows users to easily share their reviews with social connections, while instant personalization customizes the website experience to each user and facilitate social interaction. Accordingly, websites may expect to see an increase in engagement, as we have observed here.

However, as we have also shown, this integration can lead to a number of unintended, likely unanticipated consequences (Kontaxis et al. 2012; Toch et al. 2012). Increases in platform sociability and the loss of anonymity lead to a more salient social presence and increased social inhibition. On the positive side, we have observed that the latter leads to a significant decline in the use of controversial and abrasive language (language with reference to negation, swearing and sexually explicit words). However, the former leads to an increase in the use of affective language and a decline in the use of cognitive language, which implies a reduction in the perceived helpfulness of reviews (Yin et al. 2014). Thus, our findings demonstrate that social network integration is a double-edged sword, providing benefits in terms of review quantity, apparently at the cost of quality.

5.2. Implications

This study extends prior research on digital social visibility, anonymity and online reviews in several ways. Firstly, past work on digital social visibility is limited to outcomes such as trust (Animesh et al. 2010), purchase intentions (Ou et al. 2014), and choice decisions (Rhue and Sundararajan 2013). We examine users' authorship of online reviews (volume and linguistic characteristics), a novel outcome driven by increasing digital social visibility. Second, prior studies on anonymity have mainly emphasized the privacy implications (Ayyagari et al. 2011; Acquisti et al. 2013) or online disinhibition effects (Suler 2004; Reader 2012; Santana 2014). We present empirical evidence that inhibition affects language use as well. That is, users begin to abstain from controversial language (sexually explicit, negative and abrasive words) with the loss of anonymity. Lastly, previous research on the social aspects of online reviews, and user-generated content more broadly, have focused on outcomes such as contribution quantity (Huberman et al. 2009; Chen et al. 2010), evaluation negativity and extremity (Wang 2010; Goes and Lin 2014). The findings of this study consider a novel aspect: the linguistic characteristics of review content. Our study provides the first empirical evidence suggesting social elements of an online review platform may cause reviewers to write with more emotional language, rely less on cognitive mental processes, and employ less controversial language.

This study also carries important practical implications for the design of IT platforms that host and heavily rely upon user generated content. Given the recent trend toward social network integration on online platforms, it is crucial that we improve our understanding of the possible unintended consequences. Our findings demonstrate that social network integration is a double-edged sword, providing benefits in terms of review quantity, apparently at the cost of quality. Specifically, we have found that digital social visibility increases the contribution volume

of online reviews. This result suggests that social network integration is likely to be most useful for online review websites (or websites that host other forms of user-generated content) that face challenges of under-provision. Our results also show that digital social visibility leads to an increase in the use of emotional language and a decrease in the use of cognitive language. Emotional language reduces the perceived helpfulness of online reviews (Yin et al. 2014). Thus, our results suggest that review platforms should nudge users to be more objective and logical when presenting their reviews, to enhance review quality, else they run the risk of diluting the quality of reviews on the platform.

5.3. Limitations and Future Research

Our work is subject to a number of limitations. First, our measures are relatively simplistic and the accuracy of the results depends on how comprehensive the LIWC dictionaries are. Notably, however, LIWC has recently been applied by a number of scholars in Information Systems (Yin et al. 2014) and Marketing (Lurie et al. 2014, Sridhar and Srinivasan 2012). As such, this does not appear to be a serious concern. Second, we have focused on only a few aspects that digital social visibility introduced via social network integration would have an effect upon. Future research can extend our study by exploring other outcomes of digital social visibility. For example, researchers can examine the impact of digital social visibility on dimensions of psychological distance. Digital social visibility might change the perceived social distance among users on the online platforms, which in turn would affect the perceived spatial distance or temporal distance for users.

There is also other significant potential for future work. First, it would be useful for scholars to establish the external validity of LIWC's measures via cross-validation, comparing our metrics with users' perceptions. It may also be fruitful to explore data mining techniques,

such as natural language processing, to undertake a more nuanced textual analysis. Second, although we have leveraged natural experiments to identify the effects of social network integration on user-generated content, due to the observational nature of our data, these analyses may nonetheless suffer from issues of endogeneity (e.g., an unobserved correlated shock). Accordingly, future studies could improve on our analysis via an experimental manipulation of reviewer anonymity – e.g., priming subjects with privacy concerns (Burtch et al., 2015), to better establish causal relationships. Alternatively, we could even foresee a future experiment, in which we exogenously "friend" people on *Yelp.com* or *TripAdvisor.com*, to see if the content of their reviews changes.

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Appendix I: Robustness Check

In this robustness check, we report separate DID analyses for the two exogenous shocks in this section to check the robustness of the main findings. First, we report the separate DID results for review volume. Based on Table 7 and Table 8, we observe that, compared with Yelp as baseline control group, the review volume of TripAdvisor increased 37% after implementing Instant Personalization. Compared with TripAdvisor as baseline control group, the review volume of Yelp increased 17% after integrating the Facebook Connect system change.

Table 7. TripAdvisor DID Volume Effect

DV:	ln(Review Volume)
Trip	-0.927***(0.019)
Trip_Change	0.243***(0.006)
Trip * Trip_Change	**0.372*****(0.014)
Constant	1.103***(0.006)
Observations	117,044
R-squared	0.191
Number of restaurants	3,966
Restaurant Fixed Effect	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 8. Yelp DID Volume Effect

DV:	ln(Review Volume)
Yelp	0.665***(0.021)
Yelp_Change	0.018(0.014)
Yelp * Yelp_Change	**0.170*****(0.015)
Constant	0.218***(0.018)
Observations	48,488
R-squared	0.195
Number of restaurants	3,191
Restaurant Fixed Effect	Yes
Time Fixed Effect	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Second, we report the separate DID results for mental processes. Based on Tables 9 and Table 10, we observe that, compared with Yelp as baseline control group, the language

references to affective process on TripAdvisor increased 1.8% after implementing Instant Personalization. Positive emotion increased by 3% and negative emotion decreased by 21%. Compared with TripAdvisor as baseline control group, the language references to affective process on Yelp increased 6.4% after implementing Facebook Connect. Positive emotion increased by 7.8% and negative emotion decreased by 10.2%.

Table 9. TripAdvisor DID Affective Process Effect

	(1)	(2)	(3)
DVs:	Affective Process	Positive Emotion	Negative Emotion
Trip	-0.160***(0.006)	-0.196***(0.006)	0.225***(0.014)
Trip_Change	0.042***(0.002)	0.047***(0.003)	-0.044***(0.005)
Trip * Trip_Change	**0.018**(0.006)**	**0.030***(0.007)**	**-0.210***(0.015)**
ln(words)	-0.235***(0.003)	-0.270***(0.003)	-0.300***(0.007)
rating	0.094***(0.002)	0.188***(0.002)	-0.295***(0.003)
Constant	2.745***(0.015)	2.410***(0.016)	2.425***(0.033)
Observations	110,337	109,966	86,307
R-squared	0.152	0.236	0.129
Number of restaurants	3,958	3,958	3,929
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 10. Yelp DID Affective Process Effect

	(1)	(2)	(3)
DVs:	Affective Process	Positive Emotion	Negative Emotion
Yelp	0.076***(0.011)	0.097***(0.012)	-0.052*(0.022)
Yelp_Change	-0.035**(0.012)	-0.040**(0.013)	0.049*(0.024)
Yelp * Yelp_Change	**0.064***(0.013)**	**0.078***(0.014)**	**-0.102***(0.025)**
ln(words)	-0.193***(0.004)	-0.226***(0.005)	-0.231***(0.009)
rating	0.076***(0.002)	0.171***(0.003)	-0.253***(0.005)
constant	2.498***(0.024)	2.118***(0.027)	2.054***(0.050)
Observations	46,767	46,670	38,299
R-squared	0.103	0.191	0.112
Number of restaurants	3,174	3,173	3,108
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Based on Tables 11 and Table 12, we observe that, compared with Yelp as baseline control group, the language references to cognitive process on TripAdvisor decreased by 0.9%

after implementing Instant Personalization. References to words related to insights decreased by 9.1% and references to words related to causation decreased by 19.3%. Compared with TripAdvisor as baseline control group, the language references to cognitive process on Yelp decreased by 2.4% after implementing Facebook Connect. References to words related to insights decreased by 11.5% and references to words related to causation decreased by 9.4%.

Table 11. TripAdvisor DID Cognitive Process Effect

	(1)	(2)	(3)
DVs:	Cognitive Process	Insight	Causation
Trip	0.051***(0.003)	0.212***(0.011)	0.246***(0.014)
Trip_Change	0.004**(0.001)	-0.069***(0.005)	-0.051***(0.005)
Trip * Trip_Change	**-0.009*(0.003)**	**-0.091***(0.012)**	**-0.193***(0.014)**
ln(words)	0.039***(0.002)	-0.152***(0.006)	-0.245***(0.007)
rating	-0.012***(0.001)	-0.024***(0.003)	-0.023***(0.003)
constant	2.571***(0.009)	0.954***(0.031)	1.066***(0.037)
Observations	108,368	94,346	86,850
R-squared	0.015	0.028	0.035
Number of restaurants	3,953	3,939	3,932
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 12. Yelp DID Cognitive Process Effect

	(1)	(2)	(3)
DVs:	Cognitive Process	Insight	Causation
Yelp	-0.013*(0.006)	-0.055**(0.018)	-0.101***(0.021)
Yelp_Change	0.025***(0.007)	0.062**(0.019)	0.055*(0.023)
Yelp * Yelp_Change	**-0.024**(0.007)**	**-0.115***(0.020)**	**-0.094***(0.024)**
ln(words)	0.063***(0.003)	-0.063***(0.008)	-0.196***(0.009)
rating	-0.011***(0.001)	-0.025***(0.004)	-0.016***(0.004)
constant	2.458***(0.015)	0.647***(0.045)	0.953***(0.051)
Observations	46,807	41,539	38,352
R-squared	0.022	0.011	0.026
Number of restaurants	3,174	3,143	3,119
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Third, we report the separate DID results for inhibition effect. Based on Tables 13 and Table 14, we observe that, compared with Yelp as baseline control group, the language references to negation on TripAdvisor decreased 11.9% after implementing Instant Personalization. References to swear language decreased by 66% and references to sexually explicit language decreased by 49.4%. Compared with TripAdvisor as baseline control group, the language references to negation on Yelp decreased 8.1% after implementing Facebook Connect. References to swear language decreased by 24.5%.

Table 13. TripAdvisor DID Inhibition Effect

	(1)	(2)	(3)
DVs:	Negation	Swear	Sexual
Trip	0.509***(0.010)	0.820***(0.077)	0.424***(0.026)
Trip_Change	-0.018***(0.005)	-0.241***(0.013)	-0.071***(0.009)
Trip * Trip_Change	**-0.119***(0.011)**	**-0.660***(0.086)**	**-0.494***(0.026)**
ln(words)	-0.265***(0.006)	-0.886***(0.021)	-0.866***(0.010)
rating	-0.200***(0.003)	-0.136***(0.012)	0.193***(0.007)
constant	1.993***(0.030)	3.044***(0.117)	2.464***(0.060)
Observations	93,870	22,488	53,480
R-squared	0.143	0.116	0.185
Number of restaurants	3,937	3,296	3,802
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 14. Yelp DID Inhibition Effect

	(1)	(2)	(3)
DVs:	Negation	Swear	Sexual
Yelp	-0.389***(0.017)	-0.509***(0.119)	-0.333***(0.049)
Yelp_Change	0.061***(0.017)	0.058(0.141)	-0.066(0.052)
Yelp * Yelp_Change	**-0.081***(0.018)**	**-0.245+(0.142)**	-0.039(0.054)
ln(words)	-0.231***(0.008)	-0.811***(0.027)	-0.784***(0.016)
rating	-0.170***(0.004)	-0.114***(0.015)	0.170***(0.009)
constant	2.138***(0.044)	3.384***(0.181)	2.616***(0.102)
Observations	40,877	11,310	22,641
R-squared	0.121	0.120	0.166
Number of restaurants	3,139	2,390	2,870
Restaurant Fixed Effect	Yes	Yes	Yes

Notes: Cluster-robust standard errors in parentheses.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1