One-Way Mirrors and Weak-Signaling in Online Dating:

A Randomized Field Experiment

Completed Research Paper

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Abstract

The growing popularity of online dating sites is altering one of the most fundamental human activities of finding a date or a marriage partner. Online dating platforms offer new capabilities, such as intensive search, big-data based mate recommendations and varying levels of anonymity, whose parallels do not exist in the physical world. In this study we examine the impact of anonymity feature on matching outcomes. Based on a large scale randomized experiment in partnership with one of the largest online dating companies, we demonstrate causally that anonymity indeed lets users browse more freely, but at the same time impacts the existing social dating norms (what we call a weak signaling mechanism) and thus produces negative impact on matches. Our results show that this weak signaling is especially helpful for women, helping them overcome social frictions coming from established social norms that discourage them from making the first move in dating.

Keywords: randomized experiment, online dating, privacy, anonymity

Motivation and Background

According to the United States Census (Gelles 2011), 46% of the single population in the US uses online dating to initiate and engage in the process of selecting a partner for reasons ranging from finding companionship to marrying and conceiving children, and everything in between. Finding the optimal dating and ultimately marriage partner is one of the most important socio-economic decisions made by humans. Yet, such dating markets are fraught with frictions and inefficiencies, often leading people to rely on choices made through happenstance—an offhand referral, or perhaps a late night at the office (Paumgarten 2011). Interestingly, this primal human activity is being reshaped with the advent of big data and the billion plus strong online social graph (Facebook, Twitter and the other social networks). The continued growth of online dating despite the presence of a close substitute, the physical world, reflects the presence of significant frictions in the offline dating and marriage markets. Yet, the underlying processes, dynamics and implications of mate seeking in the online world are largely unstudied; this is a gap we bridge.
Online dating sites are attracting millions of new users each month. Although they reduce multiple sources of friction that are present in offline dating markets, they do not eliminate them. Piskorski (2012) documents that dating markets are fraught with frictions ranging from high search costs to asymmetric societal norms that often lead to social failures. Akin to a market failure, which implies an economic exchange that did not take place but had it taken place would have made everybody better off, a social failure is a human connection that should have taken place (in that it would have increased the welfare of both sides), but did not. In the context of heterosexual dating, these matching inefficiencies arise due to a variety of frictions—physical constraints of time and space, the costliness of the initial information acquisition, and age-old societal norms, such as those inhibiting women from making the first move (Maccoby & Jacklin 1974, Piskorski 2012). Sandberg 2013, in a provocative book, makes the case that women do not initiate ‘lean-in’ at the work place. In the process of causally examining the role of such search and social frictions in dating markets, we contribute by conceptualizing, exploring, and actually quantifying (something not even attempted by extant research), the implications of women not ‘leaning-in’ in the other most important sphere of their lives, namely romantic markets.

As is often the case, the Internet not only replicates the physical world processes of human interaction, but also extends them, supporting a variety of features that afford new capabilities that are next to inconceivable in the physical world, and that can vary the search costs for individuals looking for prospective dates. Given the extreme scale of population of these websites as well as standardized nature of users’ profiles, these capabilities range from extensive search and algorithmic matching to big-data based mate recommendations (Gelles 2011), a science perfected for books and movies, now being deployed to humans. However, certain features of these websites such as completely anonymous browsing of user profiles have no direct analogies in offline world. Thus, existing theories may not be adequate in explaining these online phenomena. Indeed, extant research has not addressed whether these IT-enabled features impact the search, viewing, message initiation and matching behavior of individuals, a gap we begin to bridge.

In particular, in this research we focus our attention on the impact of an anonymity related feature, which we call weak signaling, on matching outcomes. Weak signaling is the ability to visit, or “check out,” a potential mate’s profile such that the potential mate knows the focal user visited her. It is akin to making a move without actually making a move, and yet, critically, the counter-party becomes explicitly aware that a move was made. Weak signaling is an important market feature that is unique to the online dating environment, and next to impossible to implement reliably in the physical world, at least with anywhere close to the level of definitiveness that can be done online. The offline “flirting” equivalents, at best, would be a suggestive look or a forward stance perhaps (Hall et al. 2010), each subject to myriad interpretations and possible misinterpretations (Henningsen 2004) contingent on the perceptiveness of the players in question. No such ambiguity exists in the online environment if the focal user views the target user’s profile and leaves a visible trail in the target’s “Recent Visitors” list.

Based on a novel large-scale randomized trial, similar in spirit to Aral and Walker (2011) and Bapna and Umyarov (2012), in partnership with one of the largest online dating companies, we causally demonstrate that weak signaling is a key mechanism that is linked to increase in matching outcomes, especially for women, helping them overcome social norms that discourage them from making the first move in dating markets. Our treatment involves gifting one-month of anonymous profile viewing to a randomly selected subset of 50,000 users from a pool of 100,000 randomly selected new users of the site. Anonymous profile viewing is a feature that allows individuals to view profiles of potential mates anonymously, without leaving a trace, while retaining the ability to know who visited their own profiles. This feature, bundled with other advanced features, is available for purchase to any user of the dating site and normally costs $14.95 (value changed for de-identification purposes) per month. In our study, we treat the randomly selected users with this feature and observe the changes in behavior that it induces. Using the gold standard of randomization is very important to avoid the myriad problems of endogeniety that would be associated with using observational data in such markets.

Conventional wisdom (McDevitt 2012, Suler 2004) suggests that anonymous profile viewing, by lowering search costs, should be associated with improved matching. Anonymity should, arguably (Holmes et al. 1998, McDevitt 2012, Joinson 1998, Suler 2004) lower social inhibitions along the preferences dimension, thus impacting the, hitherto unconsidered, social component of search costs. If, under anonymity, individuals search more uninhibitedly and are therefore more proficient in meeting other users who
match their preferences we should predict an increase in the number of matching outcomes for the average user. Essentially, in a world of non-anonymous browsing the focal user may search sub-optimally, therefore limiting the options available to her resulting in weaker matching outcomes. The anonymity gift, then, may potentially lower the “cost” associated with checking out a potential mate, therefore lowering the search costs, resulting in improved search and ultimately the improved matching. Support for this argument comes from the growing literature on the disinhibition effect of the Internet, where a user’s behavior changes once she can behave anonymously. This online disinhibition literature has its roots in social psychology (Joinson 1998, Suler 2004). Kling et al. (1999) review social behavior on the Web, and state that “people say or write things under the cloak of anonymity that they might not otherwise say or write.” Such anonymity induced changes have been observed in settings ranging from adult film and books (Holmes et al. 1998) to pizza orders (McDevitt 2012).

In the above scenario, an argument for increased matching outcomes can be made from the gift of anonymity. On the other hand, the advantage of non-anonymous browsing is that it allows a focal user to advertise herself and leave a “weak signal” to another user without actually making any unambiguous explicit first move such as sending a personal message. Thus, treating individuals with the ability to anonymously view profiles, in effect, takes away their weak-signaling mechanism. If weak signaling is an important tool, in particular for women, towards overcoming the social barriers that prevent them from making the first move, then our treated group could have lower rates of matching. These opposing forces reflect the fact that human behavior in the context of dating is incredibly complex and largely scientifically untested at the micro-level. We hope to bridge this gap in the literature.

The advent of the online dating platforms is increasing measurability, while also introducing new modalities of behaviors that do not have offline parallels. Thus, our approach in examining these opposing forces is positivist in nature. We refrain from any a priori judgments about the relative efficacy of the competing hypotheses: lower search costs improving matching versus the absence of weak-signaling hurting matching. Instead, we toss these competing forces into a cauldron of a large-scale randomized experiment in the wild, examine the outcome, and then analyze the sub-processes to understand the observed outcome. A key aspect here is that the online dating platforms provide us with an environment where participants’ choices at sub-stages of the dating process are available to the researcher objectively and in unprecedented detail, which is not observable in the offline world. We exploit this rich micro-level data to explain our key finding in a detailed and nuanced manner.

In summary, we seek to answer the following research questions in a causal manner:

1. Does weak-signaling have a significant impact on matching levels?
2. Given known gender asymmetries in mating markets (Fisman et al. 2006), does the effect of weak-signaling differ across genders?
3. How does weak-signaling manifest itself in the overall dating process, which begins with viewing, is followed by messaging and ends (potentially) in matching?

Our work complements the economics literature devoted to measurement of mate preferences (Fisman et al 2006, Hitsch et al 2010), a topic also of interest to scholars in sociology and psychology (Buss 1995). Similar to Hitsch et al. (2010), our measurement of mate preferences relies on data from one of the largest online dating sites in business. Where we depart from this stream of literature is in our use of a randomized treatment to identify the effect of a unique IT enabled artifact—weak signaling—that could potentially alter individuals’ matching outcomes. This effect, if significant, will lead to welfare gains in mating markets and will result in lower levels of social failures (Piskorski 2012).

We expect this study to be the basis of a stream of work looking at how the Internet and social media is changing some of the fundamental activities we carry out as humans. In the next section we briefly describe related literature, followed by institutional details of the online dating site we work with. We then describe our data set and outcome variables, the design of the randomized experiment as well as the experimental results. In this paper, we also discuss robustness checks that look at the time-line of the effect.
Literature Review

Our work builds upon and contributes to three streams of literature. Firstly, there is the economics literature on marriage markets starting with Becker (1973) and related work across multiple disciplines that establishes the theoretical basis for the sorting patterns that are exhibited in marriages. Marriage partners are similar in age, education levels and physical traits such as looks (Kalmijn 1998). Sorting can be attributed to search frictions or to preferences. People of similar education levels may be employed together, or be clustered in educational institutions, leading to romantic liaisons due to spending time together irrespective of preferences.

Preferences can manifest themselves horizontally (men and women may prefer matching with a similar partner) or vertically, wherein each mate ranks all potential mates in an identical manner, and in a frictionless market, the ranks of matched men and women will be perfectly correlated (Hitsch et al 2010). Because search frictions are substantially lower in online dating markets—consider the infeasibility of getting detailed profile and attribute information from even a handful of potential mates at a bar—Hitsch et al (2010) are able to break down the observed sorting outcomes in dating due to preferences over mate attributes. They find, as expected, that users of the online dating service prefer a partner whose age is similar to their own; that women generally avoid divorced men; that attractiveness is important to both men and women; that women place twice as much weight on income than men; and that while women have an overall strong preference for an educated partner, men generally shy away from educated women.

These gender asymmetries in mate selection are also the key findings of Fisman et al. (2006), who obtain mate preference data from a speed dating experiment. Similar to their research, we focus on dating, an activity that usually precedes marriage, and usually manifests itself in the form of a long learning period during which people engage in more informal and often polygamous relationships. That said, in discussing the related literature we use dating and marriage interchangeably, so as to be expansive in our coverage of the various streams of thought that can possibly influence our work.

The use of a speed dating experiment with random assignment helps Fisman et al. (2006) overcome the challenge of backing out mate preferences from observational equilibrium outcomes data, where multiple preferences structures would be consistent with a given outcome. Subjects meet between nine and twenty-one potential mates for four minutes each and have the opportunity to accept or reject each partner. If both parties desire a future meeting, each receives the other’s email address. Findings from this indicate that women put greater weight on intelligence than men, while men place more value on physical appearance. Also, they find that women put more emphasis on the partner’s race. Recognizing the gender asymmetries established in the literature and similar to Fisman et al. (2006) and Hitsch et al. (2010) we will report our empirical findings separately for men and women.

Our research also relates to the economics literature on two-sided matching markets, e.g. Roth and Sotomayor (1992) who formulate marriage as a two-sided matching problem because men and women are different. They model preference orderings in the matching process and, importantly for this research, introduce the idea of unstable matching, an outcome where people would have been better off having different partners. The unstable matching idea is intricately linked to Piskorski (2012) idea of a social failure that we discussed earlier.

This view is somewhat distant from the early thinking of the economic modeling of marriage markets as being frictionless (Becker 1973), and even broader than the more recent developments by Burdett and Coles (1997), Mortensen and Pissarides (1999) and Smith (2002), who account for search frictions but do not account for social frictions. Our research is motivated by taking into account these well-documented social frictions and examining whether the newer capabilities afforded by the online environment can mitigate them. Our random assignment of the anonymity feature to a subset of users in the online dating site can, at one level, be interpreted as an exogenous shock that lowers search frictions. Users can uninhibitedly search for potential mates (McDevitt 2012) and, if search frictions are the only force at play, this should naturally lead to higher matching outcomes. Yet, social exchange theory [Maccoby & Jacklin 1974, Piskorski 2012], reminds us that while age-old social norms prevent women from making the first move, say by messaging a potential male partner, the online dating markets give women an opportunity to leave a weak-signal. This “trail” of a profile visit can then serve as an implicit move that could trigger a response and possibly lead to a match. When we gift anonymity to our treatment group, we are in effect taking away this ability to leave a weak signal, and thereby increasing social frictions.
Thus, in departure from anything considered in the extant literature, our treatment is in effect a horse race between search frictions, which decrease with anonymity and should result in more matches, and social frictions, which rise when we take away weak-signaling and therefore should result in fewer matches. Again, while the economics literature has extended the original frictionless matching models to account for search frictions, no one has looked at social frictions and compared the two in the setting of a randomized controlled trial (RCT).

In summary, we contribute to prior work by rigorously and causally investigating the impact of the new capabilities afforded by the online dating environment on the underlying process and resulting outcomes of this fundamental human activity. In the next section we provide some institutional details about our research site.

**Institutional Details**

To conduct this experiment, we partnered with one of the world’s largest online dating site, which we call monCherie.com (name disguised). As is typical for online dating websites, monCherie.com offers the following functionality to its users:

- Users may set up their own online profiles where they describe themselves as well as reveal characteristics sought in a desired partner. Users may also put a set of pictures into their profiles.
- Users may view profiles of all other users without limits.
- Users may search for profiles of other users using an advanced search engine that allows filtering by age, location, religion and a large number of other demographic variables. Users may also discover partners using a proprietary recommendation engine that is provided by the website.
- Users may send private messages to any other user.

In addition to these features, monCherie.com constitutes a typical freemium community: most of the users sign up for free and with that they can utilize the key features of monCherie.com website listed above. In addition to these free features, users can obtain premium features if they pay $14.95 (value changed for de-identification purposes) and purchase a one-month premium subscription to monCherie.com. These premium features include anonymous browsing of profiles of others as well as extra search options and statistics.

By default, free users of monCherie.com are browsing in the non-anonymous mode such that if the focal user A visits the profile of the target user B, user B knows through her “Recent Visitors” page that user A checked her out. On the other hand, premium users are browsing in the anonymous mode such that that if the focal user A visits the profile of the target user B, user B does not know that user A checked her out. However if user B were to visit user A’s profile, user A would know that. This feature is the proverbial “one-way mirror,” the impact of which is the subject of the research of this paper.

**Experimental Design**

In order to test the impact of one-way mirrors on user behavior in online setting, we collaborated with senior executives and engineers of monCherie.com. Our high-level experimental design involves randomly selecting a subset of users of monCherie.com website and treating them with a gift of one month of anonymous browsing on the site. Then, we examine the matching outcomes for these users as compared to the control group, who were not treated. The exogenous random assignment of the treatment rules out myriad problems of endogeneity and alternative explanations that could confound any analysis of such a question based on observational data. In addition, we do not ask for anything in exchange from users who are receiving the gift and no action is needed on their side. Users are also unaware of being a part of the experiment at all, so observer bias is not applicable.

More specifically, we selected a random sample $S$ of 100,000 users of monCherie.com website from an undisclosed geographical area of the United States. Subsequently, 50,000 random users from $S$ received the “anonymous feature gift” from us and were labeled as treatment group (group $T$, manip = 1), while the
remaining 50,000 users from S did not receive anything from us and were labeled as control group (group C, manip = 0).

As discussed above, our field experiment relies on removing the “weak signal” ability for group T while keeping it for group C in order to compare their resulting search and messaging behavior as well as matching outcomes.

The sample size for the experiment is selected based on the field experiment reported in Bapna and Umyarov (2012) dealing with rare events in online communities and the agreement with administrators at the monCherie.com website. We limit our sample to only valid and active users as explained in variables Valid and Active below in order to remove spammers and dead accounts.

Experimental Data

Based on the specifics of the agreement with monCherie.com, our experiment was conducted on 100,000 random users of the website over the period of 3 months that we refer to as Month 1 (Pre-manipulation), Month 2 (During-manipulation) and Month 3 (Post-manipulation). The following data about website users was available to us:

- Anonymized user id.
- Manipulation dummy variable. This variable stores whether the user received the anonymity gift from us (manip=1) or not (manip=0).
- User’s gender and age.
- Sexual orientation. A dummy variable indicating whether a user is of straight orientation (Straight=1) or not (Straight=0).
- White race indicator.
- Attractiveness score. This score is the average vote for user’s attractiveness as collected by the website and privately voted by other website users. A user herself is not aware of her own score.
- Premium. This dummy variable is 1 if a user purchased premium subscription.
- Valid. This dummy variable is 0 if a user is a spammer or otherwise an invalid user as reported by the internal investigation of monCherie.com. For the purposes of our analysis, we only look at users such that Valid=1.
- Active. This dummy variable is 1 if a user visited at least 1 profile 10 days prior to manipulation.

In this study we limit our attention only to users who were valid and active prior to our manipulation. The following table outlines descriptive statistics of user demographic variables:

As demonstrated in Table 1, the treatment (manip=1) and control (manip=0) groups have similar observed statistical properties. In our analysis, we break down all statistics by gender (F=female; M = male) given significant gender asymmetries in the dating market.

In addition to that we collected all profile viewing and messaging activity for the users in our sample for three consecutive months that we refer to as Month 1, Month 2 and Month 3. Based on our data on individual-level viewing and messaging activity, we computed the following dependent variables:

- ViewSentCntX. Number of unique users that the focal user visited during month X.
- ViewRcvdCntX. Number of unique users that visited the focal user during month X.
- MsgSentCntX. Number of unique users that the focal user initiated a message to during month X.
- MsgRcvdCntX. Number of unique users that initiated a message to the focal user during month X.
In our setting Month 1 is pre-experimental, Month 2 is the month of the experiment and Month 3 is post-experimental month. We will name our variables as follows ViewSentCntPre (for views sent in Month 1), ViewSentCnt (for views sent in Month 2) and ViewSentCntPost (for views sent in Month 3).

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Table 1. Treatment and control groups are statistically identical

**Measure of success in online dating**

It is a challenge to define a perfect and all-encompassing measure of success in the context of online dating. For example, even if we knew which couples went for an offline date, this would not necessarily be a perfect outcome measure of success given that many offline dates turn out to be unsuccessful and do not result in a relationship. Similarly, even if we had the data on actual weddings for our users such a measure would still hardly constitute a perfect success measure given that current divorce rates are reaching almost 50%.

Recognizing that we are unable to know the ultimate success of any observed relationship, we operationalize the success in online dating as a successful outcome at a certain intermediate step in the otherwise long, complicated process, a process that starts with successful online communication, leading to a successful offline date, leading to a successful relationship, a wedding, and finally a successful marriage.

Instead of trying to predict the entire sequence of these steps and define the “perfect” success measure, we concentrate on the very first step of this online dating process: successful online communication. Clearly,
without establishing successful online communication first, the rest of the steps towards a successful relationship are simply not possible in the context of online dating.

Thus, to define successful online communication, we define that the communication of user A and user B is a *match* if user A messaged user B, user B responded and then user A messaged user B again (with user A possibly responding to that and so on), therefore forming a sequence of *at least* three messages between user A and user B.

![Figure 1. The definition of a match: the exchange of at least 3 messages](image)

As is evident from this definition, a conversation that constitutes a match may potentially be much longer than three messages. More specifically, as demonstrated in Figure 2, the average length of a conversation between matched users is 12.6 messages (median is 7 messages).

![Figure 2. The length of the conversation in a typical match](image)

While we are not aware of the content of these messages, monCherie.com does know the content and insists that this definition of a match is a very strong predictor of an actual offline date and therefore is an
industry-standard dependent variable\(^1\). Despite knowing the content of user messages, monCherie.com is using this metric as a measure of matching for their own internal success-tracking systems.

Based on this definition of match and consistent with our prior naming schemes, we computed the following variables:

- MatchCntX. Number of total matches that the focal user achieved during month X.
- MatchSentCntX. Number of the matches that were initiated by the focal user during month X.
- MatchRcvdCntX. Number of such matches that were initiated not by the focal person, but by the counter-party during month X.

We will name our variables as follows MatchSentCntPre (for matches sent in Month 1), MatchSentCnt (for matches sent in Month 2) and MatchSentCntPost (for matches sent in Month 3).

## Experimental Results

We start our analysis by exploring changes in profile browsing behavior that were induced by our manipulation. As demonstrated by ViewSentCnt in Table 2, manipulated users of both genders viewed significantly more profiles, on average, as compared to their non-manipulated counterparts. This finding demonstrates the expected effect of users browsing more when under the cloak of anonymity and essentially serves as a manipulation check: the data reveals that manipulated users understood the anonymity feature and acted upon their understanding by viewing more profiles.

Given very strong gender asymmetries, we present all our results onwards as broken down by gender. In other words, we will compare treated males to control males and treated females to control females.

<table>
<thead>
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<th>p-value</th>
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<tbody>
<tr>
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<td>0</td>
<td>ViewSentCnt</td>
<td>43.180</td>
<td>1.05373</td>
<td>0</td>
<td>1413</td>
<td>-3.41</td>
<td>0.0007</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>ViewSentCnt</td>
<td>48.700</td>
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<td>2451</td>
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<tr>
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<td>0</td>
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<td>72.614</td>
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<td>-2.89</td>
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<tr>
<td>M</td>
<td>1</td>
<td>ViewSentCnt</td>
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<td>1.72966</td>
<td>0</td>
<td>3441</td>
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</tr>
</tbody>
</table>

**Table 2. The effect of manipulation on profile browsing behavior**

Despite the significant increase in browsing activity of manipulated users as demonstrated by Table 2, our experimental results in Table 3 reveal that manipulated users themselves were visited, on average, by a significantly smaller number of people. This finding supports our theory of the importance of weak-signaling: despite visiting more profiles, the manipulated users were visited by fewer people.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Manip</th>
<th>Variable</th>
<th>Mean</th>
<th>Std Err</th>
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<tr>
<td>F</td>
<td>0</td>
<td>ViewRcvdCnt</td>
<td>126.380</td>
<td>2.12382</td>
<td>0</td>
<td>1790</td>
<td>2.43</td>
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<td>F</td>
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<td>ViewRcvdCnt</td>
<td>119.371</td>
<td>1.96109</td>
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<td>M</td>
<td>0</td>
<td>ViewRcvdCnt</td>
<td>26.134</td>
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<td>1696</td>
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</tr>
</tbody>
</table>

**Table 3. The effect of manipulation on profile browsing behavior**

Further, as demonstrated by Table 4, manipulated users received less incoming conversations after manipulation as compared to non-manipulated users, despite the fact that they initiated the same number

---

\(^1\) We conducted multiple additional robustness checks of our results with different definitions of a match, such as, for example, a match being an exchange of at least 5 messages (or, even at least 7 messages). All results presented in this paper were robust to changing the definition of a match.
of conversations, as represented in MsgRcvdCnt and MsgSentCnt variables respectively. This result regarding MsgSentCnt suggests that the manipulated users do not change their message initiation behavior significantly, but nevertheless they do experience a significant change in the number of incoming messaging initiated towards them.

Since a match between two users by definition depends on reciprocity of communication and there is a clear decline in incoming views and messages initiated towards treated users, it is now natural to expect that our manipulation will reduce the total number of matches achieved by the treatment group. This is indeed confirmed in Table 5 as demonstrated by MatchCnt variable.

Notably, the total number of matches declined very significantly for females, while it declined only marginally for males.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Manip</th>
<th>Variable</th>
<th>Mean</th>
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<td>MsgRcvdCnt</td>
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Table 4. The effect of manipulation on messaging behavior

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<td>MatchCnt</td>
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<td></td>
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</table>

Table 5. The effect of manipulation on matching behavior

**Heterogeneity of the effect by gender**

Table 5 clearly demonstrates gender asymmetries in the strength of the effect of anonymity on MatchCnt. As will be demonstrated in Table 6, males and females tend to play different role in their matches. For males, more than 75% of their matches are self-initiated, while for females less than 25% of matches are self-initiated.

Therefore, in order to explore these gender asymmetries in message and match initiation, we break the MatchCnt into two variables MatchRcvdCnt and MatchSentCnt that emphasize whether the match was initiated by the focal user (as in MatchSentCnt) or by the counter-party (as in MatchRcvdCnt) and subsequently explore the change in each of these variables induced by our treatment.

Weak-signaling theory predicts that MatchSentCnt and MatchRcvdCnt are affected differently by our manipulation: MatchRcvdCnt should be affected significantly since the focal user is unable to “leave a trace” in profiles of others and advertise herself, thus remaining unknown to the users she visits. On the other hand, MatchSentCnt should not experience significant changes since an outgoing match is initiated by the explicit message coming from the focal user and therefore, the anonymity of the focal user is irrelevant as the focal user already reveals herself by her initial message.
One-Way Mirrors and Weak-Signaling in Online Dating

<table>
<thead>
<tr>
<th>Gender</th>
<th>Manip</th>
<th>Variable</th>
<th>Mean</th>
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<th>Max</th>
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<td>174</td>
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</table>

Table 6. The effect of manipulation on matching behavior

Based on the empirical results from Table 6, it can be seen that MatchSentCnt and MatchRcvdCnt are indeed affected very differently by our manipulation: MatchSentCnt basically remains statistically unchanged for both genders, while MatchRcvdCnt is reduced very significantly with a drop of 20%-25% for both genders. This empirical finding supports the predictions given by weak-signaling theory.

This finding also explains the observed gender asymmetries in response to treatment: MatchSentCnt is not changed for both genders and only MatchRcvdCnt is significantly reduced. However, since MatchRcvdCnt is a much more significant component of MatchCnt for females as compared to males, it is females who experience a significantly bigger drop in the overall MatchCnt.

The timeline of the effect

It is interesting to note that the observed effect of anonymity disappears in Month 3 once the anonymity gift has expired (post-manipulation month). As demonstrated by Tables 7-9, the treatment group reverts to the behavior that is statistically indistinguishable from the control group in Month 3 as follows:

1) In Month 1 (prior to manipulation), the treatment and control groups were statistically indistinguishable in any observed aspect.

2) In Month 2 (during manipulation), the treatment and control groups become statistically different in numerous observed variables in a way that is consistent with weak-signaling theory.

3) In Month 3 (after manipulation is expired), the treatment and control groups became statistically indistinguishable in any observed aspect again as demonstrated by Tables 7-9.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Manip</th>
<th>Variable</th>
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<td>ViewSentCntPost</td>
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<td>1.01</td>
<td>0.3131</td>
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</tr>
</tbody>
</table>

Table 7. The effect on profile visits disappears once manipulation is expired
Table 8. The effect on messaging disappears once manipulation is expired

Therefore, we conclude that anonymity acts in an instantaneous\(^2\) fashion and leaves no observable difference on the post-treatment behavior of the users.

Table 9. The effect on matching disappears once manipulation is expired

Conclusions

Online dating platforms are rapidly growing worldwide. Given the humans are fundamentally mate-seekers, such growth underscores the inherent frictions and inefficiencies on real-world (offline) markets of dating and marriage. Our work is motivated by the fact that today’s big-data-enabled online dating platforms introduce new capabilities that have no direct parallels in the offline world. These range from

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\(^2\) We conducted a number of additional robustness tests such as comparing the effect during the last week of Month 2 versus the first week of Month 3. The same strong differences as in Tables 2-6 are observed between the treatment and control in the last week of Month 2, while all the statistical difference immediately disappears in the first week of Month 3. These additional results clearly show that the effect of manipulation disappears instantaneously once the manipulation is expired.
enhanced search to big-data based mate recommendations (much like Amazon recommends a book or Netflix recommends a movie, with the added nuance that while for books and movies the consumer has to like the book but the book does not have to like the consumer, in dating markets the individuals have to like each other!) to anonymity linked features such as weak-signaling, the focus of this paper. These new technological capabilities could be affecting user behavior in a number of different ways that are not always easy to anticipate in advance.

Our theoretical understanding of dating and marriage starts with Becker's (1973) exposition of assortative sorting as the equilibrium outcome assuming a frictionless market. Subsequent research (Burdett and Coles 1997, Mortensen and Pissarides 1999, and Smith 2002) has theoretically accounted for search frictions in the characterization of sorting equilibria. While the extant research has limited its attention to search frictions, we develop the idea that social frictions, as imposed by long-standing social norms such as women not making the first move in dating markets, are an important and, prior to this study, largely unstudied source of inefficiencies in such contexts (with the exception of Piskorski 2012). Thus, in departure from the extant literature, our treatment is in effect a horse race between different kinds of social frictions: browsing frictions, which anonymity lowers and should result in more matches, and messaging frictions, which arise when we take away weak-signaling and therefore should result in fewer matches. Again, while the economics literature has extended the original frictionless matching models to account for search frictions, no one has looked at social frictions and compared the two types of frictions in the setting of a randomized controlled trial.

In particular, in this paper, we explore the effect of one such anonymity-linked feature that we refer to as weak-signaling. Users treated and under this condition are able to browse potential mates’ profiles anonymously, without leaving a trail in the “Recent Visitors” list of the target user. While conventional wisdom suggests that such anonymity of profile browsing should be associated with improved matching outcomes by reducing search costs and allowing users to explore their options freely, our research results demonstrate that, to the contrary, there is significant drop in matching outcomes, particularly so for women. We demonstrate, by breaking down, measuring and analyzing the mate-seeking process in detail that this occurs because of dominating social friction force of not being able to leave a weak-signal. Women, who are reluctant to make the first move say by messaging a potential mate, are deprived by our treatment of even leaving a profile visit trail, which as it turns out is the key source of incoming messages and subsequent matches for them.

Under conditions of weak-signaling, when users browse their potential mates’ profiles in non-anonymous mode, they leave a clear, definitive and observable trail to their potential mates without actually messaging them and such a trail plays important role in creating the positive matching outcomes. Based on our large scale controlled randomized trial, we demonstrate that taking away this weak signaling ability causes a significant decline in the matching outcomes. Conversely, in other words, the presence of weak signaling ability improves matching outcomes.

In addition to that we establish that anonymity does lower browsing frictions— as expected users explore and check out more profiles of their prospective mates anonymously. This finding is consistent with the disinhibition effect, which suggests that under the cloak of anonymity users are less compelled to follow social norms.

The online dating platforms provide us with an environment where participants’ choices at sub-stage of the dating process are available to the researcher in unprecedented detail. We exploit this rich micro-level sub-process dating data to explain our key findings in a detailed and nuanced manner. In particular, we recognize that the final matching outcome (the outcome considered by the existing literature, e.g. Hitsch et al. 2010) is preceded by the sub-processes of viewing and messaging. Further, each of these sub-processes can be initiated by the focal user or the target user, giving rise to many possible permutations of arriving at a match. While prior literature has not considered this microscopic view, we find that it is key to better understanding our main results.

When we break down total matches into “matches sent” and “matches received” based on who initiated the matching process, we find that our manipulation causes the decrease in number of incoming matches while causing no changes in outgoing match count. We find that because our manipulation causes a decrease in the number of incoming messages, a person has fewer messages to respond to and therefore
fewer chances to establish a match. We expect the future research to examine in more depth the issue of quality of matches and long-term outcomes as they relate to marriage, happiness and divorce.

Matching two individuals is a complex task, relative to, say, matching a buyer with a product in product markets. In dating there are two sets of individual preferences that have to be taken into account in order to produce a successful match. Matching two humans is not only something that applies to dating and marriage, but also to new models of distributed work and crowdsourcing (Burtch et al. 2012). Thus, we expect this study and our associated methodology to be the basis of a stream of work on how the Internet and social media are changing some of the fundamental activities we carry out as humans.

Our work fits under the broader umbrella of emerging research that is interested in examining the societal impact of the new generation of big-data enabled online social platforms that connect people who either know each other (e.g. Facebook) or people who would like to know each other (e.g. eHarmony and Match.com) (Piskorski 2012). These newer platforms reduce many of the frictions that are present in the offline world that always exists as a close substitute for these new platforms. Many of these platforms replicate the prior social processes that they digitize; others extend and expand these social processes with newer capabilities. What is consistent across these platforms is that the very act of digitization of these social processes gives us unprecedented micro-level data and access to not just outcomes but also to the underlying sub-processes of getting to the outcomes. This, we argue, is a revolutionary research opening that awaits the broader scientific community. It is the opportunity to understand human behavior around fundamental social, economic and emotional decisions we make at a level we have been unable to imagine in the past.

References


