Propose with a Rose?

Signaling in Internet Dating Markets

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ABSTRACT

The large literature on costly signaling and the somewhat scant literature on preference signaling had varying success in showing that sending a signal affects outcomes. We use a field experiment to show that even when everyone can send a signal, signals are free and the only costs are opportunity costs, sending a signal increases the chances of success. In an online dating experiment, participants can attach "virtual roses" to a proposal to signal special interest in another participant. We find that attaching a rose to an offer substantially increases the chance of acceptance. This effect is driven by an increase in the acceptance rate when the offer is made to a participant who is less desirable than the proposer. Furthermore, participants endowed with more roses have more of their offers accepted than their counterparts.

Keywords: experiment, matching, signaling, market design, online dating

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I. INTRODUCTION

In many markets candidates vying for positions inundate employers with applications, making it difficult to decide on whom to bestow one of a limited number of costly interview or offer slots. For employers it therefore becomes important to not only assess the quality but also the attainability of an applicant.[1] To overcome these problems many markets have formal or informal preference signaling mechanisms in place. In models of such mechanisms signalers undertake an action - sending a signal to a specific agent - that is only observable to the signal recipient. While the direct costs of sending signals are the same for all agents, often even zero, in general the number of signals is limited and so they have opportunity costs (e.g. Avery and Levin, 2010, and Coles, Kushnir and Niederle, 2011). Despite the abundance of preference signaling, the empirical literature had a hard time in showing that an agent has more success when the agent sent a signal. The goal of this paper is to close this gap and provide empirical evidence that sending a preference signal can considerably improve the chances of success.

To study preference signaling, we conducted a field experiment on dating. A major online dating company in Korea organized two special dating events with 613 participants, of which about 50 percent were female. Participants were endowed with two "virtual roses" and a randomly chosen 20 percent with eight. A participant could send dating requests to up to 10 different people by sending a pre-made electronic note, a *proposal*. Participants could attach at most one virtual rose, a digital image icon, when sending a proposal. The roses were described as a way to show special interest. Hence, roses are signals that everyone could send for free to anyone and roses are costly only because they were in limited supply. We show that attaching a rose to a proposal improved the chance of a proposal to be accepted. The effect is driven by the increase in the acceptance rate due to attaching a rose when the offer is made to a participant who is a less desirable dating partner than the proposer. Instrumental variable regressions confirm that roses affect the probability that an offer is accepted. Furthermore, participants benefitted from having more roses.

Signaling private information that is relevant to others is a large research topic not only in economics, but in other disciplines as well. A much studied version of signaling is costly signaling (see Spence, 1973) where agents undertake various actions, in general visible to all participants, whose costs depend on the underlying trait to be signaled. Such costly signaling has, for example, been used as a partial explanation for education (for an early overview see Weiss,

[1] For evidence in employment see, e.g., Niederle, Proctor and Roth (2006), Roth and Xing (1997), Coles et al. (2010), Avery et al. (2001), and for college admission see, e.g. Avery et al. (2003) and Avery and Levin (2010).

1995), conspicuous consumption (Veblen, 1899) and even in biology with the famous extravagance of a peacock tail being the most prominent example of phenomena to be explained (Zahavi, 1975). Despite this broad application, it has been difficult to measure the extent to which signaling accounts for these phenomena.[2] Preference signaling differs from costly signaling in many ways: In the former, signals consist in general of a private message from the signaler to the signal recipient, the costs of sending a signal are the same for all agents, and often only consist of opportunity costs as the signals that can be sent are limited in numbers (see Avery and Levin, 2010, and Coles, Kushnir and Niederle, 2011).

Anecdotal evidence that sending a preference signal significantly improves the outcome of a signaler has been provided by Roth and Xing (1997) who studied a market in which employers – clinical psychology program directors – face congestion, that is, may not be able to make all the offers needed to fill their positions with the most desirable candidates. They documented that directors of a specific internship program deviated from their original desirability order over candidates and instead made offers to candidates who indicated they would accept such an offer while higher ranked candidates were still available. In college admission, Avery, Fairbanks and Zeckhauser (2003) documented many ways in which colleges try to assess the preferences of students when deciding whom to admit. An important channel is the option any student has to apply to that college through early admission, though in general students are allowed to apply early to one college only. Students that are accepted through early admission have lower SAT scores than those accepted through regular admission, suggesting that sending a signal increases the acceptance rate. Avery and Levin (2010) propose a preference signaling

[2] When trying to assess the empirical value of a costly signal such as a diploma in the labor literature, an ideal test would be to randomly assign diploma. While this may be ethically problematic, passing scores for the GED (Graduate Equivalency Degree) do vary. The first study to exploit such variation found a large signaling value for a GED (Tyler, Murnane, and Willett, 2000). Some subsequent papers seem to suggest smaller or no returns (e.g. Tyler, 2004, and Jepsen, Mueser, and Troske, 2010). More recently, exploiting variation in passing scores of high school exit exams, Martorell and Clark (2010) find a positive, though not large signaling value. In the biology literature, signaling models are tested by showing, for example, that the extravagance of a peacock train is a good predictor for its popularity as a mating partner. A long train has a negative effect on aerodynamic efficiency, which suggests that it is a valid sign of bird health (Thomas, 1993). However, the question is whether mating a peacock with an extravagant train leads to more healthy offspring, either because of good genes or less infectious diseases that may threaten the peahen. In general, it has been difficult to confirm the signaling theory in a coherent fashion (Johnstone, 1995). Indeed, there are other explanations for the extravagant peacock train that have nothing to do with signaling such as the runaway selection theory (Fisher, 1915, and Lande, 1981). In terms of conspicuous consumption, a recent test suggesting that it may serve as a status signal is given by Charles, Hurst, and Roussanov (forthcoming). Starting with the observation that Blacks and Hispanics devote larger shares of their expenditure bundles to visible goods than comparable Whites, they show that visible consumption declines as the income of the reference group rises. The latter being a key prediction of the status signaling model (see also Bagwell and Bernheim, 1996).

model that is consistent with many stylized facts of college admission.[3] There could, however, be other differences across students who apply early or late, such as the differential need for financial aid (Avery, Fairbanks and Zeckhauser, 2003).[4] The American Economic Association (AEA) introduced a signaling mechanism for the economics job market in 2006 (Coles, Cawley, Levine, Niederle, Roth, and Siegfried, 2010). Specifically, every student is able to signal to two universities of their choice. The problem is that most economics departments receive applications from more suitable candidates than they can interview. This means they have to decide not to interview many promising candidates for fear of filling interview slots with applicants that have no particularly strong interest in the position. Therefore, information pertaining to the preferences of candidates about the position can be helpful. Hence, signals may be especially useful when a candidate that looks very promising sends it to his first choice school among those that may not interview the candidate believing the candidate to be out of reach.[5] While there is positive evidence that sending a signal improves the chances to receive an interview at the AEA meetings, and that departments pay attention to signals, the evidence is rather suggestive and often lacks proper controls due to data restrictions (Coles et al., 2010).[6] Overall, the empirical literature on preference signaling has had a hard time in showing that an agent has more success when the agent sent a signal. Recall that it is difficult to show that costly signals sway decisions of other agents. Given that, it may not be surprising that the empirical literature on preference signals, where every agent can send a signal at the same costs had similar difficulties. The goal of this paper is to provide empirical evidence that sending a preference signal can considerably improve the chances of success.

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[3] Early admission can also come in the flavor where students promise to accept if a college were to make an early offer. Aiming for such more consequential signals is ubiquitous. For example, in the market for law clerks, preference signaling of that form is often made credible by using faculty "brokers" or social connections (Avery et al., 2001).

[4] Kim (2010) focuses on early admission as a screening device for students who do or do not require financial aid. Lee (2009) uses winner's curse type arguments to account for early admission.

[5] The AEA offers advice to participants that includes: "The two signals should not be thought of as indicating your top two choices. Instead, you should think about which two departments that you are interested in would be likely to interview you if they receive your signal, but not otherwise (see advice to departments, above). You might therefore want to send a signal to a department that you like but that might otherwise doubt whether they are likely to be able to hire you."
(see http://www.aeaweb.org/joe/signal/signaling.pdf).

[6] Coles et al. (2010) provide evidence that suggests that applicants who sent a signal to an employer are more likely to receive an interview there than at places they would have sent a signal had they a third one. Like in other studies on preference signaling, there is a lack of information to which other universities students applied and where they received offers from. This makes it hard to provide counterfactuals to what would have happened had a signal not been sent. Furthermore, participants may send a signal to a place at which they are an especially good fit, so that they may have received an interview there anyway. Hence, they can't rule out that their suggestive results are due to endogeneity reasons. For other examples on preference signaling see Coles, Kushnir and Niederle (2011).

Compared to other environments, our set-up offers three major advantages to test the impact of preference signaling. First, we were able to collect a wide range of information about participants, and furthermore, participants are probably less likely to have information about each other that is not observed. Second, even though the market is decentralized, we observe not only accepted proposals, but all proposals, because the market operates on the website of the dating company. Third, we were able to randomly select participants whom we endowed with eight roses when others received only two. Such an intervention may be ethically more problematic in labor or education markets.[7] This, however, will allow us to provide clean evidence that an agent who sent a preference signal can increase the chance that their offer is accepted. Furthermore, randomizing who receives more signals provides us with an instrument to control for possible endogeneity biases when estimating the effect of a rose that arise when participants attach a rose to offers that are more likely to be accepted anyway. Beside these three advantages, our study of online dating may itself be economically relevant because an important economic variable, marriage, is a result of dating,[8] and because online dating services are rapidly growing throughout the world.[9]

The experiment consisted of two special online dating sessions for people who are college-educated, never-married, Korean, aged between 26 and 38 for men, and 22 and 34 for women. We imposed restrictions on participants' characteristics to reduce heterogeneity in observables, which would potentially have segmented the dating market. Based on the participants' observable characteristics, we used the company's formula to predict the extent to which a participant would be desirable to the opposite sex as a dating partner. Using this prediction, we assign to a participant a desirability grade of bottom (the least desirable group), middle, or top (the most desirable group). For the first five days of the event, a participant could browse profiles and send up to 10 proposals and a proposal could be sent with at most one rose. Participants had two roses they could attach to proposals, with a randomly selected twenty percent of participants having eight roses. Once this period ended, each participant received his or

[7] The main difference between the dating and the employment environment is that a dating market is more continuous. As such any dating website is portioning off a fraction of the "natural" dating market and manipulating it. It is much more problematic to influence a national or even international market such as the economics junior market that operates once a year and whose initial outcome may have a large impact on careers (Oyer, 2006).

[8] Marriage has received some attention following the seminal work by Becker (1973). Examples of empirical studies on marriage include Abramitzky et al. (2011), Angrist (2002), Banerjee et al. (2009), Choo and Siow (2006), Fernandez et al., (2005), Fisman et al. (2006) and (2008), Hitsch et al. (2010), Lee (2009) and Wong (2003).

[9] For example, in the U.S., major dating companies have been established since the mid-1990s and the market size is expected to be $932 million in 2011 (JupiterResearch, 2007). Online dating services are popular not only in developed countries but also in developing countries such as Korea, India and China.

her proposals and observed whether they came with a rose. For the next four days, participants decided whether to accept each proposal; and where they could accept at most 10 proposals. After the acceptance phase, an accepted proposal resulted in the company sending a text message to inform the involved pair of each other's contact information.

We predict roses to be useful because our participants in the online dating experiment are busy young people who may be careful how to spend their limited spare time. They may only be interested in spending time on a date when dates may turn into a relationship. As such, offers from desirable participants may be rejected, out of fear that the interest may not be serious enough. Hence, roses may be particularly effective when they are sent to participants that are somewhat less desirable than the sender is. We therefore expect roses to be useful the way signals are suggested to be for economics job market candidates, though of course the dating market differs in many ways from entry-level labor markets.

To study the effect of attaching a rose to a proposal, we compare the acceptance rate of an offer with and without a rose using recipient fixed effects and the senders' desirability grade. We find that, overall, sending a proposal with a rose increased the probability that a recipient would accept the proposal by 3.3 percentage points, which corresponds to a twenty percent increase in the acceptance rate. This effect is similar in magnitude to the increase in the acceptance rate by recipients when the dating offer came from a middle rather than bottom desirable sender. This implies that, by sending a rose, a bottom group sender will be almost equally attractive as his or her counterpart belonging to the middle group. Furthermore, these results are robust when using IV estimates where we instrument the effect of a rose with whether the applicant had two or eight roses. This confirms that roses do affect the acceptance rate.

A more detailed analysis shows that every recipient group responds positively to roses when the proposals were made by senders from a higher desirability group. That is, when a sender from the top desirability group made an offer to a middle or bottom desirable recipient this offer was significantly more likely to be accepted when a rose was attached. Likewise for offers with and without roses from middle senders to bottom recipients. The effect of a rose in all those instances is more than a 50% increase in the acceptance rate, and therefore corresponds to twice the increase in the acceptance rate when moving the sender form the bottom to middle desirability group. Analyzing the effect of roses on proposers instead of proposals, we show directly that participants with more roses were more successful, in that they had more dates that they initiated.

The experiment on internet dating shows unambiguously that by sending a preference signal, where everyone can send signals for free, though signals are limited in numbers, a proposer can increase the chance of being accepted. Senders are able to convey information to

recipients using preference signals and recipients react to signals. This is a necessary step to hope that a market intervention that introduces a signaling mechanism can have an effect on the final outcome. The rest of this paper is organized as follows. In Section 2, we describe the experiment. Section 3 reports who proposed to whom, and what determines whether a rose was attached. Section 4 analyzes the effect of a rose. Section 5 concludes.

II. Experimental Design

II.A Background Information

We conducted a field experiment at a major online dating company in South Korea that also operates in China, Singapore and the United States. Since 1991, the company has been helping clients to find spouses among clients of the opposite sex. The company provides two types of memberships: regular and special. The main differences between the two are the membership cost, the length of service, the degree of the company's involvement in a client's search process, and the depth of supporting documents for legal verification of a client's information. A regular membership lasts for one year and costs about $900, whereas a special membership is for a one time dating event which occurs for example at Valentine's Day, during the summer vacation season and Christmas.

For regular members the company suggests "suitable" dating partners based on its matching algorithm. To match members the company creates an index (herein, *desirability index*), which is a sex-specific weighted sum of a person's characteristics many of which have to be legally verified.[10] The desirability index is intended to predict how attractive a person would be to the opposite sex as a spouse. It ranges from 0 (least desirable) to 100 (most desirable). The desirability index is not visible to members of the dating site. Using a dataset from the company (separate from the experiment) collected by Lee (2009), we find that the desirability index is a good predictor of whether a client is attractive as a dating partner (see Section 1 of the online appendix).

Special members who can only participate in special dating events are asked the same set of questions as regular members, but are not required to answer them all, and can also fail to

[10] A person's desirability index is calculated based on earnings, assets, job security (full time job or not), height, weight, a company-generated score based on the profile picture, a score based on the college attended and the chosen major, both of which are highly correlated with the score on the national college entry exam, birth order, and family characteristics (parent's wealth and marital status, and siblings' educational attainment).

submit some of the legal documents. The company constructs a verification score that is posted on the member's profile and ranges from 0 (no legal verification) to 100 (full legal verification).[11]

II.B EXPERIMENTAL DESIGN

Procedure

In the summer of 2008, the company advertised two sessions of the field experiment in Korea as one of its special dating events with a participation fee of $50. We limited participants to be Korean, college educated, never married and aged from 26 to 38 for men and 22 to 34 for women. We imposed these restrictions to reduce heterogeneity among participants and create a thick market. While this may make it easier for participants to find a good match, it may also imply that participants may not have sufficient time to date all desirable candidates.

Each session of the experiment consisted of two stages: First is a proposal stage which lasted five days; then there is a response stage of four days. In the proposal stage, each participant could browse profiles of other participants that contained their submitted information including a head-to-shoulder photo and their verification score. Each participant could send a pre-made electronic note (herein *proposal*) asking for a date to up to ten participants of the opposite sex. Furthermore, each participant could attach up to one virtual rose per proposal. The virtual roses are a preference signaling mechanism specifically introduced for this event.

In the response stage, participants received the proposals sent to them and saw whether a rose was attached. Participants could accept up to 10 proposals but did not receive any information whether any of the proposals they made were accepted. No new proposals could be made in the response stage. An accepted proposal (a date) resulted in the company sending a text message to the two involved participants about each other's phone number right after the response stage. Given the design, each participant could have at most 20 first dates.

By separating the proposal stage from the response stage, participants, when deciding whom to make a proposal, could not observe the proposals of others. Similarly, during the response stage, participants did not know whether any proposals were accepted or rejected. This simplifies the empirical analysis by preventing that a participant may make his or her decisions contingent on other participants' decisions (apart from responding to proposals he or she received).

[11] To receive 100 percent verification, a participant needs to submit a copy of the national household registration form (for age, birth order, marital history and parents' marital status), diploma (for education) and proof of employment (for type of employment and industry).

Treatments

The innovation in the dating event is to endow participants with virtual roses. The main analysis is to assess whether attaching a rose increases the chance that a proposal is accepted. The first treatment variable is to change the number of roses participants are endowed with. Eighty percent of participants received two roses, while 20 percent received eight roses. This allows us to directly assess whether participants with eight roses are more likely to have a proposal accepted. Furthermore, we will use the treatment status as an instrumental variable to control for endogeneity problems when assessing whether roses increase the chance that a proposal is accepted.

The experiment also included a second, more psychological treatment. The motivation is that many researchers document that women are more passive in dating and seem to mostly react to offers (Hitsch et al., 2010; Fisman et al., 2006; and Kurzban and Weeden, 2005). However, when women and men differ in their preferences over each other, then who marries whom may depend on who initiates matches. When marital surplus is not fully transferable, passivity in the mate search process may make women worse off.[12] The aim of the second treatment is to affect the behavior of women and men to reduce the gender inequality in the mate search process.

In the *female empowerment* treatment we randomly selected 50 percent of female participants. During the proposal stage, we showed them a banner which was built into the main webpage and visible whenever a treated participant was on the website with the aim of encouraging them to initiate a proposal.[13] Finally, we have an equivalent treatment for men, called *male empowerment*, encouraging them to accept offers by women. We randomly selected 50 percent of male participants who during the response stage saw a banner on their website.[14] The verbal encouragements had no impact. We control for them, but will not discuss them further.

Information

A participant can access the online profiles of other participants, but neither knows the treatment status of other participants nor other participants' activities. Furthermore, participants

[12] There may be several core outcomes of who is married to whom, in which case the outcome preferred by all men is different from the woman preferred outcome (see Roth and Sotomayor, 1990, for an overview). A dating market in which men make offers may be closer to achieving the male optimal stable matching, the most preferred outcome by men. Lee (2009) provides evidence that matches would be quite different when women were to make offers as opposed to men.

[13] The banner read, in translation: "Will you wait until Prince Charming asks you out? Or, will you take the lead to meet him? Dear client, did you find someone you want to date? Please do not let this opportunity pass you by. Contact him first and give him the opportunity to meet you."

[14] The banner read, in translation, "Congratulations! You received a dating request. Please give an opportunity to the one who falls in love with your charm!"

were not informed that there were different treatments.

Data

The dataset consists for each participant of their characteristics, desirability index, verification score, the list of people to whom the participant sent a proposal and whether a rose was attached, the list of people from whom the participant received a proposal and whether a rose was attached to the proposal, and for all those proposals, whether they were accepted, declined or simply ignored.

II.C PARTICIPANTS

There were 212 participants in the first and 401 in the second session. Roughly half of each session's participants were female. Thirty-three men and 25 women participated in both sessions. All participants met the participation criteria, apart from four high-school graduates. About 20 percent of participants of each sex received both eight roses and the empowerment treatment. About 37 percent of the remaining participants received two roses and the empowerment treatment. All the remaining participants, except for three men, received only two roses.

TABLE I PARTICIPANTS' CHARACTERISTICS BY TREATMENT STATUS

Treatment Status	Group 1	Group 2 [a)]	Group 3 [b)]
Number of roses	2	2	8
Perception or Empowerment	No	Yes	Yes
Male participants			
Number of participants	146	97	58
Age	32.14	32.07	33.10**
Greater Seoul (percent)	84.93	94.85**	81.03***
Desirability index by the company	75.28	74.45	76.43
Special members (percent)	47.26	42.27	19.97***
Verification – fully-verified (percent)	69.86	61.86	86.21**
Verification – not-verified (percent)	2.74	2.06	0.00
Female participants			
Number of participants	153	95	61
Age	29.54	29.48	30.13*
Greater Seoul (percent)	88.24	86.32	81.97
Desirability index by the company	78.58	79.62	79.97
Special members (percent)	30.72	21.05*	22.95
Verification – fully-verified (percent)	67.32	68.42	75.41
Verification – not-verified (percent)	3.27	5.26	1.64

Notes: The male participants of Groups 1 to 3 do not add up to 304 because three men were endowed with eight roses but were not in the empowerment treatment. Greater Seoul includes Seoul and Gyeonggi province. In column 2 (Group 2, a) we test whether the characteristics of participants in Group 2 are statistically different from those in Group 1. In column 3 (Group 3, b) we do the same for Group 3 compared to Group 2. In all cases, *, **, and *** indicate that using a two-sided t-test the difference is significant at 10%, 5%, and 1%, respectively.

To check the randomization into the treatment status, we compare the characteristics of the three groups of participants using t-tests:[15] two roses and no empowerment (Group 1), two roses and empowerment (Group 2), and eight roses with empowerment (Group 3). We report results in Table I.

For female participants the three treatment groups are not significantly different from one another in terms of the desirability index or the verification score. Concerning age and location, once more, there is no significant difference. For male participants, Groups 1 to 3 are comparable in terms of desirability index but differ on the verification score. Furthermore, there are differences in age and the likelihood of living in Greater Seoul. In light of these findings, we will always control for the characteristics that vary across groups, namely age, verification score and location. As long as there is no unobservable heterogeneity across groups, we can study the treatment effects by controlling for these observable differences.

III. PROPOSALS AND ROSES

III.A PARTICIPANT'S TYPE

For each participant, especially those that are regular members, we have a large number of characteristics, many of which are used to compute the desirability index. For regular members, we define the type to be their desirability index, age and residential location. There are two reasons why we opt to use the desirability index as a summary statistic for how desirable participants are to the opposite sex as dating partners. First, we obtained a different and much larger sample of regular members that fulfill the requirements of our experiment. We find that the variables we use to define a participants' type explain almost all the variation of a person's desirability as a dating partner compared to when we use all available characteristics (see Section 1 of the online appendix). Second, using the desirability index will make the interpretation of our results easier, though the findings remain qualitatively the same when we use alternative definitions of a participant's "desirability" (Section 3 of the online appendix).

In our analysis, we partition participants according to their desirability index into three categories within each sex: the bottom 30 percent, the top 30 percent, and the remaining 40 percent (referred to as bottom, top, and middle, respectively). Since we have also special members whose information may not be fully verified, we include this information in the participants' type through three levels: fully, partially, or not at all legally verified.[16] Therefore,

[15] Permutation tests yield qualitatively the same results.

[16] Full verification requires the national household registration form, diploma, and employment verification. Partial verification requires the national household registration form.

the type of a participant in the experiment is their desirability index which we group into bottom, middle and top, age, residential location and legal verification level.

III.B Sending Proposals and Roses

Altogether 1,921 proposals are made, of which 66% (1,261) are made by men. Men are in fact significantly more active proposers than women on any dimension. They have a higher chance to make a proposal, 54.28 percent compared to the female 36.89 percent (p = 0.00).[17] Conditioning on sending a proposal, men send more proposals than women, 7.64 compared to 5.79 (p = 0.00).[18] Figure I.A shows for each decile of the desirability index the percent of proposals made by participants of that level of desirability or lower.[19] Because the graph aligns with the 45 degree line, this suggests that one's own desirability is not a determining factor when deciding whether and how many proposals to make.

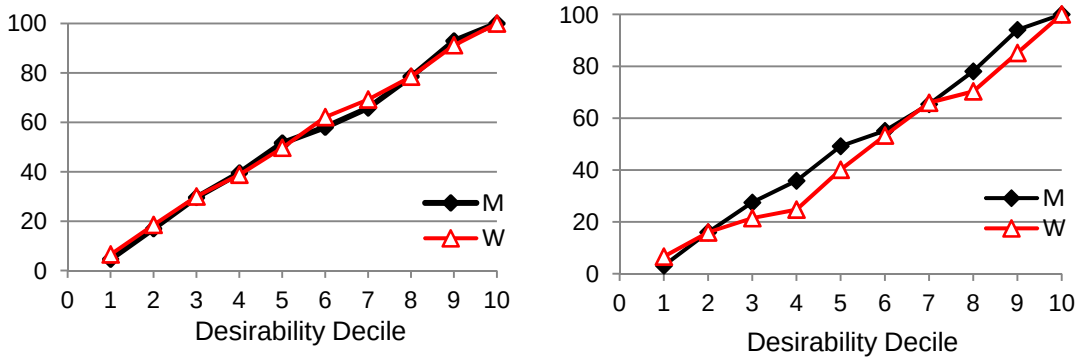

Figure I

Figure I.A: For each decile of desirability, where 1 is the least and 10 the most desirable group, the cumulative distribution function of proposals made.

Figure I.B: For each decile of desirability, where 1 is the least and 10 the most desirable group, the cumulative distribution function of roses sent.

The regressions on sending proposals reported in Table II confirm the gender differences and that the proposers own desirability is not a determining factor. We use a linear regression model to estimate which participants send at least one proposal, and how many proposals are sent

[17] For all tests on proportions and means, the p-values correspond to a two-sided t-test. The rather careful behavior in selecting a dating partner may be due to the participants' characteristics in our sample. Most participants are full-time employees whose age is close to but slightly higher than the average age of first marriage in Korea, which implies that they may not want to waste their time on "not-so-good" dating partners.

[18] Conditioning on sending a proposal, men are also significantly more likely than women to exhaust their proposals (53.94 percent compared to 27.19 percent, p = 0.00).

[19] We divide the desirability index by sex into deciles, where 1 corresponds to the bottom 10 percent of desirability index-rated participants.

(conditional on sending at least one).[20] The reported gender coefficient of -0.115 in column 1 shows that women are 11.5 percentage points less likely to send a proposal than men are. Column 4 shows that conditional on sending a proposal, women send 1.05 less proposals than men. The coefficients on the desirability index of the sender (S_Middle and S_Top) are not significant in any regression, showing that the desirability of the sender is not a significant predictor whether and how many proposals participants make.[21]

TABLE II SENDING PROPOSALS

	Sending a proposal			Number of proposals (if > 0)		
Sender	All	Men	Women	All	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.115**			-1.050*		
	(0.054)			(0.610)		
Male with 8 roses	0.239***	0.208***		0.677	0.709	
	(0.071)	(0.070)		(0.563)	(0.549)	
Female with 8 roses	0.035		0.056	0.388		0.369
	(0.080)		(0.080)	(0.838)		(0.898)
Female empowerment	0.037		0.048	-0.23		-0.271
	(0.064)		(0.064)	(0.706)		(0.749)
S_ Middle	0.001	-0.058	0.055	-0.264	0.269	-1.007
	(0.048)	(0.068)	(0.067)	(0.493)	(0.630)	(0.805)
S_ Top	0.061	0.073	0.028	-0.138	-0.028	-0.318
	(0.053)	(0.074)	(0.074)	(0.521)	(0.651)	(0.879)
No. of observations	611	304	307	278	165	113
R-sq	0.070	0.100	0.030	0.118	0.060	0.065

Notes: OLS estimates. In columns 1 to 3, the dependent variable is one if a participant sent at least one proposal and zero otherwise. In columns 4 to 6, the dependent variable is the number of proposals a participant sent. Female, Male/Female with 8 roses and Female empowerment are dummies for the described conditions. S_Middle and S_Top indicate whether the sender is from the middle or top desirability group, respectively. All regression models control for the verification level (none, medium, full), age, and a living in greater Seoul dummy. Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

Furthermore, while participants with eight roses seem slightly more active on all dimensions, only men were significantly more likely to make an offer compared to participants in the control who had only two roses. Finally, the empowerment treatment did not affect women in terms of whether they made a proposal or how many proposals they made.

[20] For regressions on whether the participant sent a proposal, that is columns 1 to 3 from Table II, the marginal effects from logit and probit models are very similar to the results from the linear probability model.

[21] The conclusions are robust to more flexible controls of a participant's desirability index (such as using a second order polynomial instead of dummy variables for three desirability groups).

A rose is attached to 670 proposals. A total of 38.70 percent (478) of proposals made by men come with a rose, compared to 27.58 percent (182) of proposals made by women ($p = 0.00$). Conditioning on sending a proposal, men are more likely than women to use at least one rose (90.30 compared to 64.91 percent, $p = 0.00$). Conditional on sending a rose, men are also more likely to exhaust their roses, that is use up all their roses or use as many roses as proposals (75.17 percent versus 47.30 percent, $p = 0.00$). Once more, when considering who sends roses, Figure I.B suggests that participants of all levels of desirability evenly send signals.

TABLE III SENDING ROSES

	Sending a rose			Number of roses (if > 0)		
Sender	All	Men	Women	All	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.222***			-0.006		
	(0.072)			(0.238)		
Male with 8 roses	0.031	0.035		4.936***	4.973***	
	(0.066)	(0.051)		(0.197)	(0.175)	
Female with 8 roses	0.170*		0.163	3.239***		3.263***
	(0.098)		(0.127)	(0.340)		(0.411)
Female empowerment	-0.061		-0.073	0.112		0.168
	(0.083)		(0.106)	(0.301)		(0.356)
No of proposals sent	0.019***	0.017**	0.019	0.219***	0.207***	0.234***
	(0.007)	(0.007)	(0.014)	(0.023)	(0.026)	(0.045)
S_ Middle	0.012	0.056	-0.043	0.368**	-0.061	1.272***
	(0.058)	(0.059)	(0.114)	(0.183)	(0.197)	(0.379)
S_ Top	-0.022	-0.079	0.066	0.307	-0.092	1.132***
	(0.061)	(0.061)	(0.124)	(0.196)	(0.211)	(0.402)
No. of Observations	278	165	113	223	149	74
R-sq	0.140	0.080	0.080	0.8219	0.8740	0.7012

Notes: OLS estimates. The sample includes participants who made at least one proposal. In columns 1 to 3, the dependent variable is one if a participant sent at least one rose and zero otherwise. In columns 4 to 6, the dependent variable is the number of roses a participant sent. Female, Male/Female with 8 roses and Female empowerment are dummies for the described conditions. S_Middle and S_Top indicate whether the sender is from the middle or top desirability group, respectively. No of proposals sent is the number of proposals that a participant made. All regression models control for the verification level (none, medium, full), age, and living in greater Seoul. Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

Linear regressions in Table III confirm that women are significantly less likely to send at least one rose (column 1), and that participants of all levels of desirability are equally likely to use a rose (columns 1 to 3). Men who make more offers are also significantly more likely to use at least one rose, while the effect for women, though similar in magnitude, is not significant.[22] Conditional on using at least one rose and controlling for the number of proposals, women and

[22] For regressions on whether the participant sent a rose, that is columns 1 to 3 from Table III, the marginal effects from logit and probit models are very similar to the results from the linear probability model.

men send a similar number of roses. Specifically, women only send 0.006 fewer roses than men (column 4). While desirability so far had no explanatory power, women in the bottom desirability group do not send as many roses as those in the middle or top group, conditional on using at least one rose (column 6). Similar to the proposal behavior, whether a female participant received the empowerment treatment is not a statistically significant predictor for the participant's usage of endowed roses. Finally, conditioning on participants who sent at least one rose, participants with eight roses use on average an additional 3.2 (for women) and 4.9 roses (for men). Women with eight roses are also somewhat more likely to use at least one rose. This implies that if roses increase the chance of an offer to be accepted, participants with more roses should have more of their offers accepted, especially if they do not differ in whom they make offers or whom they send roses to.

III.C Who Receives Proposals and Roses?

While desirability played little role when determining who sent proposals and roses, it is important for receiving proposals. This is a confirmation that within our sample the desirability index is a good predictor on how desirable a participant is as a dating partner. Figure II shows the cumulative distribution function of proposals received by desirability decile. For both genders the function is below the 45-degree line, meaning that more desirable participants receive more proposals.

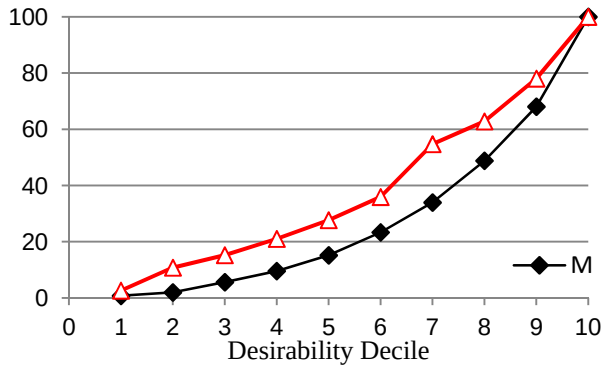

Figure II
For each desirability decile, the cumulative proportion of all offers received by recipients of that decile or lower.

In Table IV we report probit regressions to predict which 1,902 of the possible 102,064 proposals were actually made, based on sender and recipient characteristics.[23] We use "S_" to indicate sender and "R_" to indicate recipient characteristics and report marginal effects.

[23] We have 104 men and 108 women in Session 1 and 200 men and 201 women in Session 2. Two women

TABLE IV WHO SENT A PROPOSAL TO WHOM?

	All proposals			If Sender proposed		
Sender	All	Men	Women	All	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)
S_female	-0.003***			0.006***		
	(0.001)			(0.002)		
S_male with 8 roses	0.009***	0.010***		0.007***	0.007***	
	(0.001)	(0.002)		(0.002)	(0.002)	
S_female with 8 roses	0.002		0.002**	0.003		0.004**
	(0.002)		(0.001)	(0.003)		(0.002)
S_female empowerment	0.001		0.001	-0.002		-0.001
	(0.001)		(0.000)	(0.003)		(0.001)
S_Middle	-0.008***	-0.012***	-0.002	-0.015***	-0.019***	-0.005
	(0.002)	(0.003)	(0.001)	(0.004)	(0.005)	(0.004)
S_Top	-0.009***	-0.012***	-0.005***	-0.021***	-0.025***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)	(0.004)
R_Middle	0.007***	0.005*	0.005***	0.014***	0.010**	0.013***
	(0.002)	(0.003)	(0.002)	(0.004)	(0.005)	(0.004)
R_Top	0.012***	0.005*	0.011***	0.023***	0.009*	0.028***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)
S_Middle X R_Middle	0.006**	0.011**	0.000	0.012**	0.021**	-0.001
	(0.003)	(0.005)	(0.002)	(0.006)	(0.009)	(0.004)
S_Middle X R_Top	0.013***	0.016***	0.005	0.027***	0.030***	0.009
	(0.004)	(0.006)	(0.003)	(0.008)	(0.010)	(0.006)
S_Top X R_Middle	0.009**	0.014**	0.004	0.018**	0.025**	0.009
	(0.004)	(0.006)	(0.004)	(0.007)	(0.010)	(0.009)
S_Top X R_Top	0.022***	0.028***	0.014**	0.043***	0.049***	0.032*
	(0.005)	(0.008)	(0.007)	(0.010)	(0.013)	(0.016)
No. of proposals	102,064	51,032	51,032	49,496	29,104	20,392
Pseudo R-sq	0.065	0.065	0.1223	0.0659	0.0642	0.1506

Notes: Probit estimates. The dependent variable is one if a participant made a proposal to a given recipient and zero otherwise. We report marginal effects at the mean of each regressor or in the case of dummy variables at zero. "S_" and "R_" denote sender and recipient characteristics, respectively. For instance, S_female is one if a sender is female and zero otherwise. "S_Middle X R_Middle" is one if a sender belongs to the middle desirability group and a recipient belongs to the middle desirability group. All regression models control for recipient and sender's verification level (none, medium, full), age, living in greater Seoul, the squared difference of age between a sender and a recipient and a dummy indicating whether the two are in the same location. Location has five categories: Greater Seoul, Gangwon, Chungcheong, Jeolla/Jeju, and Gyeungsang. Standard errors of the marginal effect are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

We start with the regression that includes all participants in the first column. The positive marginal coefficients of 0.012 of "R_Top" means that a sender in the bottom group is 1.2

in session 2 have no desirability index. Thus, the number of potential proposals between men and women with a desirability index is 102,064, that is 2*104*108 plus 2*200*199. The multiplication of 2 is because for a given male-female pair there are two possible proposals: the man can propose to the woman and the woman can propose to the man.

percentage points more likely to make an offer to a specific recipient if that recipient is in the top rather than bottom desirability group. A sender in the top group is R_Top plus S_Top X R_Top, that is, 3.4 percentage points more likely to make an offer to a recipient in the top rather than the bottom desirability group. Overall, column 1 shows that senders are more likely to make offers to more desirable recipients, and the more so, the more desirable they are themselves. When we restrict attention to men only, this effect is significant. Women, on the other hand, already send so many proposals to top recipients, that only top desirable women are even more likely to make offers to top desirable men.[24]

The negative effect of 0.003 of "S_female" means that for a given pair of participants, the woman is 0.3 percentage points less likely to contact the man than the man is to contact the woman. Table IV further shows that men and women endowed with eight roses are more likely to make a proposal. Female empowerment, however, has no significant effect.

In the last three columns (columns 4 to 6), we restrict the sample to senders who sent at least one proposal.[25] All initial results are strengthened. However, the female dummy is now positive and significant. This is due to the restriction that the coefficients of other controls do not depend on gender. If we allow for the possibility that women send offers to middle and top desirable partners differently than men, that is include interaction terms such as S_female X R_Middle and S_female X R_Top, the marginal effect on the female dummy is negative, -0.14 and significant (p = 0.01 of the underlying coefficient with a standard error of the marginal effect of 0.00).

Being endowed with eight roses may not only affect whether senders are more likely to make an offer, but also to whom. To assess this possibility, we run a probit regression identical to the one in Table IV, but with interaction terms between the treatment group of the sender, and the desirability group of both sender and recipient.[26] Overall, the interaction terms are not statistically different from zero, suggesting that participants send proposals in a similar way in all treatment groups (see Section 2 of the online appendix).

We have seen that more desirable participants are vastly more likely to receive a proposal. If this is true for roses as well, we would expect participants to send roses to the most desirable potential mates they made an offer to. Alternatively, roses could be used as a signaling mechanism in a market in which time is scarce, and participants may not be certain whether the

[24] Note that, consistent with the results from Table II, we find that participants from the bottom, middle and top desirability group are equally likely to make an offer.
[25] Hence we have 41*108 + 124*201 potential observations for men and 23*104+90*200 for women.
[26] For example, we include for female senders with eight roses the variable "S_female with eight roses X S_Bottom X R_Bottom" that is the indicator "S_Bottom X R_Bottom" multiplied by whether a sender is female and endowed with eight roses.

other party is really interested. In that case, roses may not necessarily be sent to the most desirable potential dating partners (see Coles, Kushnir and Niederle, 2011, and Coles et al. 2010).[27]

Figure III.A shows for each desirability decile the fraction of proposals that came with a rose. The figure suggests that roses are not based on the desirability of recipients apart from possibly medium desirable men receiving somewhat fewer roses.[28]

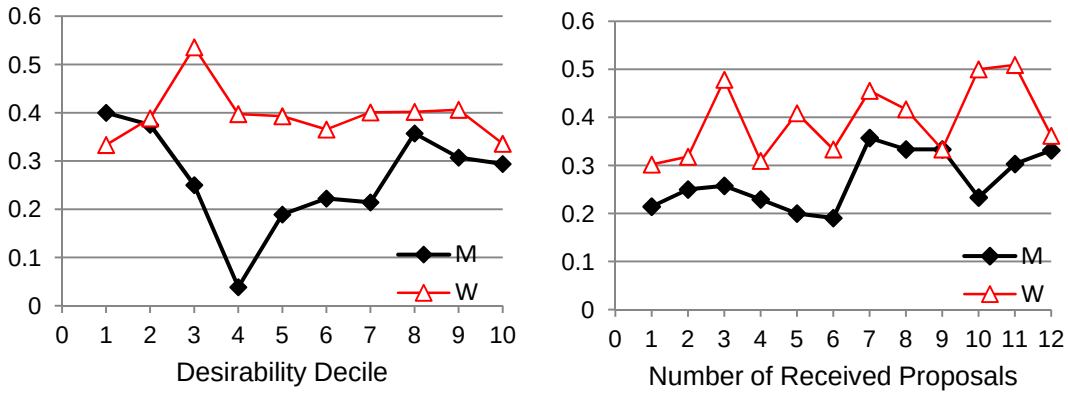

Figure III

Figure III.A: For each decile of desirability, where 1 is the least and 10 the most desirable group, the fraction of proposals accompanied by a rose.

Figure III.B: For each number of received proposals up to 12, the fraction of proposals accompanied by a rose.

In Table V, we use a linear model to regress whether a rose accompanied a proposal on the characteristics of the sender and the recipient. We use the full sample for columns 1 to 3, while columns 4 to 6 report results for senders who sent at least one rose. The coefficients pertaining to the desirability of the recipient are largely not significantly different from zero, which confirms that the decision to add a rose to a proposal seems not correlated with the characteristics of the recipient. Only in column 1 is R_Middle significant, but the coefficient is not significant when we consider men and women separately, or in any other regression. The results are the same when we condition on participants who sent at least one rose.

[27] Recall that the advice for students on the AEA website on how to use signals starts with telling them that they should not their top two choices. Rather, students may want to send them to departments who they worry may not interview them otherwise, as the departments may not realize the interest is serious enough to warrant one of the limited numbers of interview slots.

[28] While the high fraction of offers with roses made to bottom men is not a significant deviation, because very few bottom men received offers. Men in the fourth desirability decile are significantly less likely to have a rose attached to their offers than men in better desirability deciles.

Consistent with our earlier findings in Table III, proposals from senders that had eight roses are more likely to be accompanied by a rose. However, neither the gender of the sender, nor the empowerment treatment significantly correlates with the decision to add a rose to a proposal.

TABLE V WHO SENT A ROSE TO WHOM?

	All proposals			Sender sent at least one rose		
Sender	All	Men	Women	All	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)
S_female	-0.043			0.037		
	(0.040)			(0.048)		
S_male with 8 roses	0.577***	0.576***		0.585***	0.584***	
	(0.025)	(0.026)		(0.027)	(0.027)	
S_female with 8 roses	0.454***		0.441***	0.463***		0.448***
	(0.043)		(0.043)	(0.053)		(0.057)
S_female empowerment	-0.017		-0.009	0.016		0.022
	(0.038)		(0.038)	(0.049)		(0.051)
S_Middle	0.068	0.056	0.151	0.045	0.027	0.206
	(0.062)	(0.071)	(0.142)	(0.066)	(0.072)	(0.177)
S_Top	-0.059	-0.083	0.202	-0.066	-0.089	0.203
	(0.072)	(0.078)	(0.227)	(0.079)	(0.083)	(0.252)
R_Middle	-0.082*	-0.049	-0.070	-0.073	-0.044	-0.036
	(0.049)	(0.056)	(0.106)	(0.052)	(0.057)	(0.131)
R_Top	-0.027	-0.056	0.109	0.006	-0.029	0.205
	(0.049)	(0.058)	(0.104)	(0.053)	(0.059)	(0.129)
S_Middle X R_Middle	-0.012	-0.038	-0.009	-0.016	-0.039	-0.064
	(0.073)	(0.083)	(0.158)	(0.078)	(0.085)	(0.198)
S_Middle X R_Top	-0.027	-0.033	-0.085	-0.038	-0.052	-0.136
	(0.071)	(0.084)	(0.151)	(0.076)	(0.085)	(0.189)
S_Top X R_Middle	0.129	0.105	-0.033	0.104	0.096	-0.087
	(0.082)	(0.090)	(0.240)	(0.089)	(0.095)	(0.269)
S_Top X R_Top	0.082	0.107	-0.177	0.074	0.107	-0.207
	(0.080)	(0.089)	(0.233)	(0.088)	(0.095)	(0.262)
No. of proposals	1,902	1,245	657	1,615	1,153	462
Pseudo R-sq	0.280	0.300	0.220	0.280	0.310	0.250

Notes: OLS estimates. The dependent variable is one if a rose is attached to a given proposal and zero otherwise. "S_" and "R_" denote sender and recipient characteristics, respectively. All regression models control for recipient and sender's verification level (none, medium, full), age, living in greater Seoul, the squared difference of age between a sender and a recipient and a dummy indicating whether the two are in the same location. Location has five categories: Greater Seoul, Gangwon, Chungcheong, Jeolla/Jeju, and Gyeungsang. Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

As a final test that on average roses seem to follow proposals proportionally, we use an alternative measure of desirability. Specifically, Figure III.B shows the fraction of proposals accompanied by a rose depending on the number of proposals a participant received. When we define desirable participants as those who received more offers, we confirm that all participants

have the same likelihood of having a rose attached to a proposal. This is confirmed by a regression that mirrors Table V while replacing the recipient's desirability group with the number of proposals a recipient received (see Section 3.1 of the online appendix).

In a manner similar to our analysis on proposals, we examine whether the treatment group affects to whom proposers send a rose. We use a regression similar to the one in Table V with interaction terms between the treatment group of the sender and characteristics of both the sender and recipient. Overall, we find no evidence that the treatment group affects to whom roses are sent (see Section 4 of the online appendix).

IV The Effect of Roses

IV.A Acceptances and the Effect of Roses

After the proposal stage participants had four days to respond to offers they received. They could accept at most 10 proposals, actively reject proposals, or simply not respond. Of the 1,921 proposals, 295 were accepted, 445 explicitly rejected, and the remaining was not responded to. Among the 394 participants who received at least one proposal, 152 always gave explicit rejections or acceptances, 104 gave either explicit or implicit responses, and the remaining 138 participants did not respond to any proposal. Of all proposals, 15.35 percent were accepted. Men accepted 20.76 percent of their proposals, which is significantly higher than the 12.53 female acceptance rate ($p < 0.01$). We had 15 couples who proposed to each other, and they all accepted each other, with three women not responding, however.

The average number of acceptances among participants who received an offer is 0.8 for men, and 0.7 for women.[29] Even among the 16 men and 40 women who receive 10 or more offers, the average number of accepted offers is only 1.76 (2.25 for men and 1.58 for women, not significantly different). The highest number of accepted offers is 8, which implies that the restriction to be able to accept only 10 offers was not binding. These results suggest that participants have high opportunity costs of time. This would imply that there may be situations in which quite desirable dating partners are rejected because the participant believes the chance of a successful date to be too low. That is, participants may base their decision not only on how desirable a dating partner is. Participants may also care about their chances that the date may lead to a successful series of dates, that is, participants may value information that indicates whether the dating partner is very interested. So, when a participant decides which among various dating

[29] While the average number of accepted offers is similar between women and men, women are significantly less likely to accept an offer than men (16 versus 29 percent, $p < 0.01$). This is because women on average receive 5.9 offers, while men only receive 3.9.

partners to accept, and worries about how serious the requests are, then information that a specific dating request is "special" might very well be taken into account. That is, an offer with a rose may have a higher chance to be accepted than an offer without a rose. When roses do help overcome the worry that a candidate is not sufficiently serious in their proposal, then we would expect this to be the case especially for middle and bottom desirable participants. This is because top desirable participants may not have to worry about being sufficiently desirable themselves. Middle and bottom desirable participants, however, may worry they are simply a back-up plan. As such, we would expect middle and bottom desirable participants to be especially responsive to roses when they are sent by potential dating partners who they worry may not be interested: that is by dating partners who are more desirable than they are.

We start by examining the extent to which a recipient changes his or her acceptance decision depending on whether a proposal is accompanied by a rose. For this analysis, we construct a dependent variable that is one if a proposal is accepted and zero otherwise.[30] We use two types of regression models. In Model A we assume that all recipients react to a rose the same way. In Model B we allow for the possibility that the response to a rose may depend on the desirability of the recipient.

We regress in Table VI the acceptance of a proposal on whether a rose is attached, recipient fixed effects, the sender's age and legal verification level, a dummy whether the sender lives in greater Seoul, the squared age difference between the sender and the recipient and a dummy whether the sender and recipient live in the same location (Greater Seoul, Gangwon, Chungcheong, Jeolla/Jeju, and Gyeungsang). Recipient fixed effects allow for recipient specific reservation values when accepting a proposal. In Model A we include dummies for the desirability group of the sender of the proposal (S_Middle and S_Top). In Model B we include in addition interaction terms between receiving a rose and the desirability group of the recipient. For instance, "R_Bottom Rose" is one if a proposal is accompanied by a rose and sent to a bottom group recipient.

While we have an unusual amount of information over candidates and observe all communication, it may, in principle, still be the case that senders are more likely to attach a rose to offers made to recipients who would constitute a higher quality match compared to other recipients who are identical in all observables. That is, it may be that participants observe information not present in the data available to us that inform them whether a match would have a particularly high value and hence whether an offer is likely to be accepted. If participants attach

[30] This means we treat "no response" as an explicit rejection. In section 7 of the online appendix we present evidence that this is justified.

roses to offers that yield higher match qualities due to unobservable, estimating the effect of a rose based on the difference in the acceptance rate between offers with and without roses would bias the results in our favor. We therefore also report instrumental variable estimates, where we use the treatment status of the sender, whether they received two or eight roses as an instrumental variable. Recall that participants were randomly assigned to be endowed with two or eight roses, and furthermore, other participants did not know whether a sender had two or eight roses. Therefore, whether the sender has eight or two roses should not be correlated with the decision of the recipient whether to accept an offer conditional on observables.[31] As we discuss below, the results using IV estimates are very similar to those from standard regressions, confirming that roses affect the acceptance behavior.

Before analyzing the effect of a rose, note that both Model A and B show that the more desirable the sender is, the more likely a recipient accepts that proposal. For example, compared to a proposal from a sender in the bottom desirability group, an offer from a sender in the top desirability group is about 18 percentage points more likely to be accepted. For a medium group sender, the advantage is still around 5 percentage points. To evaluate the size of these effects note that the overall acceptance rate of offers is 15.20 percent when we restrict attention to offers where both senders and recipients have a desirability index.

Column 1 of Model A shows that attaching a rose significantly increases the probability of being accepted by 3.3 percentage points. This corresponds to a 20 percent increase compared to the overall acceptance rate. Furthermore, this positive effect of sending a rose is comparable to (and about three quarters of) the benefit of being in the middle desirability group relative to being in the bottom group. This implies that, by sending a rose, a bottom group sender will be almost equally attractive as his or her counterpart belonging to the middle group. When we restrict attention to male and female recipients separately, the effects only barely fail to be significant (columns 2 and 3). The marginal effect is, however, similar in size, and once more comparable to the advantage enjoyed by middle desirable senders. Furthermore, note that a one-sided test estimating whether roses increase the acceptance rate would yield significance.[32]

[31] See Section 5 of the online appendix for details including identification assumptions and a formal description of the IV model.

[32] Note that, in theory, a rational participant would never attach a rose if a rose were expected to yield negative returns, that is reduce the chance to be accepted. In that case a participant could simply not attach any rose. As such, a one-sided test of the effect of a rose may be justifiable.

TABLE VI EFFECT OF ROSES

Model	FE-R	FE-R-IV	FE-R	OLS	FE Logit	FE-R
	(1)	(2)	(3)	(4)	(5)	(6)
Recipients	All	All	Active	All	All	2 roses
Model A						
Rose	0.033**	0.041	0.054**	0.030*	0.443**	0.034*
	(0.016)	(0.029)	(0.025)	(0.018)	(0.201)	(0.018)
S_Middle	0.048**	0.047***	0.079**	0.074***	0.811***	0.052**
	(0.019)	(0.017)	(0.031)	(0.020)	(0.298)	(0.022)
S_Top	0.178***	0.177***	0.293***	0.191***	2.284***	0.181***
	(0.020)	(0.018)	(0.033)	(0.021)	(0.312)	(0.023)
R-sq (log Lik.)	0.50	0.50	0.46	0.13	-242.37	0.49
Model B						
R_Bottom Rose	0.054	0.035	0.087	0.003	0.935	0.071
	(0.047)	(0.054)	(0.071)	(0.047)	(0.598)	(0.052)
R_Middle Rose	0.078***	0.064**	0.097**	0.082***	0.677**	0.068**
	(0.027)	(0.031)	(0.040)	(0.029)	(0.317)	(0.031)
R_Top Rose	-0.001	-0.002	0.013	0.003	0.131	0.006
	(0.021)	(0.025)	(0.035)	(0.024)	(0.292)	(0.024)
S_Middle	0.047**	0.047**	0.079**	0.072***	0.815***	0.051**
	(0.019)	(0.019)	(0.031)	(0.020)	(0.299)	(0.022)
S_Top	0.176***	0.177***	0.290***	0.189***	2.283***	0.180***
	(0.020)	(0.020)	(0.033)	(0.021)	(0.314)	(0.023)
R-sq (log Lik.)	0.50	0.50	0.46	0.13	-241.18	0.49
No. of proposals	1,902	1,902	1,153	1,902	796	1,516
No. of recipients	393	393	226	393	103	310

Notes: Columns labeled FE-R report OLS estimates with recipient fixed effects. FE-R-IV of Model A follows the same specification as Model A of column (1) but instruments Rose with whether the sender is endowed with 8 roses and reports second stage regressors. The F-statistic of the excluded instrument is 442.45. FE-R-IV of Model B follows the same specification as Model B of column (1) but instruments R_Bottom Rose, R_Middle Rose and R_Top Rose with the predicted probability of attaching a rose interacted with the recipient's desirability group (for details see Section 5 of the online appendix). The Cragg-Donald's F-statistic of the three excluded instruments is 1,141.30. FE Logit reports logit model estimates with recipient fixed effects. The dependent variable is one if a recipient accepted a given proposal and zero otherwise. "S_" and "R_" denote sender and recipient characteristics, respectively. All regression models control for sender's verification level (none, medium, full), age, living in greater Seoul, the squared difference of age between a sender and a recipient and a dummy indicating whether the two are in the same location. Location has five categories: Greater Seoul, Gangwon, Chungcheong, Jeolla/Jeju, and Gyeungsang. Column 4 includes in addition control variables for recipient characteristics: number of proposals made, number of roses sent, number of proposals received, a dummy whether at least one rose was received, the number of roses received, and the recipient's characteristics corresponding to those of senders (verification level, age, living in greater Seoul, R_Middle and R_Top). Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

In the IV regression we first regress whether a proposal has a rose attached on the treatment status of the sender (two or eight roses) and regressors from the baseline specification.

We find that having 8 roses significantly predicts whether a proposal comes with a rose (F-stat 442.45). Column 2 of Table VI reports the estimates from the second stage with standard errors that take the first stage estimation errors into account. We find that sending a rose increases the chance of acceptance by 4.1 percentage points and the effect is significant in a one-sided test (p = 0.084). Note that this estimate of the effect of a rose is not statistically different from the baseline estimate at a conventional level (p = 0.794) and if anything has a slightly larger value. Hence roses directly affect the acceptance rate, the effect seems not driven by endogeneity effects.

The results on the effect of a rose are robust across various specifications and sub-samples.[33] In column 3, we restrict attention to recipients who actively responded to at least one proposal.[34] In column 4, we use a linear regression model instead of a recipient fixed effects model and control for recipient characteristics such as the number of offers and roses both sent and received. In both cases, the recipient's response to a rose is qualitatively the same as in the baseline analysis in column 1. Likewise, a logit regression with recipient fixed effects where we report the coefficients of the latent index (column 5) yields similar results.[35] Finally, we assess whether participants endowed with two roses react to roses differently than those endowed with eight roses. Column 6 shows that results are virtually unchanged when we restrict attention to recipients who had only two roses compared to all recipients (column 1).[36] This is not too surprising, since the effect of a rose is the difference in the acceptance rate of an offer with a rose

[33] Specifically, we perform the following two exercises (for details see Section 3 of the online appendix). First, instead of our baseline cutoffs (30th percentile and 70th percentile), we use the 20th and 80th percentile to classify participants into three desirability groups. We re-estimate Model A and find that a rose increases the acceptance of a proposal by 3.2 percentage points, almost identical to the baseline result. Second, we use the number of proposals a participant received as a proxy for the participant's desirability. We re-estimate Model A but include dummy variables of the number of proposals a sender received instead of the desirability index group dummies. We find that a recipient accepts a proposal by 3.4 percentage points more if the proposal is accompanied by a rose, an effect virtually identical to the baseline result.

[34] We have 56 individuals who participated in both sessions and 39 of them received at least one proposal in the second session. We examine whether recipients respond to a rose differently in their second session. To do so, we re-estimate Model A but include the interaction between a rose and a dummy variable that indicates the second session and two-time participants. Note that 215 out of 1,921 proposals are sent to two-time participants. We find that there is no statistical difference in terms of recipients' response to a rose in their second participation.

[35] We also run a regression where in addition to fixed effects for recipients we use fixed effects for senders instead of their desirability group. The estimated coefficient of a rose is 0.031 (p = 0.104), qualitatively the same as in the baseline regression (column 1), though just barely not significant (the s.e. is 0.019). However, we include an exceptionally large number of control variables, namely fixed effects for both recipients and senders, and the effect of a rose would reach conventional significance levels in a one-sided test.

[36] We also formally test whether the effect of roses on the acceptance rate depends on a recipient's treatment group. We re-estimate Model A while including an interaction term between receiving a rose and whether a recipient had 8 or 2 roses. The coefficient on the interaction term is not significant, indicating that the difference in the acceptance rate due to a rose is similar between recipients who themselves had 2 or 8 roses, see Section 6 of the online appendix.

attached compared to an offer without a rose.[37]

In Model B we allow for the possibility that the response to a rose may in addition depend on the desirability group of the recipient. Recipients in the top group of desirability have an overall acceptance rate of 12.03 percent, and are the most selective group. They do not appear to respond to roses very much as "R_Top Rose" has a coefficient close to zero. While in some specifications the point estimate is even slightly negative, it is never close to being significant, and even fails to be significant in a one-sided test.

Column 1 of Model B shows that middle group recipients are 7.8 percentage points more likely to accept an offer with a rose than one without a rose. The overall acceptance rate for middle group recipients is 18.42 percent, so a rose results roughly in a 40 percent increase in the acceptance rate. Furthermore, under all specifications, the effect of attaching a rose is similar and generally larger than the effect of moving a sender from the bottom to the middle desirability group (which is 4.7 percentage points in column 1).

Recipients in the bottom desirability group overall have a positive response to a rose of 5.4 percentage points, but the effect is not significant. However, participants in the bottom group only received a small fraction of all offers (12.04 percent) which may account for the large standard errors. Note that in almost all specifications the effect of a rose is similar in size to the increase in the acceptance rate when the sender is from the middle rather than bottom desirability group. Since the overall acceptance rate for bottom participants is 19.21 percent, a 5 percentage point increase corresponds to an about 25 percent increase in the acceptance rate. Furthermore, in many specifications, significance would be achieved in a one-sided test.

The IV regression of Model B contains three endogenous variables. Following Wooldridge (2010, Ch 21), we use three instruments excluded from the second stage regression which are the three dummies for the desirability group of the sender interacted with the predicted probability of attaching a rose (for details see Section 5 of the online appendix). The three instruments significantly predict whether a proposal comes with a rose (Cragg-Donald's F-stat 1,141.30). Column 2 of Table VI reports the second stage results. The results are qualitatively the same as baseline estimates. An F-test shows that we cannot reject that the three estimates are the

[37] Participants who had two roses may view an offer with a rose as "special", while offers without a rose show maybe "normal" interest. On the other hand, participants who had eight roses may not feel equally flattered when receiving a rose. However, for them, not receiving a rose may be a sign of really not being special, since, in their view, only 2 out of 10 offers were precluded from having a rose attached. Note that these two cases are in a way symmetric: either two out of ten offers are more special compared to other offers - for recipients endowed with two roses – or two out of ten offers are less special compared to other offers - for recipients endowed with eight. Due to that symmetry it may not be surprising that the change in the acceptance rate in reaction to a rose is similar for recipients endowed with two or eight roses.

same as the baseline estimates ($p = 0.937$).

In Table VII we allow for the possibility that the effect of attaching a rose on the acceptance rate depends on both the recipient's and the sender's desirability group. We expect roses to convey information of special interest and as such sway recipients to accept an offer that they may otherwise reject, potentially out of fear that the sender is not sufficiently interested and hence ultimately not attainable. In that case, we expect roses to be especially effective in inducing a recipient to accept an offer whenever the offer is from a sender that is more desirable than the offer recipient. We find indeed that for all recipients, the effect of a rose is positive and significant when the sender is from a desirability group strictly greater than the responder, see column 1. That is, bottom recipients react significantly (both economically and statistically) to roses when they are attached to offers from medium and top desirable participants. For middle desirable recipients the effect of a rose on the acceptance rate of an offer is positive and significant when the offer is made by a participant from the top desirability group. The effect is always more than twice the increase in acceptance when moving as a sender from the bottom to the middle desirability group. Column 1 shows the effect to be more than a 50% increase in acceptance rate for either the bottom or middle recipients.

The only surprising result is that offers from top desirable senders to top desirable recipients have a slightly lower chance to be accepted when a rose is attached. This effect is particularly large when looking at female responders. It is as if very desirable women do not favor men who are both desirable and interested. Finally, note that for all desirability groups of responders, the effect of roses is in general lower for senders that have the same desirability group as the receiver.

For Model C, we have nine endogenous variables. We use nine instruments excluded from the second stage equation which are the nine dummies indicating the sender's and the recipient's desirability group times the predicted probability of attaching a rose (for details see Section 5 of the Online Appendix). These nine instruments significantly predict whether a proposal comes with a rose (Cragg-Donald F-stat: 296.38). Column 2 of Table VII reports the second stage results. The results are qualitatively the same as baseline estimates. An F-test shows that we cannot reject that the nine estimates of the IV regression are the same as the baseline estimates ($p = 0.989$).

TABLE VII EFFECT OF ROSES

Model	FE-R	FE-R-IV	FE-R	OLS	FE Logit	FE-R
	(1)	(2)	(3)	(4)	(5)	(6)
Recipients	All	All	Active	All	All	2 roses
R_Bottom						
S_Bottom: Rose	-0.052	-0.026	-0.076	-0.024	-1.522	-0.041
	(0.064)	(0.074)	(0.096)	(0.063)	(1.401)	(0.074)
S_Middle Rose	0.125*	0.073	0.189*	-0.001	1.883*	0.122
	(0.070)	(0.078)	(0.107)	(0.068)	(0.962)	(0.076)
S_Top Rose	0.160*	0.073	0.275**	0.072	2.889**	0.170*
	(0.084)	(0.092)	(0.137)	(0.087)	(1.463)	(0.086)
R_Middle						
S_Bottom Rose	0.106**	0.097*	0.150*	0.076	1.246*	0.083
	(0.049)	(0.056)	(0.078)	(0.050)	(0.669)	(0.058)
S_Middle Rose	0.019	0.014	0.018	0.065	0.247	0.011
	(0.039)	(0.043)	(0.059)	(0.041)	(0.464)	(0.045)
S_Top Rose	0.124***	0.105**	0.151**	0.108**	0.892*	0.116**
	(0.040)	(0.045)	(0.060)	(0.045)	(0.464)	(0.045)
R_Top						
S_Bottom Rose	-0.003	0.007	-0.001	0.01	-0.654	0.018
	(0.044)	(0.053)	(0.070)	(0.046)	(0.919)	(0.051)
S_Middle Rose	0.034	0.034	0.060	0.026	0.57	0.033
	(0.032)	(0.037)	(0.051)	(0.035)	(0.425)	(0.036)
S_Top Rose	-0.033	-0.037	-0.031	-0.025	-0.069	-0.022
	(0.032)	(0.035)	(0.053)	(0.035)	(0.394)	(0.035)
S_Middle	0.041*	0.046*	0.071*	0.069***	0.677*	0.047*
	(0.023)	(0.025)	(0.037)	(0.024)	(0.368)	(0.026)
S_Top	0.171***	0.180***	0.281***	0.188***	2.182***	0.174***
	(0.024)	(0.026)	(0.039)	(0.026)	(0.370)	(0.027)
R-sq (log Lik)	0.50	0.50	0.47	0.13	-234.80	0.49
No. of proposals	1,902	1,902	1,153	1,902	796	1,516
No. of recipients	394	394	227	393	104	310

Notes: Columns labeled FE-R report OLS estimates with recipient fixed effects. FE-R-IV follows the same specification as column (1) but instruments the nine rose variables with nine dummy variables indicating the sender's and recipient's desirability group times the predicted probability of attaching a rose (see Section 5 of the online appendix). The Cragg-Donald's F-statistic of the nine excluded instruments is 296.38. FE Logit reports logit model estimates with recipient fixed effects. The dependent variable is one if a recipient accepted a given proposal and zero otherwise. "S_" and "R_" denote sender and recipient characteristics, respectively. All regression models control for sender's verification level (none, partial, full), age, living in greater Seoul, the squared difference of age between a sender and a recipient and a dummy indicating whether the two are in the same location. Location has five categories: Greater Seoul, Gangwon, Chungcheong, Jeolla/Jeju, and Gyeungsang. Instead of recipient-fixed effects, column 4 includes in addition control variables for recipient characteristics: number of proposals made, number of roses sent, number of proposals received, a dummy whether at least one rose was received, the number of roses received, and the recipient's characteristics corresponding to those of senders (verification level, age, living in greater Seoul, R_Middle and R_Top). Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

To summarize, on the proposal level, an offer with a rose is almost twenty percent more likely to be accepted than an offer without a rose. Further analysis shows that the positive effect of a rose is driven by bottom and middle desirable recipients, who increase their acceptance rate by about 25 and 40 percent, respectively. In both cases, attaching a rose increases the chance to be accepted by more than if the sender were to move from the bottom to the middle desirability group. Finally, an even more detailed analysis shows that an offer made from a sender who is in a superior desirability group compared to the recipient is always significantly, both statistically and economically, more likely to be accepted when a rose is attached. The effect of a rose corresponds to a more than 50 percent increase in the acceptance rate.

IV.B THE EFFECT OF ROSES FOR PROPOSERS

In this section we assess whether roses help proposers be more successful. Proposers may be deemed more "successful" if they are more likely to have a date or have more dates. However, maybe an even more accurate measure is to consider dates initiated by the proposer. First, proposers may be even more excited about dates they initiated independent of the desirability index of the dating partner. Second, initiated dates that are accepted may more accurately reflect the effect of roses on the senders' success to convince recipients to accept their offer.

To assess whether roses help proposers to have more initiated dates we perform two analyses. First, we analyze whether participants who received eight roses are more successful than those that received only two roses. Second, we use the results from the regression analysis in the previous section IV.A to predict the outcome of participants if they had no roses, and confirm that we would then expect participants to be worse off. In this section, all our tests will be one-sided, since we assess whether roses help participants have their proposed dates be accepted.

First, we assess the treatment effect of endowing some participants with eight roses. For men, we compare participants who had two roses (baseline and empowerment treatment) to those with eight roses, where we restrict attention to men who live in greater Seoul and have full verification. This is because men in different treatments differed in their observables (see Section

II.C).[38] Furthermore, the male empowerment treatment took place in the response stage, that is men in the baseline and the empowerment treatment should not differ in their proposal behavior and as such in outcomes corresponding to initiated dates. Since there are no observable differences among women in various treatment groups, we use all female observations. We compare outcomes among women who had two roses and were subjected to empowerment – that is women in the empowerment treatment to women who had eight roses since the latter group was also subjected to the empowerment treatment. The empowerment condition was administered in the proposal stage and hence could affect proposal behavior – though as we saw not in a significant way.

Table VIII shows the outcomes of male and female participants. Men are significantly more likely to have a date they initiated (that is an offer of theirs that got accepted) when they have eight roses, in fact that chance increases by more than 50%. Furthermore, men have significantly more dates they initiated when they are endowed with eight roses; the increase is by more than 60%.[39] Finally, participants may not only care about the total number of dates, but prefer dates with more desirable partners. We therefore quality-adjust each proposal. For each proposer we compute the weight of a proposal as the desirability index of the recipient divided by the average desirability index of participants who received at least one proposal. Men with eight roses have about 60% more quality-adjusted first dates than men with two roses. For women, the chance to have an initiated date increases from 26.3% to 32.8% when they have eight roses, but this 25% increase is not significant. Like men, women have significantly more initiated dates when endowed with eight roses; the increase is by more than 60%. Furthermore, when quality-adjusting dates, the result remains virtually unchanged.[40]

[38] In section II.C we showed that men with eight roses are significantly less likely to be special members and hence significantly more likely to have a full verification level, than men endowed with two roses. Note that offers from participants with full verification are more likely to be accepted than other offers. However, when we condition on the verification level, and whether men are from greater Seoul then there are no more differences in observables between the two groups. Furthermore, since for these two categories the modal group is greater Seoul (87.50 percent) and full verification (70.72 percent) we restrict all male participants to have these characteristics. Jointly over 64 percent of male participants live in greater Seoul and provide full legal documentation and hence have a full verification level.

[39] When looking at all dates, not just those initiated by the sender, men with eight roses are still significantly more likely to have at least one date (34%, significant at the 5% level) and have significantly more dates (55% more, significant at 5%).

[40] When looking at all dates, not just those initiated by the sender, women with eight roses are only 1% more likely to have a date, and have only 12% more dates.

TABLE VIII TREATMENT EFFECTS

	Baseline	Roses	Increase
Men (Groups 1&2 vs 3) No obs	***144***	***39***	
Have at least one initiated date	0.313	0.487	56%**
No of initiated dates	0.556	0.897	61%**
Quality adj. no of initiated dates	0.535	0.868	62%**
Men who made at least one offer	***79***	***30***	
Have at least one initiated date	0.570	0.633	11%
No of initiated dates	1.013	1.167	15%
Quality adj. no of initiated dates	0.975	1.128	16%
Women (Group 2 vs. 3)	***95***	***61***	
Have at least one initiated date	0.263	0.328	25%
No of initiated dates	0.421	0.705	67%**
Quality adj. no of initiated dates	0.403	0.688	71%**
Women who made at least one offer	***36***	***26***	
Have at least one initiated date	0.694	0.769	11%
No of initiated dates	1.111	1.654	49%**
Quality adj. no of initiated dates	1.063	1.614	52%**

Notes: Male participants include only men who live in greater Seoul and provided a full level of legal documentation. *, **, and *** indicate that the p-value of testing the increase in column 3, between the value in column 1 to the value in column 2 is significant at less than 10, 5, and 1 percent, respectively.

In section III.B we showed that participants with eight roses are similar in their proposal behavior to participants endowed with two roses, with the exception that men endowed with eight roses are more likely to make at least one proposal. To assess whether this is the main driving factor in Table VIII, we provide the outcomes based on the subset of participants who made at least one offer. While both men and women are still about 10% more likely to have a date they initiated when they are endowed with eight roses, the difference is not significant anymore. Women still have about 50% more first dates they initiated when they are endowed with eight roses, a significant increase. For men, the increase is still 15%, but fails to be significant. Note, however, that the sample becomes small. The results remain virtually unchanged when quality-adjusting those dates.

A second way to assess whether the use of roses increases the chances for proposers to have dates they initiated is to use the results from the analysis in section IV.A. We focus on participants who made at least one proposal. The row "Data" in Panel 1 of Table IX shows the average number of accepted proposals for each proposer. Next, we use the regression results similar to Table VII, where we run the regression in column 1 separately for men and women to predict for each proposer the likelihood with which his or her proposal is accepted. We aggregate results on the proposer level and present the outcome in the row "model prediction" with two-sided t-tests that compare those outcomes in parentheses. There is no significant difference

between the predicted and actual number of accepted proposals. We therefore use the model to compute two counterfactuals. First, we predict the outcome if a participant had not used any of his or her available roses. In that case, we predict proposers to only have 0.962, instead of the actual 1.057 accepted offers, a significant drop of 9% (see column 1). When we consider women and men separately, the drop in accepted offers is basically the same (8% for men and 10% for women) but only the female drop is significant.

If on the other hand proposers had used roses in order to maximize the number of accepted offers, they would have had significantly more acceptances, namely 1.179, a significant 12% increase compared to the actual outcome. This increase remains significant even when we look at women and men separately. Furthermore, compared to not using any roses, the date maximizing use of roses results in an increase of initiated dates of 23%. Once more the effects are similar in size and significant when we look at each gender separately.

TABLE IX PREDICTING THE EFFECT OF ROSES

Senders	All	Men	Women
No. accepted proposals			
Panel 1. Actual			
(i) Data	1.057	0.958	1.202
(ii) Model Prediction	1.047	0.958	1.175
(ii) vs. (i)	(-1% / .428)	(0% / .500)	(-2% / .398)
Panel 2. Counterfactuals			
(iii) Not using roses	0.962	0.881	1.079
(iii) vs. (i)	(-9% / .047)	(-8% / .139)	(-10% / .096)
(iv) Optimal use of roses	1.179	1.055	1.357
(iv) vs. (i)	(12% / .026)	(10% / .091)	(13% / .076)
(iv) vs. (iii)	(23% / .000)	(20% / .009)	(26% / .006)
Quality-Adjusted No. accepted proposals			
Panel 3. Actual			
(i) Data	1.019	0.927	1.153
(ii) Model Prediction	1.019	0.927	1.153
(ii) vs. (i)	(0% / .500)	(0% / .500)	(0% / .500)
Panel 4. Counterfactuals			
(iii) Not using roses	0.940	0.856	1.061
(iii) vs. (i)	(-8% / .075)	(-8% / .149)	(-8% / .159)
(iv) Optimal use of roses	1.173	1.055	1.344
(iv) vs. (i)	(15% / .006)	(14% / .039)	(17% / .034)
(iv) vs. (iii)	(25% / .000)	(23% / .003)	(27% / .004)

Notes: In parentheses we the percentage change of the two relevant variables, and the p-value of the corresponding one-sided t-test. Tests that compare the data versus the model prediction are two-sided, that is (ii) versus (i), as they don't test the effect of adding a rose.

While participants may prefer that more of their offers be accepted, they may have a preference over which offers are accepted. Specifically, they may prefer that offers to more rather

than those to less desirable participants are accepted. We therefore use the same quality-adjustment for each proposal as before. The weight of a proposal is the desirability index of the recipient divided by the average desirability index of participants who received at least one proposal. We then compute the probability with which a proposal is accepted times its weight and for each proposer we sum these probabilities. Panel 3 shows that the average quality-adjusted number of initiated dates is 1.019 for all participants who made at least one proposal, a number that our model matches exactly. This match is equally good when analyzing women and men separately. In the first row of panel 4, we report the quality-adjusted number of accepted proposals if senders had not used any roses. When we consider all participants, they would have about 8 percent less quality-adjusted initiated dates, a significant difference. The numbers for women and men separately are the same, though the 8% drops are not significant anymore. In terms of using roses to maximize quality-adjusted dates, compared to not using any roses, both women and men would have about 25% less dates. Compared to their actual outcomes, both women and men are not close, on average, to an optimal usage of roses.

IV.C Role of Roses: Substitution or Increase in the Number of Dates

Finally, we want to assess whether there is some indication that roses increase the number of proposals a recipient accepts, or whether they mostly serve to direct acceptances towards offers with roses and displace other acceptances. When a recipient shifts his or her acceptance from an offer without a rose to an offer with a rose by senders of the same desirability, they are likely to shift the acceptance to someone who may be more interested. However, that introduces a negative externality to the sender who did not use a rose. If, however, recipients who receive roses accept *more* offers, roses may help increase the total number of dates. To assess whether roses change the total number of acceptances, consider the following thought experiment. Take two identical recipients who have the same number of offers, with, however, one recipient having received at least one rose while the other received none. Will the former accept more offers? To perform this analysis, we need to restrict ourselves to a sample where participants, while receiving the same number of offers, are about equally likely to have at least one rose or no rose. This is the case for middle desirable recipients who have received up to three offers. This corresponds to 60.25 percent of all middle recipients who received an offer.

In Table X we use a linear regression on how many offers participants accepted depending on whether they received at least one rose. Overall, participants who received at least one rose accept 0.259 more offers than those who received no rose. For that group, each responder accepts on average 0.412 proposals, hence this corresponds to a 37 percent increase. Note that this effect

is almost entirely driven by men.

TABLE X ACCEPTANCE AND RECEIVING A ROSE

	All	Men	Women
	(1)	(2)	(3)
Receive at least one rose	0.259*	0.484**	0.087
	(0.139)	(0.237)	(0.156)
Female	-0.335**		
	(0.133)		
Constant	0.488***	0.432***	0.231**
	(0.097)	(0.117)	(0.106)
No. obs	97	49	48
R-sq	0.080	0.081	0.007

Notes: OLS estimates. The dependent variable is the number of proposals that a recipient accepted. Standard errors are in parentheses. *, **, and *** indicate significance at 10, 5 and 1 percent, respectively.

V CONCLUSION

This paper presented a field experiment in internet dating that showed that sending a preference signal can affect outcomes. In preference signaling, as opposed to costly signaling, every agent can send signals at the same costs, often zero, where each signal is sent to one participant on the other side of the market. The number of signals each agent can send is limited, which makes them meaningful. Preference signaling is widely used in many markets in which offering an interview (or a date) to evaluate a candidate, or offering a job is costly. Interview costs can arise because slots are limited, or the time spent on interviews or dates is valuable. Offers can be costly either because they are limited, because they take a long time to make or resolve and alternate candidates are meanwhile taken off the market, or because having an offer rejected is a bad signal for the proposer.[41] When interviews or offers are costly, agents may take information pertaining to the likelihood that an offer will be accepted into account. Preference signaling can help convey such information (see Coles, Kushnir and Niederle, 2011). Preference signaling is pervasive and

[41] While we have presented many examples pertaining to interviews being costly, preference signaling can also help when making offers is costly. For example, in many economic departments deans limit the number of offers a department can make. In many markets, especially entry-level labor markets, making offers to candidates and being rejected after a while is costly, as during that time other desirable candidates may have already accepted positions elsewhere. This is a reason offers often come with a short deadline (Avery et al. 2001, Niederle, Proctor and Roth, 2006, Roth, 2008, and Niederle and Roth, 2009). While anecdotal evidence suggests that in many markets the chances a candidate would accept an offer influences the decisions over whom to make an offer, this has been explicitly documented in the market for law clerks (Avery et al., 2001) and the market for medical fellows (Niederle, Proctor and Roth, 2006). While rejections may be costly for many participants, this was especially the case in college admission where the yield rate has been explicitly used to rank colleges by the US news and World report and is still available on their website where they declare it as "one of the best indicators or a school's popularity".

starts to be used in more and more in organized markets.[42] However, the lack of data has made it difficult to show that sending a preference signal can increase the chance for an offer to be accepted.

In the dating experiment we had participants who were young, never married, college educated Koreans. This group seems to have high opportunity costs of time, which is reflected in the relatively low number of dates they accepted. In the experiment, participants when proposing a date could attach a rose to indicate their special interest. We showed that attaching a rose significantly increased the chance that an offer was accepted. Overall, the effect corresponds to a twenty percent increase in the acceptance rate, which is similar to the increase in the acceptance rate when the offer is made by a candidate from the middle rather than the bottom desirability group. A more detailed analysis shows that roses alter the acceptance behavior whenever a recipient considers an offer from a sender who is more desirable than the recipient. That is, middle group recipients significantly increase their acceptance of dating requests from top senders when a rose is attached, and bottom recipients do so, when the offer is from a top or middle desirable sender and comes with a rose. In all three cases the effect corresponds to more than a 50% increase in the acceptance rate, and is about twice the increase in the acceptance rate when an offer is made by a middle rather than bottom desirable sender. Considering the effects of signals on proposers, we show that participants who received eight roses, instead of two, had significantly more accepted dates. This result holds when we impose some quality-adjustment on dates. Simulations confirm that, in an environment in which agents have signals, not using them makes agents worse off, in that they have fewer of their proposals accepted, while having more signals results in more accepted proposals. Furthermore, we found that roses seem to increase the number of offers that are accepted, which means they do not only substitute acceptances away from offers without roses.

Like any other empirical signaling paper, on costly signaling or preference signaling, we cannot assess whether the signaling mechanism improved welfare. While one can show in theory that preference signals can improve welfare (see Avery and Levin, 2010, Coles, Kushnir and Niederle, 2011), this is hard to do empirically for many reasons. Foremost is that the welfare criterion is not obvious. How should various dates be traded off? Would it be better to have one date per person, or a few participants with more dates, and some with fewer? Even counting the

[42] For example, Sparkology.com, a new website to help match male graduates from "top" universities. The main innovations is that while women can make as many offers as they want, men are offered "Spark Packs" for $15 which allows them to contact 5 women of their choice. "This way Ladies receive meaningful interactions from Gentlemen that are genuinely interested, while Gentlemen no longer need to spam dozens of profiles to get a response." http://dealbreaker.com/2011/10/its-about-ambition-and-personality-not-cash/

total number of dates may not be a good measure, as clearly some dates are more desirable than others. This may be either because the dating partner is more desirable, or because the dating partner is more interested, so the date is more likely to result in a long term relationship. Even if one were to simply count the number of dates, maybe weighted by desirability, it would be hard to assess how many additional dates occurred because of the signaling mechanism.

Indeed, in many markets, the right comparison may not be between the outcome with a preference signaling mechanism and one in which preference signaling is not possible. This is because in many markets in which offers (for interviews or positions) are costly, there already are ways and channels through which participants transmit preferences. In the economics job market, for example, it is through advisors and their connections that graduate students on the market can convey their interest. In the law clerk market, law appellate court judges seem to be able to receive binding commitments from law students (see Avery et al., 2001). In college admission, preferences for a college can be conveyed through the choice of the single university to which the student applies through early action, where high schools seem to enforce that students do not apply to more than one college early (Avery, Fairbanks and Zeckhauser, 2003). Preferences can also be conveyed by using one of the weekends to visit the university, universities in turn seem to take such visits into account when deciding whom to admit.[43] When using market design to introduce a signaling mechanism, the question may therefore be how the new signals will change the existing mechanisms. In the economics junior market, the signaling through the AEA website allows students to signal to any place, not solely the ones to which their advisors have connections. It may therefore serve to equalize the opportunities among students with various levels of connections (see Coles et al. 2010). In college admission, early applications may result in a loss of information, and this unraveling could change who is able to get into what college. If preference signaling is an important factor, one way would be for an organization, such as the National Association for College Admission Counseling to offer a signaling mechanism similar to the one used by the economics junior market.

Market design has so far mostly focused on turning decentralized markets into centralized ones, such as the market for medical residents and fellows (see Roth 1984 and Roth and Peranson 1999).[44] Market design may be ready to help decentralized markets operate differently. One such

[43] Numerous websites advise students to show interest by visiting the college. For example, collegedata, at (http://www.collegedata.com/cs/content/content_getinarticle_tmpl.jhtml?articleId=10045), claims that a factor that is of considerably importance to colleges is: "Demonstrated interest**.** Going on a college visit, talking with admission officers, or doing an enthusiastic interview can call attention to how much you really want to attend. Applying for an early decision may also make a good impression."

[44] Note that in the market for medical residents the welfare implications of a centralized clearinghouse are

way is to introduce preference signaling. This paper showed that preference signaling can work. In a market in which interviews are costly, and in which agents can signal their preferences, this paper showed that signals do affect who matches with whom.

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also hard to asses. It seems, however, that centralized clearinghouses affect who matches with whom (Niederle and Roth, 2003) and the timing of the match (Roth, 1984, and Niederle, Proctor and Roth, 2006).

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