

Marriage, Choice, and Couplehood in the Age of the Internet

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Abstract:

How do the Internet and social media technology affect our romantic lives? This study examines longitudinal data showing that meeting online does not predict couple breakup. Meeting online (and particularly meeting through online dating websites) does predict faster transitions to marriage for heterosexual couples. Critics of the Internet's effect on social life identify the overabundance of choice of potential partners online as a likely source of relationship instability, yet data show that meeting online is not associated with relationship instability. In addition to couple level longitudinal data, this paper examines trend data of divorce rates and marriage prevalence in the US since the rise of the graphical Internet in 1995. Since 1995 the divorce rate has declined, and the percentage of adults who are married has declined (though marriage prevalence has been declining since 1960). The analyses here suggest a benign effect of Internet-related partner choice on relationship outcomes.

Marriage, Choice, and Couplehood in the Age of the Internet

Introduction:

As Internet-based social media and cellular phones play a larger and larger role in our personal and social lives, individuals have adapted their rules of personal engagement and social interaction to take advantage of the new technologies. Americans text more and call less (Gayomali 2012). Online meeting has displaced many traditional ways couples used to meet (Rosenfeld and Thomas 2012). The ability to find and interact with individuals online has opened doors of opportunity for many, and yet others argue that the suddenly wider choice set of potential partners could have a destabilizing effect on our most important relationships (Slater 2013); i.e. too much choice could make us inattentive to or dissatisfied in the relationships we already have.

Technology has changed the way we interact. McKenna, Green and Gleason (2002) argue that the asynchronicity of computer mediated communication yields potential relationship advantages. Others argue that the new technologies have robbed us of the skills to be effective listeners in face-to-face interactions (Turkle 2011; Turkle 2015). If the Internet undermines our relationships, then the social effects of the Internet are to be feared.

It is important that we understand the effect of the Internet (and its associated technologies) on our social and romantic lives, because for good or ill our most important face-to-face relationships increasingly have an online component. In this paper I examine data from a nationally representative longitudinal study of American couples followed for 6 years, from 2009 to 2015. I test whether meeting online or having internet access at home is associated with higher or lower rates of breakup, higher or lower rates of transition to marriage, and higher or lower rates of transition to cohabitation. I show that couples who met online and offline have similar rates of breakup, consistent with prior literature (Rosenfeld and Thomas 2012; Cacioppo et al. 2013). I demonstrate in this paper that heterosexual couples who met through online dating transition to marriage more quickly than other heterosexual couples, which is a new finding. I also examine cross sectional national data on divorce and marriage to understand whether the Internet era is associated with more stable or less stable romantic relationships.

Theoretical Background:

Choice Overload versus the Advantage of Choice

Choice overload (Iyengar and Lepper 2000; Schwartz 2005) is one of the key theoretical ideas invoked to explain why Internet dating might undermine existing romantic relationships (Ansari and Klinenberg 2015; Slater 2013; Turkle 2015 p.182). The Internet, with its dating sites and phone apps with millions of members may (according to Choice Overload theory) give individuals too much choice. If Choice Overload theory is correct as applied to Internet dating and romance, the abundance of potential new romantic partners available online should have weakened individuals' commitments to their existing partners, and perhaps even reduced individuals' abilities to make any decisions about romantic relationships.

The literature on Internet dating contains ample anecdotal evidence of Choice Overload experienced as dating flightiness (Slater 2013; Sales 2015b; Heino, Ellison and Gibbs 2010; Vitzthum 2007). Heino, Ellison and Gibbs (2010) argued, based on 34 phone interviews with Internet daters, that the vast choice set of potential partners online seemed to lead Internet daters to judge others' dating profiles quickly and superficially. Heino, Ellison, and Gibbs did not determine, however, whether online meetings were more or less superficial than offline meetings. Despite anecdotal evidence for Choice Overload burdening relationships and delaying relationship commitment, nationally representative evidence that Choice Overload is actually a problem in real world dating markets has not emerged.

Iyengar and Lepper's (2000) supermarket jam experiment is the canonical Choice Overload study. Iyengar and Lepper showed that supermarket customers presented with samples of 6 jams tried an average of 1.5 of the samples, and 30% used an offered coupon to buy jam, whereas customers presented with a larger choice of 24 jams also tried an average of 1.5 samples, but only 3% of the customers who saw the larger selection used the coupon. Iyengar and Lepper concluded that the larger choice set was demotivating to consumers.

The applicability of Iyengar and Lepper's jam experiment to Internet dating is problematic, however, for several reasons. First, companionship, romance, sex, and love are all higher order human needs than jam. Complexity of dealing with a large choice set of jams might discourage individuals from seeking jam more readily than the complexity of a large choice set of romantic partners might discourage individuals from seeking romantic relationships. Second, in order to make the jam experiment work, Iyengar and Lepper had to exclude the flavors of jam

that people prefer most (strawberry and raspberry). One of the great advantages of choice is that if a customer has a particular preference, they are more likely to satisfy their preference with a large choice set than a small choice set. A dating website without attractive candidates (i.e., without the analogs of strawberry and raspberry jam) would not be successful for long. Third, an indelible lesson of the Internet for business is that Internet-enabled businesses like Amazon, which maximize the choice set over many product categories, have driven small book stores and record shops (with their more modest choice sets) out of business (Anderson 2006). The ascendancy of choice-set-maximizing Internet businesses like Amazon suggests that individuals preferentially seek the broadest choice sets they can find, and therefore the rise of Amazon is inconsistent with the Choice Overload hypothesis. The store that Iyengar and Lepper did their experiment in actually stocked 300 varieties of jam. Anderson (2006) suggests that if stores could sell more by carrying less variety of stock, they would have done so already. Although Iyengar and Lepper's 2000 paper is a citation classic, and their Choice Overload experiments have been replicated in some conditions, Scheibehenne et al's (2010) meta-analysis found no evidence of Choice Overload across the entire range of published studies that have tested Choice Overload in consumer retail situations.

Rosenfeld and Thomas (2012) showed that meeting online was especially common among gays, lesbians, and middle aged heterosexuals, groups that have difficulty identifying potential partners in the offline world. The technology to search across large choice sets to find the particular kind of partner each subject is looking for (whether by demographics or by acquired characteristics) is what makes the potential large choice set of Internet dating theoretically efficient. Even if individuals don't always know exactly what they want in a partner, and even if experiments show that partners outside an individual's search criteria can be just as appealing in person as partners who meet the search criteria (Rudder 2014), searching and matching can be potentially reinforcing to an individual's sense of what is most important to them.¹

Along with using the technology of search to take advantage of larger choice sets, Internet dating has the potential to increase the efficiency of data gathering about the smaller set of potential partners chosen for first dates. Among the Internet dating sites that cater to people

¹ Finkel et al (2012) and Slater (2013) found reasons to be skeptical of the algorithmic matching that some Internet dating websites advertise. And yet, even if Internet dating results in more first dates rather than better first dates (using Slater's terminology), the end result of more first dates could be better romantic matches.

looking for relationships rather than for hookups exclusively, long detailed questionnaires are the norm (Finkel et al. 2012). Many kinds of personal attributes of potential partners that might have taken weeks or months to discern in the course of a relationship are, via Internet dating profiles, discernable before the first date. To the extent that mate selection is an information gathering process (Oppenheimer 1988), Internet dating with its search technology and its presumably rich and extensive database to search from, could theoretically speed up the transition from dating to commitment to marriage. Of course, the theoretical advantage of information gathering from Internet profiles depends on the veracity of the information within those profiles. Research by Hancock et al (2007) suggests that online dating profiles are reasonably accurate along the dimensions that can be readily measured (age, height, and weight).

Prior Empirical Findings about the Internet and Social Life;

The Lost Community Hypothesis

Kraut et al (1998) describe a classic experiment which began in 1995 and 1996 with 93 families in Pittsburgh, Pennsylvania who had Internet access in their homes for the first time. The Pittsburgh families were given computers that recorded the amount of time spent online. In the subsequent 1-2 years, greater Internet use in the Pittsburgh families was associated with modest but statistically significant negative changes: less family communication, more loneliness, and more depression. The Kraut et al initial Pittsburgh experiment has been widely cited, and echoed other studies from the early days of the graphical Internet, which suggested that time spent online was negatively correlated with time spent in face-to-face social interaction (Nie and Hillygus 2002). When Kraut and his colleagues followed the same Pittsburgh cohort for an additional year, they found that most of the negative outcomes associated with Internet use they had previously reported had disappeared (Kraut et al. 2002).

One interesting aspect of the two Kraut et al studies (1998; 2002) is that the initial study which reported negative impacts of the Internet has been cited more (more than 4,200 times) than the updated and revised second study (cited more than 1,700 times) which reported neutral social impacts of the Internet (Google Scholar 2016). Even in the most recent completed years, 2013 and 2014, Kraut et al's initial negative findings received twice as many citations as Kraut et al's updated neutral findings about the social impacts of the Internet. The greater popularity (in citation counts) of Kraut et al's initial negative findings as compared to their later neutral

findings for social Impacts of the Internet is consistent with McKenna and Bargh's (2000) view that a negative bias is present in popular and scholarly writing about the Internet's social impact.

Critiques of the Internet's supposedly negative effects on social life (Kraut et al. 1998; Nie and Hillygus 2002; Sales 2015a; Turkle 2015) contribute to a long tradition of arguments that modernity (in its various manifestations) undermines family and communal social bonds; Wellman (1979) refers to this critique of modernity as the Lost Community hypothesis. In its modern form, the Lost Community hypothesis posits that technology erodes the quality of our social interactions, and therefore technology erodes the connectedness and vitality of our communities compared to a more civic-minded, more socially stable past.

In Turkle's (2011; 2015) view, Internet communication with its short text messages combined with the possibility of a rapid response necessarily lead to shorter and more impatient communication (see also Ansari and Klinenberg 2015; Rudder 2014; Slater 2013). The Internet and the cell phone put so many different streams of information at our fingertips that we inevitably multitask. Those who argue that technology impoverishes our social lives argue that multitasking makes us shallower, and robs us of our ability to concentrate on and commit to long term projects (Ophir, Nass and Wagner 2009; Carr 2011). In Carr's (2011) view, technology and the habit of multitasking have transformed the U.S. into a nation of people who skim instead of reading in depth. Franzen (2011) argued that the smartphone is a servant which feeds our narcissism and prevents us from taking the risks we would need to take in order to love other people. According to the Lost Community hypothesis, technology's pernicious impact on our social lives should be measurable in lower quality and less stable primary relationships.

Prior Empirical Findings about the Internet and the Stability of Romantic Relationships

Manning (2006 p.141) reported on an informal 2002 survey of divorce lawyers, finding that "68% of the divorce cases involved one party meeting a new love interest over the Internet." The potential ability of the Internet (which expanded the supply of new people any individual can meet) to undermine existing relationships is consistent with Choice Overload theory, but note that divorce lawyers see a population of couples that is selected on the dependent variable (divorce).

Young's (1998) study of "Internet addiction" was similarly based on a non-representative sample selected on the dependent variable, that is selected on people who self-reported that Internet use was interfering with other aspects of their lives. Young (1998 p.134) wrote:

"I heard of many cases of seemingly perfect terminal love among both married and single cyberlovers that instantly failed as real-life relationships. Stripped of their fantasy masks, cyberlovers seldom embrace the other person when they discover how he or she really looks, acts, feels and talks, and they catch on to the bigger lies easily concealed from the safety of the computer"

In order to understand whether Internet use undermines relationship stability, one needs data that are both representative and longitudinal. Manning's (2006) study of divorce lawyers and Young's study of "Internet addicts" were neither nationally representative nor longitudinal.

Cacioppo et al (2013) used a retrospective survey of 19,000 subjects and found that subjects who had met their spouses online were slightly less likely to report marital breakup than respondents who had met their spouse offline (controlling for year of marriage, age, ethnicity and other factors). Cacioppo et al also found that married subjects who met their spouses online reported higher marital satisfaction than married subjects who met their spouses offline. Rosenfeld and Thomas (2012) used nationally representative data from the How Couples Meet and Stay Together (HCMST) surveys and found no differences in breakup rate or relationship satisfaction by whether the couple had met online or offline. Cacioppo et al pointed out that the confidence intervals from Rosenfeld and Thomas's study were wide enough (because of the modest sample size of the HCMST data) to be consistent with Cacioppo et al's findings of positive effects of having met online (see also Figure 1, below). Rosenfeld and Thomas also showed that respondents with Internet access at home in 2009 were more likely to be in a relationship and were more likely to be married in 2009. Paul (2014) used HCMST data and found that couples who met online progressed to marriage more slowly and were more likely to break up, but Paul's paper used nonstandard methods.² I show below that the HCMST data yield

² Paul analyzed the HCMST data for breakup with separate non-event-history regressions for each wave, which is generally the wrong approach to longitudinal data (because of right censoring and exposure bias issues, see Tuma and Hannan 1984; Yamaguchi 1991). Paul's failure to combine the data from different waves into one event history dataset led Paul to not report the coefficient for wave 2 when the married couples who met online were less likely to break up (zero breakups for married couples who met online compared to 30 breakups for married couples who met offline), but to report the coefficient for wave 3 in which couples who met online appeared more likely to

results that differ substantively from Paul's results. Consistent with Rosenfeld and Thomas (2012), Bellou (2015) found that states with higher rates of Internet broadband adoption had higher marriage rates.

In this paper, I expand on Rosenfeld and Thomas (2012) by using five years of follow-up HCMST data, along with retrospective HCMST data, rather than the one year of follow-up data used by Rosenfeld and Thomas. I add transitions to marriage and transitions to cohabitation along with breakup as the three relationship outcomes, and I use meeting online and having Internet access at home as the two measures of the Internet's potential influence. Cacioppo et al (2013) found that 35% of couples married in the US in the 2005-2012 period had met online. Rosenfeld and Thomas (2012) found that the percentage of heterosexual couples who met online rose from about 8% in 2000 to about 22% in 2009. The 35% (reported by Cacioppo et al) of married couples who met online compared to the 8% to 22% of heterosexual couples who met online (from Rosenfeld and Thomas) could be reconciled in several ways. One way to reconcile the literature's previous findings of higher rates of meeting online among married couples than among all couples would be to hypothesize that couples who met online progressed to marriage more quickly. I show below that couples who met online did transition to marriage more quickly.

Hypotheses:

Hypothesis 1: Couples who meet online will have less stability.

Consistent with the Lost Community hypothesis and with the Choice Overload hypothesis, Hypothesis 1 implies Internet meeting will be associated with higher breakup rates, lower rates of transition to cohabitation, and lower rates of transition to marriage, controlling for other relevant factors.

Hypothesis 2: Meeting online or having Internet access at home is associated with greater relationship stability.

break up. Combining the waves into one dataset nullifies Paul's result which purported to show that meeting online is associated with higher rates of breakup for married couples. Furthermore, I have been unable to replicate Paul's one significant coefficient from Table 2 for wave 3 married couples who met online because there were only 5 married couples who met online who broke up in wave 3 of HCMST. It does not seem possible that, with only 5 breakups, the rate of breakup for married couples who met online could be significantly *higher* than the rate of breakup for married couples who met offline, regardless of how low the breakup rate for married couples who met offline in wave 3 was.

Hypothesis 2 implies that Internet meeting or Internet access at home will be associated with lower breakup rates, higher rates of transition to cohabitation, or higher rates of transition to marriage, controlling for other relevant factors. Hypothesis 2 is consistent with some recent empirical research on the Internet's effect on romantic relationships (Cacioppo et al. 2013).

Hypothesis 3: Of all ways of meeting online, meeting through an Internet dating website will be especially associated with transitions to marriage.

Hypothesis 3 is an extension of Hypothesis 2. If the Internet provides advantages due to partner choice (following Hypothesis 2), then Internet dating websites should provide the greatest relationship advantage, because Internet dating websites are dedicated to efficient search for particular partner criteria (Finkel et al. 2012) in a way that provides, in theory, better matches and more rapid information gathering on matched partners. Many other ways of meeting online, such as through gaming, or through chat are serendipitous and would lack the maximized choice set or potential informational advantage of online dating. Additionally, individuals who are more interested in finding a partner for a committed relationship might self-select into the Internet dating market.

After examining couple-level predictors of transition to breakup and transition to marriage, I will examine long-term cross-sectional U.S. data. A decline in marriage prevalence or an increase in the divorce rate would be consistent with the Lost Community and the Choice Overload predictions of an erosion of individuals' commitments to their primary romantic partners during the Internet era.

Hypothesis 4: During the Internet era, marriage prevalence will have declined and the divorce rate will have increased.

Data and Methods:

For the couple-level analysis, I use the How Couples Meet and Stay Together surveys (HCMST; Rosenfeld, Thomas and Falcon 2015) which started with a nationally representative survey of 3,009 adults who had romantic partners in 2009, and included longitudinal follow-up with the same individuals in 2010, 2011, 2013, and 2015.

HCMST surveys were implemented by survey company Knowledge Networks/GfK (hereafter KN/GfK). KN/GfK panel participants were initially recruited into the panel through a

nationally representative random digit dialing (RDD) telephone survey. Subjects who did not have Internet access at home were given Internet access. The HCMST wave 1 survey was an Internet survey, and waves 2-5 were Internet and phone surveys. Seventy one percent of KN/GfK panelists contacted for the wave 1 HCMST survey consented to participate. If one includes the initial RDD phone contact to join the KN panel (participation rate 32.6%) which took place months or years before HCMST wave 1, and each subject's completion of the KN background survey (56.8% completion rate), and multiplies those rates together to derive a composite response rate (a composite rate which considers individuals asked to join the KN/GfK panel as having been eligible to respond later to HCMST wave 1), the composite response rate for the wave 1 HCMST survey is $.71 \times .326 \times .568 = 13\%$ (Callegaro and DiSogra 2008). Despite the low composite response rate of KN/GfK surveys compared to single-stage RDD surveys, the quality of data derived from the KN/GfK panel has been shown to equal or exceed the quality of data derived from industry standard RDD surveys (Fricker et al. 2005; Chang and Krosnick 2009), in part because KN/GfK gathers information from subjects at each survey stage.

Among subjects eligible for follow-up in HCMST, the response rate was 85% at wave 2, 73% at wave 3, 60% at wave 4, and 46% at wave 5. In waves 2-5, the HCMST response rate was 93% for subjects who remained in the KN/GfK panel, compared to a 29% response rate among subjects who had retired or withdrawn from the panel. The key determinant of response to the HCMST follow-up surveys was whether the respondent was still in the KN/GfK panel at the time of the follow-up survey, rather than any factor that predicts couple longevity (such as relationship duration or marriage), which is why loss-to-follow-up does not bias estimates of relationship transitions in HCMST. In Appendix 1, I compare a key model from Table 2, weighted by the ordinary sampling weights, and then re-weighted with attrition adjusted weights (McGuigan et al. 1997). The results of the models with and without attrition weights are substantively the same, suggesting that the bias from attrition is negligible.

Methodologically, I rely on discrete time event history logistic regression (Yamaguchi 1991). My logistic regressions are weighted using the weight variable "weight2," with robust standard errors (White 1980) and clustering to account for the non-independence of repeated observations of the same couple over time (Rogers 1993). Regressions without weights, including the HCMST variable "recsource" that identifies the oversampled groups and therefore

predicts the weights (Winship and Radbill 1994) yield similar substantive results (see Table 3 below).

[Table 1 here]

Using the HCMST data, I create and analyze two separate event history datasets described in Table 1. The first dataset is a prospective dataset, starting with HCMST wave 1 in early 2009, following the 3,009 respondents who were partnered at wave 1, of whom 2,669 responded to at least one follow-up survey. Of these 2,669 partnered subjects, 1,341 met their partners in the Internet era or after, which I operationalize as 1995 or later because the graphical web browsers were first introduced in 1994 and 1995, and couples first started to meet online around 1995 (Rosenfeld and Thomas 2012). I analyze transitions to marriage only for heterosexual (i.e. different-sex) couples, because same-sex couples did not have access to legal marriage in most of the states and periods under study, and because even informal marriage among same-sex couples was historically constrained by the lack of legal marriage as an option (Rosenfeld 2014). The prospective dataset is a couple-month dataset because survey dates are specific to month, and most of the couple transitions were specific to month as well: for breakups in the 12 months between HCMST waves 1 and 2, month of breakup was not asked and was therefore imputed.³ For marriages reported in waves 2 and 3, the year of marriage was known and the month of marriage was imputed. For marriages reported in waves 4 and 5, and for breakups reported in waves 3, 4, and 5, both the month and year of transition were reported.

The second event history dataset is a retrospective dataset based on the history of relationships from wave 1 of HCMST. The time unit for the retrospective dataset is years. The retrospective dataset lacks a measure of subject education (because timing of education prior to

³ For married couples who broke up between wave 1 and wave 2, whose rate of breakup was less than 2% per year, breakups were randomly distributed to months between wave 1 and wave 2. For unmarried couples, breakup rate is much higher in the early stages of the relationship; the rate of breakup was more than 60% for unmarried couples who had been together for less than a year (Rosenfeld 2014), meaning the breakups would have been distributed more in the beginning of the year than in the end of the year between wave 1 and wave 2. To accommodate the front-loading of breakups of nonmarital unions in the period between wave 1 and wave 2, I

used the following function: $M_b = (M_e)r^{\frac{2+rd}{1+rd}}$ Where M_b is the imputed month of breakup after wave 1, M_e is the number of months elapsed between wave 1 and wave 2, r is a random uniform number between zero and 1, and rd is relationship duration in years. For short relationship duration, the random factor is nearly squared, reducing the imputed months before breakup.

wave 1 in 2009 was unknown), and the retrospective dataset also lacks a measure of whether the subject had Internet access at home, information about which only became available once the subject joined the KN/GfK panel. The retrospective data include more transitions to marriage than the prospective dataset (814 compared to 109), and more transitions to first cohabitation (1,171 compared to 108), but the retrospective data includes no breakups, because all HCMST couples were intact in 2009. The retrospective dataset has the advantage of covering events as early as 1998, when a modest number of HCMST couples who met online were first exposed to the risk of cohabitation and the risk of marriage. Together, the prospective and retrospective event history HCMST datasets provide for a more robust analysis than either dataset alone.

The prospective and retrospective datasets both rely on a measure of whether the survey subject and their partner met online, derived primarily from the open-ended wave 1 question, q24, “Please write the story of how you and [Partner_Name] first met and got to know one another and be sure to describe ‘how’ and ‘where’ you first met.” These open-ended responses were coded by the study investigators (Rosenfeld and Thomas 2012). In addition to the 270 subjects who were identified from the open-ended question as having met their partner online, an additional 19 subjects were identified from closed-ended question q32 from HCMST wave 1, “Did you use an Internet service to meet [partner_name]?” Of the 289 subjects who met their partner online, a subset of 134 met their partners through internet dating, identified either through their answers to the open-ended q24, or else by selecting the reply “Yes, an internet dating or matchmaking site (like eHarmony or match.com)” to q32. Subjects’ Internet access from home (applicable to the prospective dataset but not the retrospective dataset) was determined by the annual background question: “Does anyone in this household use the Internet from home? Include using the internet on mobile devices such as smartphones and laptops as well as on desktop computers.”

I derive national trend data on relationship dissolution from 8 cycles (1973, 1976, 1982, 1988, 1995, 2002, 2006-10, and 2011-13) of the National Survey of Family Growth (U.S. Department of Health and Human Services 2010; Copen et al. 2012), harmonized with each cycle weighted by cycle-specific analytic weights. The NSFG is a retrospective survey of subjects age 15-44, and provides the longest historical time trend of marital dissolution among datasets in the US. I supplement the NSFG data on marital dissolution in Figure 3 below with data from the American Community Survey (ACS, Ruggles et al. 2015). ACS is a dataset with

much larger sample size than NSFG but one which covers divorce in the past 12 months only for survey years 2008-14. I use US Census and ACS data 1940-2014 to chart changes in the prevalence of marriage over time.

[Table 2 here]

Results part 1: The Internet's influence on couples analyzed with longitudinal data

Table 2 shows the influence of either meeting online or of having Internet access at home on relationship outcomes using the prospective event history HCMST dataset. The first three columns describe models that predict breakup, with and without controls, where the controls match the controls used by Rosenfeld (2014) to predict breakup in HCMST through wave 4.

In column 1, the couples who met online had a monthly breakup rate of $P_1=0.00795$ per month, and the couples who met offline had a breakup rate of $P_2=0.00325$ per month, yielding a highly significant odds ratio of $(P_1 / (1 - P_1)) / (P_2 / (1 - P_2)) = 2.46$. The odds ratio for breakup without controls is highly significant in column 1 (suggesting that couples who met online were much more likely to break up) because the couples who met offline had been together much longer than the couples who met online, and were (as a consequence of longer relationship duration) less likely to break up. At wave 1, the average relationship duration for couples who met online was 4.4 years, and the average relationship duration for couples who met offline was 19.1 years. Most married couples in HCMST were married before 1995, before the graphical Internet. Controlling for relationship duration, as row G does, reduces the odds ratio of breakup (for couples who met online compared to couples who met offline) to an insignificant 1.10. The full set of odds ratio coefficients for Column 1, row G, is provided in Appendix 1.

In column 2, the unadjusted odds ratio of breakup (for couples who met online compared to couples who met offline) is a non-significant 1.31, because column 2 includes only couples who met during the Internet era, thus excluding couples who met before 1995 (all of whom met offline) and who as a result of their long relationship durations had the lowest rate of breakup. Consistent with Rosenfeld and Thomas (2012), column two shows that meeting online had no significant effect on couple longevity, either with or without controls. Row G of Column 2 shows that controlling for other factors that predict breakup for couples who met during the

Internet era, the odds ratio for breakup was not significantly different (odds ratio of 0.96) for couples who met online compared to couples who met offline.

The difference between the unadjusted odds ratio of 1.31 in row F of Table 2, column 2, and the adjusted odds ratio of 0.96 in row G of Table 2, column 2, is explained by controls for relationship duration. Between 1995 and 2009, the chance that newly formed couples would have met online rose sharply, and therefore the couples who met online were more recently formed and had less of the protection that relationship duration ordinarily provides. Without accounting for relationship duration except by the crude filter of meeting in or after 1995, the breakup rate for couples who met online would appear to be slightly higher than the breakup rate for couples who met offline, even though the difference, an odds ratio of 1.31, is not significantly different from 1. The adjusted odds ratio of 0.96 in row G of column 2 is a more reasonable estimate for the effect of meeting online on the breakup rate, and its non-significance and its closeness to 1 suggests a null association between meeting online and breakup.

Given the null findings of the effect of meeting online on breakup, I report the power of the data to reject null hypotheses. If the odds of breakup were truly 1.5 times higher for couples who met online than for couples who met offline, the HCMST data would have a 0.80 power to reject the null hypothesis of no difference, assuming a two-tailed alpha of 0.05. And if the real world odds of breakup were 2.0 times higher for couples who met online compared to couples who met offline, the power to reject null hypotheses of no difference with HCMST data would be 0.999, near certainty, with a standard two-tailed alpha of 0.05. HCMST data have sufficient power to reject null hypotheses for differences in the breakup rate between couples who met online and couples who met offline, if the differences between the true breakup rates corresponded to an odds ratio of 1.5 or higher.

Column 3 of Table 2 shows that having Internet access at home was not associated with a significantly higher rate of breakup (for couples who met during the Internet era) compared to couples who did not have Internet access at home, with odds ratio of 0.81 unadjusted, and odds ratio of 1.06 adjusted, neither significantly different from 1.

Column 4 of Table 2 shows that heterosexual couples who met online had odds of transition to marriage almost twice as high (odds ratio 1.98) compared to heterosexual couples

who met offline, among couples who met in the Internet era.⁴ The significantly faster transition to marriage among couples who met online was robust to other predictors of transitions to marriage (odds ratio 1.86). Column 5 of Table 2 shows that having Internet access at home was associated with higher odds of getting married (odds ratio 3.01). When controls were included in the model, the association between having Internet access at home and getting married was still high (1.93) but was no longer statistically significantly different from 1. The controls that mediated the effect of having Internet access at home were age and age-squared. Young adults in their 20s and 30s, the ages at which marriages were most likely to occur, were also the age groups most likely to have Internet access at home.

The confidence intervals around the odds ratios in column 5 are wider than the confidence intervals in column 4 in part because HCMST's measure of Internet access at home is a noisy measure. Having Internet access at home was determined in HCMST by one survey question only, and the substantive meaning of having Internet access at home (in terms of how people actually used the Internet) is opaque in HCMST. Despite not knowing how subjects with Internet access at home (including smartphone Internet access) actually used the Internet, we can assume that subjects with Internet access were more likely to have had access (via the Internet and their smartphones) to thousands of potential romantic partners online. The Choice Overload hypothesis suggests that individuals with Internet access at home should have been more likely to break up with their romantic partners (with or without controlling for factors such as age and education which predict Internet access). In contrast to the Choice Overload hypothesis, Table 2 shows that having Internet access at home was not associated with couple breakup.

Columns 4 and 5 provide support for Hypothesis 2, that meeting online or having Internet access at home would be associated with faster transitions to marriage, consistent with the advantages of choice associated with the online market for potential partners. Columns 6 and 7 show that transitions to cohabitation appeared to be higher for couples who met online or for subjects who had Internet access at home, though none of the associations were statistically significant.

⁴ Most transitions to cohabitation occur in the first few years of the relationship, and most transitions to marriage occur in the first 10 years of the relationship. Few couples who met before 1995 remained unmarried or had never cohabited by 2009. Supplementary analyses (available from the author) of transitions to marriage and transitions to cohabitation without the filter of meeting after 1995 yield similar results.

Table 2 shows that the key negative outcome, breakup, is not associated with Internet access at home or with meeting online (after relationship duration is accounted for). Table 2 also shows that a key positive relationship outcome, transitions to marriage, does appear to be associated with meeting online.

[Figure 1 here]

Figure 1 shows the Kaplan-Meier (1958) cumulative survival (as intact couples) function for couples who met online compared to couples who met offline, using the prospective HCMST event history data. Consistent with Table 2, Figure 1 shows no significant difference in couple survival rates for couples who met online compared to couples who met offline (at the same relationship duration). Excluding the same-sex couples (with their high rate of meeting online and their low rate of marriage, see Rosenfeld 2014; Rosenfeld and Thomas 2012) from Figure 1 yields a nearly identical figure (available from the author).

[Table 3 here]

Table 3 revisits the most robust positive finding from Table 2, that meeting online was associated with faster transitions to marriage. Model 1 of Table 3 replicates Model 4 of Table 2, showing that heterosexual couples who met online had an odds of transition to marriage 1.98 times as high as the odds of transition to marriage for heterosexual couples who met offline.

Models 1-3 of Table 3 use the prospective HCMST event history dataset, and Models 4 and 5 use the retrospective HCMST event history dataset. Except for the fact that the retrospective dataset has more transitions to marriage and therefore more statistical power to identify the known age and racial correlates of transitions to marriage (Copen et al. 2012), the results of the prospective and retrospective data are similar.

Models 2-5 of Table 3 break meeting online into two subcategories: those who met through internet dating or matchmaking websites, and those who met online in other ways (generally less structured and with smaller choice sets). In Model 2, using the weighted version of the prospective data, heterosexual couples who met through online dating had an odds ratio (equivalent to a hazard ratio) of transitions to marriage of 3.29 compared to couples who met

offline, and the ratio was highly significant. In Model 2, heterosexual couples who met online but not through online dating had an odds ratio of transitions to marriage of 1.52 compared to couples who met offline, and this odds ratio was not significantly different from 1. In each of Models 2 through 5, meeting through online dating was significantly associated with a higher odds ratio for transitions to marriage, and in models 2-5 (prospective or retrospective data, weighted or unweighted), couples who met online but not through online dating had odds of marriage that were not significantly different from couples who met offline. In Model 5, the odds ratio of transition to marriage was $(1.74/0.93)=1.87$ times higher for couples who met through online dating compared to couples who met online but not through online dating. The results of Table 3 support Hypothesis 3, because Internet dating is the most choice-intensive type of online meeting, and is also the type of online meeting most associated in the HCMST data with the transition to marriage.

[Figure 2 here]

Figure 2 shows the cumulative transition to marriage over the 2009-2015 period, for heterosexual couples who were unmarried in HCMST wave 1.⁵ Consistent with the analyses in Table 3 above, couples who met through online dating had the fastest transitions to marriage. Of the couples who met through online dating and who remained together, it took between 3 and 4 years of the relationship for 50% of the couples who remained intact and who were unmarried at wave 1 to transition to marriage.⁶ For couples who met offline, more than 10 years of couple duration were required before half of the relationship cohort had transitioned to marriage according to Figure 2's unweighted Kaplan-Meier (1958) estimates.

It is important to note that the confidence interval in Figure 2 for heterosexual couples who met through online dating is wide because there were only 13 transitions to marriage in the

⁵ Unmarried couples were at risk for marriage until breakup, or until censoring at the time of their last HCMST survey response.

⁶ Figure 2 measures transitions to marriage from the time the relationship began, using HCMST prospective data. Bramlett and Mosher (2002) reported on transitions to marriage starting from the beginning of couple cohabitation, using retrospective data from the 1995 wave of the National Survey of Family Growth. Because couples who cohabit are more likely to eventually marry, and because cohabitation is a step towards marriage for many couples, and because cohabitation takes place after the beginning of the romantic relationship, Bramlett and Mosher reported faster transition to marriage, with 58% of cohabiting heterosexual couples transitioning to marriage by the third year of cohabitation.

prospective HCMST data for heterosexual couples who met their partners in online dating.⁷ Even though the number of transitions to marriage among the couples who met through online dating was small in HCMST, the marriages occurred so early in the relationships that the cumulative marriage rate was significantly higher than for couples who met offline. Kaplan- Meier cumulative transitions to marriage in the yearly retrospective data (not shown) reflects much larger sample size of marriage events and smaller confidence intervals, and shows the same hierarchy of transitions to marriage, with couples who met through online dating transitioning to marriage significantly faster than couples who met offline or couples who met online but not through online dating. The main competing risk for transition to marriage is transition to breakup. Table 2 and Figure 1 above show that couples who met online and couples who met offline have indistinguishable breakup rates (controlling for relationship duration), so the competing risk from breakup should not bias Figure 2.

[Figure 3 here]

Results Part 2: National Trends in Divorce and Marriage Prevalence

Figure 3 illustrates the well-known US divorce rate plateau of 1980 through the early 1990s (Goldstein 1999; but see also Kennedy and Ruggles 2014). The marital dissolution rate had risen steadily for 20 years up to 1980, and according to other data sources the marital dissolution rate had risen for most of the 20th century up to 1980, aside from one sharp peak and subsequent decline immediately after World War Two (Cherlin 1992 p.21). In the Internet era, the marital dissolution rate for first marriages in NSFG has declined from the 1980-1995 plateau.

At either end of the NSFG time series, the NSFG data become sparse and the 95% confidence intervals widen. The ACS has much larger sample size, more than 5,000 divorces per year for women in first marriages younger than age 45, compared to several hundred divorces per year for women in first marriages in the NSFG (and fewer than 100 per year after 2008). The yearly divorce rates for first marriages for women under 45 are similar in ACS and NSFG in Figure 3, but the slight decline in divorce rate in the ACS data for 2007-2013 is more definitive (and statistically significant) because the ACS sample is so much larger than the NSFG. The ACS divorce rate for all women (regardless of age) is substantially lower because older married

⁷ Because 9 of the 13 marriages in Figure 2 of couples who met through online dating had their month of marriage imputed within twelve month windows, Figure 2 shows transitions to marriage in yearly, rather than monthly increments (so that Figure 2 is unaffected by imputations of the month of transition to marriage).

women have been married longer and marital longevity is associated with lower rates of divorce. The declining divorce rate in the Internet era is not consistent with either the Lost Community or with the Choice Overload hypotheses.

[Figure 4 here]

Figure 4 shows the trend in marriage prevalence of adults (age 21 and over) from 1940 to 2014. Since 1960, marriage prevalence has declined. The 1995-2014 decline in marriage prevalence among adults is consistent with the longer term decline in marriage prevalence that began around 1960, when the baby boom was over and the delay in first marriage began in earnest. Figure 4 shows two predicted values for the marriage rate, derived from individual level logistic regressions with controls. One of the predictions in Figure 4 takes into account the number of cellular phones in the US per 100 persons (World Bank 2015), which is one measure of technology penetration which has the benefit of being measured consistently every year.⁸ The other prediction takes no account of the cellular phones or technology penetration. Both prediction models take account of individual age, age squared, education (categorical), race, US nativity, gender, gender \times age, and years since 1960 (when the decline in marriage prevalence began). Coefficients and summary statistics of the models are available in Appendix 2.

The predicted marriage rate taking cellular phone penetration into account, and the predicted marriage rate ignoring cellular phone penetration differ by less than half of one percent, so that the two predicted values are difficult to distinguish in Figure 4. In 2014, the actual proportion of US adults over age 20 who were married was 49.99%. The predicted mean marriage rate without taking cellular phone penetration into account was 51.2%, while the predicted marriage rate taking account of the rise cellular phone penetration was 51.0%. The prediction that takes cellular phone penetration into account yields a slightly lower estimate of the marriage rate in 2010-2014, which is also closer to the actual rate, and significantly better fitting (across the 1960-2014 range) due to the massive sample size of the census and ACS data (more than 34 million individual cases). The pseudo R-squared of both models is identical to 4 digits. The post-1995 decline in marriage prevalence is consistent with a Lost Community

⁸ Household Internet access has been measured less consistently over time, either through Current Population Survey data, or through industry data, since many different industries and technologies have brought Internet access into the home (coaxial cable, satellite, copper phone wires, fiber optic cable, wireless).

perspective. Marriage is the core institution for stable romantic relationships between adults (Cherlin 2014), and the decline in the prevalence of marriage implies a rise in the number of adults who are either unpartnered, or who are in relationships less committed than marriages.

Figure 4 shows, however, that the rise of the Internet appears to explain (in a statistical sense) very little of the decline in marriage in the US in the Internet era.⁹ Bellou (2015) found that marriage rates were *highest* in US states that had faster adoption of broadband Internet. Bellou's findings are consistent with my Figure 2 above (showing that Internet technology is associated with faster transitions to marriage), and with Figure 4.

Discussion:

Analysis of individual level data from the HCMST project shows that meeting online is not associated with couple breakup (though the number of breakups in HCMST is modest, so the power to reject null hypotheses of small differences in breakup rates is modest as well). Meeting online was not significantly associated with transitions to cohabitation, but meeting online was significantly associated with transitions to marriage. Heterosexual couples who met online transitioned to marriage faster than heterosexual couples who met offline. The association between meeting online and faster transitions to marriage was entirely driven by couples who met through Internet dating websites, the sites on the web where choice of potential partners is maximized. The association between Internet dating and transitions to marriage for heterosexual couples was highly significant in both the prospective and the retrospective versions of the HCMST event history data.¹⁰

⁹ Taking the coefficient for cellular phone usage in Model 2 of Appendix 2, -0.00155 (which is net of year and age and gender and education and other factors), and multiplying by 10 to signify the difference associated with a 10 point increase in cellular phone prevalence per 100 persons (an increase that represented about 2 years of increased cellular phone adoption in the late 1990s, the period of fastest cellular phone adoption), the odds ratio effect of the additional cellular phones would be $e^{-0.0155}=0.985$. Starting with an actual marriage prevalence of 62% (approximately the marriage prevalence in the mid-1980s when cellular phones were first introduced), the statistical effect of raising the cellular phone penetration by 10 points would be to lower the predicted marriage prevalence to 61.6%, a decline of 0.4%. A rise in cellular phone prevalence of 100 points, i.e. going from no cellular phones to everyone having a cellular phone which according to the World Bank has taken the US approximately 30 years to accomplish, would lower the predicted marriage prevalence to 58.3%, a 3.7% decline from 62%. In the 30 years between 1984 and 2014, the actual marriage prevalence for persons 21 years old and older declined by about 12%, see Figure 4. In this way of estimating technology's potential effect on marriage prevalence, perhaps as much as a 30% of the marriage prevalence decline since 1984 could be associated with technology.

¹⁰ Individuals who use Internet dating are taking advantage of information gathering and the possibility of searching across a broad choice set of potential partners. High levels of homogamy are one potential outcome of the greater

One of the key advantages to Internet dating is information gathering from the potential partner's profile. Many of the kinds of questions that the Internet dating websites gather are the kinds of questions that are difficult to ask a potential partner at the first date or early in the relationship (i.e., what is your philosophy about money, what particular kind of travel do you like, do you have herpes, do you own a gun). Consider this story from the open ended answers of a 28 year old HCMST respondent who later married his partner of 3 years: "We met through [an Internet dating website]. We started getting to know one another through the website, then through phone/email, then after about a month, started dating in person. Our first phone conversation lasted into the middle of the night... We are soul mates... We complement each other well. We are planning to be engaged in the next month..."

Religious individuals tend to be particularly goal-oriented about marriage, and they often find themselves in thin dating markets where similarly religious potential partners are difficult to identify. A 41 year old white HCMST respondent wrote: "Met on a Christian website. We first met in person 3 days after making initial online contact. We got engaged 2 months after meeting." A 59 year old black Christian HCMST respondent found his mate because the woman saw a picture of him leaving church with his mother on his profile, and she contacted him because she liked the picture. They had to wait 4 months for first meeting because they lived in different cities, but the day after they first met in person, they decided to get married.

Although meeting through an Internet dating website is associated with faster transitions to marriage for heterosexual couples, there is likely a strong selection effect in drawing the most marriage-ready individuals into the Internet dating websites. Self-selection of marriage-ready individuals into Internet dating would be evidence that those individuals believe that the expanded choice set of potential marriage partners provided by Internet dating would be beneficial to their marriage chances. The faster transition to marriage of couples who met through Internet dating demonstrates that the perceived advantages of a wide choice set may be real.

Besides Internet dating's association with marriage, there are newer technology based ways of meeting, including GPS-based phone applications Tinder and Grindr, which have

information gathering and search facilities of Internet dating. Research on Internet dating shows that Internet daters demonstrate a strong preference for same-race dating partners (Lin and Lundquist 2013; Robnett and Feliciano 2011). The likelihood of being in a same-race relationship is similar for couples who met online and for couples who met offline (Rosenfeld and Thomas 2012). The preference for same-race dating among Internet daters is greater in practice than individual profiles generally admit (Rudder 2014; but see also Lewis 2015).

reputations for promoting hookups and short term relationships rather than committed relationships (Sales 2015b). Nationally representative data do not yet exist to explore Tinder and Grindr's effects on social interactions. The HCMST data only cover couple meetings up to March of 2009. Smartphone apps such as Tinder and Grindr post-date 2009. There were pre-2009 Internet services that prioritized hookup culture, such as Craigslist casual encounters, and the website hotornot.com. It is very unlikely that negative social impacts of the Internet will have emerged since 2009, if (as I document in this paper) there were no net negative impacts of the Internet on couples who met online before 2009.

In waves 4 and 5 of HCMST, subjects who reported a breakup were asked to explain, in an open-ended text box, why their relationship broke up. Of these 136 (mostly brief) breakup stories, 28 (21% of all breakups) mentioned infidelity as a reason for the breakup, and of those 28, six individuals (4% of all breakups) mentioned the Internet as a cause of the infidelity. One subject wrote: "She and I had constant disagreements and were unhappy. She then revealed to me that she was in love with one of my friends she met on the Internet (not in real life). We divorced afterwards." The availability heuristic (Glassner 2010) leads some to blame the Internet for infidelity and for their relationship breakup, though far less than the 68% that Manning (2006) reported of divorces resulting from Internet infidelity. Infidelities, like other relationships, often have an online component. What is not clear is whether the internet era has made infidelity more common. The declining divorce rate after 1995, and the lack of significant association between having Internet access at home and breakup would both tend to suggest that infidelity has not become more frequent in the Internet era. Reliable evidence of infidelity rates over time, however, has always been lacking.

In 2015, ashleymadison.com, an Internet website dedicated to extra-marital affairs, had their database hacked and their customer data dumped online. One assessment was that the Ashley Madison hack was a potential "hurricane" that could result in as many as 800,000 extra divorces (Barro and Wolfers 2015). Researchers soon discovered that Ashley Madison had many married male customers purportedly looking for affairs, but few women customers who wanted to have affairs with the married men (Newitz 2015; Greenberg 2015). A substantial fraction of the messages that the married men received from Ashley Madison were generated by Ashley Madison's software to make the men think that there was a female customer interested in meeting them. Many extramarital affairs were arranged through Ashley Madison, but like most

suspected negative technological impacts on social life, the real impact of Ashley Madison on the national divorce rates will probably end up being unmeasurably small.

Despite anecdotal evidence for the negative effect of Choice Overload in Internet dating (Slater 2013; Turkle 2015; Heino, Ellison and Gibbs 2010; Vitzthum 2007), survey-based studies of the internet's effect on couples find either null effects or positive effects of meeting online (Cacioppo et al. 2013; Rosenfeld and Thomas 2012). Glassner (2010) argues that cyberspace, being relatively new, is an attractive locus for our unfounded fears. Because the popular media amplify the dangers of cyberspace, individuals more readily find cyberspace a likely explanation for negative outcomes.

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Table 1: Descriptive Statistics for two event history datasets derived from the How Couples Meet and Stay Together surveys

Data Version	Prospective	Retrospective
Period Covered	2009-2015; couple met in 1995 or later	1998-2014 [¥]
time unit	couple-months	couple-years
Outcome 1: Breakups	407	N/A
Maximum number of couple-periods exposed to risk of breakup	57,081 months (equivalent of 4,757 couple years)	N/A
N of couples exposed to the risk of breakup	1,341	N/A
Weighted Percent of couples who met online	13.7%	N/A
Weighted Percent of couple-periods in which subject has Internet access at home	88.3%	N/A
Outcome 2: Transitions to marriage among heterosexual couples	109	814
Maximum number of couple-periods exposed to the risk of marriage	17,153 couple months (equivalent of 1,429 couple years)	7,646 couple years
N of unmarried heterosexual couples exposed to the risk of marriage during the exposure period	619	1,430
Weighted Percent of subjects who met online	15.4%	13.0%
percent of subjects with Internet access at home (through computer, phone, or tablet)	76.1%	N/A
Outcome 3: Transitions to first cohabitation	108	1,171

¥ Time limits in the retrospective data set by availability of unmarried heterosexual couples who met online. The difference in N of couples between the retrospective and prospective versions of the data is that the retrospective dataset includes an additional 705 couples who married between 1998 and 2009, plus an additional 106 couples who were unmarried at HCMST wave 1 in 2009 and who were lost to follow-up thereafter. If we relax the filter for prospective data that the couple needed to have met in 1995 or later, there would be 503 breakups, and 121,989 couple-months of exposure to the risk of breakup in 2009-2015.

Table 2: Comparison of event history relationship outcomes by Internet influence, using prospective data for 2009-2015, odds ratios from weighted event history logistic regressions

	1	2	3	4	5	6	7
A) Outcome	Broke up	Broke up	Broke up	Got Married	Got Married	Moved in together	Moved in together
B) Filters	none	Met in 1995 or later	none	Met in 1995 or later; Heterosexual couples	Met in 1995 or later; Heterosexual couples	Met in 1995 or later, noncoresident in 2009	Met in 1995 or later, noncoresident in 2009
C) Internet Variable	Met Online	Met Online	Have Internet Access at Home (time varying)	Met Online	Have Internet Access at Home (time varying)	Met Online	Have Internet Access at Home (time varying)
D) weighted rate (per month) of row A outcome if row C Internet variable is positive	0.795%	0.79%	0.43%	1.10%	0.77%	1.75%	1.39%
E) weighted rate (per month) of row A outcome if Row C Internet variable is negative	0.325%	0.60%	0.35%	0.56%	0.26%	1.02%	0.65%
F) Raw Odds ratio of rates (F=(D/(1-D))/(E/(1-E))) without controls [with 95% CI]	2.46*** [1.72, 3.52]	1.31 [0.91, 1.89]	0.81 [0.59,1.12]	1.98* [1.06, 3.72]	3.01* [1.01, 9.00]	1.73 [0.94, 3.18]	2.17 [0.96, 4.88]
G) Odds Ratio adjusted with controls (from logistic regressions using the controls in row H) [with 95% CI]	1.10 [0.77, 1.59]	0.96 [0.66, 1.39]	1.06 [0.73,1.53]	1.86* [1.00, 3.45]	1.93 [0.69, 5.37]	1.48 [0.94,2.31]	1.26 [0.51, 3.09]
H) Controls	age, relationship duration, relationship duration ^{-0.5} , formal union, same-sex couple, college degree	age, relationship duration, relationship duration ^{-0.5} , formal union, same-sex couple, college degree	age, relationship duration, relationship duration ^{-0.5} , formal union, same-sex couple, college degree	age, age ² , relationship duration, relationship duration ² , race, college degree	age, age ² , relationship duration, relationship duration ² , race, college degree	age, age ² , relationship duration, race, college degree, same-sex couple	age, age ² , relationship duration, race, college degree, same-sex couple

Source: How Couples Meet and Stay Together, all outcomes took place between wave 1 of HCMST and wave 5 of HCMST, 2009-2015. Rates and comparisons of rates are weighted by weight variable “weight2.” Confidence intervals determined by event history logistic regressions with robust standard errors, with standard errors clustered on couples. Controls are all time varying except for the following: same-sex couple status, race. Race excluded from the models predicting breakup because the race terms were insignificant. * P<0.05 ***P<0.00.

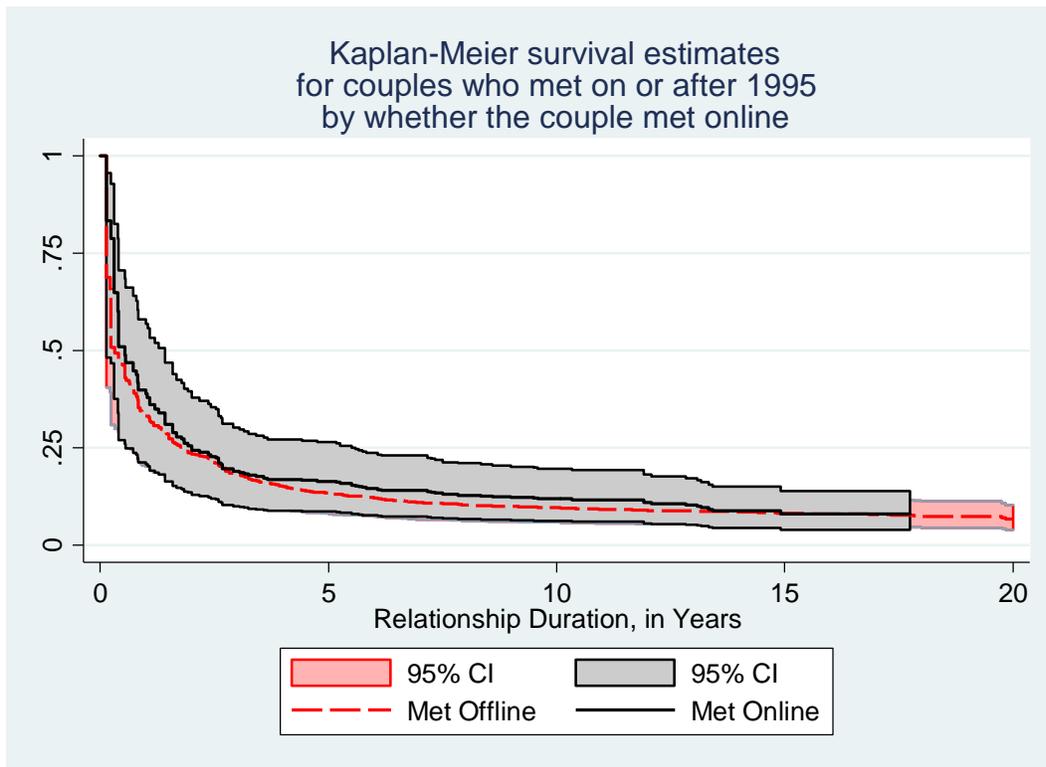
Table 3: Predicting Transitions to marriage for heterosexual couples, odds ratios [and 95% CI] from event history logistic regressions

	1	2	3	4	5
Data type	Prospective	Prospective	Prospective	Retrospective	Retrospective
Weighted	Yes	Yes	No	Yes	No
Met Online (all)	1.98*				
	[1.06, 3.72]				
A) Met Online subset: not Internet Dating		1.52 [0.66, 3.51]	1.27 [0.59, 2.73]	1.21 [0.86, 1.69]	0.93 [0.69, 1.24]
B) Met Online subset: Online Dating		3.29*** [1.58, 6.88]	3.68*** [1.84, 7.38]	1.83*** [1.36, 2.45]	1.74*** [1.35, 2.24]
Relationship Duration in Years		1.47* [1.03, 2.09]	1.42* [1.09, 1.87]	1.06 [0.99, 1.13]	1.05 [0.99, 1.11]
Relationship Duration Squared		0.97 [0.94, 1.00]	0.98* [0.95, 0.99]	0.99* [0.99, 0.999]	0.99* [0.99, 0.999]
Subject Age		1.16 [0.96, 1.41]	1.04 [0.81, 1.35]	1.06 [0.99, 1.13]	1.07** [1.02, 1.13]
Subject Age squared		1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	0.99* [0.99, 0.999]	0.99*** [0.99, 0.999]
Subject is black		0.75 [0.28, 2.05]	0.88 [0.37, 2.11]	0.63* [0.42, 0.93]	0.64** [0.47, 0.88]
Subject has BA		2.20** [1.35, 3.61]	2.00** [1.25, 3.21]		
Calendar year				0.94*** [0.92, 0.96]	0.94*** [0.92, 0.96]
Test: B/A		2.17 [0.76, 6.20]	2.89* [1.08, 7.79]	1.51+ [1.00, 2.30]	1.87*** [1.30, 2.68]

Source: How Couples Meet and Stay Together, waves 1-5. Prospective data cover exposure to the risk of marriage in 2009-2015, for heterosexual couples who met in 1995 or later. Retrospective data cover exposure to the risk of marriage in 1998-2014 for heterosexual couples regardless of when they met. All models are clustered on individual couples, with robust standard errors. Weighted logistic regressions are weighted by weight variable "weight2." Unweighted regressions add variable "recsource" as a predictor because "recsource" predicts the weights. Coefficients for "recsource" and for 3 additional race categories not shown. Calendar year not entered into the prospective models as a predictor because it was not significant. All predictors are time varying except for met online and race. Subject's education is not known in the retrospective data.

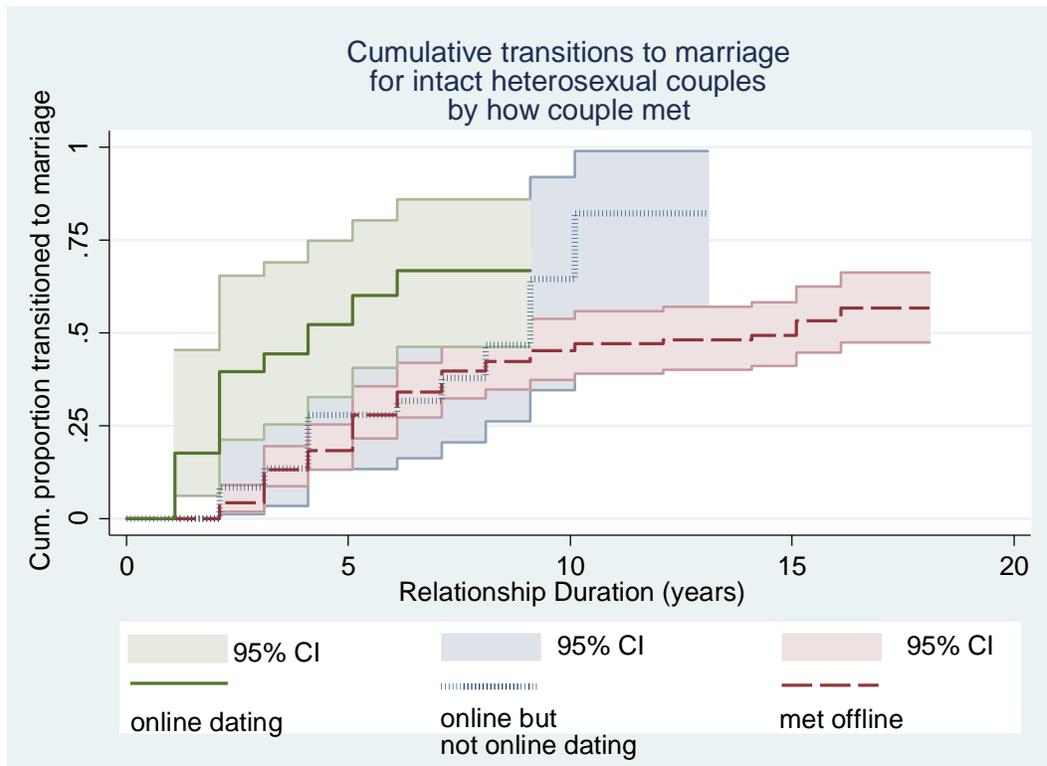
+ P<0.10; * P<0.05; ** P<0.01; *** P<0.001, two tailed tests

Figure 1: Meeting online not associated with lower couple longevity



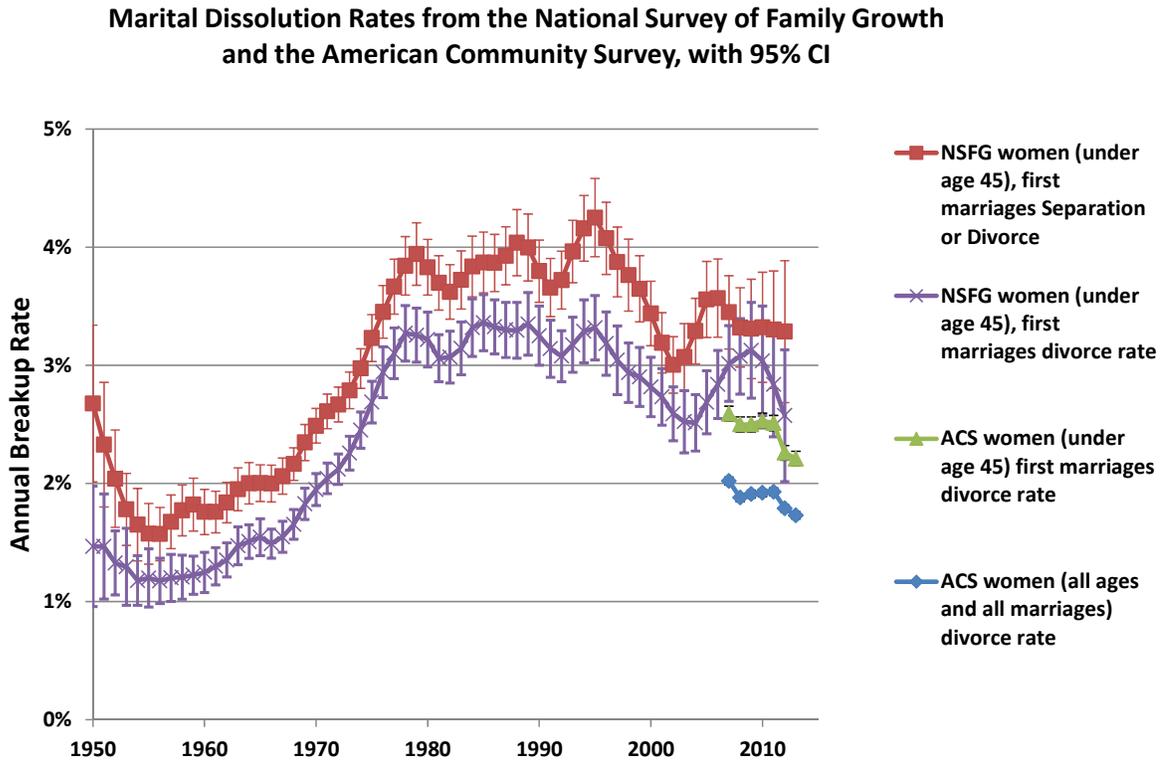
Source: HCMST prospective event history data, covering breakups between 2009 and 2015. Data are unweighted. Cumulative survival in this case means couple survival as an intact couple, i.e. without breakup. Number of breakup events: 94 for couples who met online, and 300 for couples who met offline.

Figure 2: Meeting through Internet dating associated with faster transitions to marriage



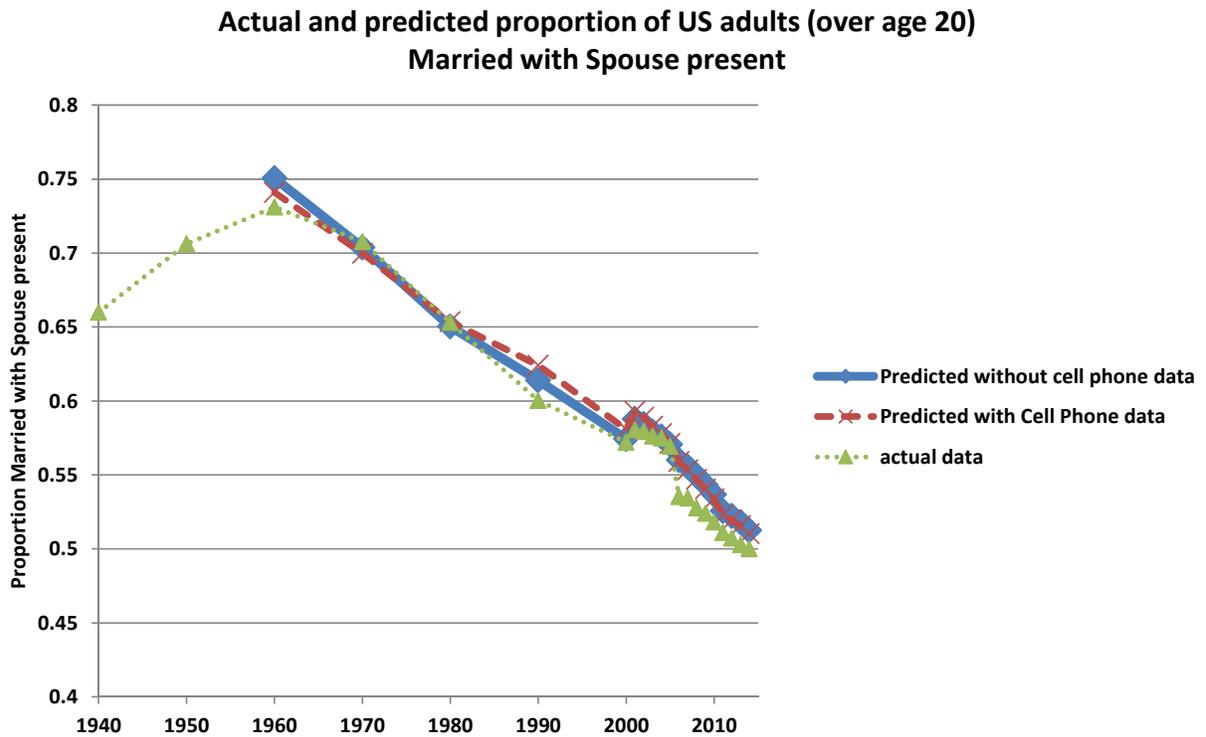
Source: HCMST prospective data. Unweighted cumulative transitions to marriage in 2009-2015 (with 95% confidence intervals) for intact heterosexual couples who were unmarried at HCMST wave 1. Cumulative transitions to marriage is $1 - S$ where S =(Kaplan- Meir survival curve for remaining unmarried). Number of transitions to marriage: 13 for heterosexual couples who met through online dating, 12 for heterosexual couples who met online but not through online dating, and 84 transitions to marriage for heterosexual couples who met offline.

Figure 3: Decline of divorce rate during the Internet era



Source: Weighted data from the National Surveys of Family Growth (NSFG) , waves 1973, 1976, 1982, 1995, 2002, 2006-10, and 2011-13 for women younger than 45 in first marriages. The NSFG data are corrected for fractional year exposure to the hazard of breakup in marriage year and in survey year. The NSFG year-by-year data points are smoothed with a 5 year moving average. American Community Survey (ACS) 2008-14 data are weighted and, because of their much larger sample size, unsmoothed. 95% confidence intervals for divorce rates in the ACS are barely visible at this scale because the ACS sample sizes of subjects exposed to the risk of divorce are so large in ACS- more than 200,000 per year for women under 45, and more than 700,000 per year for women of all ages.

Figure 4: Decline of Marriage prevalence since 1995 part of a longer trend



Source, US census microdata 1% files, 1940, 1950, 1960, 1970, 1980, 1990, and 2000, plus American Community Survey data 2001-2014, via ipums.org, all weighted by "perwt." Predicted values use 1960 and later, and use logistic regression to control for age, age squared, gender, gender× age, education (categorical), US nativity, race, and years since 1960. "Predictions with cellular phone data" controls for number of cellular phones in the US per 100 persons, data from The World Bank, ranging from <1 in 1984, to 98.4 in 2014.

Appendix 1: Predicting breakup in HCMST, Comparing models with regular survey weights and with attrition-adjusted weights, odds ratios from weighted logistic regressions [with 95% CI]

	1	2
Data type		
Weighted	regular weights	attrition-adjusted weights
Met Online (all)	1.10 [0.77, 1.58]	1.10 [0.76, 1.57]
Subject Age	0.997 [0.99, 1.01]	0.997 [0.99, 1.01]
Relationship	0.96***	0.96***
Duration in Years	[0.94, 0.98]	[0.94, 0.98]
Relationship	2.02***	2.03***
Duration ^{0.5}	[1.67, 2.45]	[1.67, 2.47]
Subject is a formal union	0.14*** [0.10, 0.20]	0.14*** [0.10, 0.20]
Same-sex couple	1.34 [0.90, 2.00]	1.47 [0.98, 2.21]
Subject has BA	0.74* [0.57, 0.97]	0.76 [0.58, 1.00]
N of subjects	2593	2593
N of couple-months	119,240	119,240
Wald Chisquare (7df)	539.4	532.6

Source: How Couples Meet and Stay Together, waves 1-5. Prospective data cover exposure to the risk of breakup in 2009-2015. Both models are clustered on individual couples, with robust standard errors. Column 1 is the same as column 1 of Table 2, weighted by survey weight “weight2.” Following McGuigan et al (1997), the attrition adjusted weights are ((weight2)/P) where P is the predicted probability of response to any of HCMST waves 2-5, and where P is determined by a logistic regression with the following wave 1 predictors: gender, marital status, relationship duration, race, recruitment source, log income, children in household, age, age squared, educational attainment, and having Internet access at home, plus a dummy variable for whether the subject ever retired or withdrew from the KN/GfK panel in waves 2-5. As noted in the text, retirement or withdrawal from the KN/GfK panel was the best single predictor of wave 2-5 response rate. Because of the way the original HCMST weights were designed, the weights create especially large errors for same-sex couples in HCMST, which is why analysis of the same-sex couples is better done without weights, see Rosenfeld (2014).
+ P<0.10; * P<0.05; ** P<0.01; *** P<0.001, two tailed tests

Appendix 2: Weighted logistic regression coefficients (with SE) predicting married (spouse present) status with Census data, from Figure 4, for individuals age >20, 1960-2014.

	1	2
cellular phones per 100 persons		-0.00155*** (0.000035)
female	1.31*** (0.0028)	1.32*** (0.0028)
age	0.20*** (0.0016)	0.20*** (0.0016)
female × age	-0.0033*** (0.000055)	-0.033*** (0.000055)
age ²	-0.0017*** (0.0000015)	-0.0017*** (0.0000015)
black (ref: white)	-0.993*** (0.0017)	-0.993*** (0.0017)
US Born	-0.21*** (0.0017)	-0.21*** (0.0017)
years after 1960	-0.027*** (0.000035)	-0.023*** (0.00009)
Educational controls (10df)	yes	yes
N	34,408,897	34,408,897
Pseudo R-square	0.1077	0.1077

Source, US census microdata 1% files, 1960, 1970, 1980, 1990, and 2000, plus American Community Survey data 2001-2014, via ipums.org, all weighted by "perwt." Ten educational coefficients not shown, 3 additional racial coefficients not shown. Cellular phones in the US per 100 persons, data from The World Bank, ranging from <1 in 1984, to 98.4 in 2014.

*** P<0.001, two tailed tests