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? 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. This study examines longitudinal data showing that meeting online does not predict couple breakup. Meeting online (and particularly meeting through online dating websites) predicts faster transitions to marriage for heterosexual couples. 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 2012, the US divorce rate has declined sharply. The percentage of adults who are married has been declining since 1960. I do not claim to measure any causal relationship between Internet technology and relationship longevity or marriage formation. Rather, I suggest that the data are more consistent with a positive or neutral association between Internet technology and relationships, than with a negative association between the Internet and romantic relationships.

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

Introduction:

As Internet-based social media and cellular phones play an increasing 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). Some scholars and observers argue that the suddenly wider choice set of potential partners available online could undermine marriages and other primary relationships (Slater 2013; Turkle 2015); 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.

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 found couples who met online had a slightly lower chance of breakup). 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 The Internet, with its dating sites and phone apps with millions of members may (according to Choice Overload theory) give individuals too much choice.

Sherry Turkle (2015) argues that Choice Overload theory is directly applicable to Internet dating. Turkle (2015 p.183) describes a man named Danny who broke up with his girlfriend because “technology made it harder to commit.” He suspected there might be a more attractive woman waiting for him online. After Danny broke up with his girlfriend, he started to doubt his own judgment, he spent more time online, and was less satisfied. Danny eventually described the infinite-seeming choice of online dating sites as “toxic.” Turkle argues that the abundance of potential new romantic partners available online has weakened individuals’ commitments to their existing partners and has perhaps made Americans lonelier (for other descriptions of Choice Overload's negative effect on romantic relationships, see Ansari and Klinenberg 2015; Slater 2013; Yang and Chiou 2010).

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 1.4 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 reason that larger choice sets are demotivating, according to Choice Overload theory, is that too much choice makes it more difficult to determine which is the *best* choice (Schwartz 2005). An overabundance of choices makes it difficult for utility maximizing individuals to find the best solution, and might even make consideration of the multitude of choices feel oppressive and difficult (Schwartz 2005; Simon 1990).

Although Choice Overload theory (a theory initially based on experiments about decisions over non-essential consumer goods) has been extended by several scholars to justify a critique of Internet dating, the extension of Choice Overload to Internet dating is potentially problematic, for three reasons. First, even if Choice Overload theory is applicable to lower order needs such as jam, the theory might not be applicable to higher order needs such as romance, sex, and companionship, as the higher order needs are more difficult to deter. 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.

A third critique of Choice Overload theory questions whether Choice Overload theory accurately explains consumer behavior. Anderson (2006) argues that the ascendancy of choice-set-maximizing Internet businesses like Amazon suggests that individuals preferentially seek the broadest choice sets they can find. 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 (as Choice Overload theory suggests would be more efficient), 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.

Whereas Choice Overload theory would predict negative impacts of broad choice sets, other literature identifies relationship advantages of choice. 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.[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 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,

[1] 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. 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.

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.[2]

Prior Empirical Findings about the Internet and Social Life;
The Community Lost Paradigm

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 4,600 times) than the updated and revised second study (cited more than 1,900 times) which reported neutral social impacts of the Internet (Google Scholar 2017). Even in the most recent completed years, 2015 and 2016, Kraut et al's initial negative findings received almost 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) and Wang and Wellman's (2010) views that a negative bias is present in popular and scholarly writing about the Internet's social impact.

[2] 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).

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 in a different context to critiques of modernity as "community lost." In Wellman's (1979) analysis, urbanization and industrialization were the technological changes whose impact on community was in question. Wellman (1979) found that urban dwellers were not as isolated as the "community lost" paradigm led scholars to expect. Hua and Wellman (2010) argued that contemporary critiques of Internet technology's supposedly isolating effect on individuals echo a prior generation's critiques of urbanization; see also Parigi and Henson (2014) who explicitly make the connection between criticism of technology's social impact and the "community lost" paradigm. I therefore use the term "community lost," to describe a broad set of critiques of Internet technology's supposed isolating effect on individuals.

Some modern applications of the "community lost" paradigm posit 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. Multitasking makes us shallower (according to critics of technology's social impact), 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 personal risks we would need to take in order to love other people. According to Turkle and others, whose work fits into a broad "community lost" paradigm, technology's pernicious impact on our social lives should be measurable in lower quality and less stable primary relationships.

The "community lost" paradigm and the Choice Overload hypothesis both predict that Internet technologies would undermine the stability of primary romantic relationships. The Choice Overload hypothesis is specific to one pathway (exposure to an over-abundance of potential partners) through which the Internet would undermine relationships. Scholars in the very broadly defined "community lost" paradigm offer a variety of reasons why the Internet would undermine 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, in Young's case selection 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"

Neither Manning's (2006) study of divorce lawyers nor Young's study of "Internet addicts" were nationally representative. Non-representative data (especially data selected on outcomes) can yield biased estimates of national populations.

In contrast to the negative findings of the Internet's impact based on non-representative data, recent studies based on nationally representative data show more benign or even positive associations between the Internet and relationship quality and stability. Cacioppo et al (2013) used a nationally representative[3] retrospective survey of 19,000 subjects and found that subjects

[3] Caccioppo et al used data from Harris Interactive, an opt-in Internet survey sample. Whereas the Knowledge Networks/ GfK data I use below includes US adults in the sample universe regardless of whether they had Internet access or not, the Harris Interactive sample had only Internet users in their sample universe. Whether opt-in

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 longitudinal 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. 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 were more likely to break up, but Paul's analysis was flawed.[4] I show below that the HCMST data yield 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

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sampling such as Harris Interactive yields nationally representative data is subject to a lively debate among scholars of survey methods (Baker et al. 2010).

[4] Paul analyzed the HCMST data for breakup with separate non-event-history regressions for each wave, which is 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 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 for online meeting (from Paul's 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.

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.

The association between meeting online and faster transitions to marriage (as I document in the HCMST data below) does not necessarily imply that meeting online *caused* couples to marry more quickly. An alternative explanation is that marriage-ready individuals selectively chose the Internet as a venue to meet partners. Selection bias is a plausible alternative hypothesis to most hypotheses about romantic relationships that are based on observational data, where neither the relationship outcome (e.g. marriage) nor the inputs (e.g. how couples met) can be experimentally manipulated by researchers.

Relevant Trends in Marriage Dissolution and Marriage Prevalence:

If the Internet era has had positive (or negative) effects on romantic couples in the U.S., we should expect to see the effects reflected in aggregate national level trends of marriage and divorce. If Internet technology undermines existing relationships (as the "community lost" paradigm and the Choice Overload hypothesis would lead us to expect), we would expect to see divorce rates rise during the Internet era. Similarly, if Choice Overload of too many potential partners makes Americans less willing to commit to romantic relationships, we would expect to see marriage prevalence decline during the Internet era. The census data I use to measure the aggregate trends in marriage and divorce lack measures of technological participation at the individual level. Therefore the aggregate trends in divorce and marriage have the disadvantage of non-specificity (because, for instance, change in divorce rates could be due to a variety of factors having nothing to do with technology).

Previous literature has suggested that the divorce rate in the U.S. plateaued in the 1980s, and declined thereafter (Cherlin 2014; Stevenson and Wolfers 2007; Goldstein 1999; but see also Kennedy and Ruggles 2014). I revisit the question of the divorce rate trend with the most recent data from the American Community Survey and the National Survey of Family Growth, with divorce data through 2015, to bring the marriage trend data up to date, and to put the divorce and marriage trends and the Internet and cell phone adoption trends into mutual context.

In 2015, ashleymadison.com, an Internet website dedicated to extra-marital affairs, had their database hacked and their customer data dumped online. If the Internet was providing new avenues for people to cheat on their spouses (in a manner consistent with Choice Overload theory), we would expect to the divorce rate rise as a result of more Internet use. One back-of-the-envelope 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), or 200,000 extra divorces per year over four years, which would imply an approximately 20% rise in the American divorce rate compared to the 1.1 million American divorces recorded in 2014. In the American Community Survey, we have initial divorce data that post-dates the 2015 Ashley Madison hack, so it is possible to test whether the hack of Ashley Madison's data was associated with a rise in the national divorce rate.

Hypotheses:

Hypothesis 1: Couples who meet online will be more likely to break up.

Consistent 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.

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.

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

A decline in marriage prevalence or an increase in the divorce rate during the Internet era would be consistent with predictions in the "community lost" paradigm, and would be consistent with the Choice Overload hypothesis.

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.[5]

[5] 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*.326*.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

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 combined, 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 2,669 subjects who 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,

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surveys (Fricker et al. 2005; Chang and Krosnick 2009), in part because KN/GfK gathers information from subjects at each survey stage.

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. For breakups reported in the 12 months between HCMST waves 1 and 2, month of breakup was not asked and was therefore randomly allocated.[6] For marriages reported in waves 2 and 3, the year of marriage was known and the month of marriage was randomly allocated. 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, and also lacks a measure of whether the subject had Internet access at home. 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

[6] 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 allocated 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 allocated months before breakup.

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 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 the American Community Survey (ACS, Ruggles et al. 2015). ACS covers divorce only for survey years 2008-15, but has enormous sample size. In the ACS, subjects were asked if they had divorced in the past 12 months. I follow Cohen's (2014) method of identifying subjects who were exposed to the risk of divorce in ACS as those who were married at the time of the ACS survey, plus subjects who reported a divorce in the past 12 months.[7] Each year of the ACS contains a 1% random sample of the US population. The ACS records approximately 10,000 divorces per year, which is 1% of the approximately 1 million divorces per year that occur in the U.S. The number of divorces in the ACS, and in the US, has dropped sharply over the 2008-2015 period, as I show below.

I supplement the ACS divorce data with 9 cycles (1973, 1976, 1982, 1988, 1995, 2002, 2006-10, 2011-13, and 2013-15) of the National Survey of Family Growth (NSFG; 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.[8] The NSFG has a much longer time trend, but has much smaller sample size of marital dissolutions, especially in the most recent years when the trend is most relevant for examination of the question of technology's impact on marital stability.

[7] Since the ACS is fielded over the entire calendar year, and since the question about divorce refers to divorces in the past 12 months, divorces reported in ACS year X are as likely to belong to year (X-1) as to year X. In Figure 3 below, I treat divorces reported in ACS year X as having occurred in year X. Applying a two year moving average to the ACS data would not substantially change the figure. Also, the addition of persons widowed in the past 12 months into the denominator for people at risk for divorce in the past 12 months would not change Figure 3 in a perceptible way.

[8] The sample frame of the first two waves of NSFG covered only ever-married women in the U.S. under age 45, whereas the sample frame for later waves of NSFG included ever-married and never-married women under age 45 (Lepkowski et al. 2010). For the purposes of analyzing divorce rates, the never-married population is irrelevant, so the NSFG waves are consistent enough to be analyzed together.

I use US Census and ACS data 1940-2014 to chart changes in the prevalence of marriage over time. I compare the census data on marriage prevalence to time series data on cell phone adoption (World Bank 2015). Cell phone adoption is one measure of technology penetration which has the benefit of being measured consistently every year.[9]

[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 prior 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

[9] 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).

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.[10]

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 0.802 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.[11] The significantly faster transition to marriage among couples who met online was robust to other predictors of transitions to marriage (odds ratio 1.86 after controls are applied). Column 5 of Table 2 shows that having

[10] 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 (see also Figure 1 below).

[11] 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.

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.[12] 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 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), because Internet access at home exposes partnered people to the theoretical temptation of millions of potential new partners online. Similarly, the "Community Lost" paradigm would have predicted that people who spent more time online (for which having Internet access at home would be a reasonable proxy) would have less satisfying interpersonal relationships, and would therefore be more likely to break up with their partners. In contrast to the predictions of Choice Overload and the "community lost" paradigm, Table 2 shows that Internet access at home was not associated with higher rates of 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 of Table 2 show no significant relationship between meeting online, or having Internet access at home, and transitions to cohabitation. The lack of significance in the relationship between meeting online and transitions to cohabitation is reinforced by analysis of the much larger sample retrospective HCMST event history data set (analyses not shown).

[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

[12] 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.

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).[13]

[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 times greater than 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 times greater than 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 transition to 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

[13] 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).

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.[14] 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 to transition to marriage.[15] 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 prospective HCMST data for heterosexual couples who met their partners in online dating.[16] 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. The retrospective HCMST data yields the same result (couples who met through online dating

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

[15] 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.

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

transitioned to marriage fastest) with much larger sample size of marriage transitions.[17] 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; Stevenson and Wolfers 2007).[18] 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; the tail end of the post-WWII spike in divorce rate is discernible on the left hand side of Figure 3).

In the smoothed (by 5 year moving average) weighted NSFG data in Figure 3, the divorce rate (for women under 45 in first marriages) declined from 1995 (3.2% annual divorce rate) to 2004 (2.5% divorce rate). The NSFG divorce rate is much higher than the overall divorce rate (from ACS, also plotted in Figure 3) because the NSFG includes only respondents who are younger than 45, and who therefore have not been married as long as the general population of married persons in the US. The NSFG shows divorce rates climbing back to 3.1% in 2010, to be near the 1995 level. After 2010, the divorce rate in NSFG appears to have plunged again, reaching a low of 2.3% in 2014 and 2015, however sample size of divorce events is an important

[17] In the retrospective HCMST data there were 963 heterosexual marriages on or after 1995, with 54 transitions to marriage for heterosexual couples who met through online dating. Kaplan- Meier cumulative transitions to marriage in the yearly retrospective data (not shown) 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.

[18] The divorce plateau of the 1990s is widely accepted (Goldstein 1999; Cherlin 2014 p.140). Kennedy and Ruggles (2014) make a counter argument that standardizing for age, the divorce rates in the U.S. have continued to rise after the 1990s. Although Kennedy and Ruggles make an interesting argument, my view is that the rapid rise in age at marriage makes standardizing for age alone an unreliable way to compare divorce rates across historical time. The fundamental underlying time process that predicts divorce is not age, but relationship duration. Today's married 35-year-olds have been married for much shorter amount of time, on average, than the married 35-year-olds of a generation ago. The shorter the duration of the marriage, the higher the breakup rate in the subsequent year (Brines and Joyner 1999). In Appendix 2, I show that the divorce rate in the ACS declined from 2008 to 2015, controlling for age *and* marital duration.

limitation in NSFG. At either end of the NSFG time series, the NSFG data become sparse and the 95% confidence intervals widen. Because of a small sample size of divorce events, the apparently sharp decline in divorce rates in NSFG from 2010-2015 is not statistically robust when individual controls are added into multivariate models (separate analyses not shown).

The ACS has much larger sample size than NSFG. ACS recorded more than 10,000 divorces per year, and more than 5,000 divorces per year for women in first marriages younger than age 45. The NSFG, by comparison, recorded several hundred divorces per year for women in first marriages (and fewer than 100 divorces per year in NSFG after 2011). The yearly divorce rates for women under 45 in first marriages are similar in ACS and NSFG in Figure 3, but the decline in divorce rate in the ACS data for divorces in 2008-2015 is more definitive (and statistically significant) because the ACS sample size is so much larger than the NSFG sample size.[19] The ACS divorce rate (divorces reported by women divided by the number of women exposed to the risk of divorce) declined from 2.05% in 2008, to 1.68% in 2015. The divorce rate in ACS for women under age 45 in first marriages (the population most consistent with NSFG), was 2.79% in 2008, declining to 2.20% in 2015.

Some scholars have predicted that the Internet would (in a manner consistent with Choice Overload theory) create a multitude of new opportunities for married people to cheat on their spouses, which would undermine marital stability. Barro and Wolfers (2015) suggested that the hack of ashleymadison.com, an Internet website dedicated to extra-marital affairs, would raise the US divorce rate by 20% above previous levels. 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.

The Ashley Madison data were dumped online in August of 2015. The American Community Survey (ACS) of 2015 was fielded throughout the year, so approximately a third of the 2015 ACS was gathered after the Ashley Madison data dump. If the Ashley Madison hack

[19] Because of the massive sample size of the ACS, the decline in divorce rate in the ACS is highly significant, derived from logistic regressions not shown. The P value for the decline in divorce rate in ACS for women in first marriages, under age 45 had a Z score of 11.2 and $P<5.7(10)^{-29}$, two tailed test. For women of all ages and all marriages in ACS, the sample size was larger and the significance of the divorce decline in 2008-2015 was even larger, with a Z score of 13.1, and a two-tailed P value of $P<6.4(10)^{-39}$.

were going to raise American divorce rates by 20%, we ought to have seen some evidence of rise in divorce in the 2015 ACS. In fact, the 2015 ACS gave no indication of a sudden rise in the divorce rate. The divorce rate in the 2015 ACS was 1.68% for women of all ages, 4% *lower* than the 1.75% divorce rate in the ACS from 2014, continuing a pattern of sharp decline of divorce rates in the U.S. that seems to have started around 2012. The drop in divorce rate in ACS from 2014 to 2015 was highly significant, because the sample size of ACS is enormous. Although the Choice Overload hypothesis and the "community lost" paradigms predicted rises in the divorce rate during the Internet era, especially in the aftermath of the Ashley Madison hack, US divorce rates have declined.

The ACS divorce rate decline for 2008-2015 is highly significant, even when including a variety of demographic controls. Appendix 2 reports models and coefficients from multivariable regressions documenting the 2008-2015 divorce rate decline. Figure 3 shows that the divorce rate decline in the US was especially precipitous after 2012.

[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 also plots the number of cellular phones in the US per 100 persons. Cell phone penetration in the U.S. rose rapidly from 12.6% in 1995 to 91.3% in 2010.

The post-1995 decline in marriage prevalence is consistent with a "community lost" 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 that the post-1995 decline in marriage prevalence is consistent with the rate of decline in marriage prevalence from 1960 to 1995. Figure 4 therefore suggests that post-1995 technology may not have played much of a role in the decline of marriage prevalence, as the trend in delay of marriage predates the Internet era by several decades (Rosenfeld 2007; Cherlin 1992).

Appendix Table 3 shows two models predicting whether an individual will be married, using US Census and ACS data. The first model includes demographic predictors (age, race, gender, education, census year), and the second model adds the national cell phone penetration rate from Figure 4 as a predictor. The second model fits better, but the substantive difference between the models is very small.

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. My results overturn Paul's (2014) earlier analysis of HCMST data; Paul had found that in wave 3 of HCMST, couples who met online appeared to have a higher breakup rate. Paul analyzed each wave of HCMST data separately, and ignored the waves in which no breakups of one group was reported (see footnote 3 above). A full event history analysis, as I have performed above, combining all the available HCMST data across waves, shows definitively that meeting online is not associated with lower couple longevity in the HCMST data.

The HCMST result showing that couples who met online transition to marriage more quickly helps explain why Cacciopo et al (2013) found that a high percentage of married couples in the U.S. (35%) had met online. My results are consistent with Bellou (2015), who found that marriage rates were *highest* in US states that had faster adoption of broadband Internet, though Bellou's marriage data were not individual level data.

The association between meeting online and faster transitions to marriage in the HCMST data was entirely driven by couples who met through Internet dating websites, the sites on the web where choice of potential partners is maximized. Meeting through the choice-intensive process of Internet dating was significantly associated with transitions to marriage for heterosexual couples in both the prospective and the retrospective versions of the HCMST event history data.

One of the key advantages to Internet dating is information gathering from the potential partner's profile.[20] 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 (e.g., what is your philosophy about money, what particular kind of travel do you like, do you have herpes, do you own a gun). One 28-year-old HCMST respondent who later married his partner of 3 years, wrote: "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. I cannot rule out the possibility that *all* of the association between meeting through online dating and transitions to marriage is due to the self-selection of the most marriage-ready individuals into online dating. If all of the association between online dating and transitions to marriage were due to self-selection, this would still imply that marriage-ready individuals *believed* that online dating improved their chances of finding a mate.

[20] 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 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).

Newer technologies for meeting include GPS-based phone applications Tinder and Grindr, which have 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 discernible negative impacts of the Internet on couples who met online before 2009. There has been no post-2009 spike in the divorce rate; on the contrary, the divorce rate in the U.S. has been declining since 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 4% of HCMST breakups that report Internet infidelity as a cause of the breakup is far less than the 68% that Manning (2006) reported of divorces resulting from Internet infidelity. Infidelities, like other relationships, often have an online component. We lack the data that would be required to know whether the internet era has made infidelity more or less common.

The decline in marriage prevalence in the U.S. during the Internet era is more consistent with a view that Internet technologies might undermine (or cause people to postpone) relationship commitment. However, marriage prevalence in the U.S. has been declining at a fairly steady rate since 1960, 35 years before the advent of the graphical Internet.
Many extramarital affairs were arranged through the affairs website ashleymadison.com, 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.

I do not claim that the decline in divorce rates during the Internet era in the U.S. was *caused* by technology; there are too many other important factors that varied over time to assign causality to any one explanatory factor. I merely suggest that the stability of the divorce rate after 1995 and the decline in divorce rates in the U.S. after 2012 are less consistent with a view that Internet technologies would undermine existing relationships, and more consistent with a view that Internet technologies would have a neutral or even a benign influence on romantic relationship commitments.

Despite anecdotal evidence for the negative effect of Choice Overload in Internet dating (Slater 2013; Turkle 2015; Heino, Ellison and Gibbs 2010; Vitzthum 2007), representative 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 supposed 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 of 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

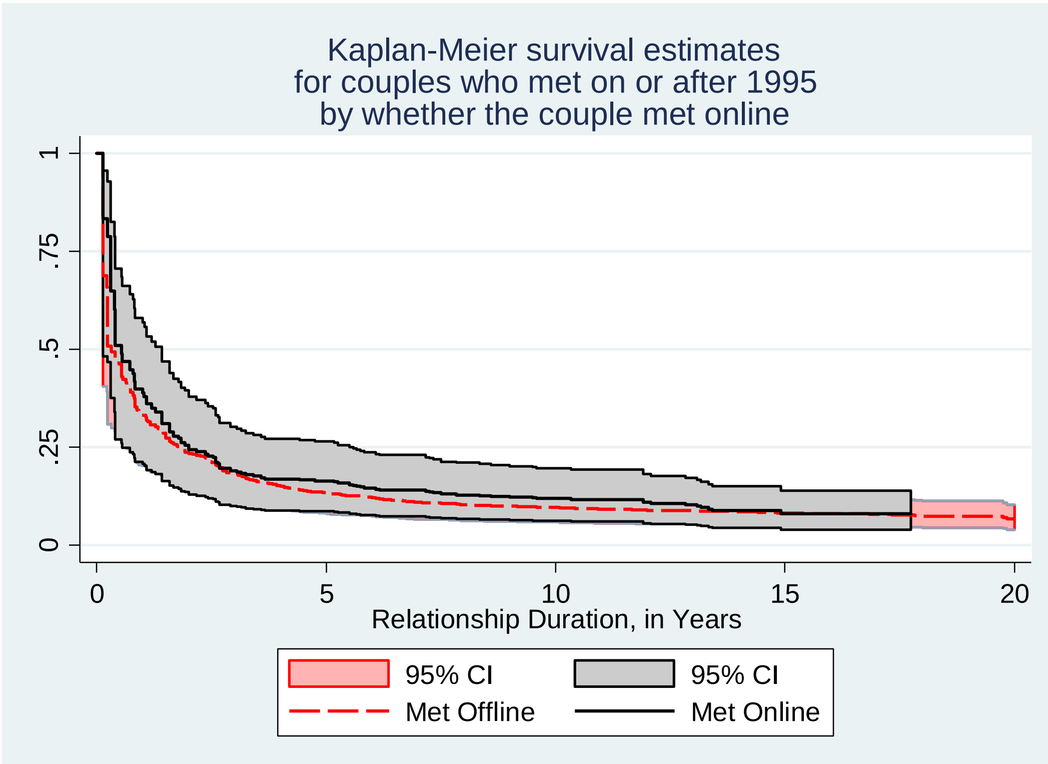
Source: How Couples Meet and Stay Together, all outcomes took place between wave 1 of HCMST and wave 5 of HCMST, 2009-2015. Rates and comparisons of rates are weighted by weight variable "weight2." Confidence intervals determined by event history logistic regressions with robust standard errors, with 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 (ref: met offline)	1.98* [1.06, 3.72]				
A) Met Online subset: not Internet Dating (ref: met offline)		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 (ref: met offline)		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]

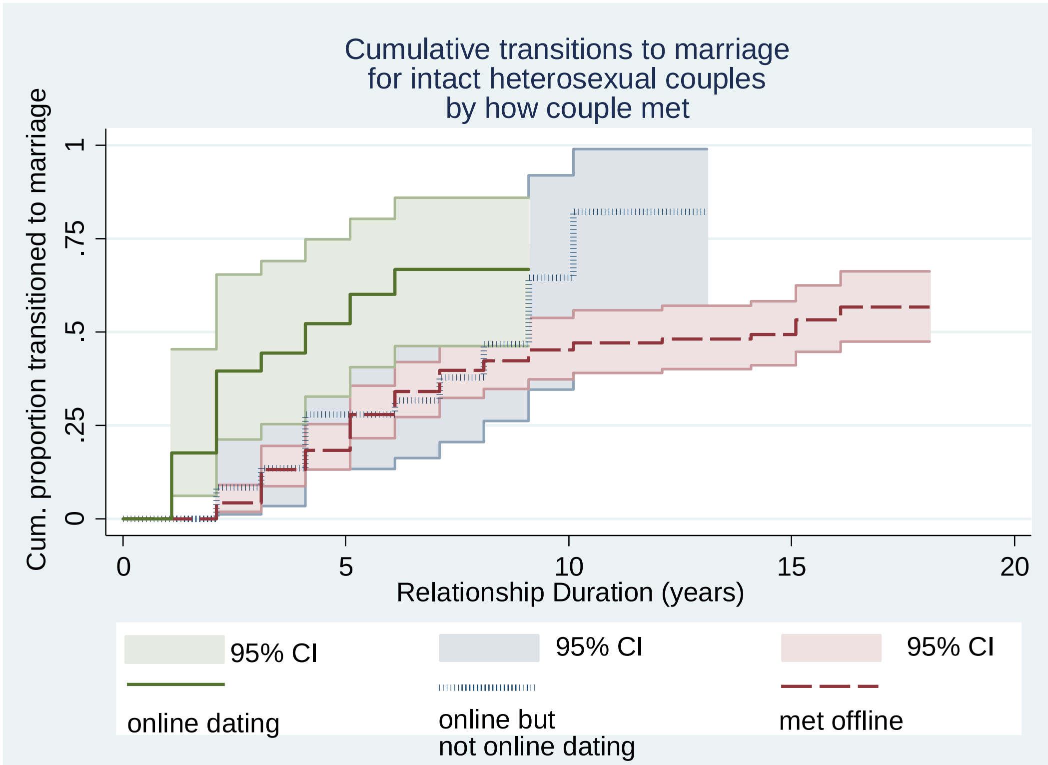
Source: How Couples Meet and Stay Together, waves 1-5. Prospective data cover exposure to the risk of marriage in 2009-2015, for heterosexual couples who met in 1995 or later. Retrospective data cover exposure to the risk of marriage in 1998-2014 for heterosexual couples regardless of when they met. 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



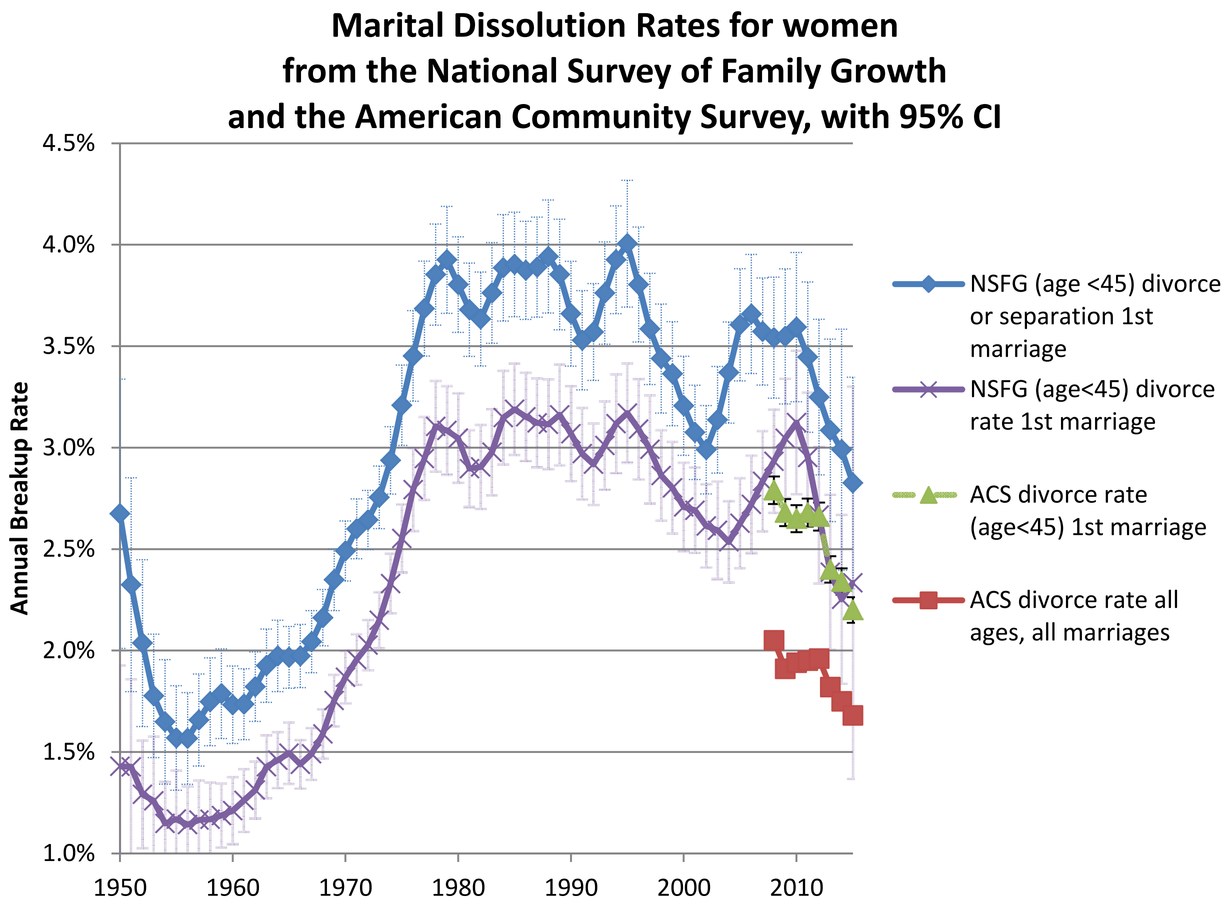
Source: HCMST prospective event history data, covering breakups between 2009 and 2015. Data are unweighted. Cumulative survival in this case means couple survival as an intact couple, i.e. without breakup. Number of breakup events: 94 for couples who met online, and 300 for couples who met offline.

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



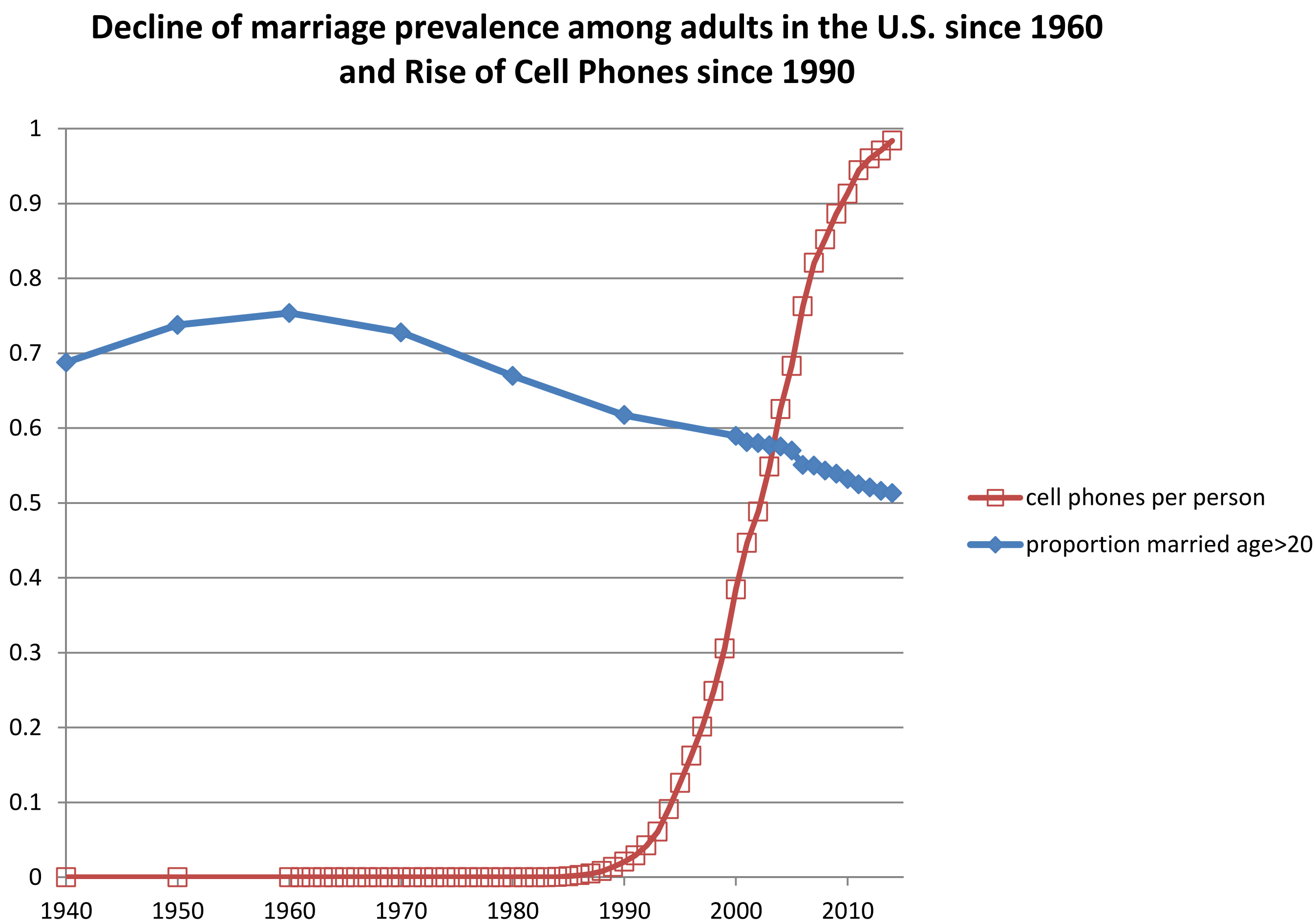
Source: HCMST prospective data. Unweighted cumulative transitions to marriage in 2009-2015 (with 95% confidence intervals) for intact heterosexual couples who were unmarried at HCMST wave 1. Cumulative transitions to marriage is 1- S where S=(Kaplan- Meir survival curve for remaining unmarried). Number 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:



Source: Weighted data from the National Surveys of Family Growth (NSFG) , waves 1973, 1976, 1982, 1995, 2002, 2006-10, 2011-13, and 2013-15 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) 2008-15 data are weighted and, because of their much larger sample size, unsmoothed. 95% confidence intervals for divorce rates in the ACS are so narrow so as to be barely visible at this scale (and for ACS divorce rate for women of all ages and all marriages, the 95% CI is not visible at all) 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 roughly 700,000 per year for women of all ages.

Figure 4:



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," group quarters residents excluded. 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, 1.59]	1.10 [0.76, 1.57]
Subject Age	0.997 [0.99, 1,01]	0.997 [0.99, 1.01]
Relationship Duration in Years	0.96*** [0.94, 0.98]	0.96*** [0.94, 0.98]
Relationship Duration$^{-0.5}$	2.02*** [1.67,2.45]	2.03*** [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: Odds Ratios (over Z scores) from weighted logistic regressions predicting divorce for women in the last 12 months from ACS data 2008-2015.

	Model 1	Model 2
Year	0.976*** (-13.05)	0.99*** (-4.92)
US Born		1.36*** (19.8)
Has BA		0.72*** (-31.0)
NH black (ref: white)		1.54*** (29.6)
Marriage Number		1.41*** (37.7)
# of children <5 y.o.		0.50*** (-58.4)
marital duration		0.98*** (-27.6)
age		0.97*** (-14.3)
age^2		0.999** (-2.81)
Additional controls	No	Yes
df	1	25
Wald Chisquare	170.2	27,571
Pseudo R-square	0.0003	0.054
N	5,584,356	5,580,312

Source: Weighted data from ACS, 2008-2015. Models predict divorce in the last 12 months for women of all ages, married any number of times. Model 2 has slightly smaller sample size because Model 2 excludes individuals who were divorced and then remarried in the past 12 months, as those individuals do not have an accurate measure of marriage duration for the divorce (since the ACS question about marriage timing is "In what year did this person *last* get married?"). Additional controls for Model 2 include: 3 additional race/ethnic categories, 8 df for region, 4 df for metro area status, and 1 df for a dummy variable indicating that subject was married in the last 12 months.

*** P<0.001, ** P<0.01 two tailed tests

Appendix 3: 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		-0.00062*** (0.000035)
female	1.27*** (0.0029)	1.27*** (0.0029)
age	0.20*** (0.0017)	0.20*** (0.0017)
female × age	-0.033*** (0.000056)	-0.033*** (0.000056)
age^2	-0.0017*** (0.0000016)	-0.0017*** (0.0000016)
black (ref: white)	-0.98*** (0.0017)	-0.98*** (0.0017)
US Born	-0.20*** (0.0017)	-0.20*** (0.0017)
years after 1960	-0.027*** (0.000035)	-0.026*** (0.000091)
Educational controls (10df)	yes	yes
N	33,407,405	33,407,405
Pseudo R-square	0.1039	0.1040

Source, US census microdata 1% files, 1960, 1970, 1980, 1990, and 2000, plus American Community Survey data 2001-2014, group quarters residents excluded, 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