

Online dating system design and relational decision making: Choice, algorithms, and control

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Abstract

One of the most popular ways to initiate romantic relationships today is through online dating. Typical dating systems follow one of three formats, *see-and-screen* (e.g., Match.com), *algorithm* (e.g., eHarmony.com), and *blended* (e.g., OkCupid.com), which differ in the amount of individual control and algorithmic involvement they offer users. Do different features affect daters' decisions and expectations regarding relational development with selected partners? Study 1 indicated that although daters appreciated the personal control over mate selection afforded by see-and-screen systems, they also enjoyed using algorithmic systems. Study 2 found that blended systems provided "the best of both worlds" by offering dual benefits of control and algorithmic validation during mate selection. Findings shed light on self-determination theory, decision making, and relationship formation more broadly.

Since its inception in the early 2000s, online dating has shed its stigma to become an important part of the current landscape of romantic relationship formation. Indeed, recent statistics indicate approximately 30 million online Americans have turned to online dating as a way to initiate romantic relationships (Smith & Duggan, 2013). A growing body of research has examined daters' behaviors at "micro" levels such as self-presentation and impression formation in dating profiles (e.g., Ellison, Heino, & Gibbs, 2006) and at "macro"

levels such as attraction through race (Lin & Lundquist, 2013; Rudder, 2014). But few existing studies have explored how the design of the dating technologies themselves may directly influence daters' perceptions and relational decision making.

There is, however, good reason to suspect that the interface and design features of online dating systems may affect romantic relationship formation by influencing attention and processing of information. Specifically, we examine whether online dating systems' level of involvement during decision making affects daters' sense of autonomy when making important choices. The impact of algorithms on decision making has been demonstrated in contexts like online shopping (Chen & Pu, 2011; Linden, Smith, & York, 2003) and movie selection in Netflix (Hallinan & Striplhas, 2014), and yet despite this impressive body of research, little is known about how people's decisions regarding relationship initiation are affected by computational systems, as is the case in online dating.

With the rise in the popularity of online dating technology, the algorithms embedded in dating websites have immense potential

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to transform the formation of romantic connections. For example, algorithmic recommendations can direct daters' attention toward potential partners that they may not have previously examined, or exclude those they may have considered. The extent to which dating websites guide people's attention may not only influence their decisions about whom to date, it might also heighten their expectations regarding a potential partner.

Therefore, the goal of this research is to investigate the role that the website itself plays in how daters perceive and evaluate prospective romantic partners. With regard to relationships, these studies advance our understanding of how people make romantic connections. For many years, concepts like propinquity and proximity were cited as the most important factors in relationship initiation (see, e.g., Bossard, 1932). However, more recently, dating websites have been shown to be more influential than ever before; in fact, online dating is currently the second most common way for people to find romantic connections (Rosenfeld & Thomas, 2012). Thus, if people are relying on online dating systems to introduce them to new romantic contacts, understanding exactly *how* the systems provide people with such introductions and influence their subsequent decisions is important to understanding how romantic relationships develop, more generally. Below, we report the results of two studies that examine how system design affects online daters' perceptions of personal control, and satisfaction with relationship decisions, and how these perceptions mediate their interest in pursuing potential romantic relationships with others.

Online Dating Systems: Features and Relationships

Online dating systems vary in the ways they match users together to create romantic relationships. Some dating websites use the *algorithm* design, often advertising how their technology can provide daters with the "best" romantic match possible. A popular industry example is eHarmony.com, which advertises their algorithm's "29 Dimensions of Compatibility." The matching process begins when

daters supply information about their personalities, interests, and preferences through questionnaire responses. The algorithm then uses that information to provide users with potential matches based on their similarity or complementarity (Finkel, Eastwick, Karney, Reis, & Sprecher, 2012). Other dating websites, such as Match.com and PlentyOfFish.com, rely on a *see-and-screen* format that allows users to browse through a database of available profiles and use different filters to select their own partners based on their own preferences. Some online dating systems combine elements from both formats into a *blended* design, such as OkCupid.com. Considering the growing popularity of online dating technology, it is important to understand how people perceive these differences in system design, and how such differences in perceptions affect romantic relationship formation.

One theoretical perspective that provides some guidance for how such designs may affect daters' behavior is self-determination theory (SDT; Deci & Ryan, 1980). SDT conceptualizes human motivations for behavior along a continuum: At one end is *heteronomy* in which behavior is motivated by external forces outside the self; on the other end is *autonomy* or self-governed behavior. As Ryan and Deci (2006) point out, experimental tests of SDT often "create experimental conditions conducive to the experience of either autonomy or heteronomy and look at their contrasting consequences" (p. 1564). Within the current context, the different forms of online dating websites provide a naturally occurring set of conditions through which to examine autonomous versus heteronomous motivations for human behavior. Specifically, we argue that *see-and-screen*, algorithmic, and blended platforms produce differential effects in daters' personal agency by providing varying amounts of *perceived control* over mate selection during the online dating process.

Perceptions and expectations: Effects of choice and control

Within SDT, control is assumed to boost feelings of personal agency. Ryan and Deci (2006) suggest that even "mistaken causality"

can increase people's feeling of agency: "People sometimes have a sense of agency even when their control over outcomes is illusory" (p. 1574). This sense of mistaken causality has been identified as part of the *illusion of control*, a concept defined as "the tendency to be overconfident in one's ability to attain outcomes that are chance determined" (Biner, Angle, Park, Mellinger, & Barber, 1995, p. 899). For example, when faced with seemingly random events while playing a slot machine, gamblers will feel more confident about their ability to control the outcome if they are presented with skill-based elements such as personally choosing which slot machine to play, or increasing their personal involvement or familiarity with a specific casino. Thus, elements such as personal choice and involvement often increase people's perceptions that they can affect the results of random events, even if such results are completely chance determined (Langer, 1975; Presson & Benassi, 1996).

Romantic relationship formation can feel like a random, serendipitous process, in which two star-crossed lovers meet under chance circumstances. Although this remains a dreamy ideal for many people, in practice leaving such important events like mate selection and relationship initiation to fate may feel risky or even foolish. In such cases, online dating may seem like a good way to take control over one's own romantic destiny. While there have been many advantages of online dating cited in previous research such as increased convenience and accessibility, one unexplored benefit of online dating systems may be the perception of control and agency they can provide during the mate selection process, although the degree to which each kind of dating system can engender such perceptions may differ.

Choice and control in online dating

Within online dating, a few notable studies have examined the nature of choice. Lenton, Fasolo, and Todd (2008) asked participants to imagine how satisfied they would be if they were presented with "choice sets" of online dating profiles that varied in number, from small sets of a few options to very large sets with hundreds. Results indicated an inverted

"U-shaped" curvilinear pattern—people preferred choice sets with 20 or 50 profiles, after which point, expectations of satisfaction declined. In their second study, Lenton et al. (2008) presented participants with several profiles and asked them to choose the one person they thought was most attractive. Participants were given choice sets featuring either 4 or 20 options from which to select, reflecting "small" versus "optimal" amounts of choice based on results of their previous study. Interestingly, male and female participants reported equal amounts of decision-making affect (e.g., satisfaction, enjoyment, and regret with the choice process) across both conditions. But in comparison to men in the 4-choice condition, men in the 20-choice condition experienced decreased memory as evidenced by their inability to recall the features (e.g., hair color, eye color) of their selected partner. Lenton and colleagues' results suggest that (at least for the male participants) expectations regarding choice, and their actual experience of the process are not entirely consistent.

In a separate study, Wu and Chiou (2009) asked participants to indicate the characteristics of their "ideal" partner. They were then randomly assigned to a choice set featuring either 30, 60, or 90 profiles and chose one partner from the set. At the end of this task, a "goodness-of-match score" was calculated in which the selected partners' actual characteristics were subtracted from the participants' previously indicated list of most desired characteristics. When participants were faced with a greater amount of choice, they selected partners who had worse overall matching scores. Wu and Chiou concluded that greater options resulted in poorer choices. Additionally, participants who had the highest number of options were less selective and attentive (e.g., as measured by time) during the choice-making process. This was cited as evidence of increased cognitive load produced by too much choice.

Both studies point out some interesting effects of choice in online dating. Lenton et al.'s (2008) results suggest that while online daters seem to desire more choice, they do not necessarily enjoy more options when they are faced with them. Wu and Chiou (2009) demonstrate the potential downsides of too

much choice: When daters face more options, they make poorer decisions and increase their effort during the process. These studies indicate both the advantages (expected satisfaction) and disadvantages (memory confusion, increased cognitive load) of choice in online dating. Elsewhere, theorists have suggested other disadvantages of too much choice, such as ego depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Overall, online daters seem to want more choice, even though increasing options also make decision-making process more difficult. Following SDT, one potential explanation for why people desire choice despite its potential downsides is perceived control and the sense of agency that comes with it. Leotti, Iyengar, and Ochsner (2010) argue that individuals like choice because it gives them a way to manage their environment, thereby promoting a sense of self-efficacy. In this way, choice may boost the experience of volition, making it a rewarding act in and of itself.

Applying this to online dating, a resulting question is: How might the design of different online dating websites influence a dater's perceived sense of control when trying to choose a relationship partner? In answering this question, it is important to note that there are multiple ways in which algorithms can be implemented in the online decision-making process. Algorithms that recommend a single partner for a dater to meet based on his or her indicated preferences have been referred to as a *delegated agent*; this is in contrast, to dating site algorithms that act as *decision aids* by narrowing down choices within a larger set to a smaller set from which the dater can still make his or her own choice (see Komiak & Benbasat, 2006). While a delegated agent type algorithm found in eHarmony might reduce a dater's overall perceived sense of control by limiting available options, it may be the case that a decision aid type algorithm found in blended systems like OkCupid may actually enhance daters' sense of control over decision making by supplying additional expert information that helps guide their choices. To examine how the algorithms common to many online dating sites affect perceived control, decision-making affect, and desire to pursue

a romantic relationship, we conducted two experiments, each discussed below.

Study 1

Hypotheses

Based on the literature reviewed above, we hypothesize that see-and-screen dating websites provide daters with greater perception of mate selection control in comparison to the algorithm dating site format, in which the algorithm operates as a delegated agent and recommends a single option. Whereas daters relinquish control over mate selection decisions in the algorithmic format, the active personal choice requirements inherent in see-and-screen formats may enhance daters' perceived control over their romantic decisions.

H1: *In comparison to algorithmic designs, see-and-screen systems will produce greater feelings of perceived control over mate selection decisions for online daters.*

Additionally, we anticipate that the heightened sense of control over partner selection afforded by see-and-screen dating systems should also produce greater satisfaction with the decision-making process itself. This hypothesis is consistent with the overall satisfaction that accompanies choice making generally (Iyengar & Lepper, 2000; Leotti et al., 2010).

H2: *Greater control over mate selection is positively related to daters' decision-making satisfaction.*

Lastly, we predict a mediation effect in H3. Specifically, compared to algorithm formats, the increased control provided by see-and-screen formats gives a dater greater satisfaction with romantic decision making. This increased satisfaction may also, in turn, lead to improved perceptions of success regarding romantic compatibility or interest in relational pursuit with one's chosen partner. This is not to suggest that actual offline dates will turn out to be more satisfying or

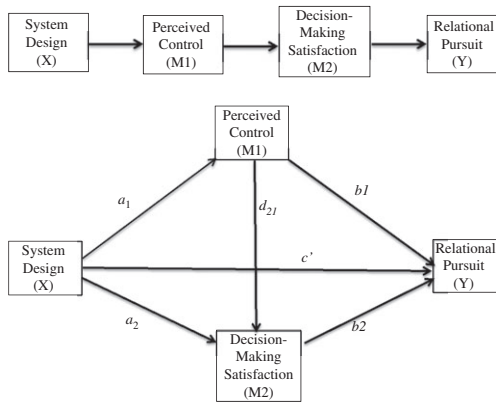


Figure 1. Conceptual and statistical models depicting hypothesized mediation effect.

successful when and if they occur. Rather, the sequence of psychological events set in motion by active choosing, rather than from being matched by the algorithm, should lead one to anticipate more potential success. Therefore, we hypothesize a serial mediation effect (Figure 1), whereby system design affects daters' feelings of perceived control, which in turn affects decision-making satisfaction, which influences the final outcome of future relational pursuit:

H3: Daters' feelings of (a) control and (b) decision-making satisfaction mediate the relation between system design and desire for relational pursuit.

Method

Sample

A sample of undergraduate communication and psychology students was recruited to participate in exchange for class credit. Participants had to be between the ages of 18 and 25, romantically single, heterosexual, and have some basic familiarity with online dating.¹

Four participants who did not meet these criteria were dropped from the study; three participants who either did not follow or did not understand the experimental procedures outlined below were also dropped, leaving a total $N = 43$ (21% male); $M_{\text{age}} = 22.02$, $SD = 2.85$. The sample was 41.9% Caucasian, 30.2% African American, 19.3% Asian, and 4.7% Other.

Procedure

The procedure was divided into two sessions. After arriving to a laboratory located on a large Midwestern university campus, the participants provided informed consent, and experimenters explained to participants that the goal of the study was to examine the development of romantic relationships through online dating websites. Participants were asked to create an online dating profile that could be used to match them with a partner who was also participating in the study. Participants created their profiles by selecting a screen-name and a profile photo that they could select from any existing media account accessible through the Internet (e.g., Facebook, Instagram, Google Photo). They also presented personal information including demographics (age, race, height, etc.), behaviors (smoking/drinking habits, etc.), interests/hobbies, and a short "about me" paragraph. Once finished, participants filled out a mate preferences questionnaire to indicate what qualities they were looking for in a potential romantic partner. After completion of these tasks, participants were scheduled for a second lab session, at which time experimenters told them they would be able to review their match results.

One week later, participants returned to the lab and were randomly assigned to one of two experimental conditions, described below. Using an adapted version of the "bogus stranger" paradigm (Byrne, 1997), experimenters gave participants bogus profiles that supposedly represented other daters who were also participating in the study. Participants reviewed these profiles, selected a partner, and then filled out a questionnaire to provide their impressions of their partner and their feelings about the matching process. Lastly, they were

1. As the current studies were being conducted using a college sample, we restricted the inclusion criteria to include only college-aged individuals (e.g., undergraduate to graduate students, ages 18 to 25). Future research may investigate age as an important moderator of the effects being tested here.

asked to write an introductory message, which the experimenter would send via e-mail to the partner on behalf of the participant; as these messages were not used in this study, no more mention of them is made. Upon completion participants were debriefed.²

Experimental design

The two experimental conditions in this study were carefully designed to closely reflect the nature of today's popular online dating systems. Participants randomly assigned to the see-and-screen condition ($N = 19$) were instructed by experimenters to select their own partner from a set of four profiles that (supposedly) represented opposite-sex available daters who were also participating in the study. The provision of four profile choices was guided by previous decision-making research in product recommendation contexts (Senecal & Nantel, 2004) and by the research reviewed above (Lenton et al., 2008), which demonstrated few differences in choice-related affect (i.e., satisfaction, enjoyment, and regret) when an individual was given 4 and 20 dating profiles. Participants in the see-and-screen condition were simply told that these four profiles represented others who were also participating in the study, who were recently active on the dating website. After participants selected their top choice, they filled out a posttest questionnaire with items designed to measure the dependent variables of perceived control, decision-making satisfaction, and relational pursuit.

In the algorithm ($N = 24$) condition, experimenters told participants that the information they provided in their first profile development session was inputted into the "Selective Tracking and Relationship Test" (START) algorithm being developed by researchers for this study. To make sure all participants understood what an algorithm was, experimenters explained that the START algorithm was a "specialized

computer program" that looked at participants' profile information, their partner preference responses, and the profile information of other available daters to find "one person in this study who is most compatible with you." All participants in the algorithm condition then received a single profile that supposedly depicted their "most optimal match" according to the START algorithm. After reviewing this profile, they then filled out the same posttest questionnaire as in the see-and-screen condition.

Our operationalization of the algorithm condition as a single, optimal profile was done deliberately to emulate the matching procedures of these websites. eHarmony states daters can expect to receive 5 to 17 "high-quality introductions" per year (eHarmony.com, n.d.). In the frequently asked questions portion of their website, eHarmony explains that it may be "a while" before daters receive any matches, with some people being "not suitable" for matching due to various reasons.

Stimuli creation

To create the bogus profiles used in this study, five research assistants examined a randomly selected sample of 55 publicly available dating profiles on PlentyofFish.com, Match.com, and OkCupid.com. Based on this sample, the research team was able to content analyze information presented in three discrete categories: (a) the self-authored text description, (b) demographic information, and (c) profile photos. Material from publicly available profiles was used to construct the stimulus profiles. Minor edits were made to make sure that the profile content was generally consistent (e.g., demographic information, word count). In addition, because angle and camera distance have been shown to affect interpersonal perceptions (Schouten, Heerkens, Veringa, & Antheunis, 2014) these were held constant; all profile photos depicted daters face forward, from the upper abdomen.³

2. Participants went through an extensive debriefing process in which experimenters explained the nature of the deception involved in the bogus profile manipulation. Participants were asked if they guessed the true nature of the experiment or the procedures. Those participants who admitted suspicion regarding the procedures were omitted from analyses.

3. In order to ensure that all bogus profiles did not differ with respect to attractiveness prior to being used in the main study, female stimulus profiles were pretested with an offset sample of male raters, $N = 17$, and the male stimulus profiles were pretested with an offset

Measures

All items in the posttest were coded so that higher scores reflected greater perceived control, decision-making satisfaction, and desire for relational pursuit. *Perceived control* was measured using three items: “I felt like I had a good degree of control over partner selection today,” “Ultimately, I felt that my choice of partner was up to me, and no one else,” and “I felt like I was able to select my own dating partner” ($\alpha = .87$).

Decision-making satisfaction

Decision-making satisfaction was measured using four items adapted from Iyengar and Lepper (2000) and Lenton et al. (2008): “Overall, I am satisfied with the person I’ve been matched with,” “I generally enjoyed the matching process that I experienced today,” “I thought the partner matching process was effective,” and “I think my dating partner was a good match for me” ($\alpha = .91$). Both of these measures used a 1 = *strongly disagree* to 7 = *strongly agree* response scale.

Future relational pursuit

Future relational pursuit used a 1 = *not at all* to 6 = *very much* response scale and contained items adapted from Kotlyar and Ariely (2013) designed to “assess participants’ interest and desire to develop a relationship with the other person” (p. 547) through the following questions: “How excited are you about your partner?” “Would you like to have a date with this person?” “Would you like to meet your partner in ‘real life’?” “Would you like to develop a romantic relationship with your partner?” ($\alpha = .91$).

Results and discussion

The first hypothesis examined whether the see-and-screen condition increased daters’ perceptions of control over partner selection relative to the algorithm condition. As predicted, an independent samples *t* test revealed that participants randomly assigned to the see-and-screen condition perceived more control, $M = 4.45$, $SD = 1.20$, than those assigned to the algorithm condition, $M = 3.37$, $SD = 1.55$, $t(41) = 2.49$, $p = .02$. The see-and-screen and the algorithm conditions did not, however, lead to differences in participants’ decision-making satisfaction, $t(41) = 0.78$, $p = .44$, or on future relational pursuit, $t(41) = 1.67$, $p = .10$, suggesting no other direct effects of the manipulations. The second hypothesis predicted a direct relation between perceived control and decision-making satisfaction. Results also indicated a significant positive relation between perceived control and decision-making satisfaction consistent with H2, $r(41) = .73$, $p < .001$. The correlation matrix is displayed in Table 1.

The results from H1 demonstrated that compared to algorithmically based systems, such as eHarmony.com that match users on a “one-to-one” basis, daters experienced greater feelings of control over mate selection when they were allowed to personally choose their prospective partners using see-and-screen systems. Also, results revealed that perceived control was associated with greater satisfaction regarding the decision-making process. The control afforded by the act of selecting one’s own partner made the choice-making process more enjoyable for see-and-screen daters, an empirical finding that echoes previous theoretical assertions regarding decision making more generally (Iyengar & Lepper, 2000; Leotti et al., 2010).

H3 predicted a serial mediation effect such that the system design would exert an indirect effect on relational pursuit through perceived control and decision-making satisfaction. Before testing the serial mediation effect, we examined the partial correlation between the two mediators controlling for system design, $prM_1M_2X(40) = .74$, $p < .001$,

sample of female raters, $N = 17$. Raters viewed all of the stimuli in random order and were then asked to judge each profile owner on six dimensions—physical attractiveness, intelligence, humor, friendliness, ambition, and interests—on a scale of 1 = *below average*, 2 = *average*, and 3 = *above average*. Scores were averaged together to create one composite overall interpersonal desirability score ($\alpha = .73$). Results indicated no significant differences on male raters’ judgments of female profiles, $F(4, 79) = 0.31$, $p > .05$, or female raters’ judgments of male profiles, $F(4, 79) = 2.48$, $p > .05$. All stimuli were therefore retained for use in the main study.

Table 1. Correlations among key variables in Study 1

Variable	1	2	3	4	Descriptives
1. System design					
2. Perceived control	-.36*				$M = 3.85, SD = 1.49$
3. Decision-making satisfaction	-.12	.73***			$M = 4.38, SD = 1.31$
4. Future relational pursuit	-.25	.38***	.64***		$M = 2.61, SD = 1.07$
5. Gender (0 = F; 1 = M)	.23	-.19	-.19	-.41*	

Note. $N = 43$. System design variable: 0 = see-and-screen, 1 = algorithm; gender: 0 = female, 1 = male.

* $p = .05$. *** $p = .001$.

as suggested by Hayes (2013). Results indicated that after adjusting for the effect of the experimental manipulation of system design, those who experienced greater perceived control over mate selection also experienced greater decision-making satisfaction, therefore implying that the serial mediation test was warranted. The following analyses relied on Hayes's (2012) PROCESS macro, which provides a point estimate of all indirect effects and the associated 95% bias-corrected bootstrap confidence intervals (based on 10,000 resamples). The see-and-screen condition was coded as 0 and algorithm condition coded as 1. Gender was also included as a covariate. As Hayes (2013) notes, in a two-mediator serial model, the total effect of system design on future relational pursuit decomposes into one direct and three indirect effects. All four were estimated in the following analysis.

Looking at the corresponding model in Figure 1, the overall total effect of X on Y was not significant; point estimate was .11, 95% CI [-.38, .63]. Further, the direct effect of system design on relational pursuit ($X \rightarrow Y$), estimated as c , was not significant; point estimate was -.46, 95% CI [-.98, .06]. But because indirect effects can exist in the absence of significant total or direct effects (Hayes, 2013, p. 155; Judd & Kenny, 1981; MacKinnon, Krull, & Lockwood, 2000; Zhao, Lynch, & Chen, 2010), we examined each indirect effect:

1. $X \rightarrow M1 \rightarrow Y$ (estimated as a_1b_1)
2. $X \rightarrow M1 \rightarrow M2 \rightarrow Y$ (predicted in H3 and estimated as $a_1d_2b_2$)
3. $X \rightarrow M2 \rightarrow Y$ (estimated as a_2b_2)

Indirect effect 1 is the effect of system design on relational pursuit via perceived control. This effect was not significant; point estimate was .11, 95% CI [-.38, .63]. Indirect effect 2 is the serial mediation predicted in H3. This effect was significant; point estimate was -.45, 95% CI [-1.10, -.10]. Compared to those in the algorithm condition (coded as 1), daters in the see-and-screen condition (coded as 0) perceived greater control over mate selection, which was associated with increased decision-making satisfaction, which then led to greater expectations for relational pursuit. Indirect effect 3 is the effect of system design on relational pursuit via decision-making satisfaction. This indirect effect was also significant; point estimate was .32, 95% CI [0.02, 0.77]. This effect, which was not anticipated, reveals that daters randomly assigned to the algorithm condition reported higher decision-making satisfaction, which in turn leads to higher reported levels of future relational pursuit (see Table 2 for detailed results).⁴

4. Regarding effect sizes: The partially standardized indirect effect (PSIE) has been estimated for both indirect effect 2 ($X \rightarrow M1 \rightarrow M2 \rightarrow Y$) and indirect effect 3 ($X \rightarrow M2 \rightarrow Y$; see Hayes, 2013, for detailed description of PSIE). PSIE is estimated as $ab_{ps} = ab/SD_y$ and represents the size of the indirect effect in standard deviation units of the dependent variable. The interpretation of ab_{ps} is the number of standard deviations by which Y is expected to increase or decrease per a change in M of size a (Preacher & Kelley, 2011, p. 99). For indirect effect 2, $abd_{ps} = -.43$. Given the negative value, those daters who were allowed to select their own partner were, on average, 0.43 SD higher in their desire to pursue a romantic relationship with their selected partner as a result of the indirect effect through control and decision-making satisfaction than those who were told the algorithm selected for them. For indirect

Table 2. Results from serial mediation analysis in Study 1

Antecedent	Consequent											
	M1			M2			Y					
	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p			
System design (X)	a_1	-1.00	0.45	.031	a_2	0.47	0.30	.12	c	-0.48	0.24	.061
Perceived control (M1)		—	—	—	d_{21}	0.69	0.10	.001	b_1	-0.25	0.12	.050
Decision-making satisfaction (M2)		—	—	—		—	—	—	b_2	0.66	0.13	.001
Constant		4.74	0.49	.001	i_{M2}	1.68	0.57	.005	i_y	1.48	0.52	.008
		$R^2 = .14$				$R^2 = .56$				$R^2 = .56$		
		$F(2, 40) = 3.36, p = .04$				$F(3, 39) = 16.81, p < .001$				$F(4, 38) = 11.87, p < .001$		

Note. $N = 43$. System design (X), 0 = see-and-screen, 1 = algorithm. Gender included as covariate in all analyses. Unstandardized coefficients are reported. Effects are estimated for each predictor variable on the specified outcome while controlling for all other variables.

How could indirect effects 2 and 3 occur in the absence of a relation between system design and future relational pursuit? As noted by MacKinnon et al. (2000), the typical method used to test for mediation presupposes a consistent (as opposed to inconsistent) mediation pattern, and so does not usually consider suppression: (a) a significant relation between the independent and dependent variables, (b) a significant relation between the independent and mediating variables, and (c) the mediator must be a significant predictor of the outcome variable in a regression equation that includes both the independent and mediating variables (p. 175). Our results reflect a situation in which mediation is present, but criterion (a) is not met, suggesting inconsistent mediation (i.e., suppression). In particular, because the see-and-screen condition was dummy coded as 0, the negative value of a_1 means that participants in the see-and-screen condition perceived higher levels of control. The negative value of a_1 produced a negative result overall when combined with the positive values of d_{21} and b_2 , creating indirect effect 2. In contrast, because the algorithm condition was dummy coded as 1, the positive relation with decision-making satisfaction (a_2) means that participants in the algorithm condition perceived higher levels of decision-making satisfaction. The positive value of a_2 when combined with the positive value of b_2 created the positive value overall seen in indirect effect 3. In essence, these opposite-signed effects, while significant, cancel each other out, and this statistical suppression rendered the total effect of the manipulation on decision-making satisfaction null.

Interestingly, the results from Study 1 imply that see-and-screen and algorithm designs operate on daters' decision-making experience in different ways: The inherent nature of choice rooted in see-and-screen websites leads to an increase in perceived

effect 3, $ab_{ps} = .30$; those daters who were told the algorithm selected for them were 0.30 *SD* higher in their desire to pursue a romantic relationship with the algorithmically selected partner as a result of the indirect effect through decision-making satisfaction than those daters who selected their own partner in see-and-screen design.

control, which in turn boosts decision-making satisfaction, and finally relational pursuit. As hypothesized in H3, analyses revealed a significant serial mediation effect: The differences in see-and-screen and algorithm designs affected online daters by subtly influencing how they perceive control over mate selection choice, which then impacted decision-making satisfaction, which in turn affected their expectations regarding the potential of romantic relationships. This suggests that the design of online dating systems may be shaping daters' psychological experience of mate selection, and this may in turn lead to heightened expectations regarding a relationship's potential for development. Taken together, the results of H1–H3 suggest that one reason daters may prefer see-and-screen formats is for the increased perception of control that they provide.

In contrast, while algorithms may not affect daters' feelings of control, they still exert a positive effect on decision-making satisfaction, which then influences daters' feelings regarding relational pursuit. The indirect effect of algorithmic websites on relational pursuit through decision-making satisfaction suggests that the receipt of algorithmic feedback can make daters feel good about their choices, despite the fact that they must relinquish some control over partner selection to the computer. Although this effect was not anticipated, in hindsight, it may be that algorithmic feedback provides daters with a form of external validation of their choice. Offline, daters often seek validation of their choice of romantic partner from members of their social network. In the case of online dating, validation may come in the form of an algorithmic recommendation, which allows online daters to feel more satisfied with their initial choices. We return to this point in the General Discussion.

The findings from Study 1 suggest that the defining characteristic of the see-and-screen format is personal choice. At first glance it would appear that this endless supply of choice is a great benefit to romantic relationship formation—the more available partners, the more chances to find a suitable mate. But the increased amount of choice can sometimes lead daters to feel more frustrated than hopeful. For example, Frost, Chance, Norton, and

Ariely (2008) note that “many online daters find the search process to be aversive” (p. 54). Among their respondents, dissatisfaction arose primarily from the inordinate amount of time spent searching through and screening profiles. Daters have also expressed frustration at their inability to perform a comprehensive search through all available profiles, or being forced to make judgments too quickly based on incomplete information (e.g., Ansari & Klinenberg, 2015). When this frustration arises, daters may look to the algorithm for help with decision making.

Study 2

Unlike see-and-screen or algorithmic online dating systems, blended systems allow daters to maintain their agency over the ultimate choice of which potential mates to select, but also give daters assistance with their choice by providing additional feedback regarding their romantic selections. Thus, algorithms in blended systems may actually give daters a *greater sense of perceived control* over mate selection relative to see-and-screen websites by providing two unique advantages. As mentioned above regarding external validation, when algorithms give feedback about which potential partners are the most compatible they may also be providing validation that allows daters to feel more confident in endorsing that recommended option. But unlike the delegated agent algorithm (e.g., eHarmony), blended systems' algorithms function as decision aids that provide feedback without restricting daters' access to the dating pool. Blended systems therefore combine the benefits of perceived control over choice with the validation of an algorithmic recommendation, thus providing an even greater boost to decision making.

If the design of blended systems means daters can “have it all,” then the benefits of choice should no longer compete against the benefits of external validation. A system that blends choice and algorithm-based selection can combine the benefits of external validation and perceived control; this further suggests that the two sets of indirect effects seen in Study 1 may not emerge. Study 2 tests this possibility and examines whether the two indirect effects

that lead to suppression disappear in a blended system condition.

Study 2 also addresses some limitations that were present in Study 1. First, the number of bogus profiles participants saw was held constant across both conditions. In Study 1, our effort to reproduce a realistic reflection of eHarmony's actual one-on-one matching process, we chose to operationally define the algorithm condition as a single, optimal profile (ostensibly) selected by the computer. This ecological validity advantage, however, created a natural confound when compared to the see-and-screen condition in which participants saw four profiles. Thus, although analyses detected differences between the two experimental conditions, the additional variation between one and four profiles may be a rival explanation that accounts for these results. To address this, the blended condition in Study 2 combined algorithmic support with multiple options. Lastly, because the sample in Study 1 had an unequal number of male and female participants, a more balanced and larger sample was required for Study 2.

Similar to the procedures of Study 1, participants in the see-and-screen condition were given four bogus profiles depicting opposite-gender partners and were told that these individuals were also participating in the study. In the new *blended* condition, each participant was given the same four bogus profiles as in the see-and-screen condition, but they were also told that the researchers had entered the self-reported profile information and mate selection criteria provided previously in their first lab session into the START algorithm. Participants were informed that while START had calculated these four particular daters as being compatible with the participant, the algorithm had further recommended one of these daters as being the most "optimal" match for the participant. Thus, in Study 2 the algorithm operated as a decision aid, allowing the participant to choose between options but with recommendation feedback, rather than as the delegated agent in Study 1 that provided a single option.

By giving participants in both the blended and see-and-screen conditions four profiles, the ultimate choice of one's partner was now left up to the participant in both conditions. Thus,

in Study 2, as the number of profiles was held constant, the only difference between the conditions is that relative to the see-and-screen condition, participants in the blended condition received feedback from the algorithm that they could use during decision making.

Hypotheses

In Study 2, as daters are now being presented with multiple options from which to choose, the task of selecting one partner from the four profiles becomes more complex than it previously was in the algorithm condition in Study 1. Therefore in Study 2, we predict that algorithmic feedback provided in the blended condition regarding their "most optimal" partner match will give daters an enhanced sense of control in their decision making:

H1: *In comparison to see-and-screen systems, blended systems will produce greater feelings of perceived control over mate selection decisions for online daters.*

Another indicator of whether participants in the blended condition value the algorithm's recommendations in their decision making is whether they select the "optimal match" partner as their final choice, above and beyond statistical chance. As all bogus profiles were previously pretested in an offset sample as being equal in attractiveness, if the algorithm has no influence over participants' decision making, there should be no pattern to the specific mate selection decisions that they make in each condition. If, however, the algorithmic feedback is influential, participants in the blended condition will be more likely to select the partner indicated by the algorithm as being most attractive:

H2: *Daters in the blended condition are more likely to select the algorithmically recommended partner as their final choice than other potential partners in the choice set.*

While the direction of the relation between algorithmic input and perceived control

predicted in H1 is expected to reverse from Study 1 to Study 2 when the number of options increases, the nature of the other predicted relations is expected to remain the same.

H3: *Greater control over mate selection is positively related to daters' decision-making satisfaction.*

H4: *Daters' feelings of (a) perceived control and (b) decision-making satisfaction mediate the relation between system design and desire for relational pursuit.*

Method

Sample

Participant recruitment procedures were the same as in Study 1. After removal of five participants who did not meet selection criteria, who did not follow or understand instructions, or who uncovered the manipulation, the final sample was $N = 83$, $M_{\text{age}} = 20.6$, $SD_{\text{age}} = 2.97$. Study 2's sample was double the size of Study 1 and more balanced with regard to gender (43% males), and consisted of 36.1% Caucasian, 19.3% African American, 36.1% Asian, 6% Hispanic/Latino, and 8.4% Other.

Procedure and design

Participants came to the lab for two sessions. In the first session, they created a profile and answered the mate preferences pretest questionnaire. When they returned a week later, they were randomly assigned to conditions. The see-and-screen condition ($N = 48$) was identical to Study 1; participants were told that the four (bogus) profiles represented other daters who were also active in the study, were then asked to select the one person they judged as "most attractive," and filled out posttest measures. In the blended condition ($N = 35$), participants were also shown four bogus profiles along with feedback that ostensibly came from the START algorithm. Similar to the verbal script delivered in Study 1's algorithm condition, experimenters told each participant that the algorithm selected these four people based on the self-reported information that all daters provided in their first session and

the information provided by other daters. Participants in this condition were then told that the algorithm's results also indicated their "most optimal match." In actuality, this was bogus; experimenters used a preselected profile as the "optimal match" for all participants; no matching procedures were actually carried out. The optimal profile was held constant across all participants. After receiving this information from the experimenter, participants selected the person they felt was most attractive and completed the posttest questionnaire. All participants were then debriefed and thanked.

Measures

Measures were replicated from Study 1 and used the same response scales. Responses were coded such that higher scores reflected greater amounts of perceived control ($\alpha = .89$), decision-making satisfaction ($\alpha = .90$), and relational pursuit, ($\alpha = .96$).

Results and discussion

The first set of hypotheses is concerned with how the algorithm in the blended format affects perceptions of control and ultimately the decision-making process. H1 predicted that daters in the blended condition would experience greater feelings of control over decision making compared to those in the see-and-screen condition given that the algorithm format allowed the participant to make a choice while also receiving algorithmic feedback. As expected, an independent samples t test revealed a significant difference $t(81) = -2.26$, $p = .03$, such that those in the blended condition reported greater feelings of perceived control, $M = 4.77$, $SD = 1.32$, compared to those in the see-and-screen condition $M = 4.03$, $SD = 1.53$. No other significant differences with respect to system design manipulations were found.

These data suggest that the introduction of algorithmic feedback during mate selection among several partner options enhanced the dater's sense of control, consistent with predictions that people prefer expert help in decision-making tasks that can involve time

Table 3. Correlations among key variables in Study 2

Variable	1	2	3	4	Descriptives
1. System design					
2. Perceived control	.24*				$M = 4.34, SD = 1.49$
3. Decision-making satisfaction	.26*	.77***			$M = 4.46, SD = 1.34$
4. Relational pursuit	-.03	.35***	.58***		$M = 2.78, SD = 1.44$
5. Gender	.09	-.03	-.19	-.49***	

Note. $N = 83$. System design: 0 = see-and-screen, 1 = blended; gender: 0 = female, 1 = male.

* $p < .05$. *** $p < .001$.

and effort (Iyengar & Lepper, 2000; Komiak & Benbasat, 2006; Senecal & Nantel, 2004). An important question, however, is whether participants also trusted the algorithm's recommendations, in addition to whether the presence of the algorithm increased perceived control. If this is the case, then H2 predicted that participants should choose the algorithmically recommended dating option at a rate above statistical chance.

To test this hypothesis, separate chi-square goodness-of-fit tests were conducted on each condition. As expected, the see-and-screen condition revealed no significant differences across the options within the choice set: $\chi^2(3, n = 48) = 3.17, p = .37$, indicating no detectable pattern to the mate selection choices. In contrast, a significant result for daters in the blended condition was found, $\chi^2(3, n = 35) = 21.57, p < .001$. Examination of mate selection frequencies revealed that the observed frequency of algorithmically recommended option ($n = 19$) far exceeded the expected frequency ($n = 8.8$). This pattern suggests that the algorithm's feedback in the blended condition did, in fact, affect participants' mate selection decisions. Participants in the blended condition not only perceived more control than daters in the see-and-screen condition, but they also included the algorithmic input in their decision making.

H3 predicted that perceived control would correlate positively with decision-making satisfaction. The data supported this prediction, $r(81) = .77, p < .001$, and replicated the effect observed in Study 1 (see Table 3 for other significant correlations). Finally, the serial mediation effect predicted in H4 was again tested

using Hayes's (2013) procedures. The partial correlation between the two mediators controlling for system design was again significant, $prM_1M_2.X(80) = .77, p < .001$, and analysis proceeded with the serial mediation test. The experimental variable was coded such that 0 = see-and-screen and 1 = blended condition. Gender was also included as a control variable.

Using the PROCESS macro, analyses produced estimates of the direct and indirect effects and the associated 95% bias-corrected bootstrap confidence interval (based on 10,000 resamples). The direct effect of system design on future relational pursuit was estimated as c in Figure 1. Results showed it was not significant; point estimate was $-.38$, 95% CI $[-.86, .08]$. Following our analytic procedure in Study 1, we found the following pattern of results for the indirect effects. First, indirect effect 1, which consisted of system design's effect on relational pursuit mediated by perceived control (estimated as a_1b_1 in Figure 1), was not significant; point estimate was $-.11$, 95% CI $[-.42, .06]$. Indirect effect 2, which was the full serial mediation effect predicted in H4 (estimated as $a_1d_2b_2$), was significant; point estimate was $.37$, 95% CI $[0.06, 0.80]$.⁵ In this case, compared to the see-and-screen condition, daters in the blended condition reported higher feelings of perceived control, which led to greater decision-making satisfaction

5. The PSIE was also estimated for indirect effect 2 in Study 2. In this case, $abd_{ps} = 0.26$, indicating that daters who were in the blended condition were, on average, 0.26 SD higher in their desire to pursue a romantic relationship with their selected partner as a result of the indirect effect, compared to those who were in the see-and-screen condition with no algorithmic feedback.

and ultimately boosted expectations regarding relational pursuit. This pattern is consistent with H4. Lastly, indirect effect 3, which tested the path from system design to relational pursuit mediated by decision-making satisfaction (estimated as a_2b_2), was not significant; point estimate was .18, 95% CI [-.05, .47]. The serial mediation results suggest that when faced with more choices, algorithmic feedback can provide guidance during people's relational decision making (see Table 4).

General Discussion

Recent data have shown that online dating websites have at least partially “displaced” other venues that were previously integral for romantic connectivity, including the family, school, neighborhoods, and the workplace (Rosenfeld & Thomas, 2012; Smith & Duggan, 2013). However, to date, most of the research in this area has been silent on exactly *how* these sites facilitate connections. The purpose of this study was to examine how the design of online dating systems can affect the ways people process information when making decisions about potential romantic partners. Results from the two experiments suggest that online daters value and rely on algorithmic assistance in their decision making, but that they also want to retain the ability to make their own choice among options. Given that all three designs (see-and-screen, algorithm, and blended) exerted effects on daters' experience of decision making, there appears to be noteworthy variation in the ways in which technology influences relationship formation.

The experience of relational decision making: Autonomy and assistance

The results from Study 1 indicate that see-and-screen systems can boost people's feelings of perceived control over decision making, which in turn made them more optimistic about the choices they made and the potential for further relational development with their selected partners. These results are consistent with previous research regarding the role of choice more broadly (Iyengar &

Table 4. Results from serial mediation analysis in Study 2

Antecedent	M1			Consequent			Y					
	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p			
System design (X)	a_1	0.74	0.32	.026	a_2	0.24	0.18	.19	c	-0.39	0.24	.12
Perceived control (M1)		—	—	—	d_{21}	0.69	0.06	.001	b_1	-0.15	0.12	.23
Decision-making satisfaction (M2)		—	—	—	i_{M2}	—	—	—	b_2	0.72	0.14	.001
Constant		4.11	0.27	.001	i_{M1}	1.64	0.30	.001	i_Y	0.97	0.44	.04
		$R^2 = .062$				$R^2 = .66$				$R^2 = .52$		
		$F(2, 80) = 2.63, p = .07$				$F(3, 79) = 50.01, p < .001$				$F(4, 78) = 20.88, p < .001$		

Note. $N = 83$. System design (X), 0 = see-and-screen, 1 = blended. Gender included as covariate in all analyses. Unstandardized coefficients are reported. Effects are estimated for each predictor variable on the specified outcome while controlling for all other variables.

Lepper, 2000; Leotti et al., 2010), but also provide greater clarity regarding how choice operates within the online dating context (Lenton et al., 2008; Wu & Chiou, 2009).

Algorithmic feedback provided by different dating systems also appears to be weighted heavily in relational decision making, albeit in various ways. Results from Study 1 indicated that even though one-on-one algorithmic matching systems reduce daters' overall feelings of control, the recommendations they make about prospective partners are influential and indirectly heighten daters' enthusiasm about potential romance by boosting decision-making satisfaction. These findings suggest that relationships that are initiated via an algorithm format (i.e., through the partner recommendations provided by the system) may benefit from the external validation provided by the algorithm. That is, although algorithms reduce feelings of control, the feedback they give may also offer daters a sense of validation for their mate selection decisions.

This notion of external approval is in line with previous research from social psychology and communication science that has demonstrated the association between a person's overall romantic relationship satisfaction and the amount of approval provided by that person's family and friends (e.g., Etcheverry & Agnew, 2004; Parks & Adelman, 1983; Sprecher & Femlee, 2000). However, while meeting the family has been described as a key "turning point" in the trajectory of a romantic relationship (Baxter & Bulis, 1986), it usually occurs at later stages of relational development. It is possible that website algorithms supply a form of external validation that many daters crave but do so up front during the selection process.

These results regarding decision making are also consistent with SDT. As noted above, when too many options are available people become frustrated, and their agency, control, and satisfaction are undermined: "Choice can, when meaningful, facilitate self-determination, especially when it allows one to find that which one can wholeheartedly endorse. But choice can be constructed to do nothing of the sort, instead engendering confusion or fatigue" (Ryan & Deci, 2006, p. 1577). In the case of

online dating, limiting choice through algorithmic recommendation can remove some of this confusion or fatigue. Indeed, algorithms may boost agency allowing daters to "wholeheartedly endorse" their decisions of the heart.

Additionally, Study 2 revealed that when blended systems provide feedback but leave the final decisions up to the user, daters can simultaneously retain a sense of personal control in their mate selection and also attend to the algorithm's recommendation. Blended systems' algorithmic feedback may provide "expertise" that augments the information daters use during decision making, thereby affording agency and autonomy with respect to his or her own choices (e.g., Komiak & Benbasat, 2006). In this way, blended systems reduce the costs associated with a delegated agent algorithm (e.g., eHarmony), and mitigate the overload effects produced in see-and-screen sites like Match.com. Overall, the combination of both features may produce an additive effect that boosts feelings of agency.

The boost in agency that blended dating systems provide may also explain their greater popularity: At the time of this writing, OkCupid.com was ranked higher (258) than either Match.com (314) or eHarmony (1,415) in terms of web traffic, page views, and visitors in the United States, according to Alexa.com (n.d.). While other factors undoubtedly contribute to the popularity rankings of these different online dating sites, the results of these studies suggest that the website's features and their impact on the psychological experience of mate selection may be one explanation as to why daters prefer different platforms.

Implications for romantic relationships

The current findings also suggest interesting parallels with existing research on idealization and positive illusions in romantic relationships. Murray and Holmes's (1997) tripartite definition of idealization consists of (a) overly positive evaluations of partner's traits, (b) exaggerated perceptions of control over the relationship, and (c) unrealistic levels of optimism—all three of which appear to be operating in the current

context. Daters' impressions of potential partners may be boosted by the algorithmic recommendation; daters' feelings of control may also be increased through the mechanism of personal choice found on online dating systems. While this suggests how idealizations may be forming at a cognitive level, previous work suggests both cognitive and behavioral mechanisms underlie the process of idealization (Murray, Holmes, & Griffin, 1996; Snyder, Tanke, & Berscheid, 1977). In line with this argument, idealization may be instantiated behaviorally if daters decide to exchange mediated messages such as text messaging or e-mail; in fact, computer-mediated communication has been known to boost interactants' feelings of control during conversation, which might further amplify the intensity of positive expectations and idealization (see Tong & Walther, 2015).

However, such idealizations may lead to disillusionment when partners meet in person and find that the connection they shared online did not transfer offline. Is this the reason why so many online daters report "the puncturing of high expectations" (Reiss, 2015) and other feelings of disappointment when meeting their dating partners offline? Individuals' cognitions may be overly positive during online mate selection as the system boosts expectations through feelings of control and validation. Heightened expectations are reflected behaviorally through partners' online message exchange. But when daters meet one another in the flesh, such idealizations might become harder to sustain, and disillusionment may result. The ideas we offer here regarding the effects of online dating systems on the impressions and expectations formed during initiation are speculative and future research may investigate them; however, they seem to be a relevant explanation for how and why disappointment occurs during relationship formation.

But it is also possible that daters' first face-to-face meeting does not produce disillusionment. In such cases, do the effects of idealization last beyond the first face-to-face meeting? Current data suggest that married couples who initiated their relationship online are less likely to end in divorce and more satisfied with their marriages than those who

met in traditional offline venues (Cacioppo, Cacioppo, Gonzaga, Ogburn, & VanderWeele, 2013). Is this boost in satisfaction facilitated by the online dating system itself? The "downstream" effects of algorithmic, see-and-screen, and blended systems are beyond the scope of this study, but an issue for future research to consider is whether or how a couple's relational development may be set into motion by the system used during initiation.

Limitations and questions for future research

As noted above, although this research found differences with respect to see-and-screen, algorithm, and blended system designs, perceived control might function differently when the number of options in choice-sets varies more substantially. Often, the number of potential mates that appear in a see-and-screen website search is restricted only by a dater's search parameters—unless those parameters are very specific, the number of profiles returned by a see-and-screen website search would likely be greater than four. Although the decision to use four profiles was guided by previous research on choice (Lenton et al., 2008; Senecal & Nantel, 2004; Wu & Chiou, 2009), the effects of more extensive choice remains an open question (see e.g., D'Angelo & Toma, 2016).

Also with regard to profiles, in Study 2, when giving the algorithmic feedback in the blended condition, profiles were held constant. Although all stimulus profiles used in these experiments were pretested for attractiveness, future research could vary profile attractiveness to investigate further how the algorithmic recommendation factors into a dater's decision making.

Online dating is most common through the decades of one's mid-20s through mid-40s, with 22% of daters reportedly within the age range of 25–34 (Smith & Duggan, 2013). The average age of our samples ranged between 22 and 20, respectively; while we did not anticipate any of the effects to be impacted by differences in age range, it remains an open question. Young adults' selection criteria may be less specific, whereas older adults may have partner preferences that reflect their life stage

(e.g., desire to have children); the number of romantic options that would be deemed manageable versus excessive should be determined by the importance and specificity of people's goals, preferences, and desires. The more specific the criteria, the more limited the viable options become, thus affecting choice making overall.

Future research should also examine whether or not daters' perceptions of the system change over time. For example, as daters encounter differential "successes" and "failures" with regard to the relational expectations they have formed, their opinions of the algorithm's effectiveness (and the system overall) may evolve as they become more experienced with the technology and resulting outcomes of use. Recent research suggests that people form aversions to algorithms after they see evidence of their failure (Dietvorst, Simmons, & Massey, 2014). Thus, potential moderating variables to consider may be the overall time spent in online dating websites, or duration of membership, as well as perceptions of "success" among daters.

Conclusion

The work presented here suggests that the design of current dating systems can influence the ways in which users approach romantic relationships, perhaps through perceptions of control over decision making, or external validation of choice. The influence of online dating systems raises important questions about the short-term and long-term effects of online dating technology on relational outcomes such as idealization, disillusionment, and satisfaction. Such questions will become increasingly important to study as the popularity of online dating continues to grow.

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