

The Influence of Technology on Romantic Relationships: Understanding Online Dating

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Abstract. A culture's social fabric is deeply dependent on how its members establish romantic bonds. What happens when the way those bonds are formed is radically changed over the course of a single generation? This is the case with the rise of online dating, which is now the second most common way for people to meet a romantic partner. Despite existing research exploring issues such as mate selection, self-presentation, and impressions, we still do not know how online dating systems affect people's perceptions—about technology, relationships, romantic partners, and themselves—and how these perceptions affect behavior. In this paper, we introduce and explicate the *Source Multiplicity, Attribution, Recognition, and Transformation (SMART) Model of Online Dating*. The SMART model is a comprehensive theoretical framework that has interdisciplinary roots in human-computer interaction (HCI), computer-mediated communication (CMC), psychology, and decision science.

Keywords: Online dating · Decision-making · Choice · Algorithms · System design · Affordances

1 Introduction

Technology often plays an invisible role in our lives by quietly influencing our perceptions, communication, and behavior. Since “good design” is often seamless, the inner-workings of many systems are hidden from users' view. Particularly influential are the algorithms that silently lurk in background of many computing systems. Through the organization and presentation of information, algorithms are capable of shaping human behavior by recommending what products to buy or which friends to include in our social networks. Yet despite their ubiquity, we still don't know how most people perceive the algorithms that are embedded in the systems that they use every day and how such perceptions affect behavior. How much trust do users place in technology when making decisions? Are people aware of technology's influence, or do they simply take these systems for granted?

Researchers have recently called for more investigation into the impact of algorithms on human decision making—and no decisions are more important than the ones people make about their personal relationships. With over 30 million people using online dating, the algorithms embedded in dating websites have an enormous influence over the formation of relational bonds. A review of the existing online dating research shows that social scientists have examined factors such as self-presentation, ethnicity/race, and physical attractiveness in mate selection, but few have investigated how sociotechnical features like algorithms influence people's behaviors and decisions. In contrast, work in decision science, human-computer interaction (HCI), and information science (IS) has examined algorithmic influence in contexts like product selection and online shopping. But online dating provides a unique, theoretically rich context that demands research attention given the important role it now plays in human bonding. What happens when systems make recommendations about people instead of products? Is the popular use of online dating websites changing the landscape of romantic relationship formation in American society? To answer these questions, we propose the SMART model to explain how technology influences the perceptions, attributions, and decisions people make in online dating. This paper begins by outlining important theoretical frameworks that provide the foundation for the SMART model. We then proceed by defining each component of the model in detail.

2 The Algorithmic Curation of Choice

Online dating companies often advertise that they provide users with access to a large dating pool filled with potential partners. But is this too much of a good thing? Theories in decision science and psychology state that when people are faced with an enormous amount of selection they are often unable to evaluate all of their available options. As a result, most people will screen options and then filter down to a smaller choice set that contains a smaller number of promising alternatives [1]. Work in HCI has found that computer-curated choice sets are capable of influencing people's decisions by directing attention toward specific options [2]. Oftentimes, computer-curated choice is a simple default rather than calculated strategy: research suggests that most people are unaware of the presence of algorithms in the systems they use [3, 4]. But because most existing studies have examined algorithmic influence in contexts like online shopping, movie selection, and news aggregators [5–7], the impact of algorithms on choice sets featuring potential wives, husbands, and lovers is unknown. Do daters naively assume that the computer-curated alternatives are the best or only alternatives from which to choose? And, to the extent that they are conscious of the algorithmic involvement, do they view it as an advantage to finding love? As current research is silent on these issues, SMART examines how the algorithms in dating websites affect people's attention to alternatives during romantic mate selection.

3 Online Self-Presentation and Impression Formation

A central framework embedded in the foundation of SMART is the hyperpersonal model of CMC [8] which has been used by many scholars in communication to explain people's self-presentation and impression formation behaviors in online environments. In the model, senders are predicted to use the sociotechnical features of CMC channels (e.g., editing, asynchronicity) for selective-self presentation, allowing them to display especially desirable characteristics to others. As receivers get to know senders based on their selectively self-presented attributes, they often form overly idealized impressions. Lastly, mediated interaction between senders and receivers is predicted to form a reciprocal feedback loop that simultaneously reinforces the other three components as interaction unfolds between partners creating "hyper"-personal effects.

Applications of the hyperpersonal model to online dating have found robust evidence of selective self-presentation: In an investigation of self-authored dating profiles, Hancock et al. [9] found that on average, heavier daters tended to strategically represent themselves as weighing less than they actually did. Similarly, with respect to height, shorter daters presented themselves as being taller than they were in reality. Hitsch et al. [10] found that the body-mass index reported by their sample of online daters was distinctly lower than the national average. And several respondents in Ellison et al.'s [11] study reported strategically exploiting CMC features for self-presentational gain. Furthermore, literature suggests that most online daters are aware that others engage in selective self-presentation: The more daters tend to misrepresent themselves in their profiles, the more they believe others do the same [11–13].

Yet a central issue that is overlooked by many of these existing online dating studies is how daters' knowledge of others' (and their own) self-presentation behaviors may affect how they judge the credibility of others' information as they make mate selection decisions. Online daters' sharpened recognition of information manipulation in CMC may influence the ways in which they process information, form attributions, and make decisions.

4 Information, Feedback and Self-Perception

The hyperpersonal model has also been used to examine the intrapersonal (i.e., individual-level) effects of online self-presentation. Integrating the hyperpersonal model with theory from psychology, Gonzales and Hancock [14] examined *identity shift*, which refers to the changes in self-perception that result from observations of one's own self-presentation behaviors in public online settings. In their study, participants (Ps) were asked to display either introversion or extraversion in written responses to interview questions. Identity shift occurred when Ps came to view themselves as being more like the trait they were asked to portray by the end of the interview. Notably, identity shift was stronger when Ps believed their responses were being collected and posted to an online weblog versus a private text file. The public nature of blogs made Ps more likely

to incorporate their openly displayed behaviors into their self-concepts in an effort to balance their external performance with internal identity.

Walther et al. [15] extended Gonzales and Hancock's findings by examining the additive effects selective self-presentation and feedback. In their experiment, Ps performed the same interview task in public blog and private text document settings. Afterwards, half of the Ps were given (bogus) feedback on their responses, while the other half received no feedback. Those in saw feedback were led to believe that it came from either a person (i.e., a college student who supposedly read blog responses looking for introversion/extraversion) or the computer system (i.e., results of a software program that supposedly analyzed responses for linguistic markers of introversion/extraversion). Results indicated that Ps who received feedback confirming their self-presented introversion or extraversion experienced greater identity shift in the direction of enacted personality characteristics compared to those who saw no feedback. This was true for Ps who saw human-generated and system-generated feedback.

As self-presentation is both highly selective and very public in online dating contexts, Gonzales and Hancock's study provides good evidence to predict the occurrence of transformative identity shift effects on daters' self-concepts. And while Walther et al. provide a solid basis for predicting feedback effects, their work also raises questions about how variations in the valence of that feedback would affect self-perception. Ps receiving feedback in this study only saw information that was consistent with their self-presentation of introversion or extraversion. Within online dating contexts, it is likely that daters will sometimes receive inconsistent feedback from others who reject or refuse them. Thus daters' reactions to inconsistent feedback remain unknown.

5 The SMART Model

The SMART model is grounded in the hyperpersonal model of CMC, but we also rely heavily on models of decision making, psychological theories of self-perception, and design research from HCI. In the SMART model, source multiplicity reflects the two classifications of information sources present in online dating: human information sources and technological information sources. Both are predicted to influence daters' attributions regarding partners, decisions during mate selection, and expectations for relational development. Secondly, a sub-process predicted to affect daters' information processing is their level of conscious recognition of technology during online relationship formation. Lastly, a second set of arrows running from attribution to information sources in a cyclic fashion indicates transformative feedback effects: As daters process information to make attributions, it is predicted that they will experience reciprocal effects on identity, thereby transforming self-perception (Fig. 1).

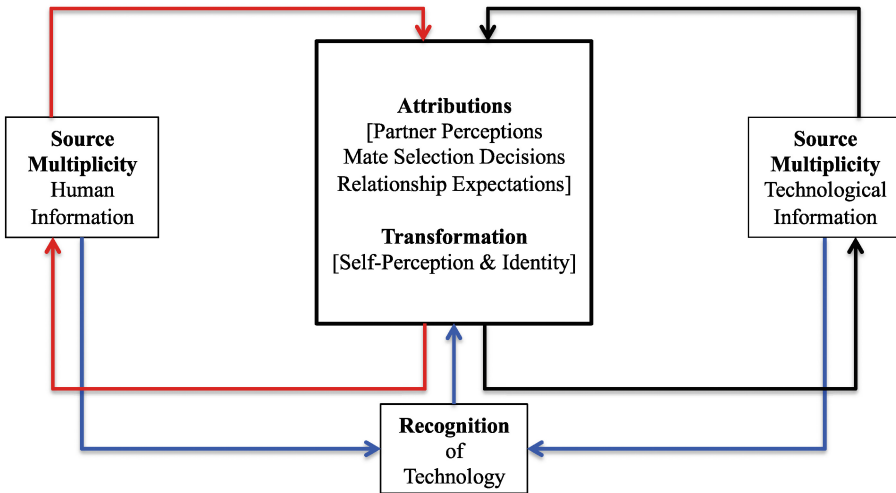


Fig. 1. The Source Multiplicity, Attribution, Recognition, and Transformation (SMART) Model of Online Dating.

6 Source Multiplicity

6.1 Human-Sourced Information

Previous CMC research indicates that people evaluate others' self-authored profile information when forming impressions and making attributions in contexts like Facebook [16]. In line with this research, we assert that such "human-sourced" profile content is important information used in mate selection. However, because most profile content is self-authored, daters must also assess the credibility of the others' self-presented information when making attributions. Daters do this by evaluating the *warranting value* of information. *Warranting value* refers to the extent to which people believe a piece of information is immune to manipulation by the source it describes [17]. For example, Abby's self-authored declaration of "I'm a fantastic rock climber" would have comparatively less warranting value than if she were to post a link from her profile to *Rock & Ice Magazine* that announces her victory at a recent competition. Because the competition results are being communicated by a third-party source, this information is presumably more difficult for Abby to manipulate, thus giving it greater warranting value. SMART asserts that the judgments daters' make regarding the warranting value of others' information affects the way they process and evaluate information during initial stages of profile review.

6.2 Technology-Sourced Information

As noted above, online dating systems have the potential to influence daters' mate selection decisions by algorithmically aggregating alternatives into computer-curated

choice sets. Consistent with this reasoning, SMART predicts that the extent to which algorithms are featured in the design of dating systems may also affect people's subsequent interpersonal attributions. Of the many dating websites currently available, most follow one of two primary designs that reflect different levels of algorithmic involvement: Algorithmically-driven websites, such as eHarmony.com, begin by asking daters to supply information about their personalities, interests, and mate preferences through lengthy questionnaires. Responses are then fed into the company's algorithm, which matches partners based on the similarity or complementarity of those dimensions [18]. Contrastingly, "see-and-screen" websites like Match.com allow user to browse through a database of profiles. These websites provide search tools that help daters narrow down the list of potential mates.

One critical way these two design formats differ is the amount of perceived control daters experience when making mate selection decisions. Research from psychology [19] has documented the *illusion of control* effect, defined as people's unrealistically high level of confidence in their ability to exert influence over the outcomes of chance-based events. Romance can feel to many people like a chance-based or random event. Following this logic, it would appear that most people would prefer to maintain control over mate selection decisions. In fact, work in cognitive science [20] suggests that since choice allows humans to feel capable of regulating our environment we have adapted to seek it out as a way to boost our self-efficacy.

Thus compared to the one-on-one matching process of algorithmic websites, see-and-screen websites give daters more control over mate selection by allowing them to view the entire dating pool to make decisions. However, the increased control may also produce an increased likelihood of choice overload, which often occurs when people are overwhelmed with too many options. Iyengar and Lepper [21] demonstrated how the feelings of choice overload created during product selection resulted in diminished decision making satisfaction, greater difficulty, and more frustration. Additionally, they suggest that choice overload may be "further exacerbated" in contexts where "(a) the costs associated with making the 'wrong' choice, or even beliefs that there are truly 'wrong' choices, are much more prominent, and/or (b) substantial time and effort would be required for choices to make truly informed comparisons among alternatives" (p. 1004). Both conditions apply to the decision context of partner selection in online dating where the costs of choosing the "wrong" partner are high, and the time and effort needed to evaluate each person in the dating pool are extensive. When online daters feel overwhelmed by too much choice, they may rely on algorithms to ease choice overload and simplify mate selection.

As daters process information in the source multiplicity stage, SMART asserts that they use that information to make attributions about (a) potential partners' attractiveness and (b) a relationship's potential for future romantic development. Regarding human information sources, previous research has shown that people assign information with a higher warranting value more "attributional weight" during the impression formation process. Effects have been demonstrated in venues such as Yelp.com [22] and Facebook [23], but the effects of judgments of warranting value on attributions in online dating environments have not yet been tested.

Regarding *technological information sources*, we noted in the source multiplicity section how differences in system design features, such as algorithms, could affect the amount of control daters experience during mate selection. SMART predicts that the amount of control afforded by different dating systems will affect daters' attributions about the decision making process itself, prospective romantic partners, and a relationship's future potential.

Our preliminary experiment investigating how the differences in the design of *algorithm-based* and *see-and-screen* dating websites influence daters' attributions regarding: (a) psychological feelings of personal control over mate selection, (b) satisfaction with the mate selection decision making process, and (c) expectations regarding the relationship's potential for future development. Using an adaptation of the "bogus stranger" paradigm, 43 participants (Ps) were recruited and told that they were helping to test a new dating website aimed at college-aged singles. Ps developed profiles and filled out questionnaires about their mate preferences. A group of 24 Ps randomly assigned to the algorithm condition received a single profile (ostensibly) chosen by the dating system's algorithm as their most "optimal" partner match. This condition was designed to mirror websites like eHarmony that match daters on a one-on-one basis. Another 19 Ps randomly assigned to the see-and-screen condition were given four (bogus) profiles and asked to select the one person they found most attractive. This condition reflected websites like Match.com, which allow daters to maintain more control over mate selection. In actuality, all profiles that Ps saw were created by the researchers using content gathered from publicly available dating profiles. Profiles were pretested to ensure that there were no systematic differences in attractiveness prior to being used in the main study. Ps then completed measures of the dependent attribution variables detailed above. The results indicated:

- Website design affected daters' feelings of *personal control* over mate selection decisions, such that daters felt more control in see-and-screen formats than algorithmic formats
- Differences in personal control affected the overall amount of *satisfaction* daters' experienced during the decision making process, such that less control resulted in less satisfaction
- Decision making satisfaction mediated the relationship between control and daters' overall feelings of enthusiasm regarding *future relationship pursuit*

Taken together, findings from our preliminary test of SMART's source multiplicity and attribution components suggest that the ways in which dating systems present information can impact daters' attributions, decision making, and expectations regarding romantic relationships. Consistent with theory from psychology and cognitive science we found computer-supported decision making reduced feelings of personal choice and perceived control over mate selection, which ultimately reduced people's optimism about the relationship's developmental potential.

While promising, our initial findings suggest necessary extensions: First, daters saw different amounts of profiles across see-and-screen and algorithm conditions (e.g., four vs. one). The choice to operationalize the algorithm condition as a single, optimal profile was a deliberate decision to maximize ecological validity of algorithmically-based

dating systems. According to the frequently asked questions portion of their website, eHarmony states that it may be a while before daters receive any matches, with some people being “not suitable” for matching due to various reasons. On average, eHarmony states most daters receive only 10 to 25 matches per year. Therefore, the choice to mirror the “one-on-one” matching procedures of algorithmic websites motivated our experimental manipulation of the algorithm condition. However, we realize that our effort to reproduce user experience of dating websites like eHarmony may be perceived as a naturally-occurring confound between the see-and-screen and algorithm conditions. Relatedly, our decision to create choice sets in the see-and-screen condition that contained only four profiles was guided by previous research [24]. But it remains to be seen if the designs of dating websites function the same way when the amount of choice varies. Amount of choice (e.g., low, moderate, high) becomes a critical process variable, because as amount of choice increases, the likelihood of overload also increases [22].

7 Recognition of Algorithmic Involvement

The next component of the SMART model addresses the issue of technological recognition. Research in HCI and IS suggests that most people remain unaware of the algorithms embedded in many popular platforms. This is especially true in online dating where companies often highlight the power of their algorithms while simultaneously obscuring their operation. For example, eHarmony members pay a monthly fee of \$19.65 to get matched with others based on eHarmony’s algorithm that features “29 dimensions of compatibility.” Given that eHarmony surpassed the \$1 billion revenue mark in 2010, people are clearly willing to pay for the privilege of algorithmic selection in their search for love. Even though eHarmony does not provide its members with an explanation of how the algorithm actually works, they have successfully created the semblance of algorithmic effectiveness as an advantage in romantic relationship formation—whether or not they empirically produce better romantic matches may not affect their bottom line [18]. Importantly, we are not interested in uncovering the actual technical processes of different dating website algorithms. Instead, SMART predicts that it is people’s perceptions of what algorithms do that affect the subsequent stages of relationship formation: If people’s perceptions shape their reality, then we must have a better understanding of perceptions to understand how they influence behavior [4].

7.1 Subconscious Attention During Decision Making

In addition to people’s conscious recognition of technological influence, research from many fields has measured people’s subconscious attention to information by tracking their eye movement behaviors (e.g., pupil dilation, gaze duration, scanpath). To obtain a complete understanding of people’s recognition of technology in online dating, SMART explores three issues regarding daters’ attention.

First, SMART examines subconscious attention and information utility. Previous large-scale studies of mate selection from psychology, sociology, and IS have suggested that human characteristics such as physical attractiveness, race, or age [25], are the most

influential. However, such assertions have not been empirically verified; daters' attention to system-generated content (i.e., match scores, rankings, etc.) may also influence attributions and decisions.

Secondly, SMART examines how a website's visual layout affects daters' attention to information. Work in decision science and HCI has found evidence of stimulus-driven attention: Factors like size, saliency, and viewing position have all been shown to influence attention to and processing of information [see for review, 26].

Lastly, SMART examines the nature of attention processes over time. Consumer behavior research has demonstrated learning effects in which people who engaged in repeated decision making tasks learned to focus their gaze on more important attributes, and reduced gaze fixations on less salient information [27]. It is possible that learning effects also occur as daters become more familiar with the system and selection task.

8 Transformation of Self-Perception Through Feedback

SMART predicts that daters' recognition and interpretation of information from multiple sources will not only produce attributional effects at the interpersonal level, but also at the individual level by transforming daters' self-concept. Identity shift refers to changes in self-perception that arise from daters' observations of their own self-presentation behaviors in public settings. The environment of online dating is ripe for triggering identity shift given that: (a) daters consistently strive to present themselves as attractively as possible, (b) the online dating arena is by nature very public, and (c) daters often seek confirmation of their self-presented attractiveness in the form of attention, communications, and flirtations from other daters.

While Walther et al. [15] indicated that confirmatory feedback increases the likelihood of online identity shift, the SMART model extends previous CMC research to consider the role of negative, or disconfirmatory, feedback. Research from psychology suggests that when faced with negative feedback like rejection, daters may engage in protective tactics such as self-serving bias, which would allow them to maintain their own positive self-perception by derogating the source of the negative feedback [28]. Thus when daters are rejected, they might actually "double down" on their self-perception, creating a stronger belief in their own attractiveness, and displaying a greater propensity to attack the source of the rejection.

But with regard to romantic rejection in online dating, a novel issue that arises is the concept of feedback absence. Since daters may be inundated with request messages, their ability to respond to each and every person is limited [13]. As a result, daters may ignore messages from people that they do not find attractive by simply being unresponsive. *Online Dating for Dummies* advises that "Internet-appropriate ways to say no" include: "Don't reply at all, ever. Just delete the message. In Internet-speak, this tactic is completely understood to mean 'Not interested at all, ever'" [29]. However, as there is little existing psychological or communication theory to predict daters' response to lack of feedback, the transformation component of the SMART model advances an important question about feedback absence.

8.1 Interaction of Source Multiplicity and Transformation

As feedback can be communicated by human and system sources in dating websites, SMART predicts that the source multiplicity component will interact with feedback to produce transformative effects on self-perception. Though dating systems vary in the type of feedback they provide to their users, some examples include: “winks,” or “smiles,” automated indications that a dater has viewed a specific profile, and a dater’s last active login into the system. Some platforms also provide notifications indicating when a message has been seen or read, as well as timestamps noting time/date of delivery. Match.com provides a “No Thanks” button that, when clicked, sends a pre-scripted, automated romantic refusal message [29]. Previous research indicates that these system-generated cues are used in online impression formation [11], but their role as a form of feedback affecting self-perception is unknown.

To illustrate the transformative effect of system-generated feedback on self-perception, imagine Abby sends a message to Bill using Match.com’s messaging system that reads: “Hi, Bill, loved your profile. We have so much in common, we should chat!” A week later, Abby still has not received a reply from Bill, but when she checks her Match.com account, she finds a system-generated cue telling her that Bill viewed her profile five days ago. She also receives the system notification: “message read 5 days ago”. Abby now knows that Bill viewed her profile and read her message, but never responded. Interestingly, Abby is only made aware of Bill’s lack of response because of the system’s responsiveness.

So how does this system feedback affect Abby’s self-perception? The existing theories from psychology, communication, and HCI point in three different directions: Self-serving bias research from psychology would predict that Abby would be most likely to derogate Bill in this scenario (“Bill never responded, he must be a jerk”). Alternatively, the hyperpersonal model of CMC and identity shift research suggest Abby would internalize Bill’s lack of feedback as part of her own self-concept (“Bill never responded; I must not be as attractive as I thought”). Work from HCI might suggest Abby would use the system as an attributional “scapegoat” (“Bill never responded; Match.com is not giving me access to the right kind of guys”). Because the SMART model considers theory from all three disciplines, it offers novel, but competing, predictions about how these dynamics of feedback might affect daters’ self concept. Therefore, a central focus within the transformation component of SMART is to uncover daters’ attributional responses to system- and human-generated feedback as they attempt to protect their self-perception.

9 Conclusions

It is clear that the process of relationship formation is being shaped mediated technology. Drawing from communication science, social psychology, and HCI, the SMART model offers a unique interdisciplinary conceptualization of this process. Although only one preliminary test of the model’s first component has been conducted, more is underway. Researchers should continue to look across disciplines to provide more powerful and parsimonious explanations for human behavior. Future research will tell us if the components of SMART offer such an explanation regarding online dating and mate selection.

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