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Dynamic competition account of men's perceptions of women's sexual interest

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ABSTRACT

This work applies a dynamic competition framework of decision making to the domain of sexual perception, which is linked theoretically and empirically to college men's risk for exhibiting sexual coercion and aggression toward female acquaintances. Within a mouse-tracking paradigm, 152 undergraduate men viewed full-body photographs of women who varied in affect (sexual interest or rejection), clothing style (provocative or conservative), and attractiveness, and decided whether each woman currently felt sexually interested or rejecting. Participants' mouse movements were recorded to capture competition dynamics during online processing (throughout the decisional process), and as an index of the final categorical decision (endpoint of the decisional process). Participants completed a measure of Rape-Supportive Attitudes (RSA), a well-established correlate of male-initiated sexual aggression toward female acquaintances. Mixed-effects analyses revealed greater curvature toward the incorrect response on conceptually incongruent trials (e.g., rejecting and dressed provocatively) than on congruent trials (e.g., rejecting and dressed conservatively). This suggests that the two decision alternatives are simultaneously active and compete continuously over time, consistent with a dynamic competition account. Congruence effects also emerged at the decisional endpoint; accuracy was typically lower when stimulus features were incongruent, rather than congruent. RSA potentiated online congruence effects (intermediate states of behavior) but not offline congruence effects (endpoint states of behavior). In a hierarchical regression analysis, online processing indices accounted for unique variability in RSA above and beyond offline accuracy rates. The process-based account of men's sexual-interest judgments ultimately may point to novel targets for prevention strategies designed to reduce acquaintance-initiated sexual aggression on college campuses.

1. Introduction

Twenty percent of women are estimated to experience an attempted or completed rape by a male acquaintance during college (Fisher, Cullen, & Turner, 2000; Krebs, Lindquist, Warner, Fisher, & Martin, 2007). Numerous factors are associated theoretically and empirically with an increased risk of sexually aggressive behavior and its established correlates, such as Rape-Supportive Attitudes (RSA) that justify and minimize the impact of rape (Abbey, Jacques-Tiura, & LeBreton, 2011; Farris, Treat, Viken, & McFall, 2008b). However, a critical factor is *cognitive*: men's misperception of women's sexual interest (i.e., sexual misperception) (e.g., Abbey et al., 2011; Farris, Treat, Viken, & McFall, 2008a). Sexual misperception early in an interaction (e.g., misperceiving friendliness as sexual interest) might increase risk for later aggression via reduced sensitivity to later non-consent cues or via dismissal of such cues as capricious or "token resistance" (Farris et al., 2008b; Treat, Viken, Farris, & Smith, 2016).

A more basic understanding of men's misperceptions of women's sexual interest may ultimately point to novel ways of targeting and modifying decisional errors. However, it may not be straightforward to apply classic models of cognitive and perceptual judgments to sexual-interest judgments, which are highly multi-dimensional, contextually influenced, and emotionally charged. Prior sexual-perception research has begun to examine this problem from a cognitive perspective using the accuracy of decisions to examine factors like cue weighting (e.g., Treat, Church, & Viken, 2017; Treat, Hinkel, Smith, & Viken, 2016; Treat, Viken et al., 2016). However, this has neglected the fact that such perceptual decision making unfolds over time. Decisional dynamics may offer useful insight into this problem, as estimates of real-time processing can reveal underlying cognitive mechanisms and enhance

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our understanding of real-world decision making in which pressure to act quickly can result in action based on incomplete decisional states.

The current work leverages a dynamic competition/cue-integration framework of decision making to examine an online (i.e., real-time) index of men's processing of women's sexual interest and an offline (i.e., accuracy) index of the end-state of this decisional process to address three questions. First, we ask whether disparate interpretations of a woman's affect (sexually interested and rejecting) are, on average, activated simultaneously and compete dynamically throughout the decisional process of judging a woman's current sexual interest. Second, we assess the extent to which individual differences in decisional dynamics are related to variability in RSA, offering a clinically important extension of these cognitive models. Third, we ask whether online decision dynamics predict individual differences in attitudes *over and above* the decisional outcome of the categorization process. Addressing these questions is essential for evaluating the relevance of dynamic theories and measures of sexual-interest decision making to clinically relevant public-health problems like sexual aggression.

Below, we describe the dynamic competition/cue-integration account that motivated the current work and summarize what is known about men's perceptions of women's nonverbal communication of dating-relevant affect, before presenting the current study and its hypotheses.

1.1. Dynamic competition and multiple-cue integration

Domains like language processing, visual categorization, and decision making require rapid processing of ambiguous inputs. This requires combining many sources of information (Freeman, Ambady, Rule, & Johnson, 2008; Goldstone & Medin, 1994; McClelland & Elman, 1986; McMurray, Horst, & Samuelson, 2012; Spivey, 2007), typically informed by the relative importance of each cue (Ernst & Banks, 2002; Jacobs, 1999; MacDonald, Pearlmutter, & Seidenberg, 1994; Toscano & McMurray, 2010). Although these models were developed for basic cognitive phenomena like speech categorization, this framing has recently been applied to more complex social judgments (e.g., Freeman, Penner, Saperstein, Scheutz, & Ambady, 2011). For example, male judges of a woman's level of sexual interest often rely on multiple nonverbal cues to varying degrees, including the woman's affect (i.e., facial expression and body language), the provocativeness of her clothing, and the level of her normative attractiveness (e.g., Farris, Viken, Treat, & McFall, 2006; Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat et al., 2017).

Beyond the idiographic reliance on various cues lies the issue of the mechanism *underlying* the decisional process. Many models suggest a gradually unfolding competition between available responses. This thinking has been applied to a wide range of domains, including speech, and face perception (Freeman & Johnson, 2016; Freeman et al., 2008; McClelland & Elman, 1986), as well as visual categorization, comparison, and search (Goldstone & Medin, 1994; Spivey, 2007). According to these models, multiple candidate interpretations are activated simultaneously, rather than serially, using bottom-up stimulus cues and often top-down expectations (Freeman & Johnson, 2016; McClelland & Elman, 1986).[1] Although this competition is pronounced for perceptually ambiguous or incomplete inputs, it is also present—at least briefly—for unambiguous inputs. This unfolding competition is resolved over time as less supported candidates are suppressed, until only one candidate remains and the decision is reached. Although this continuous process appears discrete when evaluating only the final judgments (the endpoint of the process), the dynamics leading up to the decisional endpoint may be probabilistic and graded.

Mechanistic accounts agree on the idea that multiple candidates build activation or evidence gradually and in parallel (Ratcliff, 1978; Usher & McClelland, 1986). A crucial area in which they differ is whether preliminary activation states continuously cascade to guide ongoing action.[2] Interactive accounts typically argue for the former, whereas some modular models use a race-like architecture in which candidates build activation independently of one another and action is initiated only when activation of one crosses a threshold. The continuous cascade posited by dynamic competition/cue-integration perspectives may have crucial real-world consequences (Spivey, 2007). In the real-world, there is rarely sufficient time to rely on fully processed stimuli. Thus, partially activated states and partially resolved competition may be the basis of most daily perception and decision-making. Consequently, for decisions about sexual interest, measures of partially resolved or intermediate states of processing may uniquely predict how people behave in dating situations over and above discrete measures of decisional endpoints.

Dynamic competition/cue-integration accounts are often evaluated with online processing measures that quantify competition dynamics over the course of stimulus processing. In the mouse-tracking paradigm (Dshemuchadse, Scherbaum, & Goschke, 2013; Huette & McMurray, 2010; Kieslich & Hilbig, 2014; Spivey, Grosjean, & Knoblich, 2005), participants view or hear a stimulus and move a computer mouse toward one of two response options, typically in the upper left and right corners of the screen. As the participant moves the mouse, the streaming *x, y* coordinates are recorded. These continuous trajectories are influenced by fluctuations in activation of the candidates as decision-making unfolds.

Typically, when the incorrect response is partially active, mouse trajectories "veer" or curve somewhat toward that response along the way to the final correct selection (Fig. 1). This suggests that *both* candidates influence behavior. In this way, mouse trajectories allow investigators to visualize and quantify competition dynamics over the course of decision-making as activation states of potential responses interface continuously with motor programs (Spivey, 2007). In most domains that have been studied, mouse-tracking reveals that motor or action planning does not wait for a final decision before executing a response. Rather, preliminary states (i.e., partial activation) cascade directly to action planning, suggesting a lack of modularity between decision-making and other systems in these domains.

Although dynamic competition frameworks have been around for some time (McClelland & Rumelhart, 1981), they primarily have been applied to domains where simple well-defined inputs are mapped to nearby levels of representation. Recently, these models have been profitably applied to person perception, focusing largely on social category membership (e.g., gender and race) and emotion (e.g., anger vs happiness), and studied using manipulations of perceptual properties (e.g., information in faces, voices, and men's attire; Cloutier, Freeman, & Ambady, 2014; Freeman, 2014; Freeman & Ambady, 2011; Freeman & Johnson, 2016; Freeman, Ambady, Midgley, & Holcomb, 2011; Freeman, Pauker, Apfelbaum, & Ambady, 2010; Freeman et al., 2008; Hehman, Ingbretsen, & Freeman, 2014). For instance, Freeman et al. (2008) used mouse-tracking to assess the cognitive dynamics of gender categorization. Across trials, stimulus features were either conceptually *congruent* (e.g., a male face with short hair) or *incongruent* (e.g., a male face with long hair). On incongruent trials, trajectories veered more toward the incorrect category than on congruent trials, even though the correct response was ultimately selected. This suggests that *male* and *female* categories were activated online by integrating both cues, establishing the interaction of higher-level social expectations (e.g., what

[1] Although we are describing a dynamic competition framework here, to be clear, we are using this term broadly to describe the large class of models featuring simultaneous consideration of multiple response options. This includes models like the drift diffusion model and race models, which do not incorporate inhibition among responses but do incorporate the simultaneous accumulation of evidence for multiple potential responses.

[2] Although we focus here on the parallel consideration and dynamically unfolding activation that are hallmarks of both classes of models, we discuss the distinctions between them in the online supplement (see Supplement S1).

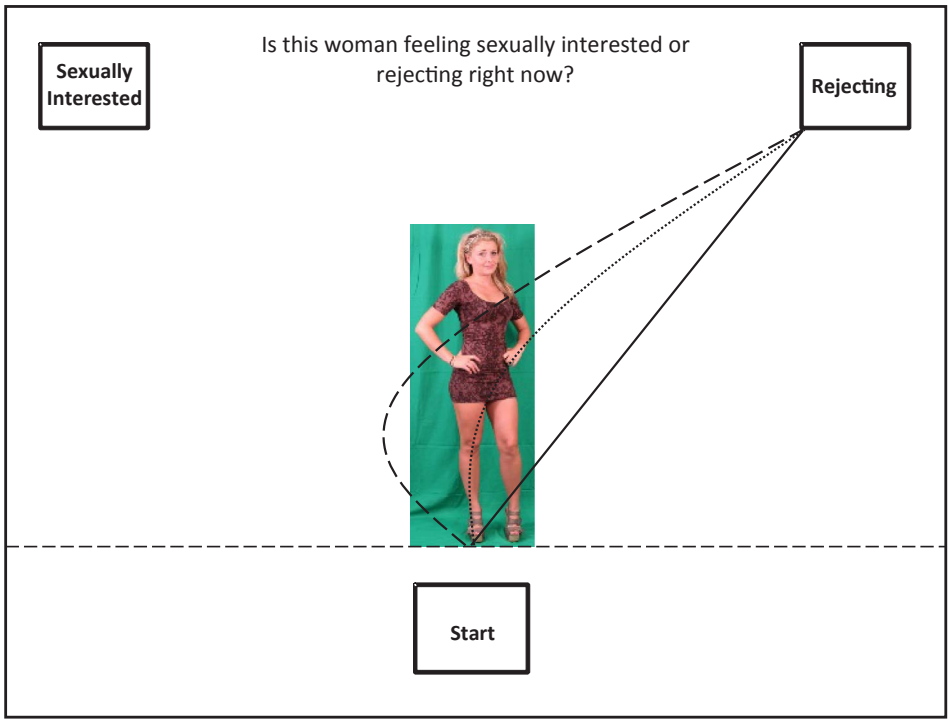

Fig. 1. Depiction of an incongruent trial (e.g., woman rejecting and provocatively dressed, according to normative data) in the Sexual Interest Judgment Task with hypothetical trajectories after the mouse crosses the invisible threshold. The average deviation (AD) is the area between the measured trajectory and the solid black hypothetical straight line (i.e., the most direct path) between the participant's start position after crossing the invisible threshold and the correct response box. The dashed trajectory indicates greater competition from Clothing Style (larger AD), whereas the dotted trajectory indicates less competition from Clothing Style (smaller AD).

constitutes "maleness" and "femaleness") and bottom-up cues (e.g., longer or shorter hair) during categorization (Freeman, Ambady et al., 2011; Freeman, Dale et al., 2011; Freeman, Penner et al., 2011; Freeman et al., 2008; Freeman & Johnson, 2016).

In other socially relevant domains, researchers working within a dynamic competition framework have also used mouse-tracking to demonstrate simultaneous activation and competition in the areas of deceptive intentions (Duran, Dale, & McNamara, 2010), moral decision making (Koop & Johnson, 2011), subjective preferential choice (Koop & Johnson, 2013), and social dilemmas (Kieslich & Hilbig, 2014). In the current work, we apply the dynamic competition/cue-integration framework to even more complex, emotionally charged social decisions.

1.2. Men's judgments of women's sexual interest

A woman's level of sexual interest in a specific man is dynamic and fluctuates over the course of an interaction. Thus, certain characteristics of her nonverbal behavior are more likely than others to be diagnostic of her level of sexual interest at a particular point in time (e.g., Farris et al., 2008b; Treat, Viken et al., 2016). A woman's nonverbal affect, as communicated on her face and in her body language, may be the most valid nonverbal cue of her momentary sexual interest in a particular person. Indeed, men focus significantly on affect when judging women's sexual interest in full-body photographs (Farris, Treat, & Viken, 2010; Farris, Viken, & Treat, 2010; Farris, Viken, Treat, & McFall, 2006; Farris et al., 2008a; Treat, Hinkel et al., 2016; Treat, Viken, Farris, & Smith, 2014; Treat, Viken et al., 2016; Treat et al., 2017). However, men also rely non-negligibly on a woman's attractiveness and the perceived provocativeness of her clothing style (Farris et al., 2006; Farris, Treat et al., 2010; Farris et al., 2008a; Farris, Viken et al., 2010; Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat et al., 2014, 2017) when judging how sexually interested she is currently feeling. These non-affective characteristics are less likely to index momentary sexual interest, because they are more static features that do not typically vary as a function of the man with whom she is currently interacting.

1.2.1. Congruence of affective and non-affective cues

Consistent with dynamic competition/cue-integration models, sensitivity to a woman's nonverbal affective cues depends non-negligibly on the stereotypical congruence between affective and non-affective characteristics (Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat et al., 2014). Observers are more likely to decide a woman is sexually interested if she displays sexually interested affect while wearing provocative clothing. Similarly, observers are more likely to deem a woman sexually rejecting if she displays rejection cues while wearing conservative clothing (Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat et al., 2014).

1.2.2. Clinically relevant individual differences in sexual-interest decisional processes

The degree to which men rely on affective (more diagnostic) versus non-affective (less diagnostic) cues when judging sexual interest is associated with the extent to which these men endorse RSA, a well-established correlate of sexual aggression (e.g., Bohner, Siebler, & Schmelcher, 2006). Numerous studies document that men with stronger RSA show impoverished processing of affect and enhanced processing of clothing style and attractiveness (Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat, Viken, Kruschke, & McFall, 2011; Treat et al., 2014; Treat et al., 2017). Additionally, men at greater risk of exhibiting sexual aggression tend to show an enhanced congruence effect when classifying women's more ambiguous affect, suggesting they may overuse these less-diagnostic cues (Farris, Viken et al., 2010; Farris et al., 2006, but see Treat et al., 2014).

1.2.3. Online processing of affective and non-affective cues

To date, much of the work on sexual perception has focused on the *endpoint* of the decision – the decisional product. However, investigating the nature of the underlying processing architecture is important if sexual-interest judgments are not discrete (e.g., sexually interested or rejecting) but continuous, fuzzy, competitive, and probabilistic (Spivey, 2007). From this perspective, even if nonverbal negative affect (e.g., a scowl and folded arms) clearly activates a 'rejecting' judgment, provocative clothing and high attractiveness may partially activate the 'sexually interested' judgment even if the ultimate decision is accurate. Thus, the sexual-interest congruence effect on

decisional products may result in part from differential activation of and dynamic competition between conceptually disparate categories (Freeman & Dale, 2013; Hehman et al., 2014). In this case, assessment of the decisional product alone would neglect the potential role of underlying dynamic competition and could underestimate the degree to which secondary cues are used.

1.3. Current study

Male participants viewed full-body images of undergraduate women who varied in affect, clothing style, and attractiveness. We presented full-body photographs because recent work suggests affective information is communicated on the body as well as the face (e.g., Van den Stock, Righart, & de Gelder, 2007). Careful stimulus selection enabled us to create congruence and incongruence between affective and non-affective dimensions. Women's affect was combined factorially with clothing style on half the trials and with attractiveness on the other half. Participants used the mouse to indicate whether each woman was feeling sexually interested or rejecting "right now." We recorded the trajectory to estimate "veer" or average deviation toward the non-selected response, and deviation was examined as a function of stimulus- and participant-specific characteristics.

We report on two levels of analysis: the offline decisional product and the online decisional process. Analysis of online processing included only correct trials. This was done for two reasons: (1) mouse deviation could be interpreted as simultaneous activation of incorrect and correct responses; and (2) online processing could be examined while *controlling for* the accuracy of the offline response (for discussion, see Huette & McMurray, 2010; McMurray, Aslin, Tanenhaus, Spivey, & Subik, 2008). This conservative strategy likely excludes trials with the most extreme deviation toward the incorrect competitor (i.e., the deviation is so marked that the participant does not recover and makes an incorrect response). Accordingly, the presence of online competition on correct trials constitutes strong evidence that (1) processing of the two responses occurs simultaneously; and (2) preliminary but ultimately suppressed social perceptions can influence motor behavior. Thus, to maximize the number of trials available for these analyses, we chose stimuli displaying either clear sexual interest or rejection—as determined by extensive stimulus norming described below—such that a correct response was apparent, if participants relied solely on affective information.

We expected a congruence effect on both the decisional process and product (e.g., higher deviation or lower accuracy when affective and non-affective cues were incongruent). We also expected that RSA would positively potentiate these congruence effects and that online measures would account for additional variability in RSA, over and above that accounted for by offline measures.

2. Method

2.1. Participants

One hundred and seventy male students participated in this study for course credit. Eighteen were dropped for the following reasons: one was unable to complete the study due to scheduling issues; two did not correctly perform the Sexual Interest Judgment Task by the end of practice; one reported not being able to see the mouse cursor; one chose not to complete the Sexual Interest Judgment Task; one reported not attending carefully to the questionnaires; one exhibited zero accuracy for a subset of the repeated-measures conditions; and 11 showed accuracy significantly below chance on congruent trials. Thus, all analyses reflect a final sample size of 152.

Participants' mean age was 19.59 years (SD = 2.05). 75.7% identified as Caucasian, 14.5% as Asian-American, and 9.8% as other races. Participants were predominantly single (92.8%) and either heterosexual (98%) or bi-sexual (2%). 79.3% of participants reported having engaged in sexual intercourse. 79.0% reported being in a serious relationship for at least one month in the past 3 years. 96.1% used their right hand to complete the Sexual Interest Judgment Task; 3.9% used both.

2.2. Stimuli

Photographic stimuli consisted of 72 full-body photographs of undergraduate women selected from a larger set of 1127 images (see Farris et al., 2006). Fifty-six of the 72 images (77.7%) depicted non-Hispanic White women, in the judgment of the experimenters. All photographs were taken in front of a fixed background. Models were photographed in their own provocative and conservative warm-weather clothing. During the photo shoot, the models displayed extreme sexual interest and extreme rejection. Accordingly, the images vary most prominently in Affect, Clothing Style, and Attractiveness.

Ratings of Affect and Clothing Style were obtained from four expert judges (the first two authors, as well as Viken and Farris, other members of our research team; see Treat et al., 2011). Each expert judged each woman's affect on a 21-point scale from extremely rejecting (−10) to neutral (0) to extremely sexually interested (10), and each woman's Clothing Style on a 10-point scale from extremely conservative (1) to extremely provocative (10). Experts were asked to focus only on the relevant dimension and to ignore the irrelevant dimensions. The average bivariate correlations among the expert raters were .92 for Affect and .86 for Clothing Style, indicating high reliability. After the current study was finished, 9 undergraduate females also rated Affect and Clothing Style, following the same instructions as the experts. Inter-rater reliability was high for both Affect and Clothing Style (ICCs = .97, .95), and the undergraduates' and experts' average ratings correlated strongly (Affect: r = .97, Clothing Style: .96). Ratings of Attractiveness were obtained from a large sample of undergraduate men (see Farris et al., 2006; Treat et al., 2011). An average rating of Affect, Clothing Style, and Attractiveness was computed for each photo. These ratings were used to select the stimulus set, as described below.

Sexual interest, attractiveness, and provocativeness of dress are inherently subjective concepts, yet we refer to ratings of these concepts as "normative", reflecting population-level estimates of each factor (e.g., how most people would evaluate a typical image). We use this term to refer to these properties of the images, and we refer to responses that are consistent with normative ratings of sexual interest as correct for ease of communication.

2.3. Sexual interest judgment task (mouse-tracking)

Participants viewed these photographs across 4 blocks of trials. On each trial, they indicated whether the woman was communicating sexual interest or rejection (Fig. 1), responding to the question, "Is this woman feeling sexually interested or rejecting right now?" Similar to most mouse-tracking paradigms (Spivey et al., 2005), response options – "Sexually Interested" and "Rejecting" – were in the upper right and left corners of a computer screen (1280 × 1024 pixel resolution). The location of the response options was constant within a block, but randomized across blocks. At the beginning of each block, participants were informed about response option locations.

Each trial began when participants clicked the "start" box in the center of the bottom of the screen. Participants then immediately moved the mouse directly up (toward the responses), so that the movements captured the decision in progress (Spivey et al., 2005). When the mouse crossed an invisible threshold one-fifth of the way up, the stimulus appeared for 1000 ms. Participants were instructed to move the mouse continuously toward the appropriate response. This task began with 15 practice trials. The experimenter modeled the desired performance on the first two practice trials and then supervised each participant during the remaining 13 practice trials, providing feedback when necessary.

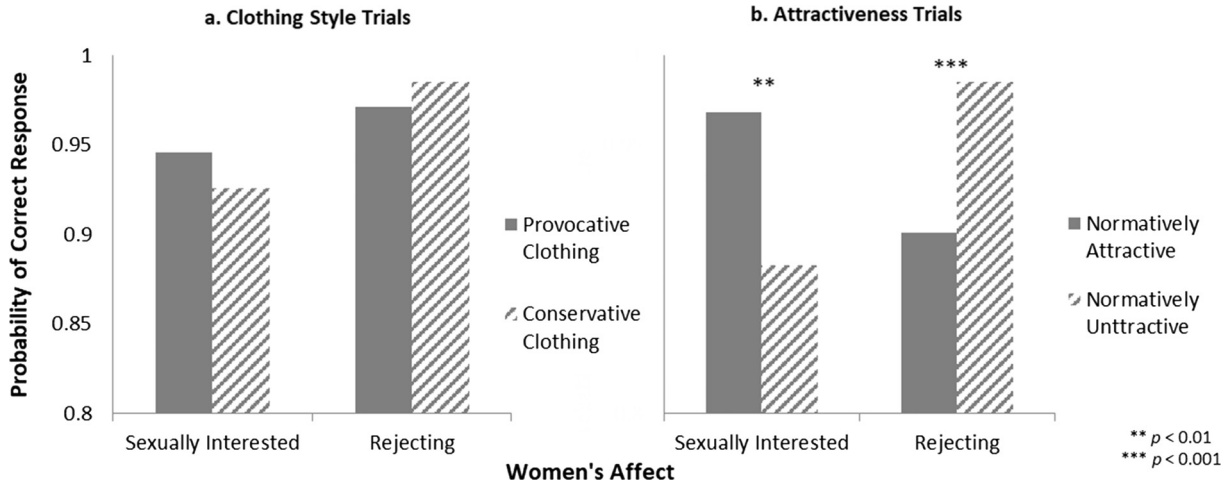

Fig. 2. Model-predicated probability of a correct response as a function of women's Affect and Clothing Style (a) or women's Affect and Attractiveness (b).

If the participant did not complete a trial correctly, three different error messages could appear. If the invisible threshold was not crossed within 1000 ms, a message prompted the participant to move the mouse quickly and continuously after clicking "start". If a participant took too long to finish a trial (> 5000 ms), a message encouraged the participant to move the mouse quickly and continuously throughout the trial. If a participant clicked outside the response boxes, he was reminded to click within one of the response boxes. To increase motivation to complete the task properly, error messages remained on the screen for 1000 ms, slowing progress. Error messages were explained during the practice trials as errors were made by participants. If a participant did not make all possible errors, the experimenter asked the participant to make one to demonstrate the resulting message. After practice, participants completed 288 trials of the Sexual Interest Judgment Task in a randomized order.

Pilot testing examined stimulus presentation times from 300 ms to 1500 ms and found a gradual increase in accuracy at longer times. Reaction time was about 1000 ms regardless of presentation time. Thus, to maximize accuracy and limit variability in stimulus exposure, 1000 ms was chosen.

2.4. Experimental conditions

Across conditions, women's affect was either extreme Sexual Interest (i.e., a normative rating of 7 or higher) or extreme Rejection (i.e., a normative rating of −7 or lower). Our stimulus set precluded simultaneous manipulation of Affect, Attractiveness, and Clothing Style; thus, we ran two fully crossed, within-subject conditions examining Affect × Attractiveness and Affect × Clothing Style.

In the *Clothing Style (CS) condition*, the women were dressed either provocatively (top 25% of CS ratings; high-CS) or conservatively (bottom 25% of CS ratings; low-CS); Clothing Style was fully crossed with Affect; and Attractiveness was held at a moderate level by including only women with Attractiveness ratings in the middle 50% of the distribution. In the *Attractiveness (ATT) condition*, women were either normatively attractive (top 25% of ATT ratings; high-ATT) or unattractive (bottom 25% of ATT ratings; low-ATT); Attractiveness was fully crossed with Affect; and Clothing Style was held at a moderate level by including only women with CS ratings in the middle quartiles.

The final stimulus set consisted of 9 unique women in each of the 8 cells, for a total of 72 stimuli (i.e., 72 different women). Each stimulus was presented four times, for 288 trials. Among the selected stimuli, Attractiveness was unrelated to Clothing Style, r = .103, p = 0.387.

2.5. Questionnaires

Participants completed the 45-item Illinois Rape Myth Assessment (IRMA), a measure of Rape-Supportive Attitudes (RSA; e.g., women claim rape for attention, women secretly want to be raped; Payne, Lonsway, & Fitzgerald, 1999). RSA is a well-documented correlate of self-reported perpetration of sexual aggression (e.g., Bohner et al., 2006; Murnen, Wright, & Kaluzny, 2002). The IRMA shows adequate reliability and validity (Payne et al., 1999). Participants also reported demographic information, including ethnicity, age, sex, marital status, sexual orientation, and handedness.

3. Results

3.1. Sample characteristics

On the Sexual Interest Judgment Task, participants responded accurately (M = 89.22%; SD = 9.54%) and quickly (M = 1124.43 ms; SD = 341.66 ms). Trials with error messages were excluded from analysis. The distribution of RSA scores was roughly normal (M = 98.19; SD = 32).

3.2. Reporting strategy

We first present findings bearing on the predicted congruence effect and its moderation by RSA for accuracy and mouse tracking. Next, we report results from a hierarchical linear regression examining the incremental contribution of online dynamics in predicting RSA. Additional analyses reported in the online supplement (see Supplement S1) examine the degree to which our data are consistent with alternative information-processing and decision-making frameworks.

3.3. Accuracy

Accuracy was high, but effects of stimulus congruence still were observed. For example, Fig. 2A suggests that when women displayed sexual interest, male participants were less likely to respond correctly if their clothing style was conservative; conversely, when women displayed rejection, participants were less likely to respond correctly when the women's clothing style was provocative.

3.3.1. Analyses

Two logistic mixed-effects models were fit using the glmer function in lme4 (Bates, Maechler, Bolker, & Walker, 2015) in R (R Core Team, 2017). Separate models were fit for Clothing Style and Attractiveness trials (Smith, Treat, Farmer, & McMurray, 2017a). Both models

Table 1
Logistic mixed-effects model results for Accuracy on Clothing Style trials.

Row #	Factor	Estimate	SE	z	*p*
1	**(Intercept)**	**3.2848**	**0.160**	**20.47**	**< 0.0001**
2	**Affect**	**−0.5887**	**0.138**	**−4.26**	**< 0.0001**
3	CS	−0.0797	0.125	−0.64	0.522
4	**RSA**	**−0.0113**	**0.003**	**−3.38**	**0.001**
5	**Affect * CS**	**0.2521**	**0.127**	**1.99**	**0.047**
6	**Affect * RSA**	**0.0066**	**0.002**	**3.03**	**0.002**
7	CS * RSA	−0.0002	0.001	−0.18	0.856
8	Affect * CS * RSA	−0.0006	0.001	−0.47	0.641

Note. CS = Clothing Style, RSA = Rape-Supportive Attitudes (centered). SE = standard error. Reliable effects are bolded. In the mixed-effects analyses, sexually interested affect, provocative clothing, and normative attractiveness were coded as 1, and rejecting affect, conservative clothing, and normative unattractiveness were coded as −1.

Table 2
Logistic mixed-effects model output for Accuracy data on Attractiveness trials.

Row #	Factor	Estimate	SE	z value	*p* value
1	**(Intercept)**	**2.9511**	**0.172**	**17.11**	**< 0.0001**
2	Affect	−0.2316	0.165	−1.41	0.160
3	ATT	−0.1381	0.154	−0.90	0.371
4	**RSA**	**−0.0074**	**0.003**	**−2.85**	**0.004**
5	**Affect * ATT**	**0.8351**	**0.157**	**5.30**	**< 0.0001**
6	Affect * RSA	0.0030	0.002	1.47	0.141
7	ATT * RSA	−0.0008	0.001	−0.89	0.372
8	Affect * ATT * RSA	−0.0015	0.001	−1.13	0.261

Note. ATT = Attractiveness, RSA = Rape-Supportive Attitudes (centered). SE = standard error. Reliable effects are bolded. In the mixed-effects analyses, sexually interested affect, provocative clothing, and normative attractiveness were coded as 1, and rejecting affect, conservative clothing, and normative unattractiveness were coded as −1.

included a full factorial combination of fixed effects (e.g., Affect × Clothing Style × RSA). RSA was centered. Affect (sexually interested or rejecting), Clothing Style (provocative or conservative), and Attractiveness (attractive or unattractive) were effect coded, with sexual interest, provocative clothing, and attractive coded as 1.0. Using model comparison procedures (Crawley, 2012; Matuschek, Kliegl, Vasishth, Baayen, & Bates, 2017), the maximal random effects structure supported by the data for both conditions included random intercepts for subject and photo, and random subject slopes for Affect, Clothing Style or Attractiveness, and their interaction (e.g., (1 + Affect ∗ Attractiveness|subject) + (1|photo), in glmer notation).

3.3.2. Clothing style trials

Affect negatively predicted accuracy, $p < 0.0001$ (Table 1, Row 2). The probability of a correct response was greater when women expressed rejection (0.98) than interest (0.94). RSA also negatively predicted accuracy, $p < 0.001$ (Table 1, Row 4). Most importantly, a congruence effect emerged: Affect interacted with Clothing Style, $p < 0.05$ (Table 1, Row 5, & Fig. 2a). Follow-up models conducted separately for rejecting and interested women showed that when women expressed rejection, the probability of a correct response was not greater when they were conservatively (0.99), rather than provocatively (0.97), dressed, B = −0.30, z = −1.58, $p = 0.114$. When the women expressed interest, the probability of a correct response also did not differ when they were provocatively (0.95), rather than conservatively (0.93), dressed, B = 0.17, z = 1.04, $p = 0.299$.

Contrary to expectations, RSA did not moderate the congruence effect in the Clothing Style condition. However, RSA interacted with Affect, $p < 0.002$ (Table 1, Row 6). Follow-up tests indicated the negative relationship between RSA and accuracy was reliable when the women expressed rejection, B = −0.02, z = −4.31, $p < 0.001$, but not interest, B = −0.005, z = −1.36, $p = 0.174$.

3.3.3. Attractiveness trials

There were no main effects of Affect or Attractiveness; however, similar to the Clothing Style condition, RSA negatively predicted accuracy, p < 0.01 (Table 2, Row 4).

Importantly, the expected congruence effect (the affect × attractiveness interaction) was significant, $p < 0.0001$ (Table 2, Row 5). Both follow-up analyses showed statistically significant effects of attractiveness: when the women expressed rejection, the accuracy was greater when they were normatively unattractive (0.98), than normatively attractive (0.90), B = −0.96, z = −5.42, $p < 0.0001$. Conversely, when the women expressed interest, the probability of a correct response was greater when they were attractive (0.97), than unattractive (0.88), B = 0.71, z = 2.75, $p < 0.01$ (Fig. 2b). Again, contrary to expectations, RSA did not moderate the congruence effect on accuracy in the Attractiveness condition.

3.4. Mouse trajectories

3.4.1. Data processing

The streaming coordinates of mouse movements were recorded at 200 Hz. Ultimately, these were used to compute the Average Deviation (AD), the average area in pixels between the observed trajectory and a straight line connecting the mouse position at stimulus onset and the response box (Fig. 1). Coordinates underwent a number of preliminary processing steps to compute AD (Huette & McMurray, 2010). First, trajectories were trimmed to begin when the cursor crossed the threshold (triggering stimulus presentation) and to end at the earliest moment the cursor entered the response box. To reduce irrelevant variability prior to stimulus presentation, the coordinates of the whole trajectory were shifted relative to the position of the mouse at stimulus presentation (when the mouse crossed the threshold), such that the initial position was treated as 0, 0. Thus, the reference line indexing the most direct path always began at the same coordinates as the observed trajectory.

Second, each trial's trimmed trajectory was time-normalized relative to trial duration, using 80 time bins, to permit averaging across trials. Third, trajectories were flipped across the center axis such that all trajectories curved toward the right. Fourth, trajectories were rotated clockwise such that the X-axis corresponded with the straight line between the start position and the center of the response box. Rotating the coordinate space created a trajectory in which a purely horizontal (rightward) motion corresponded to movement from the origin to the response. The Y-axis then corresponded to orthogonal deviation *away* from this straight line.[3] Finally, we computed average deviation (AD) as the average of the (rotated) Y coordinates of the time-normalized trajectory. Greater ADs indicate greater competition from the incorrect response, while holding accuracy constant.

Fig. 3 depicts the observed mouse trajectories for Clothing Style and Attractiveness trials, after flipping and rotating the trajectories. Here, the line indexing the most direct path (i.e., the hypothetical straight black line on Fig. 1) becomes the *x*-axis. Consistent with the congruence effect, the average trajectories on incongruent trials show greater AD values.

Two linear mixed-effects models (for Clothing Style and Attractiveness trials) were fit to the AD data (Smith, Treat, Farmer, & McMurray, 2017b) using the lmer function in lme4 (Bates et al., 2015). *P* values and degrees of freedom were obtained using the Satterwaithe approximation, implemented in lmerTest (Kuznetsova, Brockhoff, & Christensen, 2013). Both models included a full factorial combination of fixed effects. The maximal random effects structure supported by the

[3] Note that this practice deviates from the more standard way of using the raw X coordinate as a measure of deviation; however, that measure is somewhat problematic because the X coordinate is not orthogonal to the direct line between the origin and the response. By rotating the coordinate space, the new, rotated Y-coordinate is now orthogonal to this line (cf., Huette & McMurray, 2010).

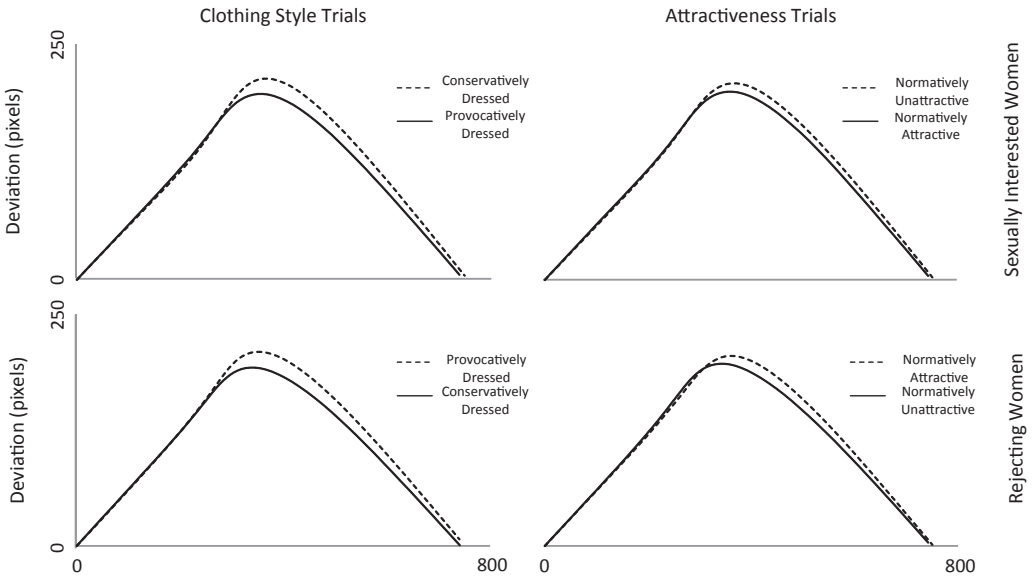

Fig. 3. Average trajectories (flipped to the right, if necessary, and rotated 45°) on congruent and incongruent Clothing Style and Attractiveness trials for all participants. The axes are units of pixels. The x-axis represents the distance in pixels between the trajectory origin and inner bottom edge of the response box. The y-axis represents the deviation in pixels from the reference line (i.e., the most direct path from the origin to the inner bottom edge of the response box). Note that mouse trajectories on incongruent trials (dashed lines) deviate more toward the incorrect response than trajectories on congruent trials (solid lines). See text for additional information.

data was identical for both models: random intercepts for both subject and photo, as well as a random subject slope for Affect or Clothing Style (i.e., (1 + Affect|subject) + (1|photo), in lmer). Fixed effects were effect coded, except that RSA was centered.

3.4.2. Clothing style trials

Fig. 4a shows a partial congruence effect on AD for Clothing Style trials, with more deviation to the competing response when the woman was either (1) sexually interested and conservatively dressed, or (2) rejecting and provocatively dressed. The analysis (Table 3) showed no significant main effects. A congruence effect, however, was observed: Affect significantly interacted with Clothing Style, $p < 0.01$ (Table 3, Row 5, Fig. 4a). As shown in the Clothing Style column of Fig. 3, across affective expressions, the average trajectories on incongruent trials showed greater AD values, reflecting greater deviation toward the incorrect response. Follow-up tests conducted separately for sexual interest and rejection showed that when a woman expressed interest, participants deviated more toward the incorrect response when she was conservatively than provocatively dressed, B = −4.17, t(16) = −2.48, $p < 0.05$. In contrast, when a woman expressed rejection, participants' deviation toward the incorrect response was not reliably related to Clothing Style, B = 4.28, t(16) = 1.73, $p = 0.104$.

Table 3
Linear mixed-effects model output for Average Deviation on Clothing Style trials.

Row #		Estimate	SE	df	t	p
1	**(Intercept)**	**108.0000**	**3.222**	**169**	**33.51**	**< 0.0001**
2	Affect	2.1370	2.013	87	1.06	0.291
3	CS	0.0538	1.489	31	0.04	0.971
4	RSA	0.0756	0.009	150	0.83	0.407
5	**Affect * CS**	**−4.2060**	**1.489**	**31**	**−2.83**	**0.008**
6	Affect * RSA	−0.0406	0.005	149	−0.88	0.378
7	CS * RSA	0.0244	0.002	18,500	1.36	0.173
8	**Affect * CS * RSA**	**−0.0376**	**0.002**	**18,470**	**−2.10**	**0.036**

Note. CS = Clothing Style, RSA = Rape-Supportive Attitudes (centered). SE = standard error. Reliable effects are bolded. Sexually interested affect, provocative clothing, and normative attractiveness were coded as 1, and rejecting affect, conservative clothing, and normative unattractiveness were −1.

Consistent with expectations, RSA potentiated the congruence effect, $p < 0.05$ (Table 3, Row 8). For follow-up analyses, the RSA distribution was subdivided into terciles that were analyzed separately. The models were identical to the model described above, except that the fixed effect for RSA was omitted. The congruence effect was stronger in the highest (3rd) RSA tercile, B = −4.80, t

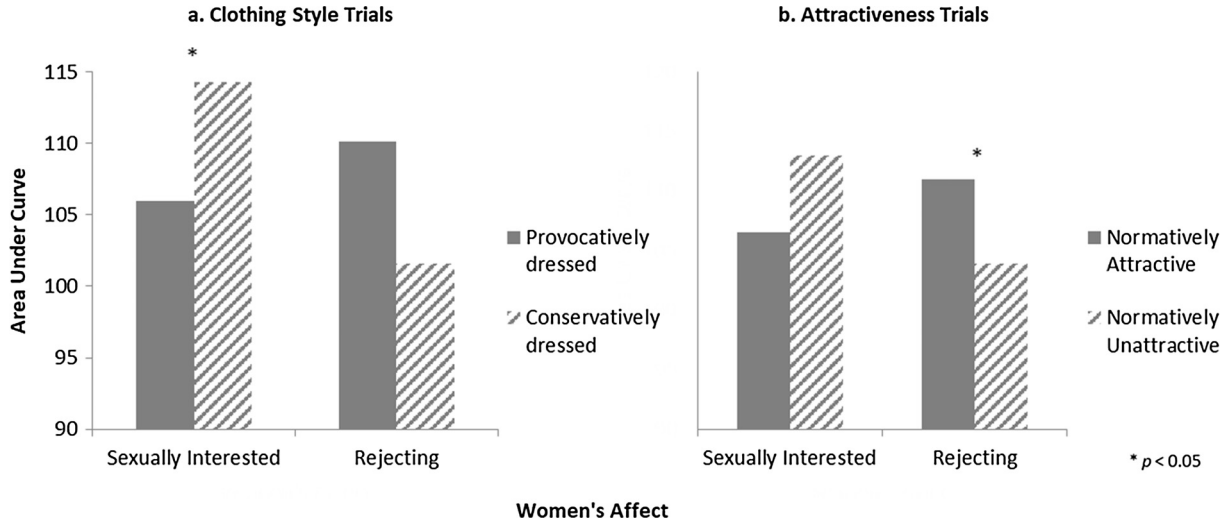

Fig. 4. Model-predicated average deviation as a function of women's Affect and Clothing Style (a) or women's Affect and Attractiveness (b).

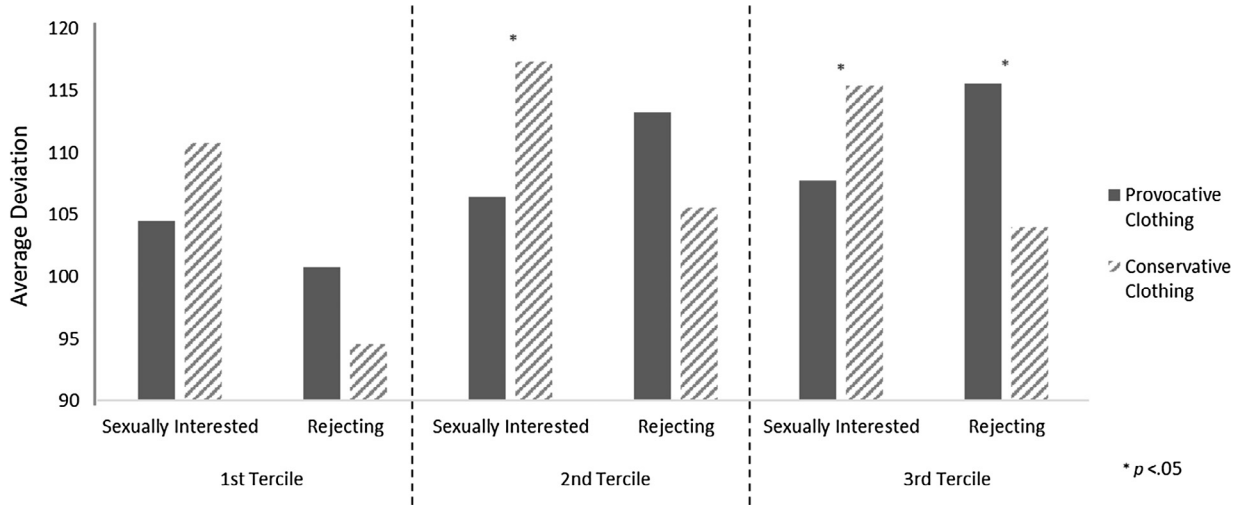

Fig. 5. Average deviation on correct trials for participants who endorsed rape-supportive attitudes in the 1st, 2nd & 3rd terciles of the distribution as a function of women's Affect and Clothing Style.

(31.36) = −3.37, $p < 0.01$, than the middle (2nd) tercile, B = −4.66, t(30.54) = −2.58, $p < 0.05$, and lowest (1st) tercile, B = −3.12, t(29.72) = −1.91, $p = 0.065$ (see Fig. 5). See Supplement S2, Figs. S4 and S5 for the mouse trajectories for the 1st and 3rd tercile of RSA for Clothing Style trials.

3.4.3. Attractiveness trials

Fig. 4b shows the average AD for the attractiveness trials. As on clothing style trials, a congruence effect again emerged: Affect reliably interacted with Attractiveness, $p < 0.05$ (Table 4, Row 5, Fig. 4b). Across affective expressions, trajectories showed greater AD on incongruent than congruent trials. Follow-up models indicated that for women expressing rejection, participants deviated more toward the incorrect response when she was normatively attractive than normatively unattractive, B = 3.59, t(16) = 2.25, $p < 0.05$. However, for women expressing interest, deviation toward the incorrect response was not influenced by attractiveness, B = −3.33, t(16) = −1.32, $p = 0.206$. Inconsistent with hypotheses, RSA did not moderate the congruence effect on AD (i.e., the three-way interaction was not significant); however, the two-way interaction of Affect and RSA was marginally significant. See Supplement S2, Figs. S4 and S5 for the observed mouse trajectories for the 1st and 3rd tercile of RSA for Attractiveness trials.

3.5. Hierarchical linear regression

Next we asked whether AD—our online processing measure—predicted RSA, *over and above* offline accuracy. Because RSA varied across participants, not across trials, AD and accuracy were aggregated across relevant trials to compute a single measure of each predictor for each participant. These were used in a hierarchical regression with RSA as the dependent variable (Smith, Treat, Farmer, & McMurray, 2017c). On the first block, overall accuracy (collapsing across Attractiveness and Clothing Style) was entered as the sole predictor. On the second block, four variables were entered that indexed the congruence effect on accuracy (i.e., the reduction in accuracy from congruent to incongruent trials): the congruence effect for Clothing Style trials when the women expressed interest (1) and rejection (2), and for Attractiveness trials when the women expressed interest (3) and rejection (4). On the third block, overall AD (on correct trials) was entered to account for individual differences in motor dynamics unrelated to congruency. Finally, on the fourth block, the congruence-linked AD variables were entered: two each for Clothing Style and Attractiveness trials. Each variable was the AD difference between incongruent and congruent trials.

In the full model, the four blocks of predictors accounted for 20.7% of the variability in RSA. Overall accuracy accounted for 5.1% of the variability, F(1, 150) = 8.08, $p < 0.01$. The four congruence-linked accuracy predictors accounted for an additional 7.6% of unique variance, F(4, 146) = 3.20, $p < 0.05$. Overall AD did not account for additional variability in RSA over and above the offline accuracy measures, F(1, 145) = 0.64, n.s. Most importantly, the four congruence-linked AD predictors accounted for an additional 7.6% of the variability in attitudes, F(4, 141) = 3.37, $p < 0.05$.

Table 4
Linear mixed-effects model output for Average Deviation data on Attractiveness trials.

Row #		Estimate	SE	df	t	p
1	**(Intercept)**	**108.6000**	**3.211**	**170**	**33.83**	**< 0.0001**
2	Affect	1.1580	1.985	86	0.58	0.561
3	ATT	0.1520	1.488	32	0.10	0.919
4	RSA	0.0760	0.091	150	0.84	0.403
5	**Affect * ATT**	**−3.4020**	**1.488**	**32**	**−2.29**	**0.029**
6	Affect * RSA	−0.0791	0.045	148	−1.77	0.080
7	ATT * RSA	−0.0053	0.018	18,020	−0.30	0.768
8	Affect * ATT * RSA	0.0080	0.018	18,020	0.45	0.657

Note. ATT = Attractiveness, RSA = Rape-Supportive Attitudes (centered). SE = standard error. Reliable effects are bolded. Sexually interested affect, provocative clothing, and normative attractiveness were coded as 1, and rejecting affect, conservative clothing, and normative unattractiveness were −1.

4. Discussion

The current work leveraged a dynamic competition/cue-integration framework to examine (1) online processing and offline accuracy of men's judgments of women's sexual interest; (2) the extent to which clinically relevant individual differences in RSA moderated online processing and offline accuracy; and (3) whether online processing predicted variability in rape-supportive attitudes over and above offline accuracy. We first review the pattern of results addressing each of these questions. Next, we consider the theoretical and practical implications of decisional errors in sexual-interest judgments. We close with brief conclusions and suggestions for future research.

4.1. Online processing and offline accuracy of men's perceptions of women's sexual interest

As predicted, the stereotypical congruence between women's

Table 5
Summary of condition-specific omnibus congruence effects and follow-up effects of non-affective cues on online and offline indices.

Woman's non-affective cue (condition)	Accuracy (offline)			AD (online)		
	Omnibus interaction of affective and non-affective cues	Effect of non-affective cues in follow-up analyses		Omnibus interaction of affective and non-affective cues	Effect of non-affective cues in follow-up analyses	
Clothing style	B = 0.25, $p = 0.047$	Sexually Interested Rejecting	B = 0.17 n.s. B = −0.30 n.s.	B = −4.21, $p = 0.008$	Sexually Interested Rejecting	B = −4.17 $p < 0.05$ B = 4.28 n.s.
Attractiveness	B = 0.84, $p < 0.0001$	Sexually Interested Rejecting	B = 0.71 $p < 0.01$ B = −0.96 $p < 0.0001$	B = −3.40, $p = 0.029$	Sexually Interested Rejecting	B = −3.33 n.s. B = 3.59 $p = 0.05$

Note: Regression coefficients are unstandardized but can be compared meaningfully across conditions within a dependent measure (Accuracy or AD), given that relevant predictors are effect-coded. AD = Average Deviation.

affective and non-affective characteristics influenced both online and offline indices of men's processing of women's dating-relevant affect (Table 5 for summary). Online mouse trajectories were more direct when women's clothing style or attractiveness was stereotypically congruent with their affect (Fig. 3). Offline accuracy was also higher when affective and non-affective cues were congruent than incongruent.

Before considering the theoretical importance of this congruence effect, we note that the reliability of post-hoc comparisons varied somewhat across analyses. For example, mouse trajectories deviated significantly toward the incorrect response as a function of attractiveness when the women expressed rejection, but not sexual interest. For several reasons, we are hesitant to make too much of these differences across analyses. First, the hypothesized omnibus interactions were reliable. Second, the quantitative direction of the effects mirrored theoretical expectations, and the numerical difference between means was similar on each side of the cross over (Figs. 2 and 4). Third, one must consider the intentionally conservative nature of the design. Recall that the online processing analyses excluded incorrect trials. Theoretically, incorrect trials occur under these unambiguous conditions in part because the incongruence of stimulus features produces competition too great to overcome. Indeed, there is evidence to support this assumption. In one of the two conditions in which congruence did not significantly influence AD (i.e., the effect of attractiveness for interested women), the corresponding effect on accuracy was statistically significant. Thus, in our view, a true congruence effect likely exists for both sexually interested and rejecting affect but simply failed to reach significance in select sub-conditions due to the conservative design.

Although the current findings are consistent with dynamic-competition/cue-integration models, their consistency with alternative decision-making models remains in question. For example, dual-process models commonly used in social psychology posit separable implicit and explicit processes (Evans, 2008), and race models also posit competition between responses but stipulate that intermediate states are encapsulated from later motor processes (e.g., Merkle & Van Zandt, 2006). Both could be consistent with our data if average trajectories represent a combination of straight-trajectory trials with trials in which the trajectory initially proceeded to the wrong response and then corrected mid-flight. However, distributional analyses of the AD (in Supplement S1) rule out such accounts.

Taken together, our data are consistent with the basic assumptions of dynamic cue-competition accounts: (1) multiple representations are simultaneously considered prior to discrete end-point categorization; (2) competition between decisional alternatives resolves dynamically over time as perceptual evidence for a given category is processed; and (3) preliminary decision states immediately cascade through the motor system during response execution (see Supplements S1 and S2). Converging with reports of congruence effects on real-time competition in social categorization and emotion identification (e.g., Freeman & Ambady, 2014; Freeman, Ambady et al., 2011; Freeman, Dale et al., 2011; Freeman, Penner et al., 2011; Freeman et al., 2010; Hehman et al., 2014), our findings support the utility of extending the dynamic competition framework to socially relevant affective judgments about highly complex and emotionally charged stimuli.

Although we focused primarily on online decisional dynamics, product-level analyses (accuracy) were critical for two reasons. First, they contribute to prior work showing congruence effects between affect and clothing style (Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat et al., 2014). We extend these findings to attractiveness when affective expressions are more clear-cut and judgments are categorical. Second, the congruence effect on accuracy is stronger in the attractiveness than clothing-style trials (Table 5). Attractiveness may be more perceptually complex, require more processing time, and, therefore, show stronger effects at later time points (e.g., at the final mouse click) than during earlier processing. Third, the accuracy analyses afforded the inclusion of incorrect trials, offering a more complete picture of the congruence effect. Together, mouse-tracking and accuracy reveal that participants integrate at least three sources of information when making sexual-interest judgments, consistent with the multiple-cue integration and dynamic competition approach.

The nomothetic congruence effects on accuracy were reliable but smaller than in prior work (e.g., Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat et al., 2014), suggesting that our use of unambiguous expressions in the current work may have produced a near-ceiling effect. Notably, however, this pattern of results supports dynamic competition/cue-integration accounts (Farris et al., 2006, 2008a; Farris, Treat et al., 2010; Farris, Viken et al., 2010; Treat et al., 2014). When stimuli are more ambiguous along the focal dimension, less reliable sources of information should exert greater influence. A similar pattern would be expected under conditions that reduce sensitivity to women's affect. Consistent with this, a moderate dose of alcohol produces a moderate reduction in men's sensitivity to women's nonverbal affective cues (Farris, Treat et al., 2010). Our work suggests that these effects may reflect the operation of basic competition processes, given that online analyses revealed significant contributions from the less-relevant dimensions even when affective expressions were clear-cut.

4.2. Moderation of real-time processing by individual differences in attitudes

We also found some evidence that nomothetic congruence effects were stronger among men who endorsed more RSA. On clothing style trials, RSA moderated the congruence effect on online processing, such that high-risk men – but not their low-risk peers – experienced

increased competition from women's clothing style. RSA did not moderate the clothing-style congruence effect on accuracy, however, contrary to the findings in two prior studies (Farris, Viken et al., 2010; Farris et al., 2006; but see Treat et al., 2014). As noted before, however, our use of less ambiguous expressions in the current work may have reduced individual differences in accuracy, thereby decreasing power to detect a moderating effect of RSA. Thus, building on our prior work with more ambiguous stimuli, we show here that high-risk men experience greater decisional competition from women's clothing style *throughout* the decisional process, even when judging unambiguous affective expressions and even when they ultimately select the correct decision. Such enhancement is consistent with increased reliance on cues less diagnostic of momentary sexual interest like clothing style or attractiveness.

This suggests high-risk men may experience additional difficulty in accurately identifying women's more dynamic and potentially more ambiguous expressions in dating situations. Consistent with this, the frequency with which men misperceive sexual interest in the real-world positively correlates with RSA (Abbey et al., 2011). Moreover, this difficulty may be exacerbated by obfuscating factors like alcohol or drug consumption and peer pressure, all well-established correlates of the perpetration of acquaintance-based sexual assault (e.g., Abbey, 2011; Thompson, Swartout, & Koss, 2013).

Counter to expectations, RSA did not potentiate congruence effects on attractiveness trials for either online or offline measures. In prior work, those who endorsed RSA relied more on women's attractiveness and less on women's affect, relative to low-risk peers, when judging a more continuous distribution of affective expressions (Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat et al., 2017). Thus, under more ambiguous stimulus conditions, high-risk men may engage in more affective projection and may rely more than their peers on attractiveness to disambiguate affective cues.

In documenting the effects of clinically relevant individual differences in attitudes on sexual-interest judgments, this work adds to a recent literature demonstrating that stable individual differences (e.g., overall language ability, dietary self-control, personality traits, race) are associated with real-time processing in a variety of domains (Borovsky, Burns, Elman, & Evans, 2013; Freeman, Ma, Han, & Ambady, 2013; Kieslich & Hilbig, 2014; McMurray, Samelson, Lee, & Tomblin, 2010; Revill & Spieler, 2012; Sullivan, Hutcherson, Harris, & Rangel, 2015). Moreover, in a mouse-tracking study on eating behavior, variability in the speed with which the tastiness and healthiness of food are processed is related to individual differences in dietary self-control (Sullivan et al., 2015).

The current work extends these studies in three important ways. First, we document the relationship between online-processing dynamics and clinically relevant attitudes, a previously unexamined factor. The findings suggest that unfolding perceptions of women's sexual interest result from simultaneous integration of characteristics of the perceiver with bottom-up characteristics of the women being perceived, consistent with current dynamic-competition models of social perception (e.g., Freeman & Johnson, 2016). Second, among studies examining dynamic competition accounts of decision making, our stimuli represent a relative increase in complexity, which underscores the generalizability of dynamic competition frameworks to clinically relevant individual differences in processing of more complex, emotionally significant, socially relevant stimuli. Third, this is the first study linking online processing to individual difference *over and above* offline accuracy in a related task.

4.3. Incremental predictive power of online measures

Substantial research relating individual differences to online measures has been conducted, particularly in language (Borovsky et al., 2013; McMurray et al., 2010; Revill & Spieler, 2012), but also in other domains (Freeman et al., 2013; Kieslich & Hilbig, 2014; Sullivan et al., 2015). Although online data are arguably richer and provide distinct information at a mechanistic level, we do not yet know whether intermediate states of behavior are wholly isomorphic with endpoint states or provide a uniquely valuable characterization of an individual.

The analyses discussed thus far suggest online decisional dynamics may uniquely capture individual differences. For example, congruence effects emerged even when only correct trials were considered, and RSA-moderating effects were more robust for AD than accuracy, suggesting that online measures may show greater sensitivity. Moreover, a comparison of findings across offline and online levels of analysis provides a preliminary window into the time course of men's processing of women's sexual interest. When effects occur on the unfolding decisional process, but are absent at the level of the product (e.g., among sexually interested women in the Clothing Style condition), we can speculate that early online competition was resolved within the time constraints of the trial (i.e., ~1000 ms). In contrast, when effects occur at the level of the decisional product, but are absent at the process level (e.g., among sexually interested women in the Attractiveness condition), online competition may have been too great to overcome, increasing the likelihood of an incorrect decision. Effects that emerged online but not offline are particularly informative, as they are a key marker of dynamic competition.

Most importantly, we found that online measures accounted for variability in individual differences in RSA *over and above* offline accuracy measures. As expected, accuracy (both overall and congruence-linked) accounted for a moderate proportion of variability in RSA (~12% combined), converging with prior work documenting that high-risk men are less accurate than low-risk peers when judging affect (Farris et al., 2006, 2008a; Farris, Viken et al., 2010; Treat et al., 2014). Notably, the four congruence-linked online predictors accounted for an additional 7.6% of unique variance in attitudes. In other words, the degree of online competition men experience from clothing style and attractiveness predicts a significant percentage of the variability in their RSA. Note that this predictive power cannot be attributed to general motor factors, as high-risk men did not show greater deviation than low-risk. Taken together, we conclude that intermediate states of behavior uniquely predict variability in relatively stable, clinically relevant attitudes over and above endpoint states of behavior, which, until now, has remained unassessed in other investigations of real-time processing and individual differences.

4.4. Theoretical and practical implications of the congruence effect

The congruence effects reported here have potentially important theoretical and practical implications for men's behavior in heterosocially relevant situations, as well as for our efforts to enhance the accuracy of young men's judgments of women's sexual interest. The offline nomothetic data indicate that the normative attractiveness of a clearly rejecting woman can activate the 'sexually interested' category to a degree too great to overcome, producing an incorrect response. As a consequence, the average undergraduate man might conclude erroneously that a woman is communicating sexual interest via her appearance.

The finding that men overestimate the sexual interest of highly attractive women converges with previous work from our laboratory (Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat et al., 2017), as well as that of other research teams. For example, Perilloux, Easton, and Buss (2012) showed in a speed-dating study that men are more likely to over-perceive the sexual interest of more attractive, relative to less attractive, women. Similarly, Maner et al. (2005) demonstrated that men perceive attractive women to be more sexually aroused than unattractive women. Maner et al. (2005) and Maner, Miller, Moss, Leo, & Plant (2012) argue that such findings may reflect a type of adaptive affective projection in which a man subconsciously ascribes his emotion or desire (e.g., sexual arousal) to a third party (e.g., a woman in a club) in a way that is functionally related to the pursuit of his goal (e.g.,

sexual activity). Evolutionary theorists would argue further that such mate-seeking motives reflect fundamental, evolutionarily based drives to maximize reproductive opportunities (Haselton & Buss, 2000; Kenrick, Griskevicius, Neuberg, & Schaller, 2010; Maner et al., 2005, 2012; Neel, Kenrick, White, & Neuberg, 2016). Regardless of the time scale on which mate-seeking motives develop and unfold, however, motivated social-perception accounts suggest that a man who feels sexually interested in a particular woman will be more likely to conclude erroneously that the woman feels interested as well. If men, on average, are more sexually interested in highly attractive than less attractive women, affective projection may help to explain why the sexual interest of attractive women in particular is more likely to be overperceived.

Considering again that the women expressed unambiguous sexual interest and rejection, it is disconcerting that a sexually interested woman's unattractiveness and a rejecting woman's attractiveness can engender erroneous affective conclusions. In real-world situations, overreliance on normative unattractiveness or conservative clothing may lead undergraduate men to conclude that a sexually interested woman is communicating rejection. This misperception may engender confusion, miscommunication, and perhaps a missed dating or sexual opportunity.

On the other hand, erroneously concluding that a rejecting woman is sexually interested due to overreliance on her normative attractiveness or provocative clothing may minimally induce embarrassment for the man and irritation for the woman. However, at the extreme, from a more clinical and public-health perspective, misperceiving a woman's rejection as sexual interest may increase the likelihood that some men engage in sexually coercive or aggressive behavior, perhaps secondary to feeling that such behavior is justified because they perceive that they have been led on (Abbey et al., 2011). The current findings extend our past work in this area by documenting that higher-risk men show enhanced congruence effects of clothing style on online processing.

The implications of dynamic models add an important dimension to prior work on sexual decision making. Social interactions are fundamentally time-varying and often ambiguous. Given these time demands, much social action or decision making may rely on intermediate states of processing rather than careful judgments, perhaps explaining why intermediate measures account for unique variance in attitudes. By adopting measures and models that explicitly capture this temporal unfolding, we may make more headway on understanding these complex dynamic interactions.

This body of work underscores the potential utility of developing cognitive-training approaches to enhance the accuracy of men's perceptions of women's sexual interest. Recent studies have shown that both trial-by-trial feedback and explicit instruction about nonverbal indicators of sexual interest increase college men's focus on affective information and decrease their focus on irrelevant non-affective information when judging women's momentary sexual interest (Treat, Viken et al., 2016; Treat et al., 2017). Encouragingly, these cognitive-training effects are observed for both average college men and for higher-risk college men. Currently, we are evaluating whether such cognitive-training programs are robust to moderate alcohol consumption, given the central role of alcohol consumption in sexual aggression between acquaintances (e.g., Abbey et al., 2011).

5. Conclusions

By applying a dynamic account of decision making to the domain of sexual perception, our data support our three hypotheses. First, conflicting complex cues (affect, clothing style, attractiveness) embedded in a multidimensional, socially relevant stimulus activate disparate affective categories to varying degrees and in a simultaneous, rather than serial, fashion. The ensuing decisional competition resolves probabilistically and dynamically, as the competition favors one decision over another. The results of this investigation are consistent with a key tenet of dynamic competition models – namely, that cognitive processing, decision making, and the action dynamics of overt physical behavior are fundamentally inseparable processes (Cisek & Kalaska, 2005; Freeman, Ambady et al., 2011; Freeman, Dale et al., 2011; Freeman, Penner et al., 2011; Gold & Shadlen, 2000; Song & Nakayama, 2009). Second, the current study demonstrates that the dynamics of online decisional competition are linked to clinically relevant individual differences in attitudes in theoretically consistent ways. Although misperceiving sexual interest is a nomothetic phenomenon, expanding the scope of analysis to incorporate potential individual-differences moderators is critical to integrating our understanding of how these decisional processes impact both normative and non-normative – and even clinically relevant – phenomena. Finally, we document for the first time the unique predictive power of online performance-based measures in accounting for individual differences in attitudes over and above offline accuracy, highlighting the importance of assessment at multiple levels of analysis, as critical information about how decisions are made may be lost if looking solely at decisional end states.

In future work, a more formal analysis of the time course of online processing of women's affect—understanding when in the decisional process clothing style, attractiveness, and affective information come online and are processed relative to each other—may point to novel ways of targeting and modifying processing errors. For example, mouse-tracking might be used in conjunction with cognitive training (e.g., instructional manipulations, provision of feedback) in an effort to reorganize how men use a woman's affect, clothing, and attractiveness when determining how sexually interested she is feeling (Treat, Hinkel et al., 2016; Treat, Viken et al., 2016; Treat et al., 2017). Ultimately, research in this area may engender new strategies to reduce the likelihood of men's misperceptions of women's sexual interest, which may, in turn, play a role in increasing the effectiveness of sexual assault prevention programs on college campuses (see Anderson & Whiston, 2005; DeGue et al., 2014).

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cognition.2017.12.016.

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