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## How do we form romantic bonds? Investigating the effect of attraction on social cognition

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# Chapter 10

## **General Discussion**

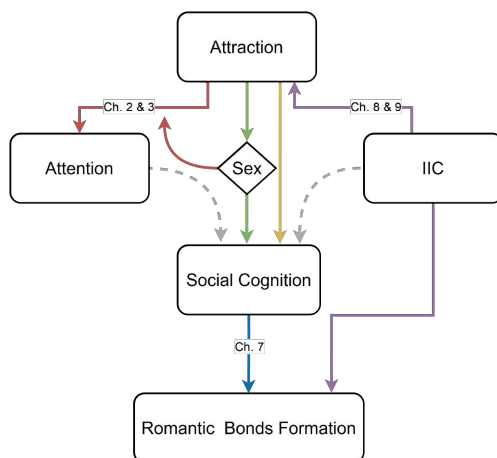


In order to navigate our romantic environment, we have to be able to express attraction, detect it in others, and adjust our behavior so that we maximize our chances of forming romantic bonds. We notice an attractive potential partner faster, and our attention lingers on them more than on a less attractive partner. We tend to judge attractive people more favorably than others, an effect that in the literature is known as “what is beautiful is good” (Dion et al., 1972). This cognitive bias likely increases the likelihood that we approach attractive potential partners. Finally, when we approach our romantic interest, we are more likely to imitate them, which might increase our chances of establishing a romantic bond.

In the present dissertation, I examined, in a series of studies, the effects of attraction on social cognition. Specifically, I examined how attraction influences our attention and judging others’ intentions, and how inter-individual coordination (IIC) might facilitate the formation of romantic bonds. Figure 1 displays an overview of the topics examined in each chapter. In the final chapter, I attempt to integrate the key chapter findings and discuss theoretical implications. Crucially, I also highlight potential new directions for future research.

## Summary of key findings

In **Chapter 2** (Figure 1; red arrow), we examined how attractive faces modulate attention and social cognition. In Experiment 1, using the dot-probe task, participants were presented with attractive or unattractive faces paired with an intermediate-attractive face. The results showed that participants responded faster to the probe when presented at the same location as an attractive face. In contrast, participants responded slower when the probe was presented at the same location as an unattractive face. In Experiment 2, we examined whether a similar effect can be found when the stimuli used are symmetrical (an index of attractiveness) compared to asymmetrical or original portraits (without a symmetry manipulation). We found no effect of symmetry on reaction times, indicating that symmetry did not modulate attention. In Experiment 3, we investigated whether attractiveness modulates social gaze cueing using a modified Posner task (Deaner et al., 2007). The results showed that attractiveness did not manipulate gaze cueing; however, attractive faces did overall enhance reaction time, indicating that people responded faster to attractive than unattractive faces. However, this finding could be due to the longer stimulus presentation (300ms) compared to previous studies (e.g., B. C. Jones et al., 2010, where 200 ms but not 400 ms produced an effect). This suggests that attractiveness effects on attention might be best captured by paradigms designed to influence bottom-up attention, rather than allowing top-down effects to emerge. The findings of this study illustrate that attractiveness modulates attention and



**Figure 1.** Graphical illustration of the topic of each chapter. Chapters 2 and 3 examined the influence of attraction on attention. Chapters 4 and 5 investigated how sex moderates the relationship between attraction and social cognition (specifically, the sexual overperception bias). Chapter 7 provided a theoretical overview of this relationship and extended it to the formation of romantic bonds. Chapter 6 examined whether people that are not involved in a date are able to detect attraction in others. Chapters 8 and 9 examined whether inter-individual coordination (IIC) is associated with attraction and facilitates the formation of romantic bonds. The gray dashed lines connecting Attention to Social Cognition and IIC to Social Cognition reflect suggestions for future studies elaborated on in the *Methodological considerations and future directions* section.

that traditional metrics of attractiveness (i.e., symmetry) might not be as important as previously thought, but other parameters such as averageness, might be more important in judging a face as attractive (e.g., see A. Jones & Jaeger, 2019). Importantly, we did not find evidence that attractiveness also modulates gaze cueing, even though this might be due to the stimulus presentation duration.

In **Chapter 3** (Figure 1; red arrow), we examined the relationship between attention and attractiveness, and willingness to date a potential partner. We used a manual reaction time task (i.e., dot-probe task) and a preferential-looking task (incl. eye tracking) to obtain a more fine-tuned understanding of the automatic or voluntary processes underlying this relationship. Regarding the dot-probe task, we found that men were more likely to be distracted by and attend to images of women they found attractive. Interestingly, even though both men and women were distracted by images of people with whom they would like to go on another date, only men re-

sponded faster to images of women with whom they would like to go on another date. In the preferential-looking task, the results showed that men and women tend to look more at an image of a partner they found attractive and with whom they would like to go on another date.

In **Chapter 4** (Figure 1; green arrow), I zoomed in on how people's emotional state affects their interpretation of others' emotional state in order to better understand how attraction may arise. This functional projection hypothesis was initially posed in the seminal work by Maner et al. (2005), which I replicated in this chapter. In Experiment 1, male participants viewed either a romantic video segment depicting a White heroine or a Black heroine or a neutral video segment. Then, participants were presented with a series of female White and African American neutral faces that were rated as high or average in attractiveness. They were asked to indicate whether the people they viewed were sexually aroused, afraid, happy, or angry. The results showed that independent of the video condition, men indicated highly attractive White women as more sexually aroused than all other faces (also called the sexual overperception bias). In the original study, Maner et al. (2005) found that men that had watched a romantic film were more likely to interpret the expressions of highly attractive White women as sexually aroused than men that had watched a neutral film, and compared to medium-attractive White women, highly-attractive Black women, and medium-attractive Black women. Therefore, our results partially replicated the findings of Maner et al. (2005) and furthermore show that the sexual overperception bias might also arise due to a transient arousal state. In Experiment 2, male and female participants watched a fearful or neutral video segment and were presented with a series of male and female White and African American neutral faces. In contrast with Maner et al. (2005), who found that Black men were rated as angrier compared to all other stimuli, we found that independent of the video condition, participants were more likely to indicate that White men were angrier than all other stimuli. This discrepancy between our findings and the findings by Maner et al. (2005) could be due to the fact that we used a different stimulus set, did not control for participants' ethnicity, and, importantly, the different ethnicity of the samples in our and the original study, as our study was conducted in the Netherlands. In contrast, the original study was conducted in the US.

In **Chapter 5** (Figure 1; green arrow), I investigated the factors underlying the sexual overperception bias. Using responses from a large speed-dating study, where people went on a maximum of 10 dates with a member of the opposite sex, I examined whether people were more likely to overperceive attraction in their potential partners as a function of sex, projection of their own interest, self-rated attractiveness, or trait sexual desire. The results showed that men were more likely to indicate that their partner was interested in another date only when they themselves felt attracted to their partner. Men detected their partners' interest more accurately when they were

not attracted to them. On the other hand, women were approximately 50% (i.e., chance level) accurate in detecting their partners' attraction. These findings suggest that projection might be the mechanism by which the sexual overperception bias is manifested. In other words, the sexual overperception bias might occur because men tend to project their own sexual interest onto women they are interested in, leading them to misperceive the level of sexual interest in a potential partner. In contrast to previous literature (e.g., A. J. Lee et al., 2020; Perilloux et al., 2012), self-rated attractiveness and trait sexual desire did not influence overperception. However, this could be due to the fact that previous studies measured sociosexual orientation instead of specifically sexual desire. Furthermore, previous studies measured different aspects of attractiveness (e.g., physical and personality), whereas we only examined self-rated physical attractiveness.

The previous study showed that men are accurate in inferring whether their partner is attracted to them but only when they are not interested in that partner. This suggests that people may be more accurate in detecting attraction when they are neutral observers. In **Chapter 6** (Figure 1; yellow arrow), I examined whether third-party observers could detect attractions in others. In Experiment 1, I presented adults and children with two brief videos (3 sec) of people on a date and asked them to indicate whether each person was interested in their partner. Unbeknownst to the participants, half of the videos were presented not with their original partner but with a random partner. I expected that participants would be less accurate in detecting attraction when presented with these videos, as participants could not rely on cues indicating attraction. Contrary to my expectations, I did not find this effect. Furthermore, I found that overall, participants could not accurately detect attraction in others. As expected, children were worse than adults at detecting attraction, especially when the daters presented were not interested in their partners. In general, participants were better at detecting whether there is attraction when the people presented in the videos were attracted to their partners compared to when they were not. In Experiment 2, I examined whether the decreased accuracy observed in children was due to increased cognitive load since, in Experiment 1, two video streams were presented simultaneously. Therefore, in Experiment 2, I presented one video at a time. As in Experiment 1, I found that overall, could not accurately detect attraction in others compared to chance level. This time, there was no effect of age, as children and adults performed at chance level. Crucially, I again found that participants were able to indicate with above chance level accuracy the presence/absence of attraction when the daters presented were interested in their partners using video segments from different timeframes in a blind date. In Experiment 3, I examined whether adults could detect attraction in others with longer video segments. The results showed that this was not the case; the length of the video segments did not influence the participants' accuracy. Similar to Experiments 1 and 2, participants

were more reliable in detecting attraction when the people presented in the videos were attracted to their partner. To examine whether this difference was due to the emotional expressions of the daters, I coded the emotional expressions of the daters in the 9-second videos for flirting cues (e.g., coy smiles) and examined whether they differed between daters that were interested in their partner or not. Our results suggested that subtle expressions indicating attraction differed depending on whether daters were interested in their partner. This finding combined with the ability of the participants to detect attraction when the daters were interested in their partner, might indicate that subtle expressions of attraction are detectable and can be used in decision-making. However, an alternative explanation could be that participants were biased due to the dating context and tended to indicate that the daters were interested in their partner more often than not. Overall, the findings of these experiments show that, in contrast with previous studies (Place et al., 2009), detecting attraction might not be as straightforward as, for example, detecting basic emotions.

In **Chapter 7** (Figure 1; green and blue arrow), I focused on sex differences in the sexual overperception bias. To this end, we commented on the work of Lee et al. (2020). In their speed-dating study, the authors found that projection of own interest, self-rated attractiveness, and sociosexual orientation mediated the relationship between sex and sexual overperception. They interpreted these findings as evidence that there are no sex differences in sexual overperception. Therefore, they argued that the explanation proposed by the Error Management Theory (EMT; Haselton, 2003; Haselton & Buss, 2000), that sexual overperception is adaptive for men as it increases the chances of reproduction, is incorrect. In our commentary, we proposed that their interpretation relies on a proximate level to disprove an explanation on the ultimate level, based on the “proximate-ultimate distinction” by Tinbergen (1963). In short, we explain that if, for example, we discovered that male birds sing because of an increase in testosterone levels, it would not contradict the simultaneous explanation that male birds sing as a means of courtship. Similarly, the fact that men tend to project their own interest more onto their partners, does not contradict the fact that this projection could serve as a mechanism to enhance their chances of attracting additional partners. Furthermore, the effects described by Lee et al. (2020) describe a perfect mediation between sex and overperception by means of the projection of own interest. Lee et al. (2020) interpret this as evidence that sex, therefore, is not informative or relevant in the model. On the contrary, in our interpretation, the projection of own interest is the mechanism by which the effect is manifested. Since the projection of own interest is more likely to occur in men, sex is still an important factor in the theoretical model. Finally, we proposed that EMT would benefit by incorporating the proximate mechanisms described in Lee et al. (2020).

In **Chapter 8** (Figure 1; purple arrow), we took a comparative approach to better understand the underlying mechanisms in attraction, or more generally, pair bonding. Specifically, we reviewed the effect of inter-individual coordination (IIC), an umbrella term encompassing synchrony and mimicry, for pair-bonding, maintenance, and offspring rearing based on a comparative framework. We suggested how IIC can be used to quantify the pair-bond strength, thus extending the pair-bonding hypothesis. The pair-bonding hypothesis suggests that pair-bond strength enhances a couple's reproductive success. In our framework, this can be quantified by examining differences in IIC and reproductive success between couples. Furthermore, IIC might be used as a threshold in the initial courting phases, so only couples with high coordination are formed. Crucially, we illustrated how a comparative framework might be useful in examining the effect of IIC on pair bond formation, maintenance, and offspring rearing.

In **Chapter 9** (Figure 1; purple arrow), I focused on testing our idea that inter-individual coordination can be used to quantify the strength of the bond between two individuals. To this end, I examined whether mimicry facilitates pair-bond formation. Specifically, using videos obtained from a speed-dating study, I obtained metrics regarding expressions indicating attraction for each dater in couples where both daters indicated they would like to go on another date with their partner and in couples where both daters indicated that they would not like to go on another date with their partner. As expected, based on the pair-bond hypothesis described above, I found that people mimicked coy smiles more when they were attracted to their partner than when they were not. These findings align with previous research illustrating that mimicry facilitates the formation of romantic bonds (Lakin et al., 2003; Hess & Fischer, 2014). Furthermore, these findings support the pair-bonding hypothesis (Roth, Samara, Tan, et al., 2021; Rasmussen, 1981), which suggests that mimicry and synchrony can be used to quantify the pair-bond strength.

## Theoretical implications

The findings of my studies converge on three points: (1) attraction modulates attention; (2) attraction influences how we evaluate others depending on our sex; and (3) attraction facilitates the formation of romantic bonds, which rely on IIC.

It is well-known that evolutionary-relevant stimuli should capture attention (Cosmides & Tooby, 1992), and, as my studies show that attractive faces capture attention, they suggest that attractive faces constitute such an evolutionary-relevant stimulus. Attractive faces are thought to capture attention because they signal potential mates, and this is an important evolutionary adaptation for reproducing and passing on one's genes. Crucially, previous research has demonstrated that people attend more to attractive

faces and that they are more likely to remember and recognize them (Langlois, Roggman, & Musselman, 1994). In my work, I show that attraction modulates attention at a very early stage of visual processing. One factor that may contribute to the attractiveness of a face is facial symmetry. Indeed, symmetry is often seen as a sign of good health and genetic quality, and research has shown that people find symmetrical faces more attractive (Thornhill & Gangestad, 1999). However, the findings of this dissertation suggest that symmetry may not be as important as previously thought. The attraction between two individuals might be much more idiosyncratic, meaning it cannot be captured by what is generally (on average) rated as attractive. Furthermore, real, unmanipulated faces are more ecologically valid, and they provide more information about what people might encounter in everyday life. Therefore, we extended the original methodology by extending it to real-life interactions. Specifically, we used as stimuli the (non-manipulated) faces of opposite-sex participants in a speed-dating paradigm, meaning that participants were rating people that they would later meet and deciding whether they would like to go on another date. This allowed us also to incorporate individual attractiveness ratings as well as dating choices when decoding attentional dwell, and we found that these modulate attention, whereas manipulated symmetric faces did not. To the best of my knowledge, this study is the first to examine whether the biases found in a laboratory attentional task would match what we find in a real-life ecologically valid speed-dating paradigm, which can have several practical implications. These implications are described in the Methodological considerations and future directions section below. For now, the question remains which features, then, are deemed attractive by people, and future studies should incorporate subjective attractive ratings to further model individual rater differences.

Attraction not only modulates our early attention but, crucially, also influences social cognition and how we perceive others' emotional states. Specifically, attraction influences our approach motivation, increasing the likelihood that we will try to increase our proximity towards others. Chapters 4, 6, and 8 focus on the sexual overperception bias and illustrate that (a) independent of the underlying emotional state, men are more likely to perceive ambivalent cues in women as sexual arousal when they find the woman attractive; (b) men are more likely to overinterpret attraction from women when they themselves are interested in them in a real-life speed-dating paradigm. However, men are able to read women's interest when they are not interested. This suggests that the sexual overperception bias is very specific, it seems to manifest when men are interested in a potential partner and not in other circumstances. Finally, (c) the likely mechanism underlying the sexual overperception bias is the projection of one's own interest in a partner. This projection could be included as a mechanism in the Error Management Theory (Haselton, 2003), which suggests that the

ultimate function of the sexual overperception bias is to ensure that men do not miss mating opportunities.

Previous literature has suggested that detecting attraction in others might be beneficial, as it allows us to create a network of potentially available partners (Simao & Todd, 2002). Indeed, people are able to detect above chance whether people are interested in their partner (Place et al., 2009). In three studies, I showed that this effect might be more nuanced than initially thought. Even though people should have their own experiences with romantic interactions, meaning they have come across cues associated with attraction, such as facial expressions, they cannot extrapolate these experiences to others. As such, when confronted with expressions exchanged between other people that might or might not be interested in their partner, they fail to assess attraction correctly above chance level. This finding might suggest that attraction might not be readily discernible from a prototypical facial expression or bodily posture. Another explanation could be that similar to other studies (Hall et al., 2015), people are not familiar with flirting during first dates, as these instances are rare (Abbey, 1982), therefore they might not be able to accurately detect it. Crucially, one potential explanation is that people might be able to better detect attraction by assessing the inter-individual coordination of a couple, as in, how much and how fluidly they mimic each other. A couple with high inter-individual coordination may suggest a strong bond or “chemistry” (Tickle-Degnen & Rosenthal, 1990). However, accurately assessing this property would require the presentation of both members of a couple together, rather than in separate videos, as was done in Experiment 1 of Chapter 8. In Chapter 8, I further discuss the importance of a couple’s inter-individual coordination (IIC) as an indicator of attraction and the formation of a romantic bond.

In Chapter 8, we review the literature on inter-individual coordination and whether it can be used to assess whether a potential partner is suitable for a romantic relationship. Previous models have suggested that coordination between people facilitates bond formation (e.g., Perper, 1985; Rasmussen, 1981). In our work, we suggested that the coordination of both motor and physiological responses is the mechanism supporting the bond formation, and maintenance, and likely enhances offspring rearing (Zeevi et al., 2022; Prochazkova et al., 2022); thus, it can be used as an index of bond strength in a comparative framework. Crucially, I then examined the predictions generated by our model by investigating whether mimicry of subtle cues predicted dating outcomes in a real-life speed-dating setup (Chapter 9). I found that mimicry of coy smiles, a smile associated with attraction, predicts a higher likelihood of people wanting to go on another date with their partner. We extend the model by Rasmussen (1981) by providing a mechanism for the pair-bond strength, namely the IIC. Furthermore, we demonstrate that mimicry, a sub-component of IIC, can indeed be used to predict the formation of a romantic bond.

## Methodological considerations and future directions

Investigating how attention, social cognition, and IIC are modulated by attraction has illustrated that currently used experimental tasks, designs, and stimuli can provide first insights into the processes underlying attraction and dating choices. Future studies can build on this knowledge and improve the methodological approach in several ways.

Speed dating studies have been considered a reliable and cost-effective to acquire data on how people form romantic bonds (Finkel & Eastwick, 2008). Even though speed-dating studies are widely used (N. P. Li et al., 2013; Tidwell et al., 2013; Todd et al., 2007), they are usually combined with surveys relating to the dating experience or personality questionnaires. However, as I have shown in the present thesis, the combination of experimental cognitive tasks with speed-dating studies and precise codings of couples' behaviors provides a unique opportunity to investigate whether and the manner in which cognitive biases and nonverbal cues predict real-life dating decisions.

Several studies have demonstrated the sexual overperception bias, and multiple mechanisms have been proposed to underlie its emergence. For example, a few factors that have been proposed were sociosexual orientation, projection of one's own interest to the partner, and self-rated attractiveness. Interestingly, in our work, we found that men who were interested in their partner were likely to over-perceive attraction in them. In contrast, men who were disinterested in their partner exhibited a higher degree of accuracy in detecting whether their partner was interested in them. Women were not able to accurately detect whether their partner was interested in them or not, independent of how they felt about their partner. We suggested that this effect might be due to differences in physiological arousal between men and women, namely that men might experience physiological arousal faster than women (Kukkonen et al., 2007), which consequently biases their decision-making when they are attracted to their partner. However, no studies to date have examined the physiological underpinnings of the sexual overperception bias. I aim to investigate this in my future work, as this discrepancy might provide a physiological explanation for the sexual overperception bias.

Regarding future directions, in our work, we suggested that IIC might facilitate bond formation and maintenance. Crucially, we showed that a mimicry index could be used to quantify the pair-bond strength (Samara et al., in prep). Even though it is well-understood that coordination with a partner is beneficial for promoting a romantic bond, the underlying mechanism remains unclear. Different models and hypotheses have been proposed to explain the relationship between mimicry and social bonds. For example, recently, it was suggested that mimicry might facilitate the prediction of others' behavior (e.g., Kret & Akyüz, 2022). Others have suggested that

mimicry promotes the formation of social bonds because people evaluate a synchronous interaction more positively than an asynchronous one, during which they might feel uneasy (Pfaus, Zakreski, & Safron, 2022). Disentangling the different processes that underlie this intricate relationship would benefit the literature. Thus, future work should focus on detailing cognitive models illustrating the mechanisms underlying coordination and bond formation.

In our review, we outlined evidence showing that in serially monogamous birds, the IIC between parents likely influences the couple's reproductive success. For example, zebra finch couples that picked their mate exhibited more behavioral coordination and were more successful and produced more fledglings than pairs that were formed by the researchers (Ihle et al., 2015). A few studies illustrate that hormonal synchrony between parents might facilitate parental investment (Saxbe et al., 2017); however, the relationship between IIC, reproduction, and child-rearing remains under-investigated in humans. Future research should aim to conduct longitudinal studies investigating how the IIC between parents might influence reproductive success and child-rearing.

Future research can employ experimental tasks to advance our understanding of the relationship between attention, social cognition, and inter-individual coordination in romantic bond formation. One potential task is the imitation-inhibition task, which has been used to study automatic imitation (Brass, Bekkering, Wohlschläger, & Prinz, 2000; Brass, Derrfuss, Matthes-von Cramon, & von Cramon, 2003). In this task, participants are required to perform a movement while watching a video of a person performing a movement that is either congruent (same) or incongruent (different) with the movement they were instructed to perform. Previous research has shown that participants tend to respond slower and make more errors in the incongruent condition, indicating that imitation of the observed behavior is automatic. Future studies could examine how participants' idiosyncratic attractiveness ratings of the presented stimuli influence their performance on the incongruent condition of the imitation-inhibition task. Eye-tracking measures could also be incorporated to investigate how these attractiveness ratings influence participants' attentional dwell, and whether attractive faces are prioritized over changes in movements. Finally, participants could be asked to rate the trustworthiness, intelligence, and dominance of the people in the stimuli, which would allow for an examination of how attraction, inter-individual coordination, and social cognition interact.

The use of big data is prevalent in psychology and can also be used in romantic decision-making. In Chapter 3, we showed that fixations in an eye-tracking task could be used to predict dating choices in a speed-dating study. Specifically, the more people preferentially attended to a person's image, the more likely they were to indicate later that they would like to meet them again. In other words, the findings of the present dissertation

suggest that attraction to another can be detected by implicit processes, such as increased attentional dwell. Therefore, in popular dating apps, such as Tinder, decisions about a potential romantic partner could be taken using not necessarily explicit choices but rather implicit processes, such as the duration of viewing a person's profile. Whether this addition to dating apps reliably predicts initial attraction and date success would have to be further examined. However, such an approach would be a valuable first step in getting more insight into the intricate interplay between attention, implicit processes, and dating choices.

## Conclusion

In conclusion, the findings of my dissertation illustrate that when people are attracted to someone, they are more likely to focus on them as their attention narrows down to the potential partner. People are also more likely to perceive a person they find attractive in a more biased way, which increases the chance that they approach them. Finally, when they approach them, they are more likely to mimic them, thus increasing their chances of getting another date. Altogether, my findings contribute to our understanding of how attraction influences social interactions and relationships.