The matching hypothesis re-examined once more

Does the structure of the partner market matter?

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1. Introduction

The question of who marries whom has been central to sociological research since the beginnings of the discipline (Mare, 1991). It has also occupied an important place in prof. Matthijs's career (e.g., Puschmann et al., 2016; Van de Putte & Mathijs, 2001; Van Leeuwen et al., 2019). In this contribution, I seek to honor his work by examining the social dynamics that lead to positive assortative mating. Positive assortative mating describes a situation in which romantic partners are more similar in their social, psychological, or biological characteristics than mere chance would imply (Schwartz, 2013). This phenomenon has been observed for many characteristics and can have important consequences for individuals and society. For example, if people tend to match on their social status, existing inequalities between individuals can become aggravated in the families they form (Blossfeld & Buchholz, 2009). Understanding the forces that lead to positive assortative mating is therefore an important step towards a better understanding of society. In this paper, I contribute to this understanding by exploring how people's partner preferences and the structure of the partner market interact in shaping assortative mating.

My contribution departs from Kalick and Hamilton's (1986) work, who sought to explain a puzzling empirical observation in the research literature of their time. Many studies had shown that the physical attractiveness ratings that members of committed romantic relationships receive tend to be similar, resulting in intra-couple correlations in the range of .3 to .6. Because of this, scholars had argued that people may prefer partners of similar attractiveness, and this view had come to be known as the 'matching hypothesis'. However, experimental research that directly assessed men's and women's partner preferences was at odds with this hypothesis. When individuals are asked to indicate which opposite-sex members they find most desirable as a partner, they typically do not choose somebody who is about as physically attractive as they are. Instead, they tend to choose somebody who is very physically attractive, regardless of their own physical attractiveness.

Kalick and Hamilton (1986) addressed this inconsistency by exploring whether a preference for similarly physically attractive partners is strictly necessary to generate positive assortative mating. For this, they developed a simple simulation model, in which they assumed that there is a closed and balanced population of heterosexual men and women, who are differentiated by their physical attractiveness (captured in a single numerical value, with higher values representing higher physical attractiveness). These individuals encounter each other in random meetings between opposite-sex members, with the goal to find a partner. During each meeting, they need to decide whether they want to form a union with the person they have just met. If both want to do so, they form a union and are removed from the partner market. These decisions are guided by one of three decision rules. The first rule implements the partner preferences implied by the matching hypothesis, so that individuals are the more likely to accept somebody as a partner, the more similar his/her physical attractiveness is to their own. The second rule implements the partner preferences observed in empirical research, so that individuals are the more likely to accept somebody as a partner the more attractive he/she is, regardless of their own physical attractiveness. The third rule combines the first two rules by assuming that individuals desire partners who are very physically attractive but are reluctant to partner with somebody who is much more physically attractive than they are.

Kalick and Hamilton (1986) submitted their model to simulation experiments, in which they applied each of the three rules separately to the entire population. They found that the intra-couple attractiveness correlations that the model generated were high, no matter whether individuals preferred partners who are very attractive, similarly attractive, or a mix of the two. At first glance, it may appear counterintuitive that a preference for attractive partners would generate positive assortative mating. However, a closer look at the model's dynamics illuminates the driving forces behind this result. If individuals prefer physically attractive partners, those who are most physically attractive are most desirable and are most likely to be accepted as partners by others. Hence, very attractive men and women are most likely to form unions with each other whenever they meet. If such unions form, the male and female attractiveness distributions in the population are curtailed at the top. Still, among the remaining individuals, the same principle remains at work. Those men and women who are most physically attractive in the new distributions are most desirable and therefore most likely to form unions with each other whenever they meet. In this way, the formation of unions among similarly physically attractive individuals over time trickles down through the ranks of the attractiveness ladder, leading to positive assortative mating.

Kalick and Hamilton's (1986) model is simple and abstracts from many factors that may affect people's partner choices in real life. However, it is powerful because it shows in a controlled environment that quite different partner preferences can generate remarkably similar mating patterns. Indeed, the notion that both a preference for partners of similar quality and a preference for partners of high quality can lead to positive assortative mating, regardless of the specific quality under consideration, has become common wisdom in the research literature (e.g., Kalmijn, 1994; Schwartz, 2013). In this contribution, I take a closer look at this wisdom and suggest that its validity may depend on the structural conditions under which partner search takes place. In more detail, Kalick and Hamilton (1986) assumed that the different attractiveness levels in the population were evenly distributed. This means that each attractiveness level was equally likely to occur and–more crucially–that men and women were on average equally attractive. In reality, many characteristics follow more complex distributions, and these distributions often differ between the sexes. For example, women are typically rated as more physically attractive than men (Eastwick and Smith 2018), men tend to be taller than women (Stulp & Barrett, 2016), and men often have higher incomes than women (Grow & Van Bavel, 2020). I expect that such differences can affect the matching patterns that different partner preferences create. A thought experiment helps understanding why.

Imagine that men's and women's physical attractiveness values are normally distributed but differ in their means. Such a situation is illustrated in Figure 1, where women are on average more attractive than men. Assume now that people prefer partners of similar attractiveness. In Figure 1, few men and women are similarly attractive, with the exception of those who are in the overlapping parts of the male and female attractiveness distributions, labeled 'A'. These individuals find each other most desirable and are therefore most likely to form unions whenever they meet. When this happens, the next most-similarly attractive men and women who are not partnered yet are in the areas labeled 'B'. Even though they are not very similar to each other, they still find each other more desirable than the remaining alternatives on the partner market. They are therefore most likely to form unions whenever they meet. Once these individuals are removed from the partner market, only the most dissimilar men and women in the areas at the top and the bottom of the female and male attractiveness distributions remain (labeled 'C'), respectively. Unless they accept to remain single, they are forced to form unions with each other for lack of better alternatives. In the end, what emerges is a pattern of negative assortative mating: the most physically attractive men are paired with the least attractive women, average attractive men are paired with average attractive women, and the least attractive men are paired with the most attractive women. This happens even though individuals prefer similarly attractive partners.

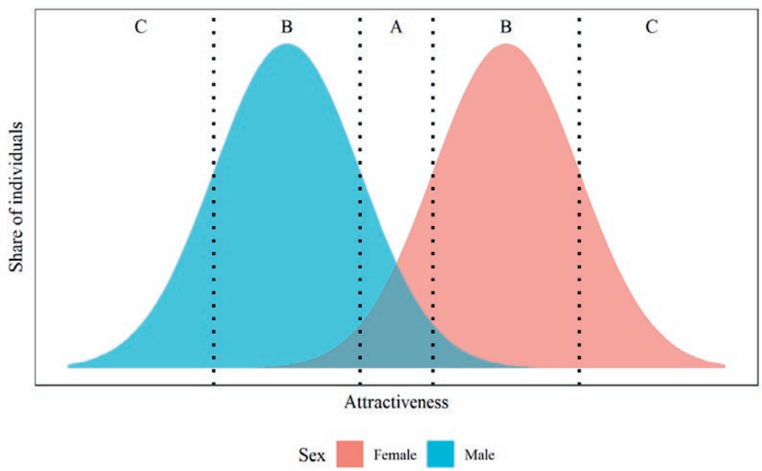

FIG. 1. Example of sex-differences in attractiveness distributions

The above example may appear plausible, but many aspects of the dynamics that it describes remain uncertain. For example, it remains uncertain how large the difference between men's and women's physical attractiveness needs to be for negative assortative mating to occur. Furthermore, it is uncertain what dynamics develop when individuals prefer very attractive partners. To address these questions, I extend Kalick and Hamilton's (1986) model, to allow for more complex, sex-specific attractiveness distributions. I use this model to explore how theoretical distributional differences between men's and women's physical attractiveness may affect the intra-couple attractiveness correlations that emerge from the three different partner preferences that Kalick and Hamilton (1986) proposed. In what follows, I describe the model in some detail, present my results, and close the paper with a conclusion and an outlook for future research. I have implemented the model in NetLogo V6.1.1 (Wilensky 1999). The model code and the scripts of my analysis can be obtained from https://github.com/MPIDR/MatchingOnceMore. For brevity, from here on I refer to 'physical attractiveness' also simply as 'attractiveness'. I distinguish this from the notion that one individual may desire somebody else as a partner, to which I refer with the term 'desirable'. To illustrate this, imagine a man X who is (physically) very attractive. If woman Y values attractiveness in a partner regardless of her own looks, she will find man X a desirable partner. However, if she values similarity in attractiveness, she may not find man X a desirable partner, even though he is (physically) very attractive.

2. Modelling partner search with sex-specific quality distributions

The simulation starts with creating 1,000 male and 1,000 female individuals (indexed by *i, j, ….*), who are characterized by their physical attractiveness A_i. The value of A_i can vary in the range 1 to 10, which higher values indicated higher attractiveness, and is assigned probabilistically, based on the distributions discussed below. Initially, all individuals are single.

After the artificial individuals have been created, the simulation proceeds in the following iterative steps (see Kalick & Hamilton, 1986, p. 676):

1. All men and women who are single are randomly paired with one opposite-sex member for a date.
2. During each date, both individuals decide whether they are willing to form a relationship with the person they have just met; these decisions happen probabilistically based on the two individuals' attractiveness values (see details below).
3. If both participants of a given date decide that they are willing to form a relationship with the respective other, they form a relationship and are removed from the partner market.
4. All 'unsuccessful' dates are dissolved, so that the involved men and women become available for new dates in the next iteration.

Steps 1-4 are repeated in each iteration until all men and women have a partner.

The decision probabilities in step 2 are determine by the following equations (see Kalick and Hamilton 1986, pp. 677–678), that implement different partner preferences. The first two equations implement a preference for very attractive partners, so that the likelihood that individual i accepts opposite-sex member j is determined by j's attractiveness:

$$P_1 = \frac{(A_j)^3}{1,000}.$$

This implies that the probability that i will accept j as a partner convexly increases from a minimum of .001 (in case of $A_j = 1$) to a maximum of 1 ($A_j = 10$).[1] This probability is corrected for the time that i has already been looking for a partner without success, thereby implementing the notion that individuals lower their aspirations if they are unsuccessful in finding a partner. This is implemented as

$$P_{1c} = (P_1)^{(51 - d)/50},$$

where d is the number of dates that i has already taken part in. This function has the effect that the probability that i will accept j increases with the number of dates that i has already been on (reaching the value of 1 after 50 dates, at the latest). Note that the value of d is always the same for all individuals who are still on the marriage market, because all single men and women take part in exactly one date per iteration. Hence, the simulation always stops at the latest after 50 iterations, given that at this point everyone accepts anybody they meet as a partner. The simulation can stop earlier if everybody has found a partner in less than 50 rounds of dates.

The second pair of equations implements the matching hypothesis, so that the probability that i is willing to form a relationship with j increases with their similarity in attractiveness:

$$P_2 = \frac{(10 - |A_j - A_i|)^3}{1,000}.$$

This implies that the probability that individual i will accept j is highest ($P_2 = 1$) when $A_i = A_j$, regardless of whether A_i and A_j are high or low. The probability is lowest ($P_2 = .001$) when A_i and A_j are at the opposite ends of the attractiveness scale. Again, this value is corrected by the number of dates that the individual has already taken part in:

1 Note that the model is a two-sex model, which means that both i and j need to accept each other as a partner before a relationship can form. In the model, this is technically implemented by letting each member of a date i and j independently determine whether they want to form a relationship with the respective other according to, e.g., Eq. (1). If both have determined that they want to form a relationship with each other, they actually form such relationship. This means that the fact that, e.g., i may want to form a relationship with j has no impact on j's decision.

$$P_{2c} = (P_2)^{(51 - d)/50}.$$

The last pair of equations implement a mix of the above preferences, so that individuals prefer partners who are attractive, but not much more attractive than they are. This is implemented by taking the average of P_1 and P_2 and correcting the result for the number of dates that individuals have been on already, so that

$$P_3 = \frac{(P_1 + P_2)}{2},$$

and

$$P_{3c} = (P_3)^{(51 - d)/50}.$$

In the original model, the random assignment of individuals' attractiveness values was based on a uniform distribution that was the same for men and women. I use this distribution as a benchmark against which I compare the outcomes based on an alternative specification. In this specification, I use sex-specific normal distributions that are truncated at 1 and 10, with $\bar{x}_m/s_m$ and $\bar{x}_f/s_f$ representing the means/standard deviations of the distributions for men and women, respectively. These distributions implement the observation that most individuals are typically rated as average attractive, whereas few individuals are rated as very unattractive or very attractive (e.g., Eastwick & Smith, 2018). The truncations at 1 and 10 are necessary to ensure that the attractiveness values remain within the operational boundaries of the model. By varying the means and standard deviations of these distributions, it becomes possible to explore how different magnitudes of attractiveness differences between men and women affect model outcomes. Note that the model assumes that men and women have the same partner preferences. For simplicity, I do not explore all possible combinations of $\bar{x}_m$ and $\bar{x}_f$ values. Rather, I study pairs of values, moving from a situation of identical means ($\bar{x}_m = \bar{x}_f = 5.5$), to a situation of medium differences ($\bar{x}_m = 4.5$ and $\bar{x}_f = 6.5$), to a situation of large differences ($\bar{x}_m = 3.5$ and $\bar{x}_f = 7.5$) in favor of women. I explore this for three different values of s_m and s_f, representing small ($s_m = s_f = 1$), medium ($s_m = s_f = 2$), and large

($s_m = s_f = 3$) intra-sex variability.[2] Figure 2 illustrates the nine different combinations of sex-specific attractiveness distributions that these values create in combination. As can be seen from this figure, the overlap in the male and female attractiveness distributions tends to be largest when their averages and standard deviations are the same. The overlap decreases when the difference the means increases, but this is attenuated when intra-sex variability is larger.

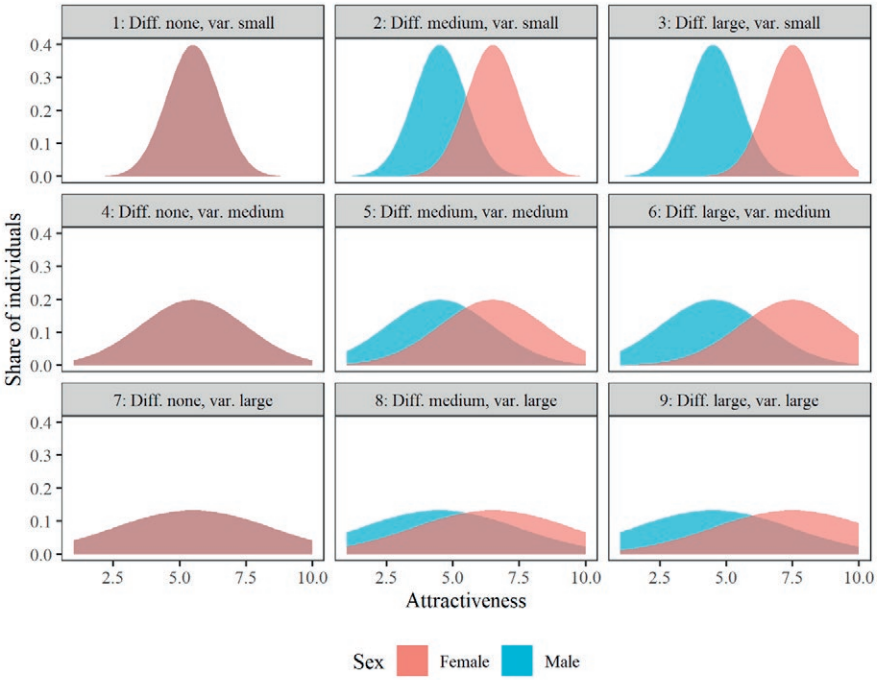

FIG. 2. Combinations of sex-specific attractiveness distributions considered in the simulation

In terms of outcomes, I focus on the intra-couple attractiveness correlations that emerge at the end of a given simulation run. For this, I average outcomes over 50 independent simulation runs for each of the nine differ-

2 It is not necessary to explore the mirror images of these conditions, in which men would be more attractive than women. The reason is that in the model men and women behave in the same way and have the same partner preferences. If we find that, say, a preference for similarly attractive partners leads to negative intra-couple attractiveness correlations when women are on average more attractive than men, the model will generate the same negative correlation when men are more attractive than women. The only difference will be that in the first scenario women will on average be more attractive than their partners, whereas in the second scenario men will be more attractive than their partners, but the resulting correlation remains unaffected by this.

ent combinations of sex-specific attractiveness distributions, to account for outcome variability that derives from the stochastic nature of the model. For brevity, from here on I refer to the preference for very attractive partners as the "attractiveness preference", the preference for partners of similar attractiveness as the "matching preference", and the preference that combines the two as the "mixed preference".

3. Results

Table 1 reports the average intra-couple attractiveness correlations that the model generated across 50 independent simulation runs, under the assumption that men's and women's attractiveness values are identically and uniformly distributed. With this assumption, the model is equivalent to the model proposed by Kalick and Hamilton (1986), and the attractiveness correlations that my model generated are very close to those reported by these authors. The highest value occurred under the matching preference (.83), the second highest value occurred under the mixed preference (.73), and the lowest value occurred under the attractiveness preference (.61). Hence, my model likely implements the algorithm of the original model correctly, so that the values shown in Table 1 can be used as benchmarks.

TABLE 1. Results of simulation experiments with uniform attractiveness distributions and different partner preferences

Attractiveness	Matching	Mixed
.61	.83	.73

NOTE: Results show the average intra-couple attractiveness correlations obtained from 50 independent simulation runs per simulation condition. The columns refer to three different types of partner preferences.

Table 2 reports the average intra-couple attractiveness correlations that my model generated under the assumption that men's and women's attractiveness values are normally distributed, with different means and standard deviations. As a first observation, what strikes is that the observed correlations for each preference were always lower than those generated by the original model. For example, in the modified model, the highest correlation that could be observed for the attractiveness preference was .47 (vs. .61 in the original model), the highest correlation for the matching preference was .75 (vs. .83), and the highest value observed for the mixed preference if .62 (vs. .73). Hence, partner search in the context uniformly distributed qualities seems to have a higher potential to generate positive assortative mating than partner search in the context of non-uniformly distributed qualities.

TABLE 2. Results of simulation experiments with different theoretical attractiveness distributions and different partner preferences

	Attractiveness			Matching			Mixed		
Av. diff. / Variability	No	Med.	Large	No	Med.	Large	No	Med.	Large
Small	.15	.15	.14	.41	-.17	-.29	.30	-.05	-.09
Medium	.37	.35	.29	.67	.12	-.18	.52	.23	<.01
Large	.47	.46	.42	.75	.42	.15	.62	.44	.24

NOTE: Results show the average intra-couple attractiveness correlations obtained from 50 independent simulation runs per simulation condition. The three columns per preference refer to three different types of differences in the averages of men's and women's attractiveness distributions (no: $\bar{x}_m = \bar{x}_f = 5.5$, med.: $\bar{x}_m = 4.5$ and $\bar{x}_f = 6.5$, and large: $\bar{x}_m = 3.5$ and $\bar{x}_f = 7.5$). The rows refer to three different levels of within-sex variability in attractiveness (small: $s_m = s_f = 1$, medium: $s_m = s_f = 2$, and large: $s_m = s_f = 3$),

A closer look at Table 2 shows that (1) the strength of this depressing effect depends on the specific shapes of the gender-specific attractiveness distributions and (2) is contingent on the specific partner preference under consideration. To illustrate this, consider first the results for the attractiveness preference. For this preference, changes in the variability in the attractiveness distributions (i.e., changes in the standard deviation) among men and women had a strong depressing effect on the attractiveness correlations that emerge, but changes in the average attractiveness of men and women had no such effect. For example, if variability is large, moving from a situation in which men and women are on average similarly attractive to a situation in which women are much more attractive leads the resulting correlation to decrease only from .47 to .42. By contrast, moving from a situation of large variability to a situation of small variability led to a decrease in the resulting attractiveness correlation of a of about .3 units, regardless of whether or not women were more attractive than men.

In case of the matching preference and the mixed preference, both changes in the average attractiveness of men and women and changes in intra-sex variability matter. For example, when men and women prefer partners of similar attractiveness, the intra-couple attractiveness correlation decreases by about .6 units when we move from a situation in which men and women are on average similarly attractive, to a situation in which women are much more attractive than men. For this, the exact level of intra-sex variability among men and women does not matter much. Similarly, when we move from a situation of small variability to a situation of large variability, the correlation typically increases by about .3 units, and for this is does not matter whether women are more attractive than men.

A second striking feature of the numbers reported in Table 2 is that both preferences that consider similarity in attractiveness (i.e., matching and mixed) can generate negative intra-couple attractiveness correlations. More specifically, negative assortative mating was most likely to occur when there were medium to large differences in men's and women's average attractiveness, and when the intra-sex variability in attractiveness was low to medium. Formulated differently, a preference for similarly attractive partners can lead to negative assortative mating, and this is the more likely, the less the male and female quality distributions overlap.

4. Discussion and conclusion

In this contribution I have explored some of the social dynamics that can lead to positive assortative mating. Common wisdom holds that both a preference for partners of high quality and a preference for partners of similar quality can, in the aggregate, lead to a situation in which romantic partners are predominantly of similar quality. I have argued that this outcome may crucially depend on the way in which the quality is distributed among men and women. If members of one sex are on average of 'higher quality' than the members of the respective other sex, this might affect patterns of assortative mating, and under certain circumstances may even lead to negative assortative mating. To assess the logical consistency of my argument, I modified a seminal simulation model of assortative mating, so that it accommodates sex-specific quality distributions. My experiments with this model largely support my core argument. If there are large differences in men's and women's average qualities, a pattern of negative assortative mating can occur, particularly when individuals prefer partners of similar quality.

My results contribute to a more nuanced picture of how people's partner preferences and the structure of the marriage market interact in shaping marriage patterns. Recent literature highlights that it might be an ecological fallacy to infer people's partner preferences from observed marriage patterns, because *very different preferences* can lead to *very similar marriage patterns* (Grow & Van Bavel, 2015, 2020; Smaldino & Schank, 2011). My results add to this, by showing that *one and the same preference* can lead to *very different outcomes*, depending on the exact structure of the partner market. Indeed, my results point to a highly counterintuitive possibility. The matching hypothesis came into being based on the belief that a preference for similarly attractive partners is the only preference that can bring about high intra-couple attractiveness correlations. Kalick and Hamilton's (1986) proved this notion wrong, and my results show that under certain circumstances such a preference can even lead to negative intra-couple attractiveness correlations. What is more, my results suggest that a preference for very attractive partners is the only preference that consistently leads to positive attractiveness correlations, regardless of the structure of the marriage market.

Of course, as with any modelling effort, my results may be contingent on some of the specific assumptions that I make, and it is worthwhile to discuss some of the arguably more crucial assumptions. First, I inherited from Kalick and Hamilton (1986) the assumption that individuals assess each other's desirability based on their 'absolute' attractiveness. In reality, men's and women's relative attractiveness might be more important. That is, when a woman evaluates a man, she might be more concerned about how he compares to all the other available alternatives, rather than his absolute attractiveness, *vice versa*. If this were the case, the matching preference might not lead to a negative attractiveness correlation: even if the average attractiveness of men and women is very different, more attractive men are likely to match with more attractive women, given that their ranks in the respective sex-specific attractiveness distributions will be similar.

Second, I assumed that men and women perceive their attractiveness in the same way. By contrast, empirical evidence suggests that men and women may perceive attractiveness differently and this might lead to dynamics that are difficult to anticipate (Voges et al., 2019). For example, what union patterns would emerge from a preference for similarly attractive partners if, e.g., men perceive themselves as more attractive than women perceive themselves? This is an interesting question that future research could explore with a modified version of my model.

Third, the model assumes that physical attractiveness is the only characteristic that individuals care about in a partner, and that men and women value this characteristic similarly. In reality, individuals consider multiple characteristics in potential partners and there are systematic differences between the characteristics that men and women value in prospective partners. In particular, earlier research suggests that men tend to place relatively more emphasis on the physical attractiveness of women, whereas women place relatively more emphasis on the socioeconomic status of men (Buss, 1989; Buss et al., 1990, 2001). In a social exchange perspective, these differences may partially derive from traditional resource differences between the sexes. In the past, women's average educational attainment, attachment to the labor market, and income potential were lower than that of men. This rendered women's own socio-economic status largely dependent on the status of their partner. In exchange for this status, they would offer other desired resources, such as homemaker skills, youth, and physical attractiveness (McClintock, 2014). Yet, as women became more similar to men in their economic roles in society over the course of the 20th century, so did their partner preferences (Zentner & Eagly, 2015; Zentner & Mitura, 2012). Exploring the possibility that individual's partner preferences may partially result from differences the distribution of resources between the sexes goes beyond the scope of this contribution. However, future research that extends the model in this regard may generate interesting new insights into the dynamics that have shaped partnering patterns in a historical perspective.

Despite these caveats and need for future research, my work highlights the importance of considering both preferences and structure when theorizing about the social forces that bring about observed marriage patterns.

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