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# A dynamic game theoretical model predicts variance in choosiness when mate availability fluctuates

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Evolution of mate choosiness is a central topic in the Darwinian framework and has stimulated many experimental approaches in sexual selection. The optimal choosiness may depend on the quality of both the chooser and the potential partner, but it should also account for the complexity of intra-sexual competition for mate, mutual choice and fluctuation of partner availability. Most existing models, however, have focused on single-sex discrimination, treating mate choice as an optimization problem for either males or females alone. Johnstone (1997) thus developed a game theoretical model of mutual mate choice to calculate the Evolutionary Stable Strategy (ESS) of choosiness flexibility when individuals pair only once per breeding season under constant and even operational sex ratio (OSR). Yet, OSR is rarely even in natural populations. On the contrary, it fluctuates and depends on adult sex ratio (ASR) and the duration of the refractory period (i.e. time to become available for another reproduction). The results of Johnstone's seminal work have yet to be generalized to this larger picture that encompasses different options to multiple mating for both sexes. In the present work, we develop his model by integrating biased ASR and variable refractory period, while still considering the dynamic mutual mate choice framework under scramble competition and the variation in quality for each sex.

Our results evidence for a predominant role of refractory period (via multiple mating) over ASR, controlling the choosiness of both sexes, different combinations of periods between sexes producing different outcomes in ESS of choosiness. When males and females mate more than once, variance in choosiness is substantial and is correlated to variance in quality. Additionally, patterns of positive homogamy demonstrated by Johnstone hold in many cases, although with decreasing strength with the biased ASR. This theoretical investigation confirms that evolution of optimal flexible choosiness leads to positive assortative mating and explains maintenance of variance in choosiness within populations.

**Keyword:** Game theory, Dynamic Programming, Mate choice, Mutual Choice, Choosiness, Evolutionary Stable Strategy.