Why Your Mates Shouldn't Date

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1. INTRODUCTION
The topological properties of inter-individual interaction networks play a large role in governing the flow of genetic information throughout an evolving population. While a large amount of research has focused on the relationship between the topology of *potential* mating interactions (*i.e.* the population structure) and evolutionary dynamics, the relationship between the topology of *actual* mating interactions and evolutionary dynamics has received little attention. In a recent study [1], the concept of an emergent mating topology (EMT) was introduced in the context of generational genetic algorithms. One interesting observation made in [1] was that the *clustering coefficient* observed in each EMT was exceptionally small, even when the population evolved on a highly clustered population structure. In this study, we systematically investigate the relationship between increased clustering in the EMTs of panmictic genetic algorithms and evolutionary dynamics. This is achieved through the introduction of a new selection mechanism, referred to as *Triad Selection*, which allows for a tunable degree of clustering in the EMT.

2. TRIAD SELECTION
In the Triad selection algorithm, a small set of parents are first selected from the population by employing an embedded selection mechanism, which can be one of many commonly implemented selection policies (*e.g.,* tournament, fitness proportionate). The selected individuals are added to the vertex set of the EMT (V) and the mating interactions between these individuals are added to the edge set (E) [1]. After the first set of parents has been selected, the algorithm shifts its focus toward the generation of clustering in the EMT. The remaining pairs of parents are selected using a *Triad Formation* (TF) step with probability p_{TF} or by calling the embedded selection mechanism with probability (1-p_{TF}) (Figure 1). This selection mechanism allows for a tunable degree of clustering in the EMT, controlled primarily by p_{TF}.

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3. EXPERIMENTAL RESULTS
We investigated the relationship between clustering in the EMT and the evolutionary dynamics of a panmictic genetic algorithm on two benchmark optimization problems. Our results demonstrate that increasing the degree of clustering in the EMT of a panmictic genetic algorithm has undesirable effects on the evolutionary dynamics of the population, reducing overall population diversity and quality of solution. This occurs because some individuals, possibly of low or intermediate fitness, are selected to mate with higher frequency than they would be otherwise (in order to promote the formation of mating triads) and the number of unique individuals that are allowed to mate in a given generation is therefore reduced. This limits the population's ability to effectively mix different genotypic combinations, reducing the exploratory power of genetic search.

4. Acknowledgements
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5. References
[1] Payne, J.L., & Eppstein, M.J. Emergent mating topologies in spatially structured genetic algorithms. In *Proc. Genetic and Evolutionary Computation Conference*. ACM Press, New York, N.Y., 2006, 207-214.

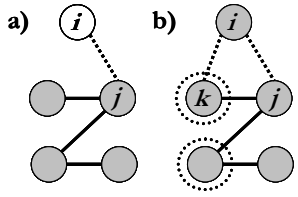

Figure 1. Schematic diagram of the Triad Formation (TF) step. (a) First, individual *i* is chosen from the parental pool using the embedded selection mechanism and subsequently mates (dashed line) with a randomly chosen individual from the mating topology (grey nodes). (b) Then, an individual *k* is chosen at random from the neighbors of *j* (dashed circles) and *i* mates with *k* (dashed line).