

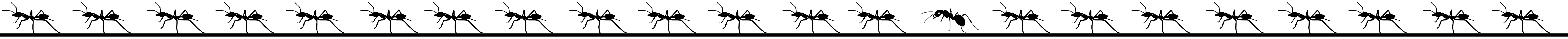
# Interaction Games explain persistence of mutualistic partners with varying degrees of investment



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Mutualisms can be perceived as exploitative interactions in which partners exchange services and goods with variation in investment to the interaction. The fundamental puzzle lies in understanding what promotes coexistence and stability of mutualisms in face of variation in quality of interaction partners. In ant-plant mutualisms, ants attack and consume plants' natural enemies in exchange for housing and/or food.

We explored mechanisms promoting coexistence in a mutualism between a host plant and its protective ant partners. More specifically, how predation strategy and a cost associated with the interaction influence the diversity of strategies found in the system.

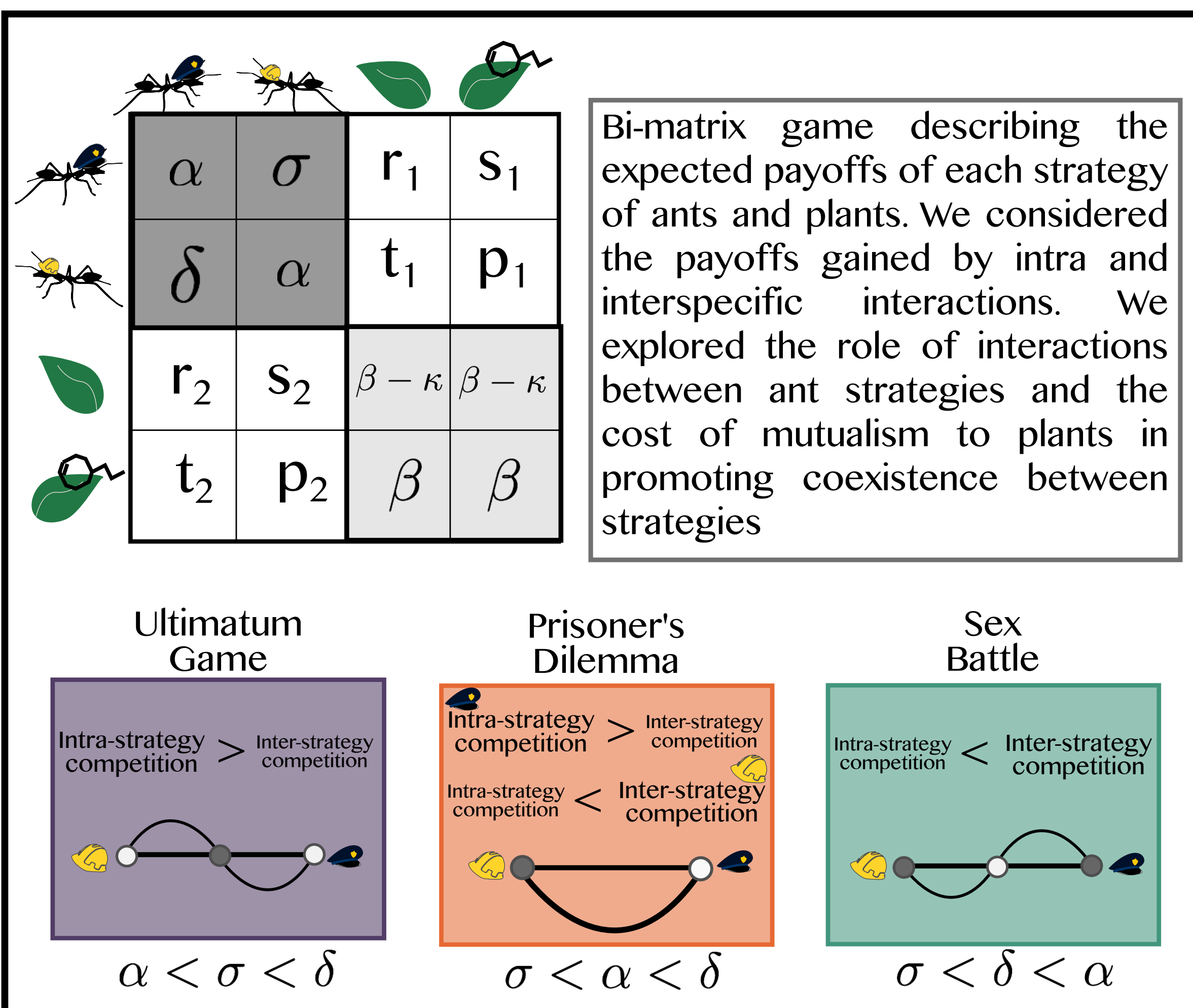
Ants can engage in two strategies to acquire prey: (i) actively forage through the foliage

(ii) build galleries that trap herbivores

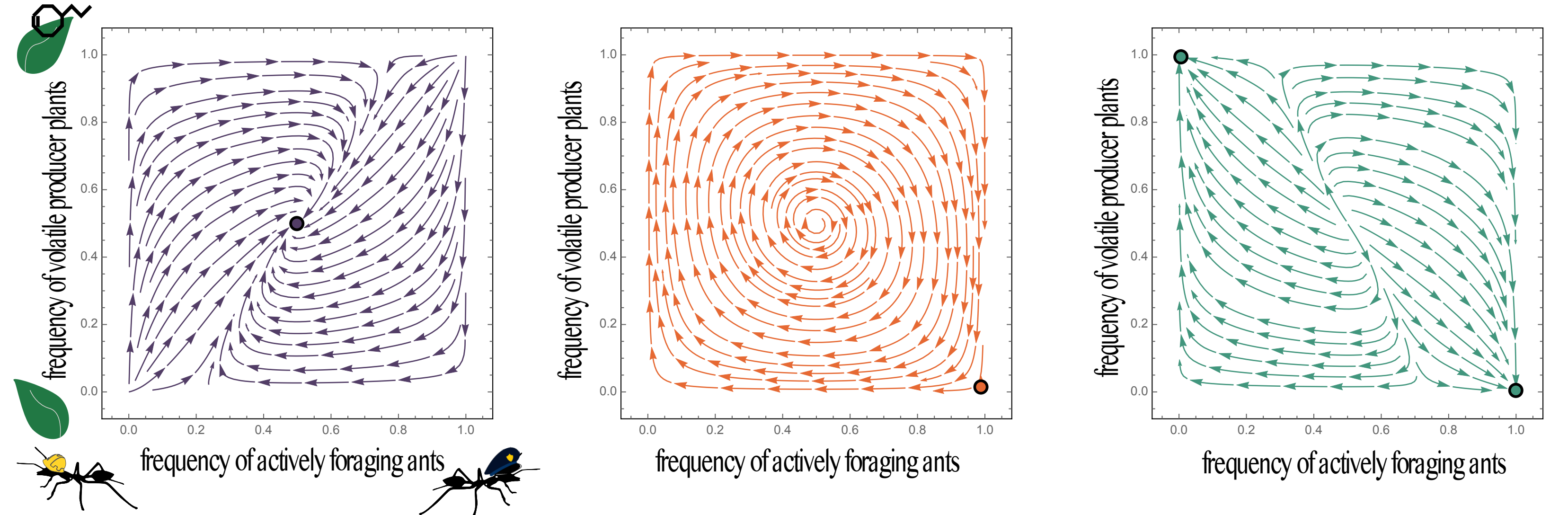
Plants show variation in the allocation of resources for producing volatiles that attract the ants to injured tissues showing two strategies:

(i) investment in production of volatiles

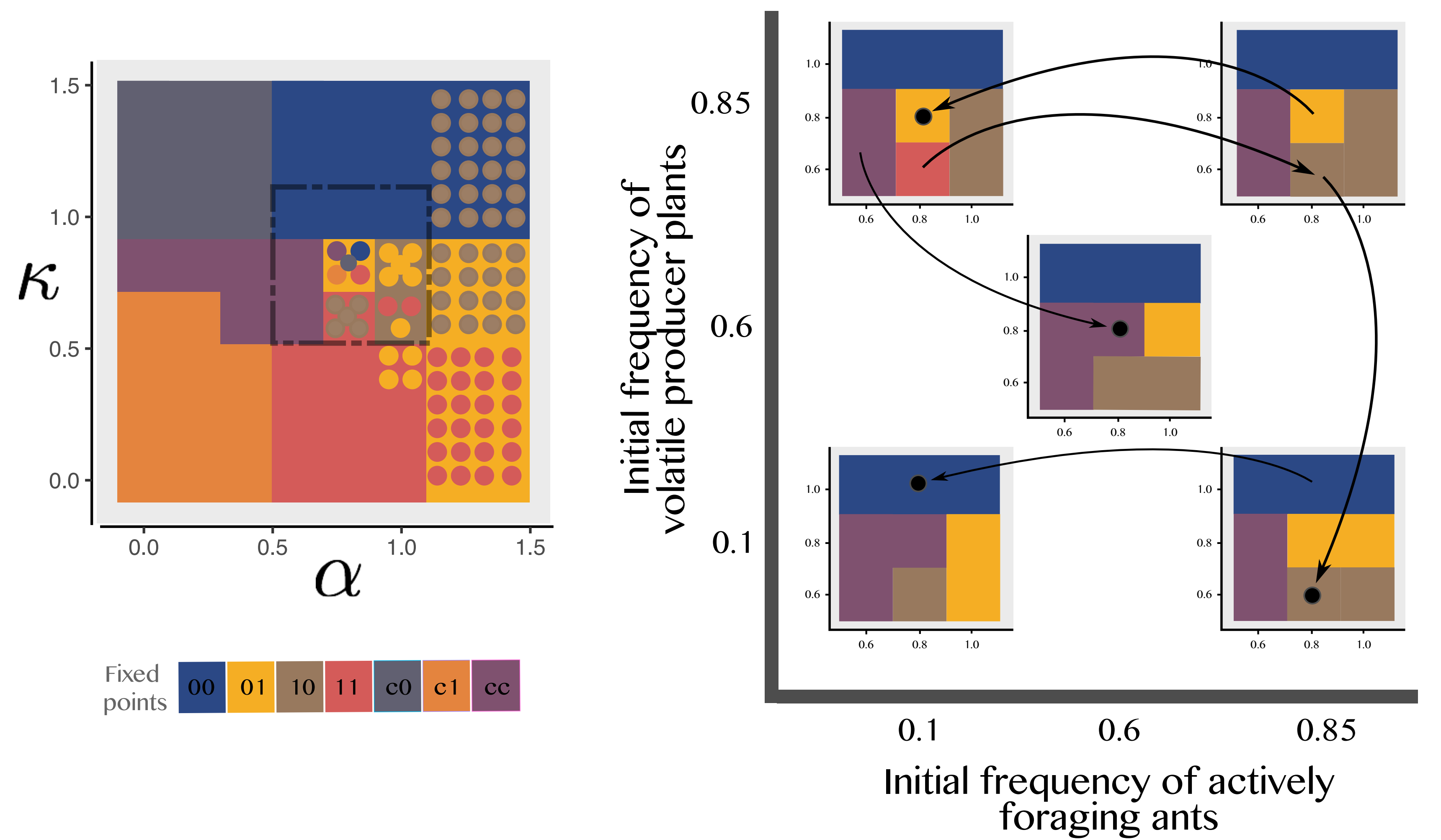
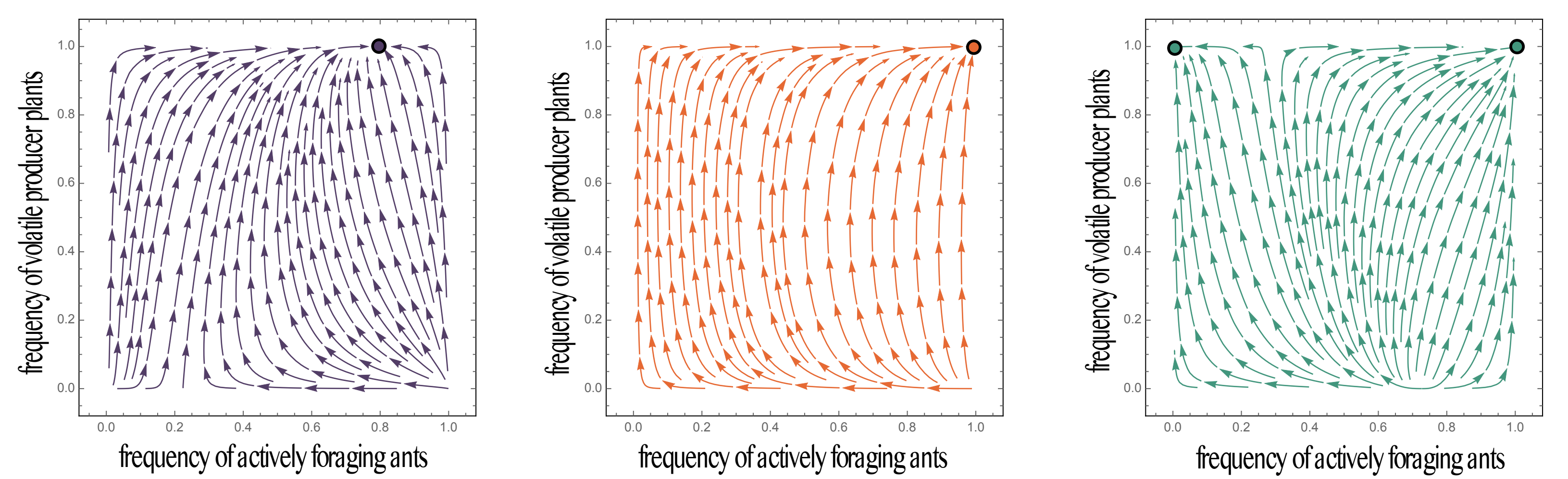
(ii) volatiles as a byproduct of metabolism



Investment in the production of volatiles incurs a cost to the plant  $\kappa = 0.75$



Production of volatiles is a metabolic byproduct with low cost  $\kappa \approx 0$



We translated strategies into payoffs and explored which strategies are evolutionary stable as well as mechanisms promoting coexistence of strategies and diversity in this system.

Coexistence between all strategies in both ants and plants with ants that actively forage and gallery builder ants as well as plants that invest in the production of volatiles and the ones that do not is possible when competition is higher for ants adopting the same strategy and volatiles are costly to produce.

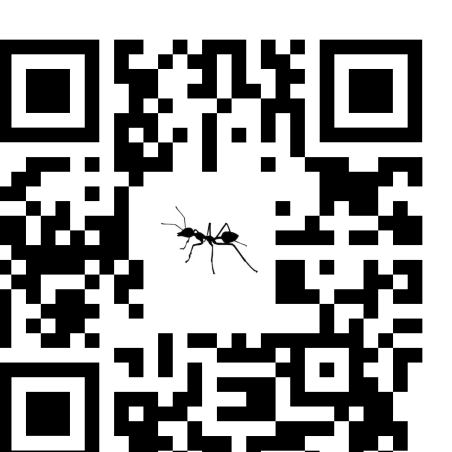
Asymmetries in competition, depicted as different payoffs associated with interactions within and between ant strategies and intermediate cost in the production of volatiles leads to a richer possibility of stable equilibrium.

Greater competitive interactions between ants adopting different strategies results in exclusion of one of the strategies. The thriving strategy depends on both the cost of volatile production and priority effects in the form of initial distribution of strategies in the community

$$\begin{aligned} \alpha &= 0.3 & \sigma &= \frac{1}{2} & r_1 &= 1 & s_1 &= 1 \\ \alpha &= 0.8 & & & t_1 &= \frac{1}{2} & p_1 &= 1 \\ \alpha &= 1.3 & & & & & & \\ \delta &= 1 & & & & & & \\ r_2 &= \frac{5}{2} & s_2 &= 2 & & & \beta &= 2 \\ t_2 &= 2 & p_2 &= 1 & & & & \end{aligned}$$

Gokhale & Traulsen 2012 Proc. Roy. Soc B 279, 4611-4616  
 Jones et al 2012. Ann. NY Acad. Sci. 1256, 66-68  
 Maynard-Smith & Price 1973 Nature 246, 15-18  
 Orivel et al 2017 Proc. Roy. Soc. B 284, 20161679

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Can you find the intruder?