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Gamergate controls dopamine levels of workers in Diacamma sp.

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Eusocial insects construct complex societies by local interactions among individuals. It has been suggested that the queen signal is a principle cue that can regulate the fertility of workers, establishing a reproductive division of labor. Traditionally, much effort has been devoted to identifying queen pheromones. Recently, some researchers have investigated the dynamics of physiological regulators, such as JH or biogenic amines, to reveal how the queen signal acts on worker's physiological conditions. *Diacamma sp*. is a queenless ant species. Colonies consist of a mated worker, called gamergate, and helper workers. The queen signal is transferred to workers by direct contact with the gamergate. Dominance interactions among workers occur frequently in large colonies or in colonies lacking a gamergate, indicating that the dominance interactions are also controlled by direct contact with the gamergate. Thus, the gamergate equalizes the physiological conditions of workers by physical contact. Although previous research indicated correlations between social rank and amine levels in other ant species, little is known about how such heterogeneity among individuals arises. To address the physiological basis of the heterogeneity of workers, we examined amine dynamics in worker brains in the presence and absence of queen signals. First, our results indicated that dopamine levels in dominants were higher than those in subordinates, whereas octopamine levels showed the opposite pattern in the colonies with the gamergates. Second, the dopamine level and variance increased within only 3 h of isolation from the gamergate, suggesting that the contribution of the gamergate to the regulation of dopamine levels in worker brains may be limited. Together with the network analysis of the dominance hierarchy, we further discuss the role of dopamine as the key factor in constructing the hierarchy.