



Doublesex regulates reproductive division of labour in honey bees

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The evolution of eusociality has been a puzzle for biologists since the publication of *On The Origin of Species*, especially the mechanism underlying the regulation of the individual reproduction to maximize colony and individual fitness. In eusocial insects, sterility of workers is accomplished by queen pheromones, (e.g. queen mandibular pheromone in honey bees; QMP). However, the transcriptional regulatory network underpinning reproductive division of labour remain and of pheromonal signalling remains poorly understood. Doublesex (*Dsx*) is a well-known regulator of sex differentiation in arthropods. This gene is known to affect the development of sexual secondary characteristic, including ovary development and pheromonal signalling in other insects. We therefore hypothesized that *DSX* may jointly regulate reproductive labour division and alters pheromonal communication in honey bees. We tested this hypothesis using RNA interference (RNAi) in the honey bee (*Apis mellifera*). In the absence of queen mandibular pheromone (QMP), reproductive division of labour breaks down in the honey bee colony as workers initiate ovary development. We conducted a blind study where we injected bees with either *DSX* RNAi or a non-target control gene green fluorescent protein (GFP). As expected, *Dsx* knockdown resulted in reduced ovary development in treated workers. Furthermore, these workers had higher levels of QMP, compared to control workers, suggesting that *Dsx* does affects pheromonal signalling, but not as a simple activator of QMP activity. These data provide a strong support for the central role of *Dsx* in reproductive division of labour via the mediation of both ovary development and mandibular gland pheromone synthesis in workers.