**Supplementary Material – Appendix 1**

**Supplementary Material – Appendix2**

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**Extended caption Figure 1.**

**Figure 1.** **Framework for discussion of the range of expression of social and individual immune traits ranging from highly constitutive to highly inducible.** Social insect colonies function, in many ways, as a “superorganism” (1-3), which is particularly relevant regarding parasite and pathogen defense. In this manner both the social and individual immune systems have many analogous features (4) and therefore language established for physiological immunity (constitutive vs. inducible immunity) can be extended to the discussion of social immunity (5). Selection of the location for each trait is based on the following, largely honey bee work, but other non-honey bee work was used for this framework as appropriate:

***1) Task allocation*** reduces exposure to and spread of disease, and only changes upon significant loss of one age or task group (6-8)

***2) External use of glandular secretions*** (e.g. venom and metapleural glands) is seen in wasps, bees and ants that spread self-produced compounds on their own cuticles, but also in some cases on others or on nest materials (9-14). These compounds may reduce both colony-level disease and individual infection

***3) GOX and Defensin-1*** in brood food and honey stores aligns more in the range of parental care, appears to be constitutive ((15-17), this paper)

***4)*** ***Resin use*** is largely constitutive but is also induced by certain pathogens in some species (18-25)

***5) Trophallaxis and exchange of antimicrobials*** may be increased in immune challenged individuals (26), but exchange of regurgitates has non-disease related benefits as well as potential benefits for social immunity (27, 28)

***6) Hygienic behavior*** is a highly inducible behavior. While individuals are constantly performing inspection-related behaviors to assess sick versus healthy larvae and pupae, the full suite of the behavior from detection to removal is induced by presence of disease and parasitism (29-32)

***7) Allogrooming*** of sick individuals has been seen to increase; allogrooming can lead to “social vaccination” of nestmates indicating an individual benefit to the behavior (33-35)

***8) Social fever***, an increase in brood/nest temperature, only occurs in response to challenge (36, 37)

***9) The phenoloxidase cascade*** is the major component of insect innate immunity, used to assess constitutive investment in immune function (38, 39)

***10) Self-grooming*** of parasites and pathogens can lead to decrease in individual infection, and at times, colony-level infection (34, 40, 41)

***11) Antimicrobial peptide*** expression is highly induced by infection, however they are regularly present at low levels in apparently healthy individuals (42). Use of some antimicrobial peptides seems to have been co-opted for social defenses and brood rearing, as in the case of Defensin-1 ((16, 17), this study)

***12) Self-medication with nectar antimicrobials and other environmental compounds*** occurs when pathogen-challenged bees selectively prefer certain nectar and nectar based antimicrobial compounds, some of which can reduce infections (43-46). This currently appears to be focused on the individual level, but could also have some social affects.

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