Online Supplementary Material

Social immunity and chemical communication in the honeybee: immune-challenged bees enter enforced or self-imposed exile, by Tarli Conroy and Luke Holman.

The figures and tables in this document, along with the with the R code used to generate them, can also be viewed online at https://lukeholman.github.io/social_immunity/

Table S1: Table summarising the posterior estimates of each fixed effect in the Bayesian multinomial logistic model of Experiment 1. Because there were three possible outcomes for each bee (Stayed inside, Left voluntarily, or Forced out), there are two parameter estimates for each predictor in the model. 'Treatment' is a fixed factor with three levels, and the effects shown here are expressed relative to the 'Intact control' group. The p column gives the posterior probability that the true effect size is opposite in sign to what is reported in the Estimate column, similarly to a p-value.

Response	Parameter	Estimate	Est. Error	Lower 95% CI	Upper 95% CI	PP	
% bees leaving voluntarily	Intercept	-4.94	0.93	-6.97	-3.30	0.0000	***
	Treatment: Ringers	0.59	0.97	-1.43	2.38	0.2570	
	Treatment: LPS	1.57	0.56	0.55	2.73	0.0007	***
% bees forced out	Intercept	-3.59	0.81	-5.24	-2.00	0.0000	***
	Treatment: Ringers	0.60	0.46	-0.31	1.50	0.0977	~
	Treatment: LPS	1.16	0.37	0.46	1.93	0.0001	***

Table S2: This table gives statistics associated with each of the contrasts plotted in Figure 1B. Each pair of rows gives the absolute effect size (i.e. the difference in % bees) and standardised effect size (as log odds ratio; LOR) for the focal treatment, relative to the treatment shown in parentheses, for one of the three possible outcomes (Stayed inside, Left voluntarily, or Forced out). A LOR of $|log(x)|$ indicates that the outcome is x times more frequent in one treatment compared to the other, e.g. $log(2) = 0.69$ and $log(0.5) = -0.69$ correspond to a two-fold difference in frequency. The PP column gives the posterior probability that the true effect size has the same sign as is shown in the Estimate column; this metric has a similar interpretation to a one-tailed p value.

Response	Comparison	Metric	Estimate	Est. Error	Lower 95% CI	Upper 95% CI	PP	
% bees staying inside	LPS (Ringers)	Difference in % bees staying inside	-6.50	6.26	-22.41	1.41		
		Log odds ratio	-0.65	0.42	-1.52	0.14	0.0516	~
	LPS (Intact control)	Difference in % bees staying inside	-11.22	8.64	-31.40	-1.03		
		Log odds ratio	-1.27	0.35	-2.00	-0.60	0.0000	***
	Ringers (Intact control)	Difference in % bees staying inside	-4.72	5.83	-20.54	1.53		
		Log odds ratio	-0.62	0.48	-1.59	0.30	0.0902	~
% bees leaving voluntarily	LPS (Ringers)	Difference in % bees leaving voluntarily	2.26	3.37	-2.86	10.72		
		Log odds ratio	0.92	0.88	-0.63	2.79	0.1392	
	LPS (Intact control)	Difference in % bees leaving voluntarily	3.53	3.45	0.08	12.40		
		Log odds ratio	1.46	0.57	0.42	2.64	0.0029	**
	Ringers (Intact control)	Difference in % bees leaving voluntarily	1.27	2.91	-1.97	9.71		
		Log odds ratio	0.55	0.97	-1.46	2.33	0.2716	
% bees forced out	LPS (Ringers)	Difference in % bees forced out	4.24	5.60	-1.24	20.39		
		Log odds ratio	0.54	0.37	-0.18	1.29	0.0743	~
	LPS (Intact control)	Difference in % bees forced out	7.69	8.14	0.54	28.33		
		Log odds ratio	1.12	0.37	0.41	1.89	4e-04	***
	Ringers (Intact control)	Difference in % bees forced out	1.27	2.91	-1.97	9.71		
		Log odds ratio	0.55	0.97	-1.46	2.33	0.2716	

Table S3: Table summarising the posterior estimates of each fixed effect in the model of Experiment 2. This was a multinomial model with three possible outcomes (Stayed inside, Left voluntarily, or Forced out), and so there are two parameter estimates for each predictor in the model. 'Treatment' is a fixed factor with two levels, and the effect of LPS shown here is expressed relative to the 'Ringers' treatment. The PP column gives the posterior probability that the true effect size is opposite in sign to what is reported in the Estimate column, similarly to a p-value.

Response	Parameter	Estimate	Est. Error	Lower 95% CI	Upper 95% CI	PP	
% bees leaving voluntarily	Intercept	-3.42	0.55	-4.60	-2.39	0.0000	***
	Treatment: LPS	0.35	0.44	-0.51	1.21	0.2132	
% bees forced out	Intercept	-3.65	0.62	-4.96	-2.47	0.0000	***
	Treatment: LPS	1.08	0.43	0.27	1.96	0.0046	**

Table S4: This table gives statistics associated with each of the contrasts plotted in Figure 2B. Each pair of rows gives the absolute (i.e. the difference in % bees) and standardised effect size (as log odds ratio; LOR) for the LPS treatment, relative to the Ringers control, for one of the three possible outcomes (Stayed inside, Left voluntarily, or Forced out). A LOR of $|log(x)|$ indicates that the outcome is x times more frequent in one treatment compared to the other, e.g. $log(2) = 0.69$ indicates a two-fold difference in frequency. The PP column gives the posterior probability that the true effect size has the same sign as is shown in the Estimate column; this metric has a similar interpretation to a one-tailed p value in frequentist statistics.

Response	Metric	Estimate	Est. Error	Lower 95% CI	Upper 95% CI	PP	
% bees staying inside	Absolute difference in % bees staying inside	-10.16	4.45	-19.54	-2.19		
	Log odds ratio	-0.81	0.33	-1.46	-0.18	0.0051	**
% bees leaving voluntarily	Absolute difference in % bees leaving voluntarily	1.12	2.23	-3.06	5.92		
	Log odds ratio	0.24	0.44	-0.63	1.10	0.2953	
% bees forced out	Absolute difference in % bees forced out	9.04	4.20	1.96	18.30		
	Log odds ratio	1.06	0.43	0.25	1.93	0.0053	**

Table S5: Table summarising the posterior estimates of each fixed effect in the model of Experiment 3 (a binomial GLMM where the response variable was 0 when bees were not in close contact, and 1 when they were). 'Treatment' is a fixed factor with two levels, and the effect of LPS shown here is expressed relative to the 'Ringers' treatment. 'Hive' was a fixed factor with four levels (modelled using deviation coding). The model also included one random effect, 'pair ID', which grouped observations made on each pair of bees, preventing pseudoreplication. The PP column gives the posterior probability that the true effect size is opposite in sign to what is reported in the Estimate column, similarly to a p-value.

Parameter	Estimate	Est. Error	Lower 95% CI	Upper 95% CI	PP	
Intercept	1.67	0.14	1.39	1.94	0.0000	***
Treatment: LPS	-0.37	0.20	-0.75	0.02	0.0322	*
hive1	-0.20	0.18	-0.55	0.15	0.1343	
hive2	0.14	0.16	-0.17	0.46	0.1860	
hive3	-0.23	0.18	-0.58	0.12	0.0999	~

Table S6: Pairs in which one bee had received LPS were observed in close contact less frequently than pairs in which one bee had received Ringers. The PP column gives the posterior probability that the true effect size is opposite in sign to what is reported in the Estimate column, similarly to a p-value.

Metric	Estimate	Est.Error	Lower 95% CI	Upper 95% CI	PP	
Absolute difference in % time in close contact	5.55	3.0	-0.35	11.45		
Log odds ratio	-0.37	0.2	-0.75	0.02	0.0322	*