

## Supplementary Material

# Similarities in the behaviour of dance followers among honey bee species suggest a conserved mechanism of dance communication

Ebi Antony George<sup>1\*</sup>, Smruti Pimplikar<sup>1</sup>, Neethu Thulasi<sup>1</sup>, Axel Brockmann<sup>1</sup>

<sup>1</sup> National Centre for Biological Sciences, Bangalore, India – 560065

### ORCID

E.A.G.: 0000-0002-5533-5428

S.P.: 0000-0002-6683-5946

N.T: 0000-0003-4702-8900

A.B.: 0000-0003-0201-9656

\* corresponding author:

Ebi Antony George

Email ID: ebiantonyg@ncbs.res.in, ebi.antony.george@gmail.com

## Tables

Table S<sub>1</sub>

Distance (m)	<i>Apis florea</i>			<i>Apis dorsata</i>			<i>Apis cerana</i>		
	Bees	Dances	Waggle Runs	Bees	Dances	Waggle Runs	Bees	Dances	Waggle Runs
100	5	9	65	1	1	47	4	8	94
200	3	7	50	2	2	26	3	7	79
300	7	9	65	2	2	28	5	7	84
400	7	8	85	1	2	18	4	6	62
500	5	8	65	-	-	-	3	7	92

List of bees, dances and waggle runs analysed for each of the 3 *Apis* species in this study.

Table S<sub>2</sub>

Model Number	Conditional Model				Zero-inflation Model		
	Zone	Waggle Run Phase	Species	Distance	Zone	Waggle Run Phase	Species
1	+					+	
2		+			+	+	+
3			+		+	+	+
4				+	+	+	+
5	+	+			+	+	+
6	+		+		+	+	+
7	+			+	+	+	
8		+	+		+	+	+
9		+		+	+	+	+
10			+	+	+	+	+
11	*	*			+	+	+
12	*		*		+	+	+
13	*			*	+	+	+
14		*	*		+	+	+
15		*		*	+	+	+
16			*	*	+	+	+
17	+	+	+		+	+	+
18	*	*	+		+	+	+
19	*	+	*		+	+	+
20	+	*	*		+	+	
21	+	+	+	+	+	+	
22	*	*	+	+	+	+	+

23	*	+	*	+	+	+	+
24	*	+	+	*	+	+	+
25	+	*	*	+	+	+	+
26	+	*	+	*	+	+	+
27	+	+	*	*	+	+	

List of models used in the model selection and model averaging. All models had the number of followers as the response and were zero-inflated Poisson models with the bee ID as a random effect. The predictors present in the conditional part of each model are either the zone of the follower, the waggle run phase, the species, the distance or a combination thereof. A '+' indicates that the predictor was encoded in the model without an interaction term, whereas an '\*' indicates that two predictors in the model were encoded with an interaction term between them. Only 2-way interactions were included in conditional part of the models. The predictors present in the zero-inflated part of the model were usually the zone of the follower, the waggle run phase and the species. In five models, due to overfitting, we had to reduce the number of predictors in the zero-inflated part of the model. No interactions were included in the zero-inflated part of the model.

**Table S<sub>3</sub>**

Model Number	Degrees of Freedom	Log Likelihood	AICc	Delta AICc	Weight
<i>18</i>	<i>19</i>	<i>-10983.45</i>	<i>22005.0</i>	<i>0.00</i>	<i>0.662</i>
22	20	-10983.17	22006.5	1.45	0.321
27	16	-10990.14	22012.3	7.35	0.017
19	19	-11002.89	22043.9	38.88	0.000

List of the top four models based on their AICc values for the analysis on the number of followers. For each model, the model number (see Table S<sub>1</sub> for predictors), the degrees of freedom, log likelihood, AICc, delta AICc and the weight is provided. Only model 18 (highlighted in italics) was present in the final shortlist of models based on a cut-off value of 0.95 of the cumulative sum of weights.

**Table S<sub>4</sub>**

Model	Predictors			Effect Size	CI	p value
	Zone*	Waggle Run Phase*	Species			
Conditional Model	Anterior	Start	Apis florea	0.2054	0.039 - 0.3718	0.0155
	Lateral	Start	Apis florea	0.4916	0.2371 - 0.7462	< 0.0001

	Posterior	Start	Apis florea	0.2625	0.0038 - 0.5212	0.2253
	Anterior	Middle	Apis florea	0.1279	-0.1336 - 0.3893	0.1102
	Anterior	End	Apis florea	0.0973	-0.1648 - 0.3594	0.0270
	Anterior	Start	Apis dorsata	0.2292	-0.0124 - 0.4708	0.5347
	Anterior	Start	Apis cerana	-0.0357	-0.2462 - 0.1748	< 0.0001
	Lateral	Middle	Apis florea	0.5972	0.1272 - 1.0673	0.0029
	Posterior	Middle	Apis florea	0.6309	0.1541 - 1.1078	< 0.0001
	Lateral	End	Apis florea	0.6810	0.2106 - 1.1514	< 0.0001
	Posterior	End	Apis florea	0.6283	0.1503 - 1.1064	< 0.0001
Zero-inflation Model	Anterior	Start	Apis florea	-2.7763	-4.0726 - -1.4799	< 0.0001
	Lateral	Start	Apis florea	-16.7564	-1908.6021 - 1875.0893	0.9884
	Posterior	Start	Apis florea	-21.0202	-8141.7127 - 8099.6723	0.9965
	Anterior	Middle	Apis florea	-21.1792	-8912.0147 - 8869.6564	0.9968
	Anterior	End	Apis florea	-21.3387	-9681.5457 - 9638.8683	0.9970
	Anterior	Start	Apis dorsata	-18.2326	-3570.3292 - 3533.8641	0.9932
	Anterior	Start	Apis cerana	-21.7804	-10748.4043 - 10704.8435	0.9972

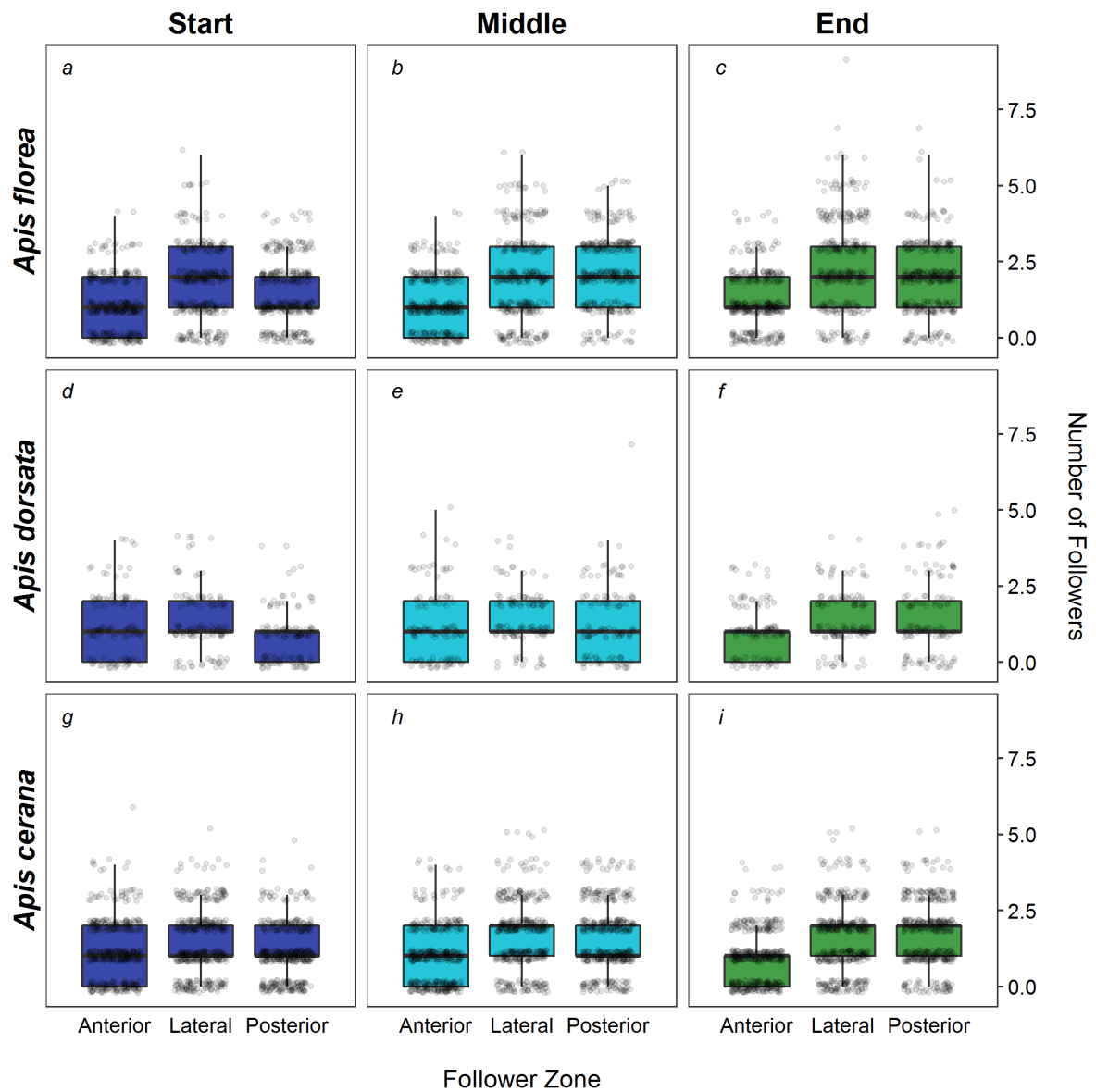
List of predictors in the shortlisted model 18 for the analysis of the number of followers. For each predictor level in the final model, the effect size and confidence interval (CI) are given. In addition, the  $p$  value based on the comparison between the base contrast level (Anterior, Start, *Apis florea*) and the other levels obtained from the model summary is also provided [In the case of the base contrast level, the  $p$  value is based on whether the effect size is significantly different from zero]. The predictors marked with an \* were present as an interaction term in the conditional model. In the zero-inflation part of the model, there are no interaction terms.

**Figure S1**



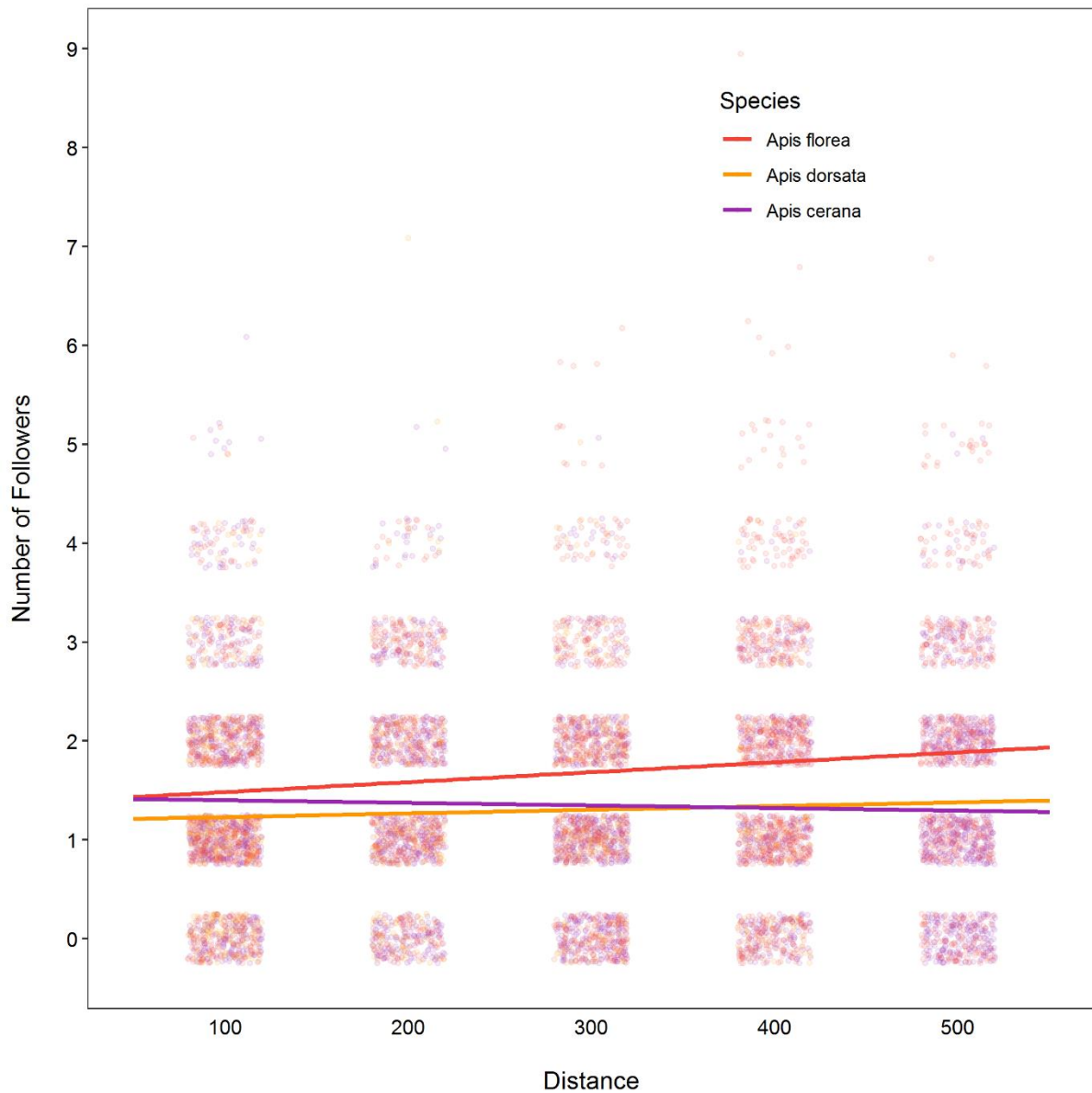
(a) A photo of the botanical garden in GKVK, Bangalore, where the experiments were performed with all the 3 species. This image is at distance of zoom from the hive in the transect used for both *A. florea* and *A. cerana*. (b) The box in which *A. florea* colonies were kept during the feeder training and dance observations. Foragers utilised the crown area of the comb as the dance floor for recruitment of the nest mates. (c) The feeder box used to train *A. dorsata* foragers. (d) The observation hive used for housing the *A. cerana* colony (picture courtesy Patrick Kohl). The observation hive had a glass wall on the side towards the entrance, which allowed us to record dances happening in the first frame (which acted as the dance floor).

Figure S2



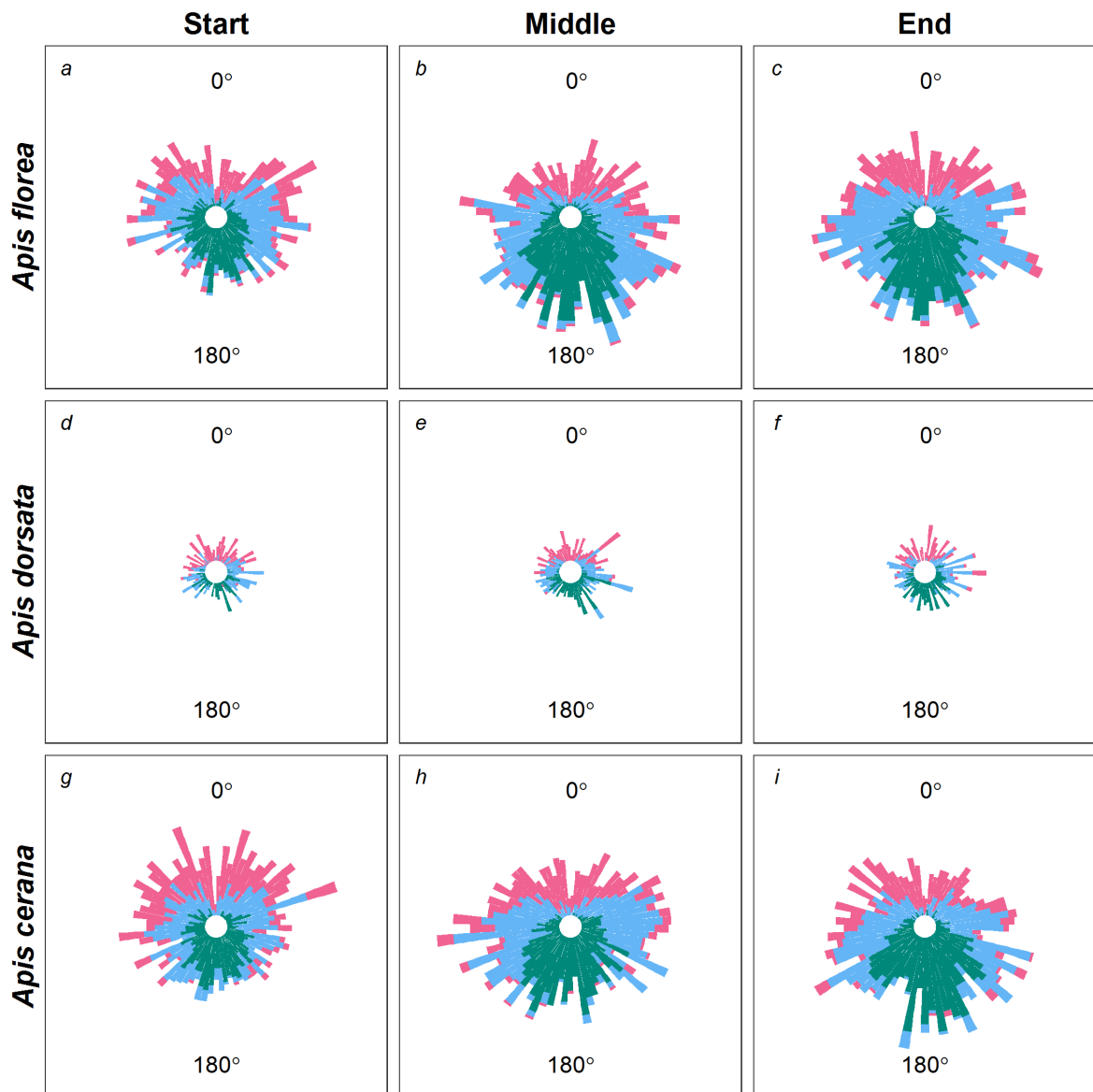
Boxplots (with the median and the quartile ranges) representing the number of followers present in each zone over the 3 phases of the waggle run for all 3 species. Each circle represents the number of followers present in one waggle run. The boxplots are filled according to the waggle run phase, with blue representing the start, cyan representing the middle and green representing the end of the waggle run.

Figure S3



Correlation between distance and the number of followers in all 3 species. The line represents the best fitting linear correlation with each circle representing data from one run. The lines and circles are coloured according to the species, with red for *A. florea*, orange for *A. dorsata* and purple for *A. cerana*. There was no significant effect of distance on the number of followers in a waggle run in either of the 3 species, as can be seen from the horizontal lines.

Figure S4



Circular histogram of the body orientation of the followers with respect to the dancer. Each bar represents the number of followers in a bin width of 5°. A follower at 0° is facing the dancer and a follower at 180° is exactly behind the dancer. The bars are coloured based on the zones occupied by the follower with pink for followers in the Anterior zone, blue for followers in the Lateral zone and green for followers in the Posterior zone.