In our experiments, waggle phase duration did not show a simple linear relationship with distance in both species. Further, we found that in *A. cerana*, the mean waggle phase durations, and the spread of the accompanying distribution, for the lower distances were higher in the Sparse vegetation conditions as opposed to the Dense vegetation conditions (e.g., 200 m distribution, Fig. 2B in the main manuscript). We performed two additional analyses to investigate the non-linearity in the waggle phase duration. We did this as most previous studies on the waggle dance behaviour have modelled the relationship between waggle phase and distance as linear.

LMM for Waggle Phase duration in *A. florea*

In the first analysis, we built a linear mixed effects model (LMM) to compare the slope of the calibration curve (change in waggle phase duration with distance) in the two vegetation conditions in *A. florea*. We could do this for *A. florea*, but not for *A. cerana* as the model assumption of homoscedasticity was not validated in the case of the LMM for *A. cerana*. The model structure was similar to the non-linear mixed effects model (NLMM), with the waggle phase duration (in seconds) as the response variable, an interaction between distance (in metres) and the visual contrast condition as the predictor variable and Bee ID as the random effect on the intercept. We then compared the results obtained from the NLMM described in the main text with the results of this LMM.

We found that the LMM also gave the same results as the NLMM. The waggle phase duration increased with distance, but this increase was significantly higher in the Dense vegetation condition as compared to the Sparse vegetation condition (Fig. 1; difference estimate between slopes in Dense and Sparse condition = 0.0018 s/m, confidence interval = 0.0010 - 0.0026, $t = 4.2039$, $p = 0.0001$).

Effect of Intermediate Dances

On finding food at a new location, not all honey bee foragers immediately update their waggle phase duration to reflect the new location of the food source (Chatterjee et al., 2019). Most foragers can take up to 3 waggle dances to show the changed waggle phase duration. In the dances before the change-point, these foragers show waggle phase durations which are intermediate between the durations for the old location and the new location. In our experiments, we could not ensure that none of the recorded dances encoded intermediate waggle phase durations. This is because we had a short time window in which to perform the experiments. *Apis florea* and *A. cerana* are known to abscond relatively easily as compared to *A. mellifera*. In addition, the shifting of the colonies to two new locations within a week increased the likelihood of the colonies absconding.

In our second analysis, we tried to account for the effects of these potential intermediate dances. For *A. cerana,* we calculated the dance number after the shift for each dance analysed for each individual forager. We then produced a second dataset removing all the dances that would potentially have intermediate waggle phase durations (first to third dance at each distance for each forager) and performed the same analysis as in the main manuscript on this dataset. In total, after removing intermediate dances, we had 57 dances (out of the initial 100) in our second dataset.

Results

We found that in the LMMs for waggle phase duration and return phase duration built based on this second dataset, the model assumption of homoscedasticity was not validated. We then fitted NLMMs for both these parameters. For the number of dance circuits, we fitted a negative binomial mixed effects model as described in the manuscript.

The pattern of the slopes was the same for all parameters, with no significant difference between the slopes for the two vegetation conditions in all three dance parameters (Table 1). Additionally, there was no effect of distance on the slope in the case of the number of dance circuits also. Thus, the removal of potential intermediate dances does not make our dataset linear nor does it affect the results obtained in our main analysis.

The relationship between circuit duration (which includes both waggle phase and return phase duration) and distance has been described as monotonic before (Dyer, 2002) and in a previous study two separate linear segments were fit to the non-linear curve linking circuit duration and distance (Dyer and Seeley, 1991). We believe that future studies should take into consideration a non-linear relationship between the waggle phase and distance as the nature of the relationship between the spatial information signal and distance is important to understand the benefits of the signal itself.

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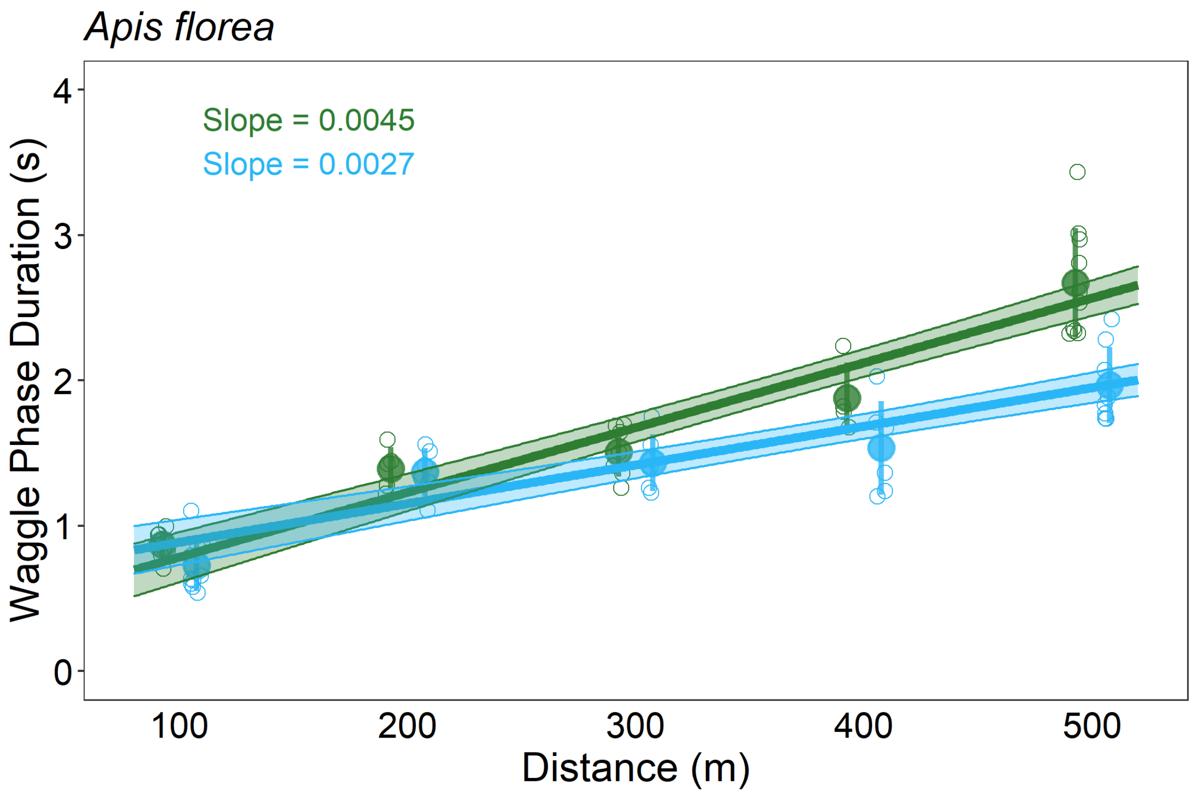
Table 1

Parameters	Analysis of All Dances			Analysis without Intermediate Dances		
	Dense	Sparse	*p* value	Dense	Sparse	*p* value
Waggle Phase Duration	0.863	0.998	0.186	1.075	0.864	0.472
Return Phase Duration	0.670	0.408	0.255	0.545	0.445	0.704
Number of Waggle Circuits	-0.0002	-0.0003	0.893	-0.00003	-0.0010	0.285

Comparison of the analysis including the whole dataset and the analysis of the dataset without potential intermediate dances in *A. cerana*. The slopes for the Dense and Sparse vegetation conditions, as well as the p values associated with the difference estimates between the slopes are provided

Figure 1



Waggle phase duration (in seconds) with distance (in metres) in both vegetation conditions in *A. florea*. The mean waggle phase duration for individual dances (open circles), along with the mean of all the dances and the standard deviation (closed circles with error bars) is plotted. Overlaid on top of this is the predicted line and confidence interval associated with this prediction (at the fixed effects level) obtained from the LMM. The slope values, circles, lines and confidence interval region are coloured based on the vegetation condition, with green for Dense vegetation and blue for Sparse vegetation.