**Supplementary Information**

**“Rational time investment during collective decision making in *Temnothorax* ants”**

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*Nest designs*

To test for irrational time investment, we designed three target nests, namely, ‘good’, ‘mediocre’, and ‘poor’. These nest designs were identical except for the cavity light level. Given that *Temnothorax* ants and colonieshave a strong preference for dimmer cavities [1,2], the good and poor nests had dark (1 lux) and bright (120 lux) interiors, respectively. The mediocre nest had intermediate brightness (42 lux). The base of each nest was composed of a glass microscope slide (50 x 75 x 1 mm) secured beneath a balsa wood slat (50 x 75 x 3 mm). A circular hole (40 mm diameter) was bored through the middle of the slat to create the nest cavity as well as a 4 mm wide entrance (see [3] for further details of the nest design). The roof was composed of two identical glass slides stacked on top of one another. Interior illumination was adjusted by placing transparent neural density filters (Rosco Cinegel) between the roof slides. This design prevented ants from directly contacting the filters, which can build up an electrostatic charge that the ants find repellent. The design of home nest, in which all colonies lived when they were not in the experiment, was identical to that of these target nests except the interior light level (60 lux). Nests were illuminated by two dimmable LED lights (GVM LED-480LS) placed 40 cm above the bench on which all experiments were conducted. This provided even illumination of 840 lux at the benchtop as measured by a light meter (Dr. Meter LX1330B). The light level of each nest type was measured using a chipboard sheet for the nest floor instead of the glass slide; we made a small hole and inserted the probe of the light meter.

*Subjects*

Because a minority of workers in *Temnothorax* colonies participate actively in nest-site migrations [4,5], we selected workers who retrieved brood items outside of the home nest as ‘active’ ants (see [6] for a detailed description of this procedure). All colonies had at least one queen, a worker population ranging between 60 and 205 individuals, and approximately 50 to 200 brood items. Colonies were collected on the Isle of Portland near Weymouth, UK (50°32'13.2"N 2°27’12.4”W). In the lab, colonies were housed in standard home nests described above and kept in plastic boxes (17.5 x 12.5 x 5.5 cm) with Fluon-coated walls. Each colony was provided with water and weekly fed with sucrose solution and dead *Drosophila*.

*Experimental Procedure*

To test if similarity of choice quality affects decision-making latency, we provided two different binary choices to each subject (colonies and lone ants). The first binary choice was between a good nest and a poor nest (GvsP) and the second was between a good nest and a mediocre nest (GvsM). The first choice had a greater difference in quality than the second one. Note that the better option, and thus the one more likely to be chosen, was identical in both choices. The only difference between these choices was the worse option.

In each test, all subjects were first forced to move into a home nest. For colonies, we placed both their original home nest, which contained a whole colony, and a new home nest of the same design next to each other into an experimental arena (24 x 24 x 7 cm). The roof of the original home nest was then removed to induce a migration. All colonies successfully moved to their new home nest within 24 hours. For individuals, before introducing an individual to the arena, we placed a new home nest into the arena and deposited three brood items nearby. In approximately 94% of individual tests (73/78), ants successfully transported the brood into the home nest within 24 hours. The individuals who failed to do so were returned to their colonies and were not used for the test.

Following successful relocation to the home nest, one of the two binary choices (GvsP or GvsM) was presented to the subject. After removing the roof of the home nest, we recorded the whole arena for 13 hours using a video camera (Sony FDR-AX100E). We later used these videos to determine each subject’s choice and how long it took to make it. In both individual and colony tests, decision-making latency was defined as the time between removal of the home nest roof and transport of the last brood item to the new site [7]. Individual ants always showed an unambiguous choice by transporting all the brood items into one site, while colonies sometimes split between sites. If one site contained all queens and brood items, as well as over 90% of colony members, we designated that as the colony’s choice. This criterion was not met in 5 out of 60 trials (4 in the GvsM choice and 1 in the GvsP choice). Furthermore, while all colonies successfully moved to a new nest, 12 individuals failed to transport the brood items within 13 hours (6 in the GvsM choice and 6 in the GvsP choice).

All subjects faced both the binary choices, but half of them did the GvsM choice first and the other half did the GvsP choice first. The period between the two choices was two to three weeks because past research has suggested that retention of memory for these ants is less than two weeks [8]. In the individual condition, all ants were returned to their original colony between the tests. Each of these ants was marked with a unique paint drop on its gaster before the first test so that it could be identified and retrieved for the second test [1]. Before each test, all glass slides were washed using commercial dish soap and wiped with ethanol, and the experimental arena was cleaned with ethanol. Balsa slats were made fresh for each experiment and never reused.

*Analysis*

Because we were interested in how similarity of choice quality would affect latencies for choosing the better option, we first analyzed only the cases where the good option was chosen, as in a previous human study [9]. In this analysis, we log-transformed decision-making latencies and used a general linear mixed model to compare them between the GvsM and GvsP conditions within each subject group (individuals or colonies). For the individual data, each colony provided two ants, creating a potential problem with pseudoreplication. To account for this, we included colony as a random effect in the model. For the colony data, we included numbers of workers and brood items as random effects. The normality of residuals and equality of variances were checked using a Shapiro’s test and a Levene’s test, respectively. The assumptions for a linear model were met for the log-transformed data (p > 0.05 for Shapiro’s and Levene’s tests).

To test robustness of the outcome, we also analyzed all the data points, including the cases where the poor nest was chosen and no nest was chosen within 13 hours (i.e. the censored data). We compared the latencies between conditions via survival curves fit using the Cox proportional-hazards regression model, which can account for censored data points. As the parametric test showed (Figure 2), individuals made faster decisions for the GvsP choice than for the GvsM choice, although it was not significant in the survival analysis (P = 0.22; Figure S1). In colonies, on the other hand, the decision-making latency was shorter for the GvsM choice than for the GvsP choice (P = 0.02; Figure S1), consistent with the results of the parametric test (Figure 2),



Figure S1. Decision-making latencies for individuals and colonies. Latencies are represented as survival curves showing the decline in number of undecided subjects over time (faster decisions give steeper declines). Black and red lines show decisions in the more similar choice (Good nest vs Mediocre nest) and in the less similar choice (Good nest vs Poor nest), respectively.

All statistical tests were performed in Rstudio version 1.0.136. Data and R scripts are available on Dryad, DOI: tbc upon acceptance.

**References**

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