

Supplementary information for:

Wild chimpanzees remember and revisit concealed, underground army ant nest locations throughout multiple years

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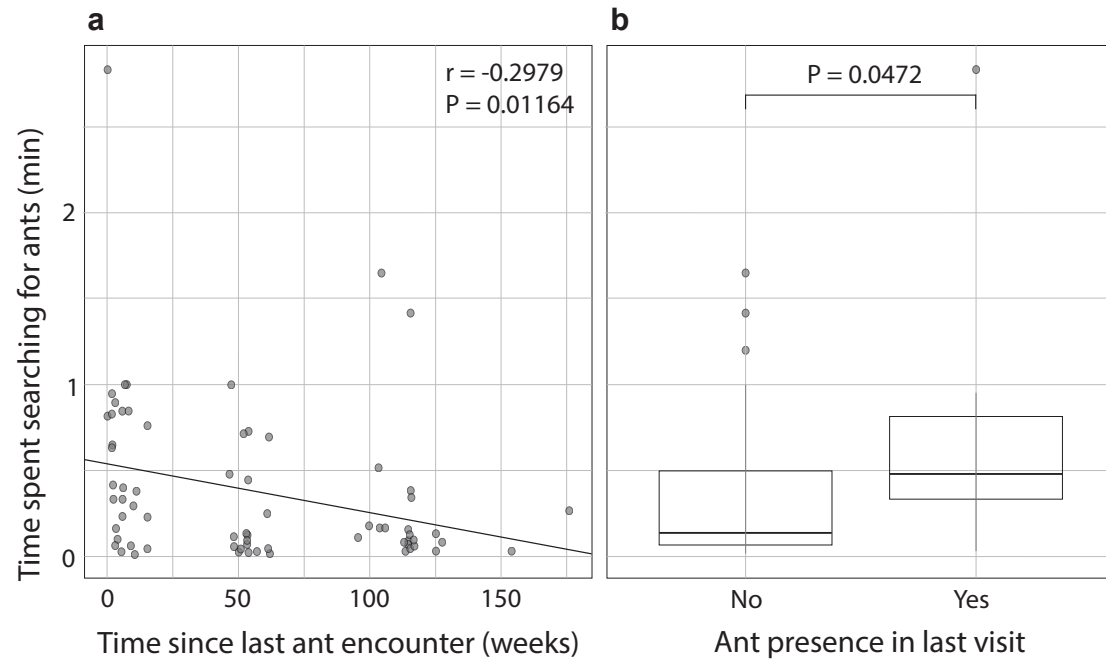


Figure S1. Chimpanzees invested more time inspecting an ant nest when they had recently found ants at that same nest. a, The time that an individual chimpanzee spent inspecting a given army ant nest decreased as the time since the same chimpanzee last found ants in that same nest increased ($N = 71$ chimpanzee revisits; Supplementary Data 5). Data are presented in min (Y-axis) and weeks (X-axis). **b**, Chimpanzees spent more time inspecting a nest in which they had found ants during their last visit ($N = 73$ chimpanzee revisits; Supplementary Data 5).

Table S1. Research questions, hypotheses, and predictions to investigate how chimpanzees find army ant nests and verify army ant presence within, and whether we found support for each prediction.

Research questions	Hypotheses	Predictions	Results
How do chimpanzees find army ant nests?	They use spatial memory to find ant nests	Individual chimpanzees repeatedly visit individual army ant nests throughout the year	Supported
		Individual chimpanzees repeatedly visit individual army ant nests throughout different years	Supported
		Chimpanzees are present in ant nest sites more often than in sites without ant nests in the same vegetation types and during the same years	Supported
	They find ant nests opportunistically	Individual chimpanzees do not revisit individual army ant nests	Not supported
		Chimpanzees are present in ant nest sites as often as, or less often than in sites without ant nests in the same vegetation types and during the same years	Not supported
Do chimpanzees remember past ant nest visits?	They use episodic memory to remember past ant nest visits	Individual chimpanzees revisit sooner ant nests in which they found ants in their last visit versus in which they had not	Supported
		Individual chimpanzees inspect for longer time ant nests in which they found ants in their last visit versus in which they had not	Supported
How do chimpanzees verify army ant presence inside a nest?	They use sight	Chimpanzees remove vegetation gathered at the nest entrance, such as dead leaves, that may impede them to see the entrance without removing the vegetation	Supported
		Chimpanzees visually inspect the ant nest entrance	Supported
		Chimpanzees visually inspect tools after inserting them in the ant nest	Supported
		Chimpanzees visually inspect their hands after inserting them in the ant nest	Supported
	They use smell	Chimpanzees bring their nose close to the ant nest entrance	Supported
		Chimpanzees bring tools close to their nose after inserting them in the ant nest	Supported
		Chimpanzees bring their hands close to their nose after inserting them in the ant nest	Supported
	They use hearing	Chimpanzees bring their ear close to the ant nest entrance	Not supported
	They use taste	Chimpanzees put tools into their mouth after inserting them in the ant nest	Supported
		Chimpanzees put their hands into their mouth after inserting them in the ant nest	Supported

Table S2. Chimpanzee fresh faeces collected in Dindefelo from October 2021 to July 2022 (N = 85), and the percentage of faeces containing army ants each month.

Month and year	Number of faeces	Percentage of faeces with army ants
October 2021	10	80%
November 2021	12	0%
December 2021	19	10.5%
January 2022	17	0%
February 2022	5	40%
May 2022	12	25%
June 2022	4	0%
July 2022	6	16.7%

We did not find faeces in March and April 2022.

Table S3. Number of individually identified chimpanzees that visited (once) and revisited (more than once) each of the four monitored army ant nests, and the mean visits and revisits per individual. We defined an ant nest visit as the instance in which a chimpanzee appeared in an ant nest site and interacted with the ant nest, either to consume ants (successful visit) or to look for them (unsuccessful visit). The number of visits per individual includes all instances in which we recorded a chimpanzee visiting a single ant nest, including those who we identified doing so only once. The number of revisits per individual includes only the instances in which we recorded a chimpanzee revisiting a single ant nest (more than once). The number of days and years represent the different days and years in which a given chimpanzee visited a given ant nest. See Table S3 for the visits and revisits to each ant nest by each individual separately.

	Ant nest			
	A	B	C	D
N visiting individuals	18	12	6	12
Visits per individual				
Mean number of visits	8.4 ± 9.4	3.1 ± 4.4	1.3 ± 0.5	3.4 ± 2.8
± SD (range)	(1–34)	(1–15)	(1–2)	(1–10)
Mean number of days	7 ± 7.1	2.7 ± 3.5	1.2 ± 0.4	2.5 ± 1.6
± SD (range)	(1–25)	(1–12)	(1–2)	(1–5)
Mean number of years	2.8 ± 1.5	1.3 ± 0.7	1.2 ± 0.4	1.4 ± 0.8
± SD (range)	(1–5)	(1–3)	(1–2)	(1–3)
N revisiting individuals	14	4	2	7
(% of visiting individuals)	(82.4%)	(33.3%)	(33.3%)	(58.3%)
Revisits per individual				
Mean number of revisits	10.6 ± 9.6	7.3 ± 5.7	2	5 ± 2.7
± SD (range)	(2–34)	(3–15)		(2–10)
Mean number of days	8.7 ± 7.2	6.0 ± 4.5	1.5 ± 0.7	3.4 ± 1.5
± SD (range)	(2–25)	(2–12)	(1–2)	(1–5)
Mean number of years	3.4 ± 1.3	2 ± 0.8	1.5 ± 0.7	1.7 ± 1
± SD (range)	(1–5)	(1–3)	(1–2)	(1–3)

Table S4. Total recording days and days when chimpanzees were recorded in the four ant nest sites and in the four similar sites without ant nests. Sites without ant nests shared the same vegetation types and were recorded during the same years. For ant nest sites, we report the days when chimpanzees interacted with the army ant nest, including both successful and unsuccessful visits.

Site	Vegetation type	Ant nest site	Days with chimpanzees (percentage and number of recording days)	Dates when chimpanzee visited the ant nests, dd/mm/yy (total number, percentage of days with chimpanzees)
A	Gallery forest	Yes	241 (30.4%, N = 792)	29/1/18, 3/2/18, 4/2/18, 5/2/18, 8/2/18, 10/2/18, 12/2/18, 14/2/18, 16/2/18, 17/2/18, 19/2/18, 26/2/18, 27/2/18, 1/3/18, 13/3/18, 14/3/18, 15/3/18, 17/3/18, 18/3/18, 21/3/18, 22/3/18, 26/3/18, 27/3/18, 31/3/18, 1/4/18, 2/4/18, 4/4/18, 8/4/18, 11/4/18, 13/4/18, 14/4/18, 15/4/18, 18/4/18, 22/4/18, 23/4/18, 28/4/18, 22/5/18, 7/1/19, 8/1/19, 11/1/19, 20/1/19, 22/1/19, 23/1/19, 25/1/19, 30/1/19, 5/2/19, 7/2/19, 9/2/19, 10/2/19, 30/3/19, 31/3/19, 1/4/19, 3/4/19, 5/4/19, 6/4/19, 7/4/19, 9/4/19, 10/4/19, 11/4/19, 12/4/19, 13/4/19, 14/4/19, 15/4/19, 18/4/19, 20/4/19, 21/4/19, 13/6/19, 4/12/19, 7/12/19, 13/12/19, 20/12/19, 25/12/19, 2/1/20, 7/1/20, 10/1/20, 11/1/20, 13/1/20, 16/1/20, 23/1/20, 24/1/20, 25/1/20, 27/1/20, 28/1/20, 29/1/20, 1/2/20, 2/2/20, 3/2/20, 4/2/20, 6/2/20, 15/2/20, 17/2/20, 19/2/20, 21/2/20, 23/2/20, 24/2/20, 28/2/20, 29/2/20, 4/3/20, 5/3/20, 13/3/20, 18/3/20, 19/3/20, 21/3/20, 28/3/20, 30/3/20, 2/3/20, 4/4/20, 5/4/20, 11/4/20, 12/4/20, 19/4/20, 22/5/20, 3/1/21, 9/1/21, 12/1/21, 13/1/21, 14/1/21, 16/1/21, 21/1/21, 22/1/21, 13/1/21, 9/4/21, 11/4/21, 15/4/21, 20/4/21, 15/5/21, 14/6/21, 18/6/21, 20/6/21, 23/6/21, 2/7/21, 10/11/21, 5/1/22, 7/1/22, 8/1/22, 11/1/22, 12/1/22, 13/1/22, 15/1/22, 17/1/22, 21/1/22, 10/3/22, 15/3/22, 16/3/22, 22/3/22, 23/3/22, 24/3/22, 25/3/22, 29/3/22, 30/3/22, 31/3/22, 2/4/22, 3/4/22, 30/5/22, 2/6/22, 5/6/22, 6/6/22, 11/6/22, 22/6/22, 24/6/22, 3/7/22 (161, 66.8%)
B	Gallery forest	Yes	54 (13.3%, N = 406)	1/2/18, 3/3/18, 5/3/18, 12/3/18, 14/4/18, 15/5/18, 16/5/18, 3/5/18, 22/1/20, 22/1/21, 25/1/21, 28/5/21, 1/2/21, 10/2/21, 11/3/21, 14/3/21, 18/3/21, 19/3/21, 22/3/21, 25/3/21, 29/3/21, 30/3/21, 6/4/21, 8/4/21, 26/4/21, 2/5/21, 15/5/21, 30/5/21, 2/6/21, 7/6/21, 14/6/21, 18/3/22, 23/3/22, 26/3/22, 6/5/22, 13/5/22, 28/5/22, 5/6/22 (39, 72.2%)
C	Woodland	Yes	36 (20.2%, N = 178)	22/1/20, 23/1/20, 24/1/20, 25/1/20, 6/3/20, 6/4/21, 18/9/21, 19/9/21, 20/9/21, 21/9/21, 25/9/21, 26/9/21, 31/3/22, 17/4/22, 23/4/22 (16, 44.4%)
D	Gallery forest	Yes	21 (21.4%, N = 98)	29/11/21, 8/1/22, 14/1/22, 4/2/22, 10/2/22 (5, 23.8%)

In three occasions, due to camera malfunctioning, we were unable to obtain the exact dates of the videos that were recorded in a period of two weeks (in February 2021 for sites A and B, and in December 2021 for site C). In these cases, we conservatively assumed that all videos belonged to one day, which was the minimum number of days we could confirm. These days were added to the total number of days when successful and unsuccessful visits occurred but are not listed here because the exact date is unknown.

Table S4. (cont.)

Site	Vegetation type	Ant nest site	Days with chimpanzees (percentage and number of recording days)	Dates when chimpanzee visited the ant nests, dd/mm/yy (total number, percentage of days with chimpanzees)
E	Gallery forest	No	32 (5.2%, <i>N</i> = 611)	-
F	Gallery forest	No	38 (4.4%, <i>N</i> = 863)	-
G	Gallery forest	No	20 (4.1%, <i>N</i> = 491)	-
H	Woodland	No	28 (4.4%, <i>N</i> = 639)	-

Table S5. Behaviours displayed by the chimpanzees in unsuccessful visits, the sense associated to each behaviour, frequency of each behaviour, and percentage of visits in which each behaviour occurred. We analysed 534 unsuccessful visits containing 1616 behaviour occurrences. A dash (-) indicates that no sense is associated with this behaviour. We did not observe any behaviour linked to hearing use.

Behaviour	Associated sense	Proportion of behaviour occurrences	Proportion of visits
Look at nest	Sight	36.4%	84.6%
Remove obstacles from nest	-	12.9%	25.3%
Bring face to nest entrance	Smell	9.7%	21.7%
Introduce hand into nest	Touch	1.9%	4.1%
Smell hand	Smell	1.5%	3.4%
Visually inspect the hand	Sight	0.3%	0.9%
Insert hand in mouth	Taste	0.2%	0.6%
Insert tool into nest	-	18.2%	25.7%
Visually inspect tool	Sight	4.8%	8.8%
Smell tool	Smell	9.3%	16.5%
Bring tool to mouth	Taste	4.9%	10.5%

Table S6. Number of unsuccessful visits ($N = 534$) in which chimpanzees used each sense (sight, smell, taste, touch) combination. The behaviours associated with each sense are listed in Table S6.

				Number of visits
Sight Yes	Smell Yes	Taste Yes	Touch Yes	4
			Touch No	35
		Taste No	Touch Yes	6
			Touch No	112
	Smell No	Taste Yes	Touch Yes	1
			Touch No	9
		Taste No	Touch Yes	9
			Touch No	299
Sight No	Smell Yes	Taste Yes	Touch Yes	0
			Touch No	5
		Taste No	Touch Yes	0
			Touch No	28
	Smell No	Taste Yes	Touch Yes	0
			Touch No	4
		Taste No	Touch Yes	2
			Touch No	20

Table S7. Ethogram of behaviours exhibited by Dindefelo chimpanzees to look for ants.

Behaviour	Description
<i>Look at nest</i>	A chimpanzee stares at the nest entrance, by turning the head.
<i>Remove obstacles from nest</i>	A chimpanzee clears the nest entrance of obstacles, such as leaves or other debris.
<i>Introduce hand into nest</i>	A chimpanzee inserts the hand inside the nest cavity ^{1,2} .
<i>Introduce arm into nest</i>	A chimpanzee inserts the arm inside the nest cavity ³ .
<i>Visually inspect hand</i>	A chimpanzee visually inspects his/her hand after inserting it into the nest.
<i>Smell hand</i>	A chimpanzee smells his/her hand after inserting it into the nest, by moving it near the nose.
<i>Bring hand to mouth</i>	A chimpanzee inserts its hand in his/her mouth after inserting it into the nest.
<i>Visually inspect tool</i>	A chimpanzee stares at the tool after inserting it into the nest.
<i>Smell tool</i>	A chimpanzee smells the tool, by moving it close to the nose.
<i>Bring tool to mouth</i>	A chimpanzee inserts the tool in his/her mouth after inserting it into the nest.
<i>Bring face to nest entrance</i>	A chimpanzee brings his/her face close to the nest entrance.
<i>Bring ear to nest</i>	A chimpanzee brings his/her ear close to the nest cavity.
<i>Source tool</i>	A chimpanzee obtains raw material from the surrounding vegetation.
<i>Manufacture tool</i>	A chimpanzee modifies raw materials (e.g., by clipping the ends, stripping the leaves) to make a tool.
<i>Search for tool</i>	A chimpanzee searches for a tool or raw material to make a tool from the surroundings, in order to ant dip.
<i>Modify tool</i>	A chimpanzee modifies/amends a tool before continuing to use it (e.g. clipping the ends with her/his teeth).
<i>Transport tool</i>	
Arrive with tool	A chimpanzee enters the camera frame holding a tool with his/her limbs or mouth.
Depart with tool	A chimpanzee leaves the camera frame holding a tool with his/her limbs or mouth.
<i>Transport tool inside the camera frame</i>	A chimpanzee moves along the camera frame with a tool held with his/her limbs or mouth.
<i>Insert tool into nest</i>	A chimpanzee introduces a tool into the nest cavity, moving it up and down in dipping motion.

SI References

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