

# A Model of the Formation of Transactive Memory Systems

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## Hypothesis

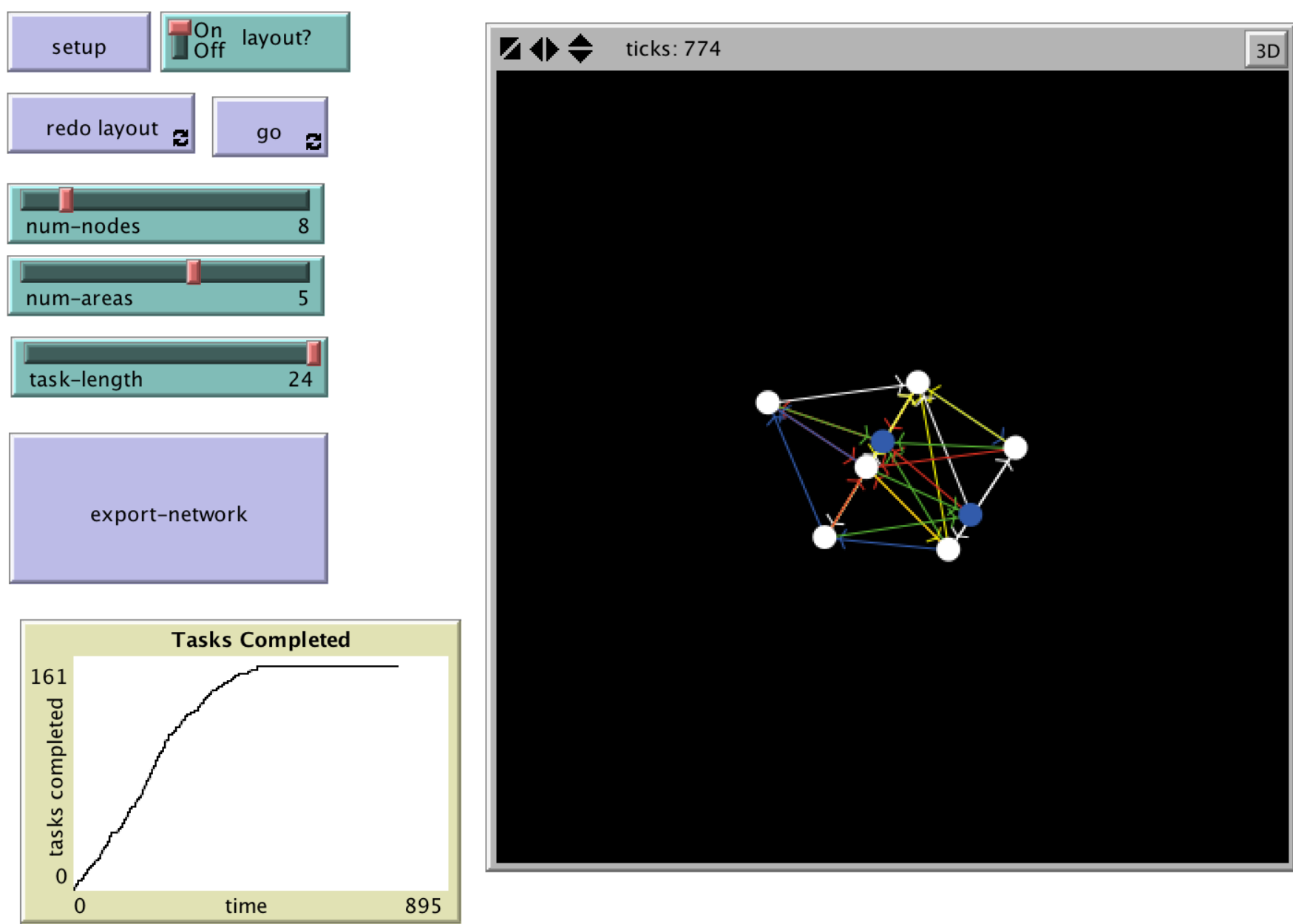
Our simulated TMSs will produce more of the microstructures<sup>1</sup> positively associated with TMSs<sup>2</sup>, and fewer of the microstructures negatively associated with TMSs.

A transactive memory system (TMS) is a system where members know “who knows what”



Microstructure	Visualization	Correlation	Literature
In-star: Two agents connected to the same agent but not to each other		Positive	Palazzolo, 2005
Out-star: One agent connected to two different agents who aren't connected to each other		Positive	Palazzolo, 2005
Transitive triad: One agent (the tertius) is connected to two agents who are also connected		Positive	Palazzolo, 2005; Lee, Bachrach, & Lewis, 2014
Cyclic triad: Each agent is connected to only one other agent in the triad		Negative	Lee, Bachrach, & Lewis, 2014

## Simulation in NetLogo



A transactive memory system network is formed by each agent completing a list of tasks. Each agent has different levels of expertise in some number of areas, and must coordinate with agents to complete tasks each couldn't complete alone.

For  $m$  areas of expertise, the *expertise* of agent  $i$  is:

$$expertise_i = [a_0^i, a_1^i, a_2^i, \dots, a_{m-1}^i]$$

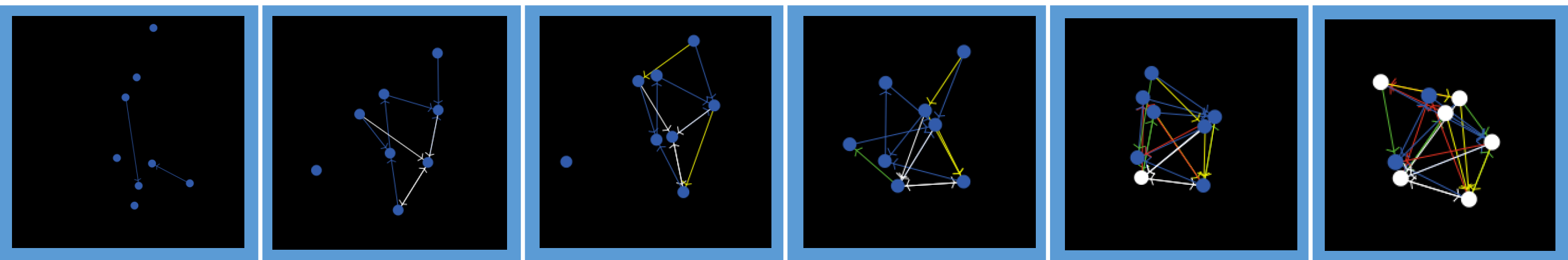
An example a length 10 **tasks-to-complete** in 4 areas:

tasks-to-complete = [3, 0, 2, 2, 1, 0, 0, 3, 1, 1]

Agents can either complete the task themselves if their expertise in that area  $\geq 1$ , or they can ask agent  $j$  to help if  $a_k^i + a_k^j \geq 1$ , for a task in area  $k$

In the model to the left, the agent has 5 areas of expertise, a task length of 24, and there are a total of 8 agents in the team.

## Example evolution of the simulation for 8 nodes and 5 task areas



## Main Findings

### Transitive Triads and Triadic Cycles

$$TMS_i = \theta_0 + \theta_1 (\text{transitive triad})_i + \theta_2 (\text{triadic cycle})_i + \varepsilon_i$$

triadic microstructure	20 edges	19 edges	18 edges	17 edges	all edges
transitive triads (030T)	0.0559***	0.0638***	0.0679***	0.0799***	0.0452***
	(49.73)	(41.44)	(29.93)	(31.21)	(45.08)
triadic cycles (030C)	-0.0532***	-0.0759***	-0.0929***	-0.0990***	-0.162***
	(-6.04)	(-9.14)	(-7.12)	(-6.49)	(-23.09)
_cons	-0.134***	-0.112***	-0.0681*	-0.0582*	0.209***
	(-7.26)	(-5.21)	(-2.40)	(-2.21)	(17.17)
N	252	286	224	234	1956

Regression table output for 8 nodes. Edge subsets are shown in the first columns, and the result taken over all edges is shown in the last column. t statistics in parentheses  
\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

### In-stars and Out-stars

$$TMS_i = \theta_0 + \theta_1 (\text{in-star})_i + \theta_2 (\text{out-star})_i + \varepsilon_i$$

triadic microstructure	20 edges	19 edges	18 edges	17 edges	all edges
in-stars (021U)	0.0686***	0.0704***	0.0647***	0.0586***	0.0615***
	(14.65)	(13.95)	(10.87)	(8.71)	(26.34)
out-stars (021D)	0.0599***	0.0630***	0.0672***	0.0724***	0.0609***
	(11.67)	(11.94)	(11.15)	(11.27)	(25.67)
_cons	-0.309***	-0.334***	-0.312***	-0.261***	-0.178***
	(-7.04)	(-7.62)	(-6.08)	(-5.03)	(-9.78)
N	252	286	224	234	1956

Regression table output for 8 nodes. Edge subsets are shown in the first columns, and the result taken over all edges is shown in the last column. t statistics in parentheses  
\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

## Unexpected Results...

...noticeable downward trend in the presence of structures associated with TMSs as the node sizes of networks increased.

triadic microstructure	6 nodes	8 nodes	12 nodes	30 nodes
transitive triads (030T)	0.0700***	0.0452***	0.0268***	0.0154***
	(35.03)	(45.08)	(46.79)	(35.76)
triadic cycles (030C)	-0.237***	-0.162***	-0.117***	-0.0680***
	(-16.80)	(-23.09)	(-34.41)	(-56.25)
_cons	0.262***	0.209***	0.224***	0.237***
	(20.56)	(17.17)	(17.39)	(12.62)
N	1810	1956	1994	2000

Regression table summary output for each set of nodes. t statistics in parentheses  
\* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

1. Lee, J.-Y., Bachrach, D. G., & Lewis, K. (2014). Social Network Ties, Transactive Memory, and Performance in Groups. *Organization Science*, 25(3), 951–967.  
2. Peltokorpi, V. (2008). Transactive memory systems. *Review of General Psychology*, 12(4), 378–394.