OfficeMoves: Personalities and Performance in an Interdependent Environment

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WHAT IS IT?

After a little work experience, we realize that different kinds of people prefer different work environments: some enjoy a fast-paced challenge; some want to get by; and, others want to show off.

From that experience, we also realize that different kinds of people affect their work environments differently: some increase the pace; some slow it down; and, others make it about themselves.

This model concerns how three different kinds of people affect their work environment and how that work environment affects them in return. The model explores how this circular relation between people's preferences and their environment creates patterns of association and performance over time.

The purpose of this model is to study the interaction of different agent strategies and their effects on the performance environment. By doing so, the model helps the user build theories about homophily, office place norms, and organizational patterns.

HOW IT WORKS

The model provides researchers with a mean to study homophily and office place norms by changing the simulation's parameters, especially the distribution of the types of people in the population. The model achieves this by using three personalities, which are defined by their preferences for performance in their two-step neighborhoods and how they affect performance in their two-step neighborhoods. The effects of the interactions between the personalities and their environment are measured by agent happiness and neighborhood performance.

The model takes inspiration from Schelling's segregation model: the agents move around the simulation space to find local regions that suit their individual preferences. This model departs from the segregation model in three ways. First, the different types of agents have different decision rules that rest on different ways of perceiving their environment: the level of current performance and the rate of change in performance. Second, the different kinds of agents have different effects on neighborhood performance. Third, performance effects have spillover: those effects go beyond the adjacent spaces.

Before describing the simulation environment and the agents in detail, two key terms need description: performance and two-step neighborhood.

Performance. The work environment is defined in terms of performance, which is an abstraction that captures the results of the agents' activities. People affect the performance of their local neighborhood and the performance in the local neighborhood affects each individual's choice to stay or move. For the sake of simplicity, performance has universal meaning.

Two-Step Neighborhood. The neighborhood of an agent (or turtle) and a space (or patch) is defined as the agents or spaces within two steps of the specified agent or space. For example, the two-step neighborhood comprises a patch, the patches adjacent to it, and the patches adjacent to those. Thus, the neighborhood comprises 25 patches: the one in the center, its eight neighbors, and the sixteen neighbors next to those eight. In short, the neighborhood comprises the patches within two steps of its center.

Simulation Environment

The default world comprises 1089 patches on a toroid. The grid displayed in the interface is 33 by 33 patches with vertical and horizontal wrapping enabled. The simulation environment has the following variables:

- *Population Density*. This is the percentage of the patches occupied by agents and can vary from 1% to 99%, as set by the user.
- *Population Distribution*. Three kinds of agents constitute the population: workers, shirkers, and posers. The user sets the percentage of the population for the workers and shirkers. The percentage of posers is calculated by the setup procedure.
- *Run Termination*. If all the agents are happy, the run will terminate. The user may also choose "num_rounds" which will terminate the run when the number of rounds selected by the user is reached.
- *Maximum Rounds*. If the user set run termination to "num_rounds," the run terminates after reaching this number of rounds.
- *Maximum Move*. This is the furthest distance that an unhappy turtle will travel in a single move.

Performance Spaces

The segments of the performance space (patches) represent jobs or positions in the organization. Each patch may only have one occupant. Each patch has one state variable.

> *Neighborhood Performance*. This is the sum of the performance of all the agents within the patch's two-step neighborhood and the agent occupying the patch. If no agent occupies the patch, its neighborhood performance is zero.

Potential performance is used to measure the neighborhood performance on unoccupied patches. Potential performance is used for the poser's decision rule.

Agents in the Performance Space

The agents (turtles) in the performance space have four state variables:

- *Happiness*. The agent is happy if the neighborhood performance of the patch occupied by the agent meets its decision rule. Otherwise, the agent is unhappy.
- *Performance Effects*. This indicates the amount of performance that each agent adds to its own patch, the patches in its first-step neighborhood, and the patches in its second-step neighborhood. The default settings for each personality follow from the plain language description of the personalities given above. For the purposes of investigation, the user is allowed to change the default settings but should do so for sound theoretical reasons.
- *Performance*. This is the sum of the agent's performance effects and the performance effects of all the agents in the selected agent's two-step neighborhood.
- *Index of Qualitative Variation*. This measures the degree of heterogeneity in the agent's two-step neighborhood. At zero, the two-step neighborhood comprises personalities of a single type. At one, the two-step neighborhood is evenly distributed across the different personality types represented in that neighborhood.

Each agent is assigned one of three personalities: worker, shirker, or poser. The user sets the distribution of personalities in the population. Each personality has performance effects on its two-step neighborhood and preferences regarding neighborhood performance that determine the agent's happiness. The decision rules follow from the agents' performance preferences. For a detailed discussion of the decision rules, see the discussion under "How to Use It" below.

Worker

The worker thrives in a challenging environment and its motivation is infectious.

Performance Effects. The worker adds performance to the environment and adds to the performance of its neighbors. Worker's positive performance effects decrease over distance in the two-step neighborhood.

Performance Preferences. The worker likes challenge, which is defined in terms of the rate of change in neighborhood performance. The worker will move to another job when the rate of change in performance is negative. This is a repulsion mechanism that uses local knowledge.

Shirker

The shirker puts in the minimum effort and thereby places burdens on its neighbors.

Performance Effects. The shirker adds the minimum necessary performance to its space but costs performance in its two-step neighborhood, as the shirker puts burdens on the people around it. Its direct effects lack the reach of the worker or the poser.

Performance Preferences. The shirker likes minimum effort, which is defined by the rate of change in performance. The shirker will move to another job is the rate of change in performance is positive. This is a repulsion mechanism that uses local knowledge.

Poser

The poser likes to be in the spotlight and adds to the performance environment. By making the organization all about itself, the poser places performance burdens on the members of its two-step neighborhood

Performance Effects. Poser adds performance to its space but costs performance in its two-step neighborhood by making the environment all about itself. The cost decreases over distance.

Performance Preferences. Poser will move when better options are available. If its neighborhood performance is less than the mean of the performance of the vacant patches, poser will move. This is an attraction mechanism that uses global knowledge.

Simulation Sequence

Set Simulation Parameters

- *Set Population Composition*. These include population density, the percentage of workers, and the percentage of shirkers.
- *Set Simulation Parameters*. These include run termination conditions, the maximum rounds for a run, the distance of the maximum move for unhappy agents, and the visualization of the world.
- *Set Agent Performance Effects*. For each personality - worker, shirker, and poser - set the performance effect of the agent, its one-step neighbors, and its two-step neighbors.
- *Set Decision Rules*. Choose one of the four decision rule sets and set the length of the window for the decision rules that use a moving average.

Initialize Simulation

- Creates the number of turtles using the population density. Turtles are assigned randomly and no more than one per patch.
- Assigns a breed - worker, shirker, or poser - to each agent randomly using the population composition.
- Sets the attributes for visualization of the run and initializes variables.
- Randomly sets the agents' happiness.

Simulation Run

- Unhappy turtles move in a random direction for a distance from zero to the maximum move. Unhappy turtles repeat this until they land on an empty patch.
- Update performance statistics.
- Update turtles' happiness by applying the selected set of decision rules.
- Update visualization and statistics.
- Stop simulation if all the turtles are happy or if the maximum rounds are met.

Comment: Initial Agent Happiness

The code sets each agent's happiness randomly giving each agent an equal chance of being happy or unhappy. Since happiness is determined, for some agents, by the change in neighborhood performance, happiness cannot be set for the first round of a run.

Sensitivity tests showed that very high and very low percentages of unhappy agents at the beginning of a simulation run had no effect on the simulation after the first round. Thus, the 50/50 random assignment was used.

HOW TO USE IT

Overview

This model supports theory building concerning homophily and workplace norms. It accomplishes this through the interaction of three different personalities - defined by the performance effects and performance preferences - in a finite space and over time. The fundamental parameters for these thought experiments are the population density, the distribution of personalities, and the decision rules.

The population density and distribution of personalities should be straight forward. The decision rules require some explanation. There are four sets of decision rules. The primary set follows from the abstract personality descriptions above and it is the set intended for theory building. The set uses a moving average of the change in neighborhood performance or neighborhood performance. The length of the moving average's window is set by the user. This allows the user to explore the differences between the effects of short-term change and long-term change. Using the moving average, agent happiness is determined as follows.

- The worker is unhappy if the rate of change in its neighborhood's performance is negative.
- The shirker is unhappy if the rate of change in its neighborhood's performance is positive.
- The poser is unhappy if its neighborhood performance is less than the mean of the potential neighborhood performance of the vacant patches.

The second set of decision rules uses performance instead of the rate of change in performance for the worker and shirker decision rules. Our theoretical understanding of the personalities suggests the first rule. This second rule is used to examine the differences between populations that respond to rates of change in performance and those that respond to the level of performance itself.

The third and fourth decision rules are identical to the first and second, respectively. However, the third and fourth rules do not use moving averages. They speed up the simulation and remain for convenience.

Once the population density, the distribution of personalities, and the decision rule set are selected, click on the setup button and then the go button located in the bottom left of the user interface.

User Interface - In Detail

The user interface allows the user to set the initial parameters, run the simulation and observe the results. Ensure that “view updates” is set to "on ticks" to observe the simulation. If it is set to "continuous," the visualization becomes misleading.

The description of the interface that follows starts in the top left of the interface and describes it from top to bottom and left to right.

Population Composition

density (varies from 1 to 99)
This sets the number of agents as a percent of the total possible number of agents, which is determined by the size of the world.

% workers (varies from 0 to 100)
This is the percentage of the population that will be workers.

% shirkers (varies from 0 to 100)
This is the percentage of the population that will be shirkers.

% posers
This is the percentage of poser in the population. The setup procedure calculates the percentage of posers using the % workers and % shirkers set by the user.

Simulation Parameters

run termination (default, num_rounds)
This tells Netlogo when to stop a run of the simulation: "default" means that the run will stop if all of the agents are happy; "num_rounds" means that the run will terminate when is reaches the max_rounds determined by the user or if all the agents are happy.

max move
Each time an agent moves, it will move a random distance from zero to the maximum distance allows, or max_move.

max rounds
This determines the maximum length of a run of the simulation. If run_termination is set to num_rounds, the run ends when the number of ticks equals max_rounds.

visualization (by performance, by change in performance)
Patch color indicates the neighborhood performance or the change in neighborhood performance by round depending on the user's selection. Green indicates positive values. Red indicates negative values.

Agent Performance Effects

Each breed - worker, shirker, and poser - has a performance effect on their environment. The prefixes "w_", "s_", and "p_" indicate which breed has the performance effect.

perf eff.
This is the amount of performance the agent adds to its patch.

perf eff1.
This is the amount of performance the agent adds to the patches in its one-step neighborhood.

perf eff2.
This is the amount of performance the agent adds to the patches in its two-step neighborhood.

As with the decision rules, the agents' performance effects follow from the abstract understanding of the personalities. The worker adds performance and inspires others yielding performance effects equal to (2,1,1). The shirker puts in minimum effort leaving others to fill in yielding performance effects equal to (1,-1,0). The poser adds to performance while leeching its neighborhood yielding performance effects equal to (2,-1,-1). The simulation allows the user to change the performance effects of the different personalities. However, it is recommended that the user do so only for sound theoretical reasons.

Decision Rules

Each rule set determines whether an agent is happy in its neighborhood during each round of the simulation. The primary decision rule, change window, follows from the definitions of the personalities above. The secondary decision rule, performance window, uses performance instead of the change in performance. This rule gives the researcher a way to compare processes and results to aid theory building. The third and fourth rules sets are simplifications of the first two and execute quickly.

change window (primary decision rule set)

- A worker is unhappy if the moving average of change in neighborhood performance over the length of the window is less than zero.
- A shirker is unhappy if the moving average of the change in neighborhood performance over the length of the window is greater than zero.
- A poser is unhappy if the neighborhood performance averaged over the length of the window is less than the moving average of the neighborhood performance of unoccupied patches over the length of the window.

performance window

- A worker is unhappy if the moving average of neighborhood performance over the length of the window is less than zero.
- A shirker is unhappy if the moving average of neighborhood performance over the length of the window is greater than zero.
- A poser is unhappy if the neighborhood performance averaged over the length of the window is less than the moving average of the neighborhood performance of unoccupied patches over the length of the window.

by change
This decision rule set is the same as change window, except a moving average is not used. Only the current values are used. This decision rule is less demanding computationally.

by performance
This decision rule set is the same as performance window, except a moving average is not used. Only the current values are used. This decision rule is less demanding computationally.

window
This is the length of the moving average window used by the change window and performance window decision rules.

Neighborhood Variation

Histogram of Neighborhood Variation
Neighborhood variation is the index of qualitative variation (IQV) calculated for each agent using its two-step neighborhood. IQV is a measure of the heterogeneity of the agent's two-step neighborhood. At 0, the neighborhood consists of a single category of neighbor - vacant, worker, shirker, or poser. At 1, the neighbors are evenly spread across the four categories.

Expected IQV
The expected IQV (eIQV) is the value of the IQV calculated using the population density and the distribution of personalities selected by the user. The purpose of the eIQV is to determine to what degree the neighborhoods depart from randomness.

Interface Tab – World

The world depicts the personality of the agent which occupies a patch, whether the agent is happy, and either the patch's neighborhood performance or the change in neighborhood performance.

Agent Shape

- *Triangle* Worker
- *X* Shirker
- *Star* Poser

Agent Color

- *Yellow* Happy
- *Grey* Unhappy

Patch Color

- *White* Vacant patch or zero performance
- *Green* Shaded by positive performance, white (zero) to dark green (max)
- *Red* Shaded by negative performance, white (zero) to dark red (min)

Population by Personality
These give the actual number of agents by breed: all, workers, shirkers, and posers.

Percent Happy
These give the percentage of the agents that are happy in the current round of the simulation.

Monitors

Percent Happy
The plot shows the change in the percent happy by breed over time. The monitors below the plot give the percent happy by breed for the current round of the simulation.

When using the change window and performance window decision rules, the percent of workers and the percent of shirkers who are happy should be ignored until the round after the length of the window.

Histogram of Neighborhood Performance
This displays the frequency of neighborhood performance by patch by round of the simulation.

Mean Neighborhood Performance
This shows the mean neighborhood performance for all patches and by the breed occupying the patch.

The user should exercise caution interpreting this plot. The default agent performance effects, for example, make the workers the most productive. The relative fluctuations are of more interest than the relative levels.

THINGS TO NOTICE

Agent Behavior

Under the change window decision rule, workers and shirkers quickly reach 100% happiness if one or the other constitutes the entire population and a moving average with a window of greater than or equal to two is used. In contrast, a population composed of posers alone will not reach a state of complete happiness. Posers are naturally disruptive.

Under the by change decision rule, neither workers nor shirkers reach 100% happiness quickly, implying that looking to the short-term is naturally disruptive.

Interpreting Population Happiness

If the change window or performance window decision rule is used, the statistic used by the decision rule begins a run with a vector of zeros with a length of the user defined window. Therefore, the measure of population happiness should not be interpreted until after the number of rounds (ticks) is greater than the moving average window.

Interpreting Mean Neighborhood Performance

The default settings for the agents' performance effects result in a mean neighborhood performance for workers that is always higher than the mean neighborhood performance for either shirker or poser. The user should not attribute too much meaning to this. Instead the user should compare the fluctuations over time between the types of agents, neighborhood performance compared to happiness, etc.

THINGS TO TRY

The purpose of this model is to study the interactions of different agent strategies with each other by way of their effects on the agents' performance environment. For the purposes of theory building, the user is encouraged to experiment with different values of the following parameters: population density, distribution of personalities, the window length, and the decision rule set.

NETLOGO FEATURES

Ensure that “view updates” is set to "on ticks." When set to "continuous," the visualization becomes misleading.

RELATED MODELS

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CREDITS AND REFERENCES

This agent-based model was built in Netlogo 6.1.1.

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Credits

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