APPENDIX: MODEL DOCUMENTATION

The Stock

Interruptions Pending = INTEG (Interruption Arrival Rate-Net Interruption Resolution Rate, Normal Resolution Rate Based on Capacity*Desired Time per Interruption)

- Units = Interruptions
- Initial Value = Normal interruption resolution rate based on capacity*Desired time per interruption
- The stock of interruptions currently pending.

Flows

Interruption Arrival Rate = Input

- Units = Interruptions/Minute
- The rate at which interruptions arrive; an exogenous variable in this model.

Net Interruption Resolution Rate = MIN (Max Interruption Resolution Rate Based on Capacity, Max Interruption Resolution Rate Based on Interruptions Pending)

- Units = Interruptions/Minute
- This is the rate at which the system successfully confronts and resolves interruptions. Interruptions handled incorrectly stay in the stock of Interruptions Pending.

Auxiliaries

Indicated Desired Resolution Rate = Interruptions Pending/Desired Time per Interruption

- Units = Interruptions/Minute
- This is rate at which interruptions should be resolved in order to achieve the desired resolution time.

Desired Resolution Rate = Smooth (Indicated Desired Resolution Rate, Time to Perceive New Interruptions)

- Units = Interruptions/Minute
- The desired resolution rate represents the system's perception of how fast it needs to resolve interruptions. The Desired resolution rate is equal to a first order exponential smooth of the indicated rate. The smooth represents the delay in perceiving change in the number of interruptions pending.

Stress = Desired Resolution Rate/Normal Resolution Rate Based on Capacity

- Units = Dimensionless
- Stress is equal to the ratio of the desired and normal resolution rates. The higher the desired resolution rate relative to how the system normally performs, the higher the stress.

Normal Resolution Rate Based on Capacity = Number of People Working*Normal Interruptions Per Minute

- Units = Interruptions/Minute
- This is the rate at which interruptions are resolved by the system when working at its normal level of productivity.

Effect of Stress on Resolution Rate = Table for Effect of Stress(Stress)
- Units = Dimensionless
- This variable captures the positive influence of stress on productivity. It is captured by an upward sloping table function (see Figure 3) that uses stress level as an input.

Effect of Overwhelming on Resolution Rate = Table for Effect of Overwhelming (Stress)
- Units = dimensionless
- This variable captures the negative impact of stress: as the system is overwhelmed, its ability to resolve interruptions decreases. It is captured by a downward sloping table function (see Figure 3) that uses stress level as an input.

Actual Interruptions Per Minute = Normal Interruptions Per Minute*Effect of Stress on Resolution Rate*Effect of Overwhelming on Resolution Rate

- Units = Interruptions/Minute/Person
- This is the current productivity of the system given the current stress level. It is the number interruptions a minute each person in the system is resolving.

Max Resolution Rate Based on Capacity = Number of People Working*Actual Interruptions Per Minute
- Units = Interruptions/Minute
- This is the maximum rate at which interruptions can be completed based on the current number of people involved and the system's productivity.

Number of People Working = Initial Input*Desired Time per Interruption/Normal Interruptions Per Minute
- Units = Persons
- This is the total number of people involved in the activity at hand.

Initial Input = INITIAL (Input)
- Units = Interruptions/Minute
- This is the initial rate of interruptions at the beginning of the simulation and is used to initialize the system in equilibrium. The system starts with an initial arrival rate of 10 interruptions/minute.

Max Resolution Rate Based on Interruptions Pending = Interruptions Pending/Minimum Time per Interruption
- Units = Interruptions/Minute
- This is the maximum number of interruptions that can be resolved (if capacity is ample) constrained by the number of interruptions available in the interruptions pending stock.

Constants

Desired Time per Interruption = 1
- Units = Minutes
- This is the time interval in which the system wants to resolve the interruption.

Minimum Time per Interruption = 0.05
- Minutes
- This is the minimum time it takes to resolve an interruption.

Time to Perceive New Interruptions = 1
- Units = Minutes
- The time required for the system to recognize that a new resolution rate is needed.

Normal Interruptions Per Minute = 10
- Units = Minutes/Interruption
- This is the rate at which people normally resolve interruptions when under the normal level of stress.

Tables

Table for Effect of Overwhelming ([(-1,0) (2.1,1.5)], (0,1), (1.2,1),(1.4,0.97), (1.6,0.875), (1.8,0.675), (2,0.2))
- Units = dimensionless
- This table depicts the negative effect of an increasing amount of stress on Actual Interruptions per Minute time. The premise of this table is that after a certain critical point, the system is overwhelmed by the amount of stress and performance declines.

Table for Effect of Stress ([(0,0)-(2,2)], (0,0.5), (0.2,0.525), (0.4,0.575), (0.6,0.65), (0.8,0.8), (1,1), (1.4,1.35), (1.6,1.45), (1.8,1.48), (1.8,1.48), (2,1.5))
- Units = dimensionless
- This table depicts the positive effects of stress. A little stress has little or no impact on net interruption resolution rate, a medium amount of stress has a close to proportional impact on interruption resolution; at a certain point more stress has no further effect on performance.

Control

Simulation Control Parameters

FINAL TIME = 15
- Units = Minute
- This is the ending time for the simulation.

INITIAL TIME = 0
- Units = Minute
- This is the beginning time for the simulation.

TIME STEP = 0.015625
- Units = Minute
- This is the time step for the simulation.

Test inputs and instructions for replicating simulations in the paper.

For the Pulse Tests:

Input = 10 + (Pulse Quantity/TIME STEP)*PULSE(Pulse Time,TIME STEP)
- Units = Interruptions/Minute

- The initial value of the input is 10 and a quantity equal to Pulse Quantity is introduced at the Pulse Time.

To replicate the "pulse" experiments presented in the text, set:
Final Time=15
Pulse Time=5
Pulse Quantity=10 for the first experiment
Pulse Quantity=12 for the second experiment.

For the Noise Tests:
The actual test stream used in these experiments is *log-normal pink noise*. Such an arrival stream is created in three steps. First, a white noise process is created using an existing Vensim macro. Second, white or uncorrelated noise is then transformed into pink or first-order auto-correlated noise using a first-order exponential smooth. Finally, the arrival process is transformed using the exponential function. See Sterman (2000) for more details concerning the choice of appropriate random test inputs for system dynamics models. The following equations detail how the test input was created.

Input = (1-STEP(1,Noise Start Time))*Desired Arrival Mean + STEP(1,Noise Start Time)*EXP(Pink Noise)

Noise Start Time = 5
- Units = Minute
- The time at which the random noise in the input begins.

Desired Arrival Mean = 10
- Units = Interruptions/Minute
- This is the desired mean in interruption arrivals.

Pink Noise= Smooth(White Noise, CorrelationTime)
- Units = Dimensionless
- Pink or First-Order Auto-correlated Noise is produced by exponentially smoothing a white (uncorrelated) noise input. See Vensim documentation for details on the Smooth function.

Correlation Time = 5
- Units = Minutes
- The smoothing time constant for converting white noise to pink noise.

White Noise= Scaled Mean+Scaled Standard Deviation*((24*Correlation Time/TIME STEP)^0.5)*RANDOM UNIFORM(-0.5, 0.5,0)
- Units = dimensionless
- This formula produces approximately white (uncorrelated noise), see Sterman 2000 for details

Scaled Mean = LN(Desired Arrival Mean)-Standard Deviation^2/2

- Units = Dimensionless
- This is the scaled mean of the white noise process that results in the desired mean of the arrival process.

Scaled Standard Deviation = 0

- This is the scaled standard deviation of the white noise.

Variance in Arrival Rate = EXP(2*Scaled Mean)*(EXP(2*Scaled Standard Deviation^2)-EXP(Scaled Standard Deviation^2))

- Units = Interruptions^2
- This is the variation in the interruption arrival rate that results from the choice of the scaled mean and standard deviation of the white noise process.

RANDOM UNIFORM(-0.5, 0.5,0) is a Vensim function that returns a random variable that is uniformly distributed on [-.5,.5]. See Vensim user manual for more details.

To perform the noise simulations presented in the paper set:

Final Time=75
Noise Start Time= 5
Desired Arrival Mean= 10

For the first experiment, set:

Scaled Standard Deviation = .1

This yields an interruption arrival rate that is distributed log-normal with a mean of 10 and a standard deviation of 1.

For the second experiment, set:

Scaled Standard Deviation = .17

This yields an interruption arrival rate that is distributed log-normal with a mean of 10 and a standard deviation of 2.

For details concerning replicating the