Stress and Productivity Performance in the Workforce Modelled with Binary Decision Automata

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Abstract—This study is the third in a series developing an agent based model of stress in the workplace. Stress and stress-related health problems are a serious matter but, prior to this series of studies, quantitative modeling of stress has been substantially neglected. This model builds on earlier work, incorporating a more realistic model of the stress relief caused by weekend time off. The model also makes drug use something that can be learned spontaneously or learned from a mentor rather than being present in an endemic, fixed fraction of the population. In this study a parameter exploration is performed on the agent representation, binary decision automata. It is found that the BDA representation is highly adaptive, responding robustly to parameter changes. Parameters investigated include number of agent states, accuracy of imitation of mentors, work requirements, and probabilities of learned and spontaneous drug use. Parameter values are taken beyond reasonable ranges to examine the model’s failure modes. This study demonstrates that the model behaves in a reasonable fashion, determines its limits, and established a baseline for further investigation.

I. INTRODUCTION

EMPLOYEE welfare is crucial to maximizing corporate productivity in today’s economy. The negative effects of stress on an employee have been demonstrated to have substantial effects on productivity loss [21]. This productivity loss translates to a sizeable loss of potential revenue for corporations [22], [13], [23]. Moreover, the well-being of individuals is increasingly being recognized by governments and employers as important to the overall profitability of organizations and GDP of nations [14]. Consequently, both governments and employers are investigating and implementing strategies to mitigate the ill-effects of work, namely stress, on individual employees [21]. Furthermore, there are business cases being developed by organizations aiming to quantify the economic benefit of an employees well-being and the loss of productivity and revenue due to the ill-being of employees [22].

Stress is a significant contributor to employee ill-being and has many adverse effects on an individual [26], [24]. Stress itself can be seen as the physiological or psychological response of the body to any given stress, real or perceived [25]. Stressors are deemed any external, chemical, biological or environmental demand placed on an organism that prompts a response [12]. Depending on the nature of a given stressor, an individual may have a positive or negative response [20]. Ideally, minimizing the negative stress (distress) and maximizing the positive stress (eustress) on an individual can yield optimal work performance from an individual. The impact of stress has been studied by psychologists Robert Yerkes and John Dodson in the development of the performance curve. This research led to the development of the Yerkes-Dodson law which is an empirical relationship between stress and performance in an attempt to attain optimal performance from an individual [27]. Furthermore, there has been significant qualitative research over the last few decades in an attempt to optimize these pressures and demonstrate the importance of work-life balance. Specifically, Barsh, Cranston and Lewis studied the correlation of employee fatigue to productivity. It was established that employees with more rest, that being the relief of stress, attained higher productivity and were more effective at problem solving [6].

![Yerkes-Dodson performance curve](image-url)

This study examines the effects of fatigue and overwork as potential contributing factors to the overall stress of individuals within an organization with a using evolutionary agent-based techniques framed as a game that models employee behavior. Previous research [2], [3] used agent-based simulations to model the propagation of stress in the workplace as a result of long working hours and fatigue of employees. Furthermore, this study attempts to reduce the number of generalizations used in previous research aiming to develop a more accurate real world model. Currently, the model is built on the assumptions of existing qualitative and quantitative social-science and health research to encode maximum hours worked, differentiated response and impact...
of the compounding effects of stress on individuals. Furthermore, this paper builds on previous research exploring the imitation of high-status individuals within an organization as a possible indirect source of stress [2], [3].

Building on the framework of past research [2], [3], this study uses binary decision automata (BDA) as the agent representation to model individuals early in their career within the workplace. The multi-state BDA were developed in similar fashion to past experiments [17], [1], [9]. This representation incorporates tests against the current work that is completed and the current stress of the agent to make its decisions. Consequently there is the potential for agents to possess rudimentary decision making capabilities and adaptive behaviour to changing workplace circumstances. There have been several other successful studies that incorporate this type of technology [11], [4], [10], [5]. Moreover this type of modelling has been applied in economics to represent human behaviour [15]. In regards to past and current research this type of quantitative modelling of stress is a novel application. While this model is regarded as a simplification of real world human behaviour, it is predicted that it can lend support to the developing business cases for employee wellbeing and assist in tailoring health policies and insurance premiums for individuals.

Individuals beginning their careers will normally try to adopt the behaviour of successful individuals in an attempt to advance their own career. Through this mimetic behaviour of successful individuals, an individual anticipates to receive recognition for their work by management. However, this recognition usually comes at the cost of additional working hours as an attempt to outperform colleagues and to adopt successful working strategies. By increasing the number of hours worked per day, an individual increases their base stress level due to fatigue and consequently if prolonged can lead to physical illness [7]. Moreover, as there is a finite number of working hours per day, an optimal and efficient work routine must be adopted in order to maximize the possibility of recognition and additionally to maintain a sustainable work-life balance.

The agents in this model have their time broken into hourly components on a monthly basis. Each of these hours is spent resting, working on their daily job requirements or working on advancing their career through special projects. This model encodes the following underlying aspects:

1) The quality of an individual’s work decays as the stress of the individual exceeds an minimum tolerance [18].
2) To avoid firing, there is a minimum productivity requirement on the base task of an individual.
3) There is a positive correlation between the productivity on the base task and special projects and the overall status of the agent in the company. As productivity increase, so does status assuming the agent has not been fired due to low performance.
4) Agents that possess low productivity and are not fired at each time step are retrained in an attempt to improve their performance [8].

5) Agents that are fired are replaced by newly hired agents that contain similar behaviour to existing agents within the organization. This attempts to demonstrate the process of hiring people that meet qualifications for a job.
6) New agents and low performing agents are assigned to a mentor for training. The Mentors are selected from a variable top percentile of performers from the company.
7) Managements perception of the relative worth of special projects and the base task requirement varies randomly on a week-to-week basis. This encapsulates the changing priorities and decision-making that exists within corporate culture.

The researchers hypothesize that BDA will demonstrate adaptive capabilities to stressful environments and additionally that by increasing stress, the overall work performance of individuals will decrease. Moreover, it is hypothesized that by having a relatively narrow range normally distributed stress tolerances will yield optimal performance of productivity within a given organization. Finally it is hypothesized that length of employment within a given organization effects productivity and stress with longer employment durations attaining higher corporate productivity and reduced individual stress loads for individuals.

II. Model Specification

The performance of individual agents is established on a monthly basis which is normalized to contain four weeks, five twelve-hour working days and two non-working days representing the weekend. Using the OECD’s study on work life balance, the maximum number of hours an agent can work on any given day is twelve [13]. Furthermore, during this twelve hour period, the agent is not required to work the entire time; rest and stress reducing activities are allowed at any point. During the two weekend days, stress is decayed by a fixed real value in the range 0 ≤ d ≤ 1. The agent’s maintain a record of current stress and productivity of both their base task and special task which are used to compute the internal state transitions of the BDA. These states will determine what the agent will do at each time step based upon a Boolean comparison of their records of stress or productivity against evolved constant values. An example of a BDA is shown in Figure 2.

A. Agent Representations

The employees within this model are software agents represented as BDAs. BDAs are augmented finite state machines with transitions driven by Boolean tests. The Boolean tests of the internal state transitions function on the input of three variables: the fraction of time the agent has spent on their base task, the time the agent has spent on their special project or their current stress multiplier. The stress multiplier is a represented by a real value between 0 and 1. In the model, 1 represents no stress and 0 represents the maximum possible stress. The use of the stress multiplier in computing fitness is explained subsequently. In each state of the BDA one
of the aforementioned values is compared using one of the operators in Table I, to a constant. If the Boolean test is true then one possible action and next state result otherwise a different second action and next state result. In this study the ‘near’ operator has a default value of \( \epsilon = 0.05 \) used for its comparison.

At any given time an agent can undertake any one of three tasks: resting (which may be true rest or low stress work), their base assigned task or a special project. The rest and low stress work are those activities that attribute to reducing stress in an agent. These activities can include socializing, eating, sleeping, and engaging in what is considered non-stress work. The base assigned task is representative of the job an agent is hired for. The special task denotes any work that both increases stress and allows for a possible pay-off of recognition by senior management for their efforts and work.

**B. The Adaptive Algorithm**

The evaluation and training of agents is governed by the adaptive algorithm as seen in Figure 3. The training of newly hired agents and under-performing agents in conducted through the use of variation operators applied to an agents states. This enables the simulation of the real world training process whereby an individual inaccuracy adopts the behaviour and work patterns of a mentor.

1) **Performance Evaluation:** Agent performance is evaluated on a weekly basis and is comprised of the agent’s base task and special projects work performance. These weekly totals are summed to attain a monthly figure that enables the adaptive algorithm to update the agent population. The weekly figures are created through the following steps:

1) The number of individual actions the agent undertakes that are not of type 0 are tallied. A standard work day is regularized to be 8 hours. If more than eight hours are worked by the agent then the daily stress score is \( \text{hours} - 8 \).

2) The total stress number, \( t \), is a number in the range 1-1024 and is calculated by multiplying the daily stress scores for the five days of the work week. 

3) The stress factor for the week is computed from \( t \) as 

   \[
   S(t) = \beta + (1 - \beta) \frac{1}{1 + (\alpha t)^2}
   \]

4) The performance on base work for an agent is calculated as the number of hours spent on their base job in a week multiplied by the stress factor. This is represented as \( A \) by \( N_A \) for an agent.

5) The performance on the special project for an agent is calculated as the number of hours spent on their special project in a week multiplied by the stress factor. This is represented for an agent as \( A \) by \( S_A \).

**Initialize a population of Agents**

Repeat the following:

- **Evaluate agent performance on base task**
- **Fire underperforming agents**
- **Sort the remaining agents by overall performance**
- **Training of new and under-performing agents**

Until Done

![Fig. 3. The agent training algorithm.](image)

The stress response curve is comprised of the the parameters \( \alpha \) and \( \beta \). The rate at which stress impacts an agent’s performance is denoted by the \( \alpha \) parameter with smaller values representing greater stress tolerance. The alpha parameters in this study are selected for agents from a normally distributed range with the minimums and maximums set as fixed parameters in the model. The \( \beta \) parameter denotes the floor of the curve and represents the maximum possible work a maximally stressed agent will achieve. When the stress response curve is established, the maximum value of 1.0 represents no stress and values near \( \beta \) represent the maximum stress for an agent.

The total performance of agents is measured on a monthly basis. If the agent’s productivity on their base task falls below an acceptable minimum performance level, \( M \), the agent is fired and a new agent is introduced into the population. The new agent is introduced by cloning an existing random agent in the population and mutating any of the states in the BDA of the selected agent. The agents that are not fired are given a performance evaluation \( P_A \), governed by:

\[
P_A = \delta N_A + (1 - \delta) S_A
\]  

Table I

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>&lt;</td>
<td>less than</td>
</tr>
<tr>
<td>( \leq )</td>
<td>less than or equal to</td>
</tr>
<tr>
<td>( \geq )</td>
<td>greater than or equal to</td>
</tr>
<tr>
<td>&gt;</td>
<td>greater than</td>
</tr>
<tr>
<td>( \approx )</td>
<td>near ((</td>
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</table>
The parameter $\delta$ in the aforementioned equation is the representation of management’s perception of the relative worth of special projects. This perception is denoted as the coefficient $0 \leq \delta \leq 1$ for any given month. Consequently, this parameter introduces stochasticity into the model by allowing the agents to predict the importance of the special projects that they undertake.

C. Training

The training of agents is governed by mimetic behaviour. At the end of each month, the adaptive algorithm determines whether an agent will be trained or not based upon their performance evaluation. The agents that are not trained are sorted and ordered according to their performance from best to worst. Furthermore, a block of these agents are selected in rank order and are designated mentors. When an agent is trained it inaccuracy copies the BDA of the mentor it is assigned to. Once copied, it applies a mutation operator to one of the seven components of the BDA states. The states of the BDA are comprised of the following components:

- The input action (stress, task1, task2).
- The comparative operator used for the Boolean test.
- The fixed numerical value operator is applied against.
- The action executed if the Boolean test is true.
- The state to proceed to after the true action is executed.
- The action executed if the Boolean test is false.
- The state to proceed to after the false action is executed.

The number of mutations that take place during a simulation on a single BDA are governed by two parameters. One parameter denotes the maximum number of mutations that can take place when introducing new agents and the other is the maximum number of mutations during training.

D. Drug Use

The potential for covert drug use is encoded into the model. These agents that use drugs possess a much higher stress tolerance than non-drug taking agents however are the same in every other regard. This parameter is denoted as $\alpha_d$. While drug taking allows for an agent to manage stressful situations in the short term and increases their stress tolerance, it is well documented that drugs have adverse effect when usage is prolonged [16]. The long term effects of drugs have not yet been encoded into the model however it is still worthwhile to investigate the impact of short term usage on corporate welfare.

III. DESIGN OF EXPERIMENTS

This study builds on the framework established in past representations of the model by reducing the number of generalizations that existed. The introduction of a normally distributed range of stress tolerances replaced a fixed stress tolerance for all agents. Additionally, the ability for drug usage to be adopted or unlearned. Finally the introduction of a weekend stress reduction component. In the past, stress was completely reset over the weekend and now is reduced by a fixed factor for all agents. To establish how the model behaves a parameter study was undertaken with the fixed base values. A population of 120 agents was evolved for 120 months (ten years) using the parameters $0.03 \leq \alpha \leq 0.07$, $\beta = 0.2$ and $0.4 \leq \delta \leq 0.6$ with both $\alpha$ and $\delta$ chosen with a uniform distribution. The initial base productivity requirement was set to 60. Both agents that are retrained and those that are newly hired are created by selecting a mentor and then adopting a mutated copy of the mentor’s BDA into the agent’s. Agents had the possibility of 3 maximum mutations during re-training and 6 maximum mutations when they are new hires. The actual number of mutations is chosen uniformly at random in the range from one to the maximum. The weekend stress reduction was set to 0.5.

The model was then tested with the parameters outlined in Table II to ascertain how each parameter effects the outcome of productivity and stress on agents. The design of experiments is star shaped, changing single values from the baseline. The number of states that each BDA possesses was changed to the values 4, 12 and 108 respectively. The expectation was that each agent would need a minimum number of states to ameliorate the effects of stress and attain an optimal productivity. The effects of varying the minimum base productivity required to avoid firing were then tested. These values were set at 45, 60, 75, 90, 105, 120, 135 and 150 out of a possible 240. The hypothesis for this was that as minimum required productivity increased the stress on the agents would increase as agents would have to spend more time working to meet minimum requirements.

The maximum number of mutations allowed for hiring and training were then varied separately. For the hiring of agents, the values were set at 3, 5, 10 and 25. The expectation was that the greater the number of mutations on an agent upon hiring, the longer the training process for the agent to obtain optimal performance. Secondly, the maximum number of training mutations were varied to include 6, 10, 15 and 25. It was anticipated that the greater the number of mutations taking place during the training process, the greater the noise introduced into the system and consequently the lower productivities and higher stress for the agents. The weekend stress reduction was then varied to determine the significance of more rest. The values were set beginning at 0 and were then varied to 0.1, 0.25, 0.5, 0.75 and 1. It was predicted that the greater weekend stress reduction values would correlate with higher productivity and lower stress values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
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<tr>
<td>Number of BDA States</td>
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<tr>
<td>Minimum Productivity</td>
<td>45, 60, 75, 90, 105, 120, 135, 150</td>
</tr>
<tr>
<td>Max New Agent Mutations</td>
<td>3, 5, 10, 25</td>
</tr>
<tr>
<td>Max Training Mutations</td>
<td>6, 10, 15, 25</td>
</tr>
<tr>
<td>Probability of Drug Use</td>
<td>0.01, 0.1, 0.25, 0.5</td>
</tr>
<tr>
<td>Weekend Stress Reduction</td>
<td>0, 0.1, 0.25, 0.5, 0.75, 1.0</td>
</tr>
<tr>
<td>Prob. of Adopting Drug Use</td>
<td>0.01, 0.025, 0.05, 0.1, 0.25, 0.5</td>
</tr>
</tbody>
</table>
A. Experiments with Drug Users

In previous research, the effect of drugs was established demonstrating that in general more drug users correlated to higher productivity. However, this increased productivity was at the cost of increased firings and stress on the agents trying to match the drug taking mentors capabilities. In this paper, the ability for drug taking behaviour is adapted to allow adoption and rejection of drug taking behaviour. This addition to the model is governed by the probability of adopting or rejecting drug use behaviour and the probability of using drugs when an agent. The parameters for adopting the behaviour were set at 0.01, 0.025, 0.05, 0.1, 0.25 and 0.5. The expectation base upon past results was that with an increased percentage of drug users, the stress of the overall population would rise and furthermore that the number of firings would increase as well. Secondly, the probability of using drugs when possessing the drug taking behaviour was set at 0.01 and varied to include 0.1, 0.25 and 0.5. It was expected that the greater the usage of drugs, the higher the performance of the agent as well as the lower the stress tolerance. Furthermore, it was anticipated that when selected as mentors, the higher drug using agents would cause a drastic increase in the stress level of the training agents and consequently increase the number of firings.

IV. Results

Upon completing the parameter study and establishing how the model behaved, the outcomes were accurately hypothesized with a few exceptions. When varying the number of states that each BDA possess the results to stress appeared to be valley shaped with the peaks of the valley representing the 4 state and 108 state BDA. This Additionally the productivity and status of the BDA's was highest at 12 states achieving an average base productivity of 63.04±10.49 and average status of 86.47±14.11. Finally the average number of fires for the 12 state machine was 67.02±22.72. By comparison to the worst BDA, the 108 state machine, the average productivity was 28.89±6.08, average status was 36.76±7.77 and average number of fires was 95.89±18.26. The maximum status attained by any BDA was achieved with 12 states and was 398.71. The average age of the agents in the population varied with the change of number of states. It would appear that the results were valley shaped as well with the minimum occurring at 12 states and was 41.47±12.20 and the maximum again at 108 states and was 64.68±13.18.

When the minimum productivity requirement was varied, the results were similar until the productivity requirement was set above 135. The average productivity of 12 state agents steadily decreased beginning at 63.12±10.44 for a requirement of 45, and decreasing until 62.69±10.88 for a requirement of 135. However, when the requirement was set above 135 the productivity dropped to 7.21±2.04. This drop in productivity correlated with a substantial increase in the average number of firings from 69.61±21.78 at requirement 135 to 115.16±15.41. This was to to an entire firing of the population being fired and re-hired repeatedly due to the inability to meet the excessive productivity requirements. The status of the individual steadily decreased from 87.43±13.99 at a productivity requirement of 45 to 82.02±14.29 at a requirement of 135. Again when the productivity was set above 135 the status of the individuals drastically dropped to 9.31±2.23. The average number of hours a week that agents worked also decreased as the productivity requirement rose. The most hours worked per week on average occurred at a productivity requirement of 45 where the max value of 4.79 was achieved. Furthermore, when the productivity requirement was set to 150, the number of hours the agents work dropped to 0.42 correlating with the sharp increase in firings at this productivity requirement.

Evaluating the effects of the number of training and hiring mutations on the BDA seemed to match the expectations of the researchers. For low numbers of mutations in hiring, the model would adapt with a small range of variation in terms of productivity change and stress on agents. With 3 mutations during hiring, the average productivity was 63.03±10.49 decreasing to 58.99±10.80 at 25 mutations. Additionally, the average stress of agents was 0.88±0.03 at 3 mutations compared to 0.90±0.03 at 25 mutations. Investigating the effects of the training mutations, the effect was greater than that of the hiring mutations. A low number of training mutations preserved the states of the BDA more accurately and correlated to a much better productivity and status result for the agent. At 6 mutations during training, average productivity was 63.04±10.49 and average status was 86.47±14.11. Increasing the number of mutations to 25 for training yielded an average productivity of 46.65±10.02 and average status of 70.15±14.50. These results were anticipated by the researchers. For the hiring process, as the agents would evolve through the duration of the experiment, the starting point would be less important. However for the training process, maintaining the states of the mentor is more critical as it is the aim of the agent to preserve good behaviour as accurately as possible. Consequently increasing the number of mutations set the population back in terms of evolving to an optimal productivity and stress tolerance due to the stochastic changes of the mutation.

Increasing the probabilities of drug use and adopting or rejecting drug use behaviour had little effect on the model. This was surprising to the researchers as in past work, the effect of a low number of drug users compared to a high number of drug users was noticeable. In this study, The probability of spontaneously starting drug use had no effect. When the probability of adopting drug use through training was increased, it increased the number of drug users in the population as expected however had little to no effect on stress, productivity and status of individuals.

The most substantial effect on the model occurred when the weekend stress reduction of the agents was varied. For low stress reduction values, that is those greater than 0.75, the stress and the productivity of agents was much lower than for the high stress reduction values of less than 0.25. In these instances, the productivity decreased from 98.10±16.13 to
47.46±8.17 corresponding to values of 0.1 stress reduction and 1.0 stress reduction respectively. The effects of weekend stress reduction on stress can be seen in Figure 6 and on productivity on Figure 5. Furthermore, the stress of the agents decreased from 1.00±0.00 to 0.86±0.03 for the aforementioned stress reduction values. Note that higher values of stress denoted less stressed individuals. Thus for high stress weekend stress reduction values, the stress of individuals is reduced to its lowest possible values. Another interesting reduction was that of the maximum possible status attained by agents. For a weekend value of 0.1 the maximum possible status peaked at 398.71 representing the best agents in the system. For a weekend value of 1, the agents status achieved the lowest possible status observed at 300.07. The number of hours an agent worked on average also correlated to the values of weekend stress reduction. For higher reduction values, the agent would work more hours on average per week achieving the highest possible values in the system of 5.21. With low reduction values, the agents would work less hours and attained a minimum hours worked per week of 3.89.

V. Conclusions and Next Steps

By reducing the number of assumptions used by the model, the researchers attempted to upgrade the model into a more accurate representation of the real world. Consequently, building on previous research [2], [3] the additions in this study have added some useful parameters that will have to be studied further to ascertain their full effect. Employing the use of BDA’s to depict agent behaviour has proven to be quite successful and in comparison to past string representations of agents [2], the BDA’s are proving quite adaptive to greater stress tolerances and work productivity requirements. This can be accredited to BDA’s adaptive behaviour and memory component contained within the inputs for the states. The number of states appears to drive the outcome of the agents behaviour as is seen in Figure 4. It would seem that an agent requires enough states to make basic decision but not so many that is takes longer to finish useful training than the duration of the simulation. Using this optimal number of states allows for increased adaptive and cognitive capability of the agents and establishes a more human-like representation of behaviour in the workplace. It is suspected that the increased adaptive capabilities of the BDA’s ameliorates the effect of drug users in most situations. There appears to continue to be a strong correlation between stress and work productivity as well as work productivity and status which suggests that while the model is generalized it seems to encapsulate many details of the workplace. Moreover, this can be seen in Figure 7 where the effects of stress drop off for long term simulations as agents fully adapt to their working environment.

While there are many improvements encoded in the current version of the model, it does allow easy modification and extension. It has been demonstrated in past work that the BDA’s are a suitable choice for agent representation and by continually incorporating new features into the model allows for a more accurate depiction of reality. There are many aspects that the researchers wish to investigate in the future such as workforce size and the long term effects of drugs. Furthermore, it is the hope of the researchers to incorporate more aspects of reality by encoding less generalizations and more complicated interaction effects.

A. Modifications and generalizations

As there are many possible areas of enhancement to the model, some changes can be made to more accurately model stress in the workplace. Some of the interesting possibilities include:

- Stress decays by a fixed parameter over the weekends in the model. It would be more accurate to allow agents to work on the weekend and still allow for rest, thereby modelling the possibility of having to work on weekends.
- Allowing the model parameters to vary during the simulation would enable more complex interactions to
Fig. 5. Effects on productivity for weekend stress reduction values of 0 and 1 respectively.

Fig. 6. Effects on stress for weekend stress reduction values of 0.25 and 1 respectively.

take place. The $\alpha$ value of individuals could be adjusted during the simulation to model new work requirements or life events.

- Currently covert drug use is tolerated within the organization. Allowing for agents to be fired if 'discovered' would more accurately depict reality.
- Incorporating different drug profiles would enable the study of effects of harmless stimulants compared to harmful by effective illicit compounds. This would involved added in the long term ill-effects of drug use possibly by increasing $\alpha$ values for the short term but substantially reducing them in the long term. Secondly, the productivity loss associated with long term drug use would need to be addressed.
- Having social and non-social rest periods would allow for the effects of spending time with colleagues, lunches out at work and meetings with one’s boss as a possible way of advancing one’s career. Furthermore, the more complicated effects of modelling rest at home could be modelled as not all time at home is restful.
- Introducing more than one special project than an agent could undertake would more accurately portray reality as there are many options for additional work one could choose. To do this though there would need to be a minimum investment of time from an individual into a project to have the possibility of a pay-off.
- Using contact networks from epidemiology would allow for the modelling of networks within an organization. Each team would be a network and thus the effects of stress diffusing through a network could be established.
- Incorporating the notion of teams at would would allow individuals to share credit for work and allow for additional outlets to diffuse stress through. Furthermore, agents in the group could additionally train one another to help further their careers together.
- Introducing possible policy changes in the model could allow for effects such as time off for being overworked thereby reducing the alpha value for individuals.
- Modelling the effect of social networks within a given organization would allow for the study of different
standards for individuals. For example, an employee who is a personal friend of someone in management might have a different base productivity requirement and might also be assigned as a mentor in spite of their actual productivity. Consequently this would allow for the modelling of nepotism.

REFERENCES