Modelling Dynamics of Social Support Networks for Mutual Support in Coping with Stress

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Abstract. This paper presents a computational multi-agent model of support receipt and provision to cope during stressful event within social support networks. The underlying agent model covers support seeking behavior and support provision behaviour. The multi-agent model can be used to understand human interaction and social support within networks, when facing stress. Simulation experiments under different negative events and personality attributes for both support receipt and provision pointed out that the model is able to produce realistic behavior to explain conditions for coping with long term stress by provided mutual support. In addition, by a mathematical analysis, the possible equilibria of the model have been determined.

Keywords: Social Support Networks, Strong and Weak Ties, Stressors, Support Recipient and Provision, Multi-Agent Simulation.

1 Introduction

Persons differ in their vulnerability for stress. To cope with stress, the social ties of the person are an important factor; [2][5]. Such ties are the basis of social networks or communities within which support is given from one person to the other and vice versa. Examples of such social networks are patient communities for persons suffering from a long or forever lasting and stressful disease. Providing and receiving social support within such a network is an intra and interpersonal process, with as a major effect that it improves the quality of life of the members of the social network.
This fundamental form of human functioning is an important aspect of our lives. Research shows that in the event of stress a social support network is able to influence individuals' wellbeing and act as a buffer for the impact of negative events. In recent years, social support with particularly the perception of support seeking and availability (provision), has well documented positive effects on both physical and psychological health. The explication of relationship between support seeking and provision has been studied intensively to explain this relationship. For example, simply knowing that someone is available to support can be comforting and capable

to alleviate the effect of negative events [4][8]. More general social support helps its recipients to escalate self-confidence and overcome the risk of stress [5][9].

However, little attention has been devoted to a computational modelling perspective on social support networks, on how the dynamics of support seeking and providing work at a societal level. In many ways, the availability of social support is still too frequently viewed as a static facet of individual or environment. However, the support seeking and provision process is highly dynamic and it involves substantial changes as demanding conditions occur [2]. From this dynamic process a collective pattern may emerge that costs almost no effort, and is beneficial for all members. While it is difficult to observe such conditions in the real world, a multiagent system model offers a more convenient perspective. This paper is organized as follows. Section 2 describes the theoretical concepts of support receipt and provision. From this perspective, a formal model is designed and developed (Section 3). Later, in Section 4, several simulation traces are presented to illustrate how this model satisfies the expected outcomes. In Section 5, a mathematical analysis is performed in order to identify possible equilibria in the model. Finally, Section 6 concludes the paper.

2 Antecedents of Social Support Receipt and Provision

Research on social support provides useful information from controlled experimental paradigms on several important factors influenced the possibilities of seeking and giving help. During the formation of stress, there is a condition where an individual either will increase the support interaction demands on support providers. It is typically involves many options, such as whether or not a support provider performs particular support, based on what actions to take and in what manner [1]. Furthermore, through a perspective of help seeking behavior, it also related to the answer of which support member is suitable to pledge for help and so forth. In general, support provision is driven by altruistic intentions and is influenced by several factors that related to provide a support. Within social support researchers' community, it has commonly been viewed that social support is related to several characteristics, namely; (1) stress risk factors, (2) receipt factors, (3) relationship factors, (4) provision factors, and (5) motivation in support [1][3][5][9]. For the first point, stress risk factor is related to the recipient ability to recognize the need of support and be willing to accept support assistance. It includes both features of stressors and appraisal of stressors. This factor is influenced by individual's perceptions of stressors, vulnerability (risk in mental illness), and expectations support from the others [7]. Research indicates that the degree of stressors is correlated to amount of support levels. For example, situations considered as stressful by both support recipients and providers are much more probable to trigger support responses than non-stressful events [2][9]. Having this requirement in motion, potential support providers will recognize the need of support assistance and be willing to offer support [1].

Another point that can be made to understand the social support process is a recipient factor. Despites evidence that primarily shows the negative event plays an important role in seeking and providing support, yet severely distress individuals as

experienced by major depression patients seems to reduce social support process. It is highly related to the individual's personality. Normally, a neurotic personality tends to attract a negative relationship between social support provider and social engagement [6]. Studies of the personality and support have documented that individuals with high self-esteem (assertive) receive more social support compared to the individuals with neurotic personality [1][6]. In relationship factors, characteristics of the relationship (ties) between support recipient and provider are equally to important to activate support selection behaviours. It includes mutual interest (experiential and situational similarity), and satisfaction with a relationship. It is eventually becomes a part of socio-cultural system that has a balance between giving and receiving support. In this connection, it should also be mentioned that there are two additional antecedents related closely to the relationship factors. These are acceptance of social norms and reciprocity norms [1]. Social norms are highly coupled with the view of individual responsibility, intimate relationship and obligation. An example of this is, it is a common fact that many individuals will feel responsible (personal responsibility) for anyone who is dependent upon them. Because of this, it will increase the likelihood of support offering in a certain relationship (either strong tie or weak tie relationship). Strong tie is a relationship typically between individuals in a close personal network. While, a weak tie is typically occurs among individuals who communicate on relatively frequent basis, but do not consider them as close acquaintances. In reciprocity norms, previous interaction and past supportive exchanges will reflect future willingness of both support recipients and providers [2]. Previous failure and frustration of past efforts may influence to reduce individual's motivation and willingness to provide support. For this reason, if individuals always refuse to receive support, it is more likely to receive less support in future [3].

The fourth factor is related to the support provision attributes. Social support members who are faced with condition to give support will be motivated by several factors. Many research works have maintained that there is a link that support-providers with experience empathy and altruistic attitude will regulate altruistic motivation to help the others. In spite of this condition related to the subject of helping people in a weak tie network, it is also useful to understand support's patterns in strong tie network as well. In addition, focus on the other individuals may escalate the potential of providing help through the increasing feeling of empathy, which later develop efficacy. The last factor is the motivation in support. This idea concerns the influence of selecting a support provider from a relationship perspective according to an individual's support need. For example, several studies have shown many individuals with long-term motivation (*future goal orientation*) having difficulty to attain appropriate support from close friends or acquaintances since they feel this group of people has limited skills or knowledge towards the individual's problems [2] [3][7]. However, if the individual's intention to seek for emotional support (*emotional goal orientation*) is higher, then they tend to choose a weak tie support over strong tie [7]. Those antecedents also related to explain several individual and interpersonal characteristics that influence an individual's decisions to seek support from particular social network members.

3 A Multi-Agent Model for Social Support Networks

To support the implementation of multiagent system interaction, the dynamic model for both receipt and provision is proposed and designed. This model uses social and behavioural attributes as indicated in a previous section.

3.1 Formalizing the Multi-agent Model

In the agent model used as a basis for the multi-agent system, five main components are interacting to each other to simulate support-seeking and giving behaviours of an agent. These agent components are grouped as; individual receipt and provision attributes, support preference generation, relationship erosion process, stress component, and support feedbacks. Fig.1 illustrates the interaction for these components.

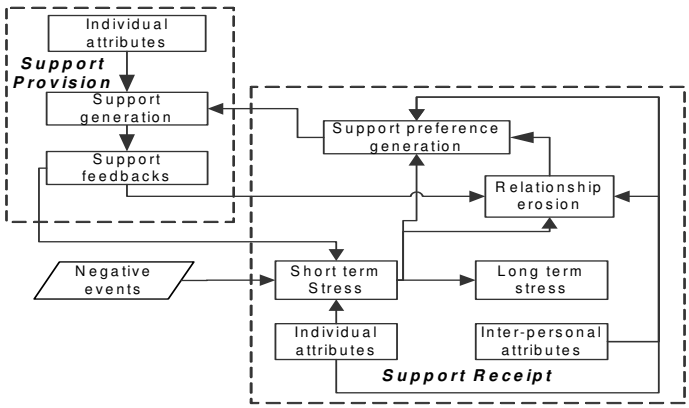

Fig 1. Overall Structure of the Underlying Agent Model

As illustrated in Fig.1, negative events acts as an external factor stimulus triggers the stress component. Such a stress condition is amplified by individual receipt attributes such as risk of stress (or risk of mental illness) and neurotic personality, which later accumulates in certain periods to develop a long-term stress condition. The short-term stress also plays an important to evoke support preference pertinent to the receipt attributes. Similarly, this triggered information will be channelled to the social erosion component, which acts to diminish individual's ability in seeking help. After the social support-tie preference is selected, then the support generation is regulated. Support provision attributes will determine the level of support feedbacks towards the support recipient. To simplify this interaction process, this model assumes all support feedbacks received provide a positive effect towards the agent's well-being (stress-buffering mechanism). Finally, the channelled social support feedback also will be regulated to reduce the relationship erosion effect within individual. The arrows

represent the piece of information that the output of one course of action serves as input for another process. The detailed components of this model are depicted in Fig. 2.

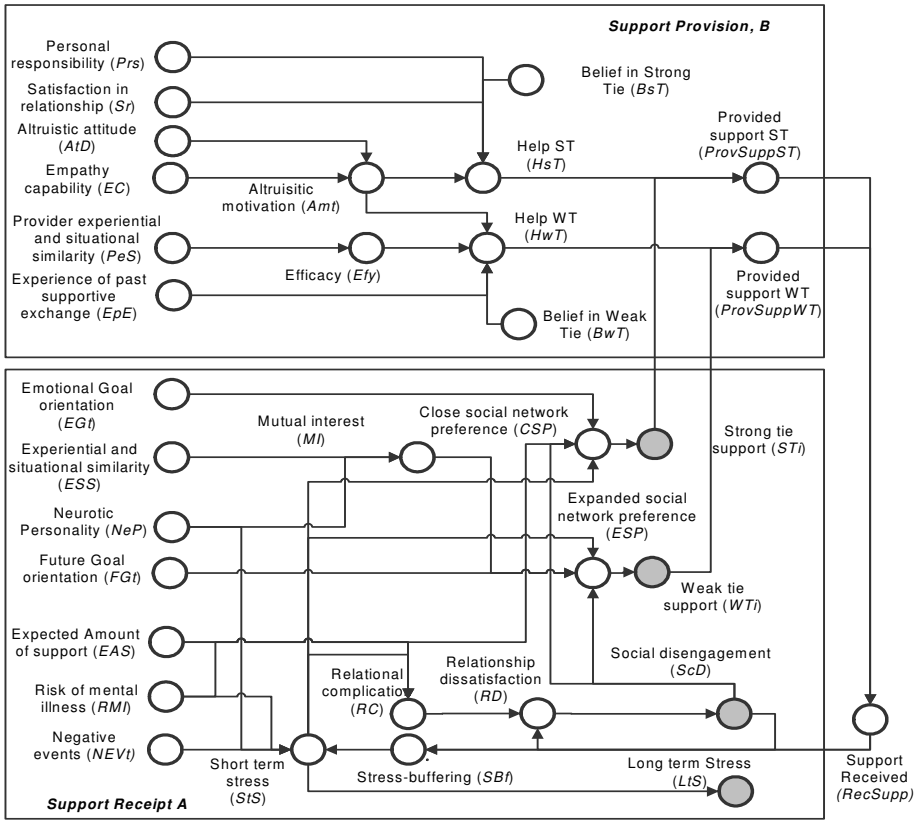

Fig. 2. Detailed Structure and Components of the Agent Model

As can be seen from Fig. 2, several exogenous variables represent individual support receipt and providing attributes. The results from these variables interaction form several relationships, namely instantaneous and temporal relations. To represent these relationships in agent terms, each variable will be coupled with an agent's name (*A* or *B*) and a time variable *t*. When using the agent variable *A*, this refers to the agent's support receipt, and *B* to the agent's support provision. This convention will be used throughout the development of the model in this paper.

3.2 The Agent Component for Support Receipt

This component aims to explain the internal process of support preference during the presence of stress. In general, it combines three main concepts, namely support goal

orientation (emotional goal orientation (*EGt*), future goal orientation (*FGt),* expected amount of support *(EAS)*), personality (neurotic (*NeP*), risk of mental illness / vulnerability (*RMI*), experiential and situational similarity (*ESS*)), and external factor (negative events (*NEVt*)). Interactions among these exogenous variables are derived from these formulae.

Mutual Interest: Mutual interest (*MI*) is calculated using the combination of experiential situational similarity (*ESS*) and complement relation of neurotic personality (*NeP*) as opposed to positive personality). That is to say, having a positive personality and a common experience will encourage a better mutual interest engagement.

$$MI_A(t) = ESS_A(t).(1 - NeP_A(t)) \quad (1)$$

Stress Buffering: Stress buffering (*SBf*) is related to the presence of support and the level of social disengagement (*ScD*). Note that, $\eta_{sbf,a}$ regulates the level for both support ties contribution. Note that a high social disengagement level ($ScD \rightarrow 1$) will cause stress buffering becomes less effective to curb the formation of stress.

$$SBf_A(t) = RecSupp_A(t).(1\text{-}ScD_A(t)) \quad (2)$$

Short-Term Stress: Short-term stress (*StS*) refers to the combination of negative events, risk in mental illness (vulnerability), and neurotic personality. The contribution of these variables are distributed using regulator parameter $\psi_{sts,\,a}$. If $\psi_{sts,\,a} \rightarrow 1$, then the short-term stress will carry only all information from the external environment, rather than individual attributes. In addition, stress-buffering factor eliminates the effect of short-term stress.

$$StS_A(t) = [\psi_{stsA} \,.\, NEVt_A(t) + (1 - \psi_{sts\,A}).RMI_A(t).\, NeP_A(t)].(1 - SBf_A(t)) \quad (3)$$

Relational Complication and Relational Dissatisfaction: Relation complication (*RC*) is measured using the contribution rate (determined by γ_{rc}) of the expected support (*EAS*) and short-term stress (*StS*). Related to this, relational dissatisfaction (*RD*) is determined by η_{rd} times relational complication when no support is given.

$$RC_A(t) = \gamma_{rcA}.EAS_A(t).StS_A(t) \quad (4)$$

$$RD_A(t) = \eta_{rdA}.RC_A(t).\,(1\text{-}RecSupp_A(t)) \quad (5)$$

Close and Expanded Support Preferences: Close support preference (*CSP*) depends to the level of emotional goal orientation (*EGt*), short-term stress (*StS*), and social disengagement (*ScD*). In the case of extended support preference (*ESP*), it is calculated using the level of future goal orientation (*FGt*), short-term stress, mutual interest, and social disengagement. In both preferences, the presence of social disengagement decreases the social network preference level. Similar circumstance also occur when $StS \rightarrow 0$. Parameters β_{csp} and η_{esp} provide a proportional contribution factor in respective social network preference attributes

$$CSP_A(t) = [\beta_{csp,A} \,.EGt_A(t) + (1 - \beta_{csp,A}) \,.(1 - ScD_A(t))] \,.\, StS_A(t) \quad (6)$$

$$ESP_A(t) = [\eta_{esp,A} \,.FGt_A(t) + (1 - \eta_{esp,A}) \,.MI_A(t).(1 - ScD_A(t))] \,.\, StS_A(t) \quad (7)$$

Dynamics of Support, Social Disengagement, and Long Term Stress:

In addition, there are four temporal relationships are involved, namely strong-tie preference (*Sti*), weak-tie preference (*WTi*), social disengagement (*ScD*), and long-term stress (*LtS*). The rate of change for all temporal relationships are determined by flexibility parameters, $\varphi_{sti,}$, ϕ_{wti},η_{scd}, and β_{lts} respectively.

$$ScD_A(t+\Delta t) = ScD_A(t) + \eta_{scd,A}.(1 - ScD_A(t)).$$
$$(RD_A(t) - \psi_{scd,A}.ScD_A(t)).\ ScD_A(t).\Delta t \quad (8)$$
$$LtS_A(t+\Delta t) = LtS_A(t) + (\beta_{lts,A}.(1 - LtS_A(t)).$$
$$(StS_A(t) - \xi_{lts,A}.LtS_A(t)).\ LtS_A(t).\Delta t \quad (9)$$
$$STi_A(t+\Delta t) = STi_A(t) + (\varphi_{sti,A}.(1 - STi_A(t)).$$
$$(CSP_A(t) - \varphi_{sti,A}.STi_A(t)).STi_A(t).\Delta t \quad (10)$$
$$WTi_A(t+\Delta t) = WTi_A(t) + (\phi_{wti,A}.(1 - WTi_A(t)).$$
$$(ESP_A(t) - \eta_{wti,A}.WTi_A(t)).\ WTi_A(t).\Delta t \quad (11)$$

The current value for all of these temporal relations is related to the previous respective attribute. For example, in the case of *STi, w*hen *CSP* is higher than the previous strong-tie preference multiplied with the contribution factor, ψ_{sti}, then the strong-tie preference increases. Otherwise, it decreases depending on its previous level and contribution factor. It should be noted that the change process is measured in a time interval between t and $t+\Delta t$.

3.3 The Agent Component for Support Provision

Another important component to regulate support within social networks is the ability to provide help. In many ways, support provision attributes are often correlated to the amount of support provided to the support recipients. Antecedents of support provision are associated to personal responsibility (*PrS*), satisfaction in relationship (*Sr*), altruistic attitudes (*AtD*), empathy level /capability (*EC*), provision experiential and situational similarity (*PeS*), and experience of past supportive exchange (*EpE*). Combining these factors respectively, instantaneous relationships of altruistic motivation, and efficacy can be derived.

Altruistic Motivation and Efficacy: Altruistic motivation (*Amt*) is determined by through the combination of individual's attributes in altruistic attitude and empathy capability. In efficacy (*Efy*), the current contribution to generate efficacy is based on proportional value γ_{efy} towards provision experiential and situational similarity.

$$Amt_B(t) = AtD_B(t).EL_B(t) \quad (12)$$
$$Efy_B(t) = \gamma_{efyB}.PeS_B(t) \quad (13)$$

Help Provision of Strong and Weak Tie Support: In help provision, it generates support provision capability to provide help, pertinent to the level of respective attributes and relations. For example, the help provision in strong tie support (*HsT*) is calculated from the level of altruistic motivation, personal responsibility, and satisfaction in relationship. The contribution from these factors is regulated using regulation parameter μ_{wst}. In addition, belief on strong tie (*BsT*) controls the help provision towards support recipients. The same concept also applies for help provision in weak tie support (*HwT*).

$$HsT_B(t) = [(\mu_{wst,B}.Amt_B(t) + (1 - \mu_{wst,B}).Sr_B(t).\ PrS_B(t))].BsT(t) \quad (14)$$
$$HwT_B(t) = [(\mu_{wwt,B}.Efy_B(t) + (1 - \mu_{wwt,B}).AMT_B(t).\ PrS_B(t))].BwT(t) \quad (15)$$

For both cases, these beliefs regulate the level of generated help for later usage in the provided support. Having no belief concerning support causes no support will be provided to the support recipients.

3.4 Social Support Distribution and Aggregation

Within the provided support, there are two main components are implemented to regulate support distribution among agents. The first component is a mechanism to differentiate the strong tie ($ProvSuppST_{B,A}$) or weak tie ($ProvSuppWT_{B,A}$) support provision offered by a support provision agent to multiple support receipt agents. By using this technique, the overall support is distributed over the support receipt agents with the proportional to the level of support that respective agents requested for. Later, the received support ($RecSupp_A$) is aggregated by multiple support provision agents to each support receipt agent accordingly.

$$ProvSuppST_{B,A} = (STi_A / \sum_A STi_A).\ HsT_B.(1-\prod_A (1-STi_A)) \quad (16)$$

$$ProvSuppWT_{B,A} = (WTi_A / \sum_A WTi_A).\ HwT_B.(1-\prod_A (1-WTi_A)) \quad (17)$$

$$RecSupp_A = 1-[(\prod_B (1 - ProvSuppST_{B,A}).(1- ProvSuppWT_{B,A}))] \quad (18)$$

4 Results

This section addresses analysis of the multiagent model using several simulation experiments. By variation of the personality attributes for support receipt and provision agents, some typical patterns can be found. Due to the excessive number of possible combinations, this paper shows example runs for four agents under two conditions, namely prolonged and fluctuated stressor events with a different personality profile. Table 1 outlines the values of these profile attributes.

Table 1. Individual Profiles for Each Agent

Support Receipt Agents	**Personality Attributes (*EGt, ESS, NeP, FGt, EAS, RMI*)**
A1	*0.8,0.7,0.8,0.7,0.8,0.8*
A2	*0.8,0.6,0.2,0.9,0.1,0.3*
Support Provision Agents	**Personality Attributes (*PrS, Sr, EL, AtD, PeS, EpE*)**
B1	*0.7,0.8,0.8,0.9,0.7,0.9*
B2	*0.7,0.7,0.3,0.4,0.6,0.7*

The duration of the scenario is up to 1000 time points with these simulation settings;

$\Delta t = 0.3$

$\varphi_{sti,} = \phi_{wti} = \eta_{scd} = \beta_{lts} = 0.2$

$\psi_{sts} = \mu_{wst} = \beta_{csp} = \eta_{esp} = \mu_{wwt} = 0.5$

$\gamma_{rcA,} = \eta_{rd} = \gamma_{efy} = 0.8$

For all cases, if the long term stress is equal or greater than 0.5, it describes the support receipt agent is experiencing stress condition. These experimental results will be discussed in detail below.

Case # 1: Support Provision and Long Term Stress during Prolonged Stressor Events. For this simulation, all support receipt agents have been exposed to an extreme case of stressor events over period of time. It represents individuals that having a difficulty throughout their lifetime. The result of this simulation is shown in Figure 3.

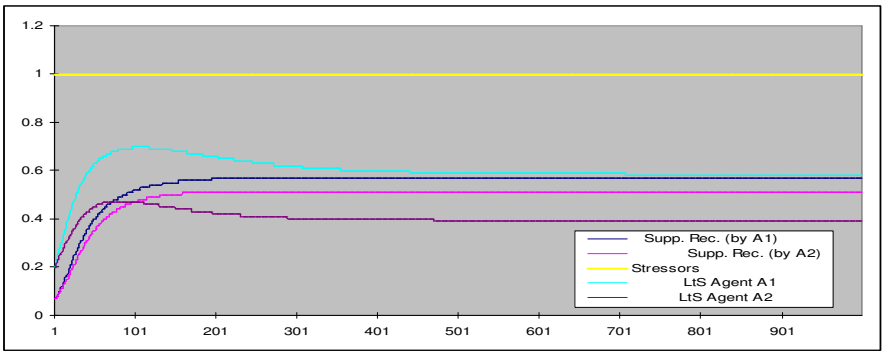

Fig. 3. The Level of Long Term Stress (*LtS*) and Support Received (*Supp. Rec.*) by Agent *A1* and *A2* during Prolonged Stressor

As can be seen from Figure 3, both agents received supports that allow them to reduce their long-term stress throughout time. The amounts of support received by both agents are varied according to their personality attributes. In this case, agent A1 received slightly less support compared to its correspondence long-term stress level. This finding is consistent with [6] who found that an individual with a high neurotic personality received less support from either strong or weak social network tie even during stressful event. Thus, agent *A2* recovers faster compared to agent *A1*.

Case # 2: Support Provision and Long Term Stress during Progression of Stressor Events.

In this experiment, both agents are exposed to the progression of stressor event. During this condition, support receipt agent will increase the amount of support needed, and support provision agent will provide certain amount of support with the respect personality attributes. Figure 4 illustrates the progression of stressor, support received, and long term stress for both support receipt agents.

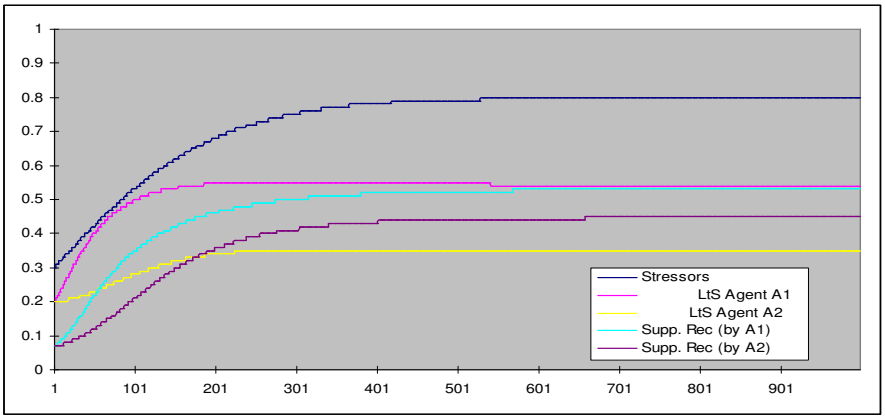

Fig. 4. The Level of Long Term Stress (*LtS*) and Support Received (*Supp. Rec.*) by Agent *A1* and *A2* during Progression Stressor

Figure 4 indicates that agent *A2* receives better support compared to *A1* where, the amount support is slightly higher compared to its long-term stress. Throughout time, it decreases the long-term stress, and providing better coping to curb the progression of it. Compared to agent *A1*, agent *A2* is unlikely to develop prolonged stress condition.

Case # 3: Support Provision and Long Term Stress During Exposure To Fluctuating Stressor Events.

In the following simulation, two kinds of stressors were introduced to agents *A1* and *A2*. The first event contains a very high constant stressor, and is followed by the second event with a very low constant stressor.

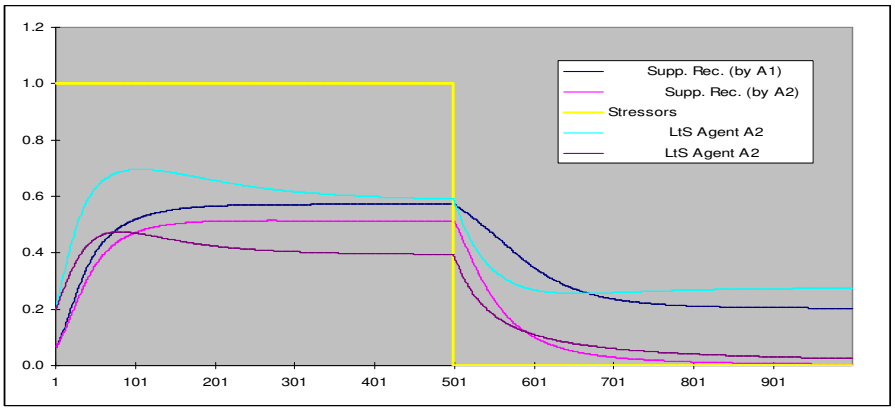

Fig. 5. The Level of Long Term Stress (*LtS*) and Support Received (*Supp. Rec.*) by Agent A1 and A2 during Fluctuated Stressor

As shown in Figure 5, it illustrates the decrease of support level received by both agents. When there is no stressor is experienced by support receipt agents, the lower of support seeking behavior is reduced. It also worth noting that agent *A1*shows slightly declining pattern for the long-term stress, compared to agent *A2* (with considerably decline towards "no stress" condition. This condition explains that individual with risk in mental illness and neurotic personal is vulnerable towards changes in environment [6]. Having these conditions in motion, more effort in support provision is needed to allow better recovery process to take place [3].

5 Mathematical Analysis

One of the aspects that can be addressed by a mathematical analysis is which types of stable situations are possible. To this end equations for equilibria can be determined from the model equations. This can be done to assume constant values for all variables (also the ones that are used as inputs). Then in all of the equations the reference to time *t* can be left out, and in addition the differential equations can be

simplified by canceling, for example, $ScD_A(t+\Delta t)$ against $ScD_A(t)$. This leads to the following equations.

Agent Component for Support Receipt (by A from some B's)

$MI_A = ESS_A.(1 - NeP_A)$ (**19**)

$SBf_A = RecSupp_A.(1\text{-}ScD_A)$ (**20**)

$StS_A = [\psi_{sts,A} . NEVt_A + (1 - \psi_{sts,A}).RMI_A. NeP_A].(1 - SBf_A)$ (**21**)

$RC_A = \gamma_{rc,A}.EAS_A.StS_A$ (**22**)

$RD_A = \eta_{rd,A}.RC_A. (1\text{-}RecSupp_A)$ (**23**)

$CSP_A = [\beta_{csp,A} .EGt_A + (1 - \beta_{csp,A}) .(1 - ScD_A)] . StS_A$ (**24**)

$ESP_A = [\eta_{esp,A} .FGt_A + (1 - \eta_{esp,A}) .MI_A.(1 - ScD_A)] . StS_A$ (**25**)

$\eta_{scd,A} .(1 - ScD_A) .(RD_A - \psi_{scd,A} .ScD_A) . ScD_A = 0$ (**26**)

$\beta_{lts,A} .(1 - LtS_A). (StS_A - \xi_{lts,A} .LtS_A) . LtS_A = 0$ (**27**)

$\varphi_{sti,A} .(1 - STi_A). (CSP_A - \varphi_{sti,A}.STi_A) .STi_A = 0$ (**28**)

$\phi_{wti,A}.(1 - WTi_A).(ESP_A - \eta_{wti,A}.WTi_A) . WTi_A = 0$ (**29**)

Agent Component for Support Provision (from B to some A's)

$Amt_B = AtD_B.EL_B$ (**30**)

$Efy_B = \gamma_{efy,B} .PeS_B$ (**31**)

$HsT_B = [(\mu_{wst,B}.Amt_B + (1 - \mu_{wst,B}).Sr_B . PrS_B)].BsT$ (**32**)

$HwT_B = [(\mu_{wwt,B}.Efy_B + (1 - \mu_{wwt,B}).AMT_B . PrS_B)].BwT$ (**33**)

Differentiation of Provided Support from B to A

$ProvSuppST_{B,A} = (STi_A / \sum_A STi_A). HsT_B.(1-\prod_A (1-STi_A))$ (**34**)

$ProvSuppWT_{B,A} = (WTi_A / \sum_A WTi_A). HwT_B.(1-\prod_A (1-WTi_A))$ (**35**)

Aggregation of Received Support by A

$RecSupp_A = 1-[(\prod_B (1 - ProvSuppST_{B,A}).(1- ProvSuppWT_{B,A}))]$ (**36**)

Assuming the parameters $\eta_{scd,A}$, $\beta_{lts,A}$, η_{scd} , β_{lts} nonzero, from the equations (26) to (29), for any agent A the following cases can be distinguished:

$ScD_A = 1$		or	$RD_A = \psi_{scd,A} .ScD_A$	or	$ScD_A = 0$
$LtS_A = 1$	or	$StS_A = \xi_{lts,A} .LtS_A$	or	$LtS_A = 0$	
$STi_A = 1$	or	$CSP_A = \varphi_{sti,A}.STi_A$	or	$STi_A = 0$	
$WTi_A = 1$	or	$ESP_A = \eta_{wti,A}.WTi_A$	or	$WTi_A = 0$	

For one agent, this amounts to $3^4 = 81$ possible equilibria. Also given the other equations (19) to (25) and (30) to (36) with a large number of input variables, and the number of agents involved, this makes it hard to come up with a complete classification of equilibria. However, for some typical cases the analysis can be pursued further.

Case $ScD_A = 1$

In this case from the equations (20), (24) and (25) it follows:

$SBf_A = 0, CSP_A = \beta_{csp,A} .EGt_A. StS_A, ESP_A = \eta_{esp,A} .FGt_A. StS_A$

This can be used to determine values of other variables by (21), (22), (23), for example.

Case $StS_A = LtS_A = 0$

In this case, from the equations (22), (24) and (25) it follows:

$RC_A = 0, CSP_A = 0, ESP_A = 0$

from which, for example, by (23) it follows that $RD_A = 0$.

6 Conclusion

In this paper, a computational model is presented that describes the mechanism of support receipt and provision within a social network. The agent model used is composed of two main components: agent receipt and provision. The first component explains how personality attributes affect support-seeking behavior, ties selection, and stress buffering, and the second one explains how personality attributes affect providing support behaviour. The model has been implemented in a multiagent environment, dedicated to perform simulations using scenarios based on different stressful events over time and personality attributes. Simulation results show interesting patterns that illustrate the relation of support seeking behaviours and level of support received, with long-term stress. A mathematical analysis indicates which types of equilibria are indeed a consequence of the model. The model can be used as the basis for a personal software agent that facilitates a person in regulating help within a social network member. In addition, using this model, a personal agent will be able to determine social tie selection, and providing information regarding to the level of support needed with correspondence to personality attributes, for both individuals who are seeking and providing support. Thus, this model could possibly be used as a building block for interventions for individual who are facing stress or as a warning system for social support members.

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