A Multi-agent Model for Supporting Exchange Dynamics in Social Support Networks during Stress

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Abstract. Humans are social creatures, and when facing certain level of events, they to seek for support from others and vice versa. In this paper, a multi-agent model for simulating the dynamics of support provision and receipt interaction among different individuals is presented. Important concepts in social support network and stress buffering studies were used as the basis for model design and verification. Simulation experiments under several cases pointed out that the model is able to reproduce interaction among social support network members during stress. Mathematical analysis was conducted to determine possible equillibria of the model. The model was verified using an automated verification tool against generated traces.

Keywords: Multi-agent Systems, Stress-Buffering Model, Social Support Networks, Dynamics in Support Provision and Receipt Interaction.

1 Introduction

The modern era of human civilization has been called the "age of stress," and as a matter of fact, humans are relentlessly exposed to various kinds of stresses. Generally, these stresses are linked with society and daily life, and signs of stress can be depicted as experiencing (but are not limited to) anxiety, anger, overwork, feeling overwhelmed, and withdrawing from others [6]. Individuals can feel stressed because of minor or daily hassles as well as in response to major life events such the death of the love ones. There has been much recent emphasis on the role of social support network to overcome stress [1, 4]. Social support network refers to a social network provision of psychological and material resources intended to benefit an individual's ability to cope with stress [7]. Essentially, it involves interpersonal transactions or exchanges of resources between at least two people perceived by the provider or recipient to be intended to improve the well-being of the support recipient. From this view, it can promote health through stress buffering process, by eliminating or reducing effects from stressors.

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However little attention has been devoted to a computational modelling perspective on how humans (preferably agents) interact to support each other under stress. It is important to see such interactions since the support seeking and offering process is highly dynamic in nature, and it requires intensive resources to monitor such process in a real world. A computational model of such a process would make it possible to study the phenomenon more easily. To do so, a multi-agent model is needed to explain complex phenomena of social support exchange among members in social support networks. In general, multi-agent systems are computational systems in which several semi-autonomous (of fully autonomous) agents interact to execute some set of goals and can be used to manifest complex behaviours even simple individual strategies [3]. In this paper, a formal multi-agent model to simulate the dynamics in the support provision and receipt behaviours is presented. This paper is organized as follows; Section 2 describes several theoretical concepts of social support networks and its relation to stress. From the point of view in Section 2, a formal model was designed and presented (Section 3). Later in Section 4, several simulation traces are presented to illustrate how the proposed model satisfies the expected outcomes. In Section 5, results from mathematical analysis are shown. Model verification using an automated verification tool is discussed in Section 6. Finally, Section 7 concludes the paper.

2 Underlying Concepts in Social Support Networks

Several researchers hold that deficits in social support increase the risk to develop a long term stress, which is later related to the formation of a depression. Related literatures suggest that a critical stress-buffering factor is the perception whether others will provide support.

One key question that is always addressed is whether, on the face of stress, an individual will always help others? The possibility of an individual helping or not helping others can be supported by several theories. Within social support literatures, it has commonly been suggested that in social support networks interaction in stress is related to four main characteristics, namely; (1) stress risk factors, (2) support-receiver and -provider factors, (3) relationship factor, and (4) motivation in support [1, 2, 7, 9, 10].

Firstly, stress risk factor is related to the recipient's ability to recognize the need of support and the willingness to accept support. It includes both features of stressors and appraisal of stressors. This factor is influenced by an individual's perceptions of stressors, risk in mental illness, and expectations about support from others. In many cases, situations considered as stressful by both support recipients and providers are much more probable to trigger support responses than non-stressful events [4]. Based on this circumstance, it becomes apparent that potential support providers need to be aware of the need of support assistance and need of willingness to offer support [1, 7]. The second point is support recipient and provider factors. Despites the evidence that primarily shows the occurrence of negative events contributes largely to individuals seeking for support, yet severely distressed individuals (e.g. patients with a major depression) seem to be detracted from the social support process [7,10]. For instance, an individual with a neurotic personality tends to show a negative relationship between social support provider and social engagement [10]. In this connection, it should also be mentioned that individuals with high self-esteem (assertive) obtain more social support as compared to individuals with a neurotic personality [8]. Such personality also correlates to the willingness to help. Several previous studies have found that support-providers with experience empathy and altruistic attitude will regulate altruistic motivation to help others [2, 7]. This attribute can be addressed as being helpful (helpfulness).

The third point is related to the characteristics of the relationship between the support recipient and provider. An important factor in this relationship is mutual interest (experiential and situational similarity), and satisfaction with a relationship. An example of this, it is a universally accepted fact that many individuals will feel responsible for anyone who is reliant upon them. Because of this, it will raise the likelihood of offering support through a certain relationship. This happens both in strong tie and weak tie relationships. Strong tie is a relationship between individuals in a close personal network [1], while a weak tie is typically occurs among individuals who communicate with each other on relatively frequent basis, but do not consider them as close acquaintances [1, 2]. Another factor that determines the relationship is previous failure and frustration about past efforts; this may reduce an individual's motivation and willingness to seek for support. It is known that if individuals always refuse to receive support, they will more likely receive less support in future [1, 9].

Finally, the last factor is the motivation for support. This concern the choice of a support provider based on an individual's support requirement. For example, a number of studies have shown that many individuals which require necessary knowledge and skills to resolve various problems and stressful situations (informational support) have difficulty to attain suitable support from close acquaintances since they believe this group of people is less proficient in solving such problems [2]. However, if the individual's objective is to receive emotional support (emotional preference support), then they have a tendency to select a weak tie more than a strong tie [1].

3 Modelling Approaches

This section briefly introduces the modelling approach used to specify the multi-agent model. To support the implementation of multi-agent system interactions, a dynamic model for agents is proposed and designed.

3.1 Formalizing the Dynamics of Multi-agent Model

The characteristics of the proposed multi-agent model are derived from social and behavioural attributes as identified in the previous section. Prior to the support seeking behaviour, negative events acts as an external factor that trigger the stress (stressors). Such a stress condition is amplified by individual receipt attributes such as neurotic personality, which later accumulates in certain periods to develop a long-term stress condition [8]. The short-term stress also plays an important role in evoking support preferences. Support provision attributes will determine the level of support feedback towards the support recipient. To simplify this interaction process, this model assumes that all support feedback received will result in a positive effect on the agent's well-being. Finally, the channelled social support feedback also will be regulated to reduce the relationship erosion effect within the individual. Detailed discussion of this agent model can be found in [3].

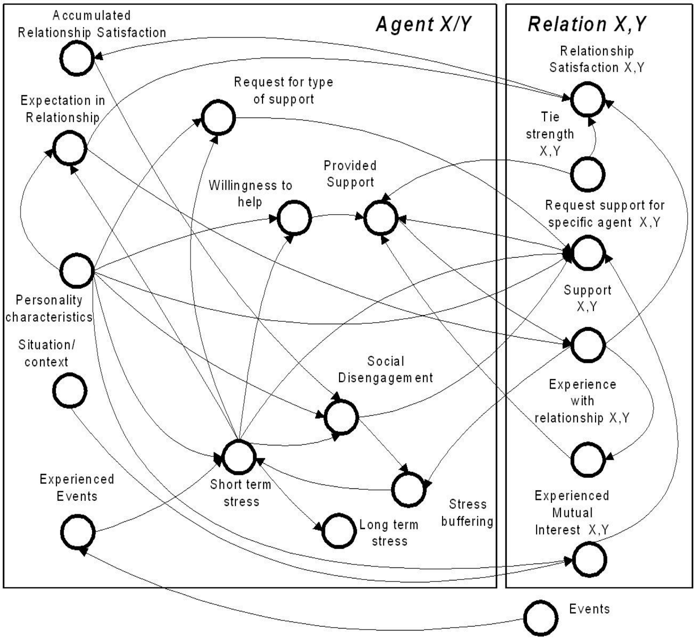

Fig. 1. Detailed Structure and Components of the Multi-Agent Model

As shown in Figure 1, several exogenous variables represent important components with social support networks members. These variables can be differentiated according to its behaviour, either instantaneous or temporal relations. Instantaneous relationship occurs without any temporal delay, in contrast to the temporal relationship. One important note is, an agent X represents several numbers of agents X_1, X_2,…,X_i. Similar concept can be addressed to the agent Y. Detailed specification of these relationships will be discussed in the following section.

3.2 Dynamic Specifications of the Multi-agent

In order to specify the model, a temporal specification language has been used. This language known as LEADSTO enables one to model direct temporal relationship between two state properties (dynamic properties). To logically specify simulation model and to execute this model, consider the format of $\alpha \twoheadrightarrow_{e,f,g,h} \beta$, where α and β are state properties in form of a conjunction of atoms (conjunction of literals) or negations of atoms, and e,f,g,h represents non-negative real numbers. This format can be interpreted as follows:

If state α holds for a certain time interval with duration g, after some delay (between e and f), state property β will hold a certain time interval of length h.

For a more detailed discussion of the language, see [5]. To express properties on dynamics relationship, the ontology of the model is specified in Table 1. Note that some atoms make use of sorts. The specific sorts that are used in the model and the elements that they contain are shown in Table 2.

Table 1. Ontology & Symbol of Concepts Used in the Specifications

Concept	Symbol	Formalization
Personality characteristics	as used in sorts	personality (X:AGENT, P:PERSONALITY, V:REAL)
Situation of each agent	as used in sorts	situation(X:AGENT, C:CAREER)
Situational similarity (context)	$sitsim_{XY}$	situation_similarity (C1:CAREER, C2:CAREER, V:REAL)
Support provided from agent X to agent Y	sup_{XY}	provided_support (X:AGENT, Y:AGENT,V:REAL)
Willingness to help	$will_X$	willingness_to_help(X:AGENT, V:REAL)
Tie strength between agent X and agent Y	tie_{XY}	tie_strength(X:AGENT, Y:AGENT, V:REAL)
Sharing mutual interest	$expmutint_{YX}$	exp_mutual_interest(X:AGENT, Y:AGENT, V:REAL)
Short term stress	sts_X	st_stress(X:AGENT, V:REAL)
Satisfaction in relationship among agents	$rsat_X$	relationship_satisfaction(X:AGENT, Y:AGENT, V:REAL)
Support requested by corresponding agents	req_{XY}	req_for_support(Y:AGENT, X:AGENT, V:REAL)
Stress buffering	stb_X	stress_buff(Y:AGENT, V:REAL)
Experience in relationship between both agents	$prevexp_{XY}$	experience_relationship(X:AGENT, Y:AGENT, V:REAL)
Expectation in relationship	exp_X	expectation_in_relationship (X:AGENT, V:REAL)
Social disengagement	$sdis_X$	soc_disgmt(X:AGENT, V:REAL)
Event (stressors)	nev_X	experienced_event(X:AGENT, V:REAL)
Accumulation of related request	$acreq_X$	acc_related_req(Y:AGENT, X:AGENT, V:REAL)
Accumulation of relationship satisfaction	ars_X	acc_rship_satisfaction(X:AGENT, V:REAL)
Long term stress	lts_X	lt_stress(X:AGENT, V:REAL)
Support received from agent X to agent Y	$rsup_X$	support(X:AGENT, Y:AGENT, V:REAL)

Table 2. Sorts Used to the Specifications

Sort	Elements
REAL	The set of real numbers
AGENT	An agent
PERSONALITY	{neuroticism ($neur_X$), helpfulness ($helpfulness_X$), vulnerability (vul_X), pref_emotional_sup ($emsuppref_Y$), pref_informational_sup($infsuppref_Y$)}
CAREER	{student, professional, elderly, young_adult}

To formalize the dynamic relationships between these concepts, the following specifications are designed:

SB: Stress Buffering
If the agent Y receives support level Sp_{XY} from each agent X, and its current social disengagement level is *Z* then the current stress buffer level for agent Y is $Sp*(1-Z)$, where $Sp = 1 - \prod_{X \neq Y} .(1-Sp_{XY})$

∀X:AGENT, ∀Y:AGENT provided_support(X, Y, Sp_{XY}) ∧ X≠Y ∧soc_disgmt(Y, Z) ↠ stress_buff(Y, (1-Z)*(1 - $\prod_{X \neq Y}$.(1-Sp_{XY})))

STS: Short-Term Stress
If the agent X faces negative events of level *Ne* and has a neurotic personality level *R*, stress buffer level *J* , and a proportional contribution ψ towards stress, then the short term stress level is calculated as $\psi*Ne+(1-\psi)*R*(1-J)$

∀X:AGENT experienced_event(X, Ne) ∧ personality (X, neuroticism, R) ∧ stress_buff(X, J) ↠ st_stress(X, ψ*Ne+(1-ψ)*R*(1-J))

EIR: Expectation in Relationship
If the agent X personal characteristics level of being vulnerable is *V* and experiencing level of short term stress *H* then the expectation in relationship is $V*H$

∀X:AGENT
personality(X, vulnerability,V) ∧ st_stress(X, H)↠ expectation_in_relationship(X,V*H)

RST: Relationship Satisfaction
If the agent X expects level *W* from any relationship, receives support *N* from Y, and has tie strength *K* with agent Y, then its relationship satisfaction level Rs_{XY} towards agent Y is $(1-W)*N*K$

∀X:AGENT, ∀Y:AGENT expectation_in_relationship (X, W) ∧ provided_support(Y, X, N) ∧ tie_strength(X, Y, K) ↠ relationship_satisfaction(X, Y, (1-W)*N*K)

WGH: Willingness to Help
If the agent X personal characteristics level of being helpful is *S* and experiences level of short term stress *H* then agent willingness to help is $S*(1-H)$

∀X:AGENT personality(X, helpfulness, *S*) ∧ st_stress(X, *H*) ↠ willingness_to_help(X, S*(1-H))

PVS: Provided support
If the agent X receives support- request level G_{XY} from agent Y, has tie strength K_{XY} with agent Y, has previous experience B_{XY} with agent Y, has level of willingness to help E_X, and receives accumulated request for support *Wr*, and *Wr* >0, then the level of provided support offered by agent X to agent Y is $(G_{XY}*K_{XY}*B_{XY}/(Wr))*E_X$

∀X:AGENT,∀Y:AGENT req_for_support(Y, X, G_{XY})∧ tie_strength(X,Y, K_{XY}) ∧ experience_relationship(X,Y, B_{XY}) ∧ willingness_to_help(X, E_X) ∧ acc_related_req(X, Wr) ∧ Wr> 0 ↠ provided_support (X, Y, (G_{XY}*K_{XY}*B_{XY}/ (Wr))*E_X)

EMI: Experience in Mutual Interest
If the agent X has neurotic personality level *R* and sharing level *Q* of situational similarity with an agent Y then the experience in mutual interest for both agents is $(1-R)*Q$.

∀X:AGENT, ∀Y:AGENT, ∀C1:CAREER, ∀C2:CAREER personality (X, neuroticism, *R*) ∧ situation_similarity (C1, C2, *Q*) ↠ exp_mutual_interest(X, Y, (1-R)*Q)

SDG: Social Disengagement

If agent X has neurotic personality level *R*, is experiencing level of short term stress *H* and has accumulated relationship satisfaction *J,* then the social disengagement level of agent *X* is *R*H*(1-J)*

∀X:AGENT personality (X vulnerability,R) ∧ st_stress(X, H) ∧ acc_rship_satisfaction(X, J) ↠ soc_disgmt(X, R*H*(1-J))

RFS: Request for Support

If the agent Y has social disengagement level *Z*, experiencing level of short term stress *H*, tie strength *K* with agent X, level preference for emotional support *Fe*, level of experience in mutual interest *EM* with agent X, and has level preference for informational support *Fm,* then the request for support from agent X is *((1-Z)*(1-H))*((K* Fe)+ (S1*Fm))*

∀X:AGENT, ∀Y:AGENT soc_disgmt(Y,Z) ∧ st_stress(Y, H)∧ tie_strength(X,Y, K) ∧ personality(Y, pref_emotional_sup, Fe) ∧ exp_mutual_interest(X, Y, EM) ∧ personality(Y, pref_informational_sup, Fm) ↠ req_for_support(Y, X, ((1-Z)*H)*((K* Fe)+ (EM*Fm)).

ARQ: Accumulated Request for Support

If the agent X receives request for support per time unit G_{XY} from each agent Y, has accumulated request for support *Wr* and flexibility rate γ for handling support, then the accumulated request for support after Δt is $Wr + \gamma (Wr- ((1-\prod_Y .(1-G_{XY})).\Delta t.$

∀X:AGENT, ∀Y:AGENT Y≠X ∧ req_for_support(Y,X,G_{XY}) ∧ acc_related_req(X,Wr) $\twoheadrightarrow_{\Delta t}$ acc_related_req(X, Wr + γ (Wr- ((1-$\prod_{Y\neq X}$.(1-G_{XY})) Δt)

SPR: Support Received

If the agent X provides level of support U_{XY} to Y then the level of support offered to agent Y is aggregated as $1-(\prod_{X\neq Y}(1-U_{XY}))$.

∀X:AGENT, ∀Y:AGENT
X≠Y ∧ provided_support (X, Y, U_{XY})↠ support_received(Y,1-($\prod_{X\neq Y}$ (1-U_{XY})))

ARS: Accumulated Relationship Satisfaction

If the agent X has for each agent Y relationship satisfaction level Rs_{XY}, level of accumulated relationship satisfaction *J*, and has adaptation rate β, then the accumulated relationship satisfaction for agent X after Δt is $J+ (1-J)* \beta*(Rs-J)*J*\Delta t$, where $Rs = 1- \prod_{Y\neq X} (1-Rs_{XY})$.

∀X:AGENT Y≠X ∧ relationship_satisfaction(X,Y,Rs_{XY}) ∧ acc_rship_satisfaction(X, J) $\twoheadrightarrow_{\Delta t}$ acc_rship_satisfaction(X, J+ (1-J)* β *(1- $\prod_{Y\neq X}$ (1-Rs_{XY}) -J)*J*Δt)

LTS: Long-Term Stress

If agent X faces level of short term stress *H*, has previous level of long-term stress *L*, and has adaptation rate α, then the long term stress for agent X after Δt is $L+ (1-L)* \alpha*(H-L)*L*\Delta t$.

∀X:AGENT st_stress(X, H) ∧ lt_stress(X, L) $\twoheadrightarrow_{\Delta t}$ lt_stress(X, L+ (1-L)* α*(H-L)*L*Δt)

4 Simulation Traces

Based on the specified temporal rules, the executable properties have implemented in a software environment that can execute such specifications. Due to the excessive number of possible complex combinations and outcomes, this paper shows example runs for three agents under selected events. The initial settings for the different individuals are the following (*neuroticism, helpfulness, vulnerability, situation*); **Jan** (*0.2, 0.8, 0.2, professional*), **Piet** (*0.6, 0.3, 0.5, student*), and **Kees** (*0.8, 0.4, 0.8, retired*). These simulation used the following parameter settings; Δt = 0.3, all adaptation and proportional are assigned as 0.9 and 0.5 respectively, and 50 time steps. From the simulation, a long term stress level for each agent can be obtained. Figure 2(a) depicts the formation of these long term stress levels for all agents.

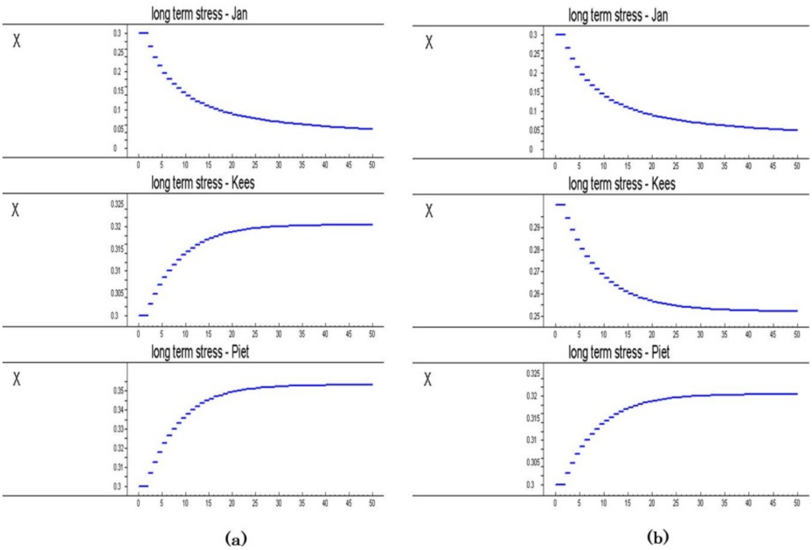

Fig. 2. The Level of Long Term Stress for Each Agent (a) initial condition, (b) after a new neuroticism level for *Kees*

Note that in this case (from Figure 2(a)), all agents, (except *Jan*) have developed a long term stress gradually, since the amounts of support received are varied according to their personality attributes. This finding is similar to the conditions reported by [8, 10], who suggested that individuals with a high neurotic personality received less support from their social support network members. To show another variation, the new neuroticism level for agent *Kees* is changed to *0.3*. As can be seen from Figure 2(b), the agent *Kees* gradually decreased its long term stress level. The effect of altruism also can be simulated by increasing the helpfulness level for all agents. Using these new helpfulness values, (*0.8, 0.7, 0.6*) correspondently to *Jan*, *Piet*, and *Kees* while retaining other initial attributes, then the effect for a long term stress level for all agents can be visualized in Figure 3(a).

This condition shows a situation in which all individuals are willing to help and provide related support to those who are in need. Eventually this results in less threatening interpretations of experienced events, thus providing a better coping ability [4]. In another experiment, for both agents (*Kees* and *Piet*), the helpfulness values have been assigned as 0.1 respectively. Using these new helpfulness values, Figure 3(b) illustrates that two agents (*Kees* and *Piet*) are experiencing more negative effects of the stressor in the long run. It is clearly shows that when all agents were less helpful, the social buffering capability became less functional [2].

5 Mathematical Analysis

By a mathematical formal analysis, the equilibria of the model can be determined, i.e., the values for the variables for which no change occurs. Note that to this end the exogenous variables are assumed to have a constant value as well. Assuming the parameters nonzero, the list of LEADSTO relationships for the case of equilibrium provides the following equations for all agents X and Y (see Table 1 and Table 2 for an overview of the symbols used):

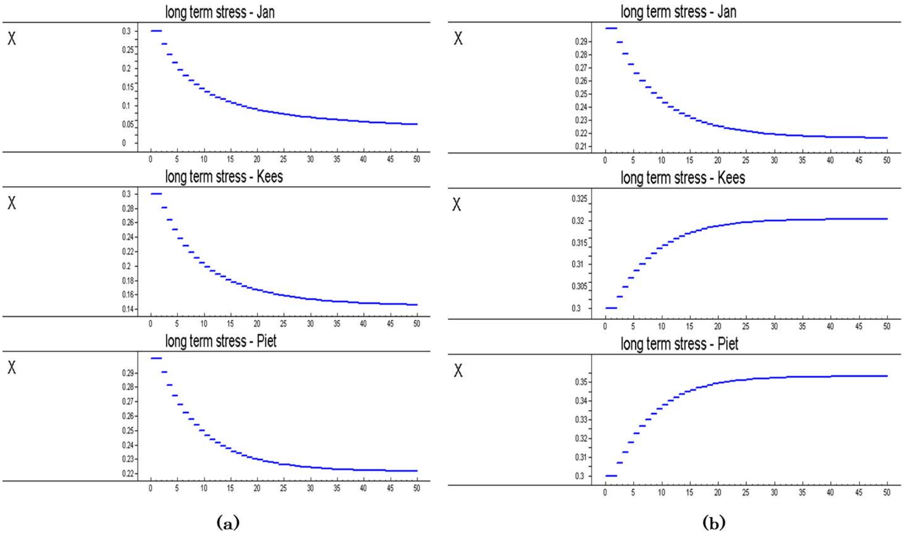

Fig. 3. The Level of Long Term Stress for Each Agent (a) when all Agents are Helpful, (b) all Agents are Less Helpful

LTS: $lts_X * (sts_X - lts_X) * (1 - lts_X) = 0 \Leftrightarrow lts_X = 0 \;\vee\; lts_X = 1 \;\vee\; lts_X = sts_X$

ARS: $ars_X * (1 - \prod_Y (1 - rsat_{XY}) - ars_X)(1 - ars_X) = 0 \;\Leftrightarrow\; ars_X = 0 \;\vee\; ars_X = 1 \;\vee\; ars_X = 1 - \prod_Y (1 - rsat_{XY})$

RST: $rsat_{XY} = (1 - exp_X)\, sup_{XY}\, tie_{XY}$

EIR: $exp_X = vul_X * sts_X$

STS: $sts_X = stressorientation_X * nev_X + (1 - stressorientation_X) * neur_X * (1 - stb_X)$

SB: $stb_Y = (1\text{-}sdis_Y)*(1 - \prod_{X \neq Y} *(1\text{-}sup_{XY}))$
SDG: $sdis_Y = neur_Y*sts_Y*(1\text{-}ars_Y)$
PVS: $sup_{XY} = (req_{XY}*tie_{XY}*prevexp_{XY}/ acreq_X)*will_X$
ARQ: $acreq_X = 1\text{-}\prod_{Y \neq X} *(1\text{-}req_{XY})$
WGH: $will_X = helpfulness_X*(1\text{-}sts_X)$
RFS: $req_{YX} = (1\text{-}sdis_Y)*sts_Y*(tie_{YX}* emsuppref_Y + expmutint_{YX}*infsuppref_Y)$
EMI: $expmutint_{YX} = (1\text{-} neur_X)*sitsim_{XY}$;
SPR: $rsupp_X = 1\text{-}(\prod_X (1\text{-} sup_{XY}))$

The first two lines provide 9 different cases for each agent, which in principle might provide 9^n cases where n is the number of agents. These cases can be elaborated further, and some of them may exclude each other. However, as long term stress is not affecting any other variable, these three cases can be considered independently. Therefore 3^n cases remain. Only for low n the total number of cases is a limited amount, for example 2 for n=2, or 9 for n = 3. Furthermore, specific cases can be considered by filling in values, and verifying whether the equations are fulfilled. As an example, if nev_X=1 and $neur_X$ = 1, stb_X = 0, then sts_X = 1 by **STS**, and hence $will_X$ =0 by **WGH**, and for all Y it holds sup_{XY} =0 by **PVS**, and $rsat_{XY}$ =0 by **RST.** If this holds for all X, then $rsupp_Y$ = 0 by **SPR**, and ars_X = 1 (or 0) by **ARS**, which implies $sdis_X$ =0 by **SDG**. Moreover**,** req_{YX} =0 by **RFS**, exp_X = 0 by **EIR** and $acreq_X$ =0 by **ARQ.**

6 Verification

In order to verify whether the model indeed generates results that adherence to psychological literatures, a set of properties have been identified from related literatures. These properties have been specified in a language called Temporal Trace Language (TTL). TTL is built on atoms referring to states of the world, time points, and traces. This relationship can be presented as a state (γ, t, output(R)) |= p, means that state property *p* is true at the output of role *R* in the state of trace at time point *t* [5].

VP1: Individual who experienced a positive relationship is unlikely to develop further long term stress [1, 2]**.**
If a person is satisfy with his/her relationship with other people, then that person will have less risk to develop long term stress.

∀γ:TRACE, t1, t2, t3:TIME, v1, v2, v3, v4 :REAL, X, Y:AGENT
[state(γ, t1) |= lt_stress(X, v1) & v1 > 0 & v1 ≠ v4, & state(γ, t1) |= relationship_satisfaction(X,
Y, v2) & state(γ, t2) |= relationship_satisfaction(X, Y, v3) & V3 > V2]
⇒ ∃t3:TIME > t2:TIME & t2:TIME > t1:TIME [state(γ, t3) |= lt_stress(X, v4) & v4 < v1]

VP2: A helpful individual and experiencing low short stress will provide a better support provision compared who is not [2, 7]**.**
If a person is being helpful, and experiencing less short term stress, then that person will offer better support.

∀γ:TRACE, t1, t2, t3 :TIME, v1,v2,v3,v4,v5:REAL, X, Y:AGENT
[state(γ, t1) |= personality (X, helpfulness, v1) & state(γ, t1) |= st_stress(X, v2) & state(γ, t1) |= prov_support (X, Y, v3) & state(γ, t2) |= st_stress(X, v4) & v4 < v2] ⇒ ∃t3:TIME > t2:TIME & t2:TIME > t1:TIME [state(γ, t3)|= prov_support (X, Y, v5) & v5 > v3]

VP3: Individual who is experiencing high stress and had a very bad experience in a relationship tends not to seek support from the others [1, 9]**.**
If a person is experiencing high stress, and had negative satisfaction in relationship, then that person will avoid from seeking support.

∀γ:TRACE, t1, t2, t3 :TIME, v1,v2,v3,v4:REAL, X, Y:AGENT
[state(γ, t1) |= st_stress(X, v1) & v1 =1 & state(γ, t1) |= relationship_satisfaction(X, Y, v2) & state(γ, t2) |= relationship_satisfaction(X, Y, v3) & v3 < v2] ⇒ ∃t3:TIME > t2:TIME & t2:TIME > t1:TIME [state(γ, t3) |= req_for_support(Y,X,v4)]

7 Conclusion

The challenge addressed in this paper is to provide a multi-agent model that is capable of simulating the behaviour of members in social support networks when facing negative events. The proposed model is based on several insights from psychology, specifically social support interactions. Using several individual attributes, this model has been implemented in a multi-agent environment. Simulation traces show interesting patterns that illustrate the relationship between personality attributes, support provision, and support receiving, and the effect on long term stress. A mathematical analysis indicates which types of equillibria occur as a consequence of the model. Furthermore, using generated simulation traces, the model has been verified against several important ideas in the literatures. The resulting model can be useful to understand how certain concepts in a societal level (for example; personality attributes) that may influence other individuals while coping with incoming stress. In addition to this, the proposed model could possibly be used as a mechanism to develop assistive agents that are capable to inform social support network members when an individual in their network is facing stress.

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