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Abstract

With decades of bystander effect literature available, this paper focuses on simulating behavioural patterns for this effect.

- From this literature specific **behavioural patterns** were identified and formulated into **three requirements**
- Seven simulated **scenarios** were explored addressing **factors**, such as the Proportional Dominance Effect, In-Group Effect, Dangerous emergency, and Distress perception and how they affect decision making in the bystander effect.
- Suitable values for unknown parameters were identified by **parameter tuning** using a Simulated Annealing algorithm.
- The created model **adhered** to the three identified requirements.

Network-Oriented Approach

The Network-Oriented Modelling approach applied makes use of three types of network characteristics :

- 1. Connectivity**
Strengths of connections expressed by weights $\omega_{X,Y}$
- 2. Aggregation**
Combining multiple impacts on a state by a combination function $c_Y(..)$
- 3. Timing**
Speed of change of a state by a speed factor η_Y

This was used to design a dynamical model for the bystander process.

Bystander effect in Temporal Causal Model

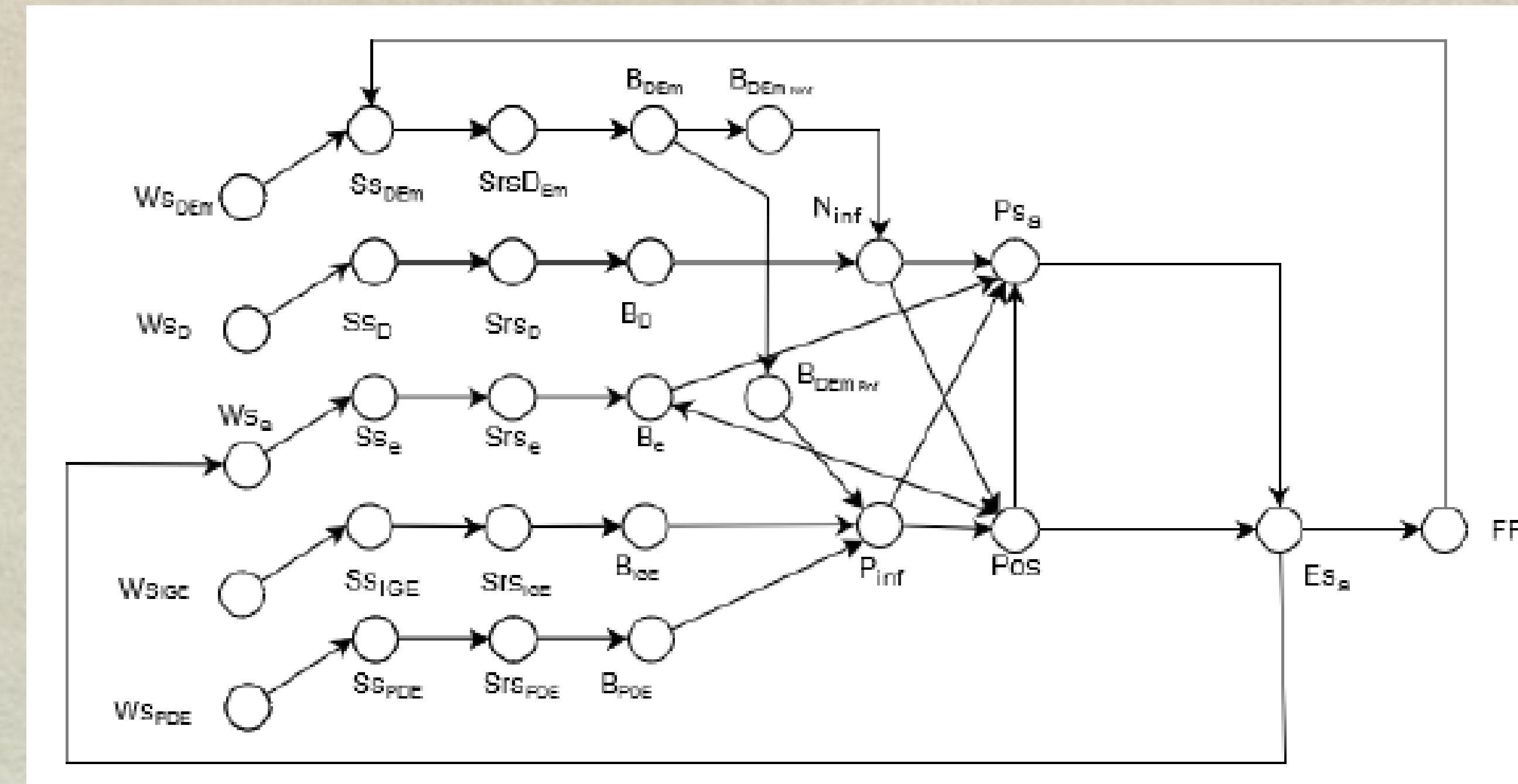


Figure 2. Temporal-causal network for two individuals determining to help victim Es_v .

Simulation results DEM

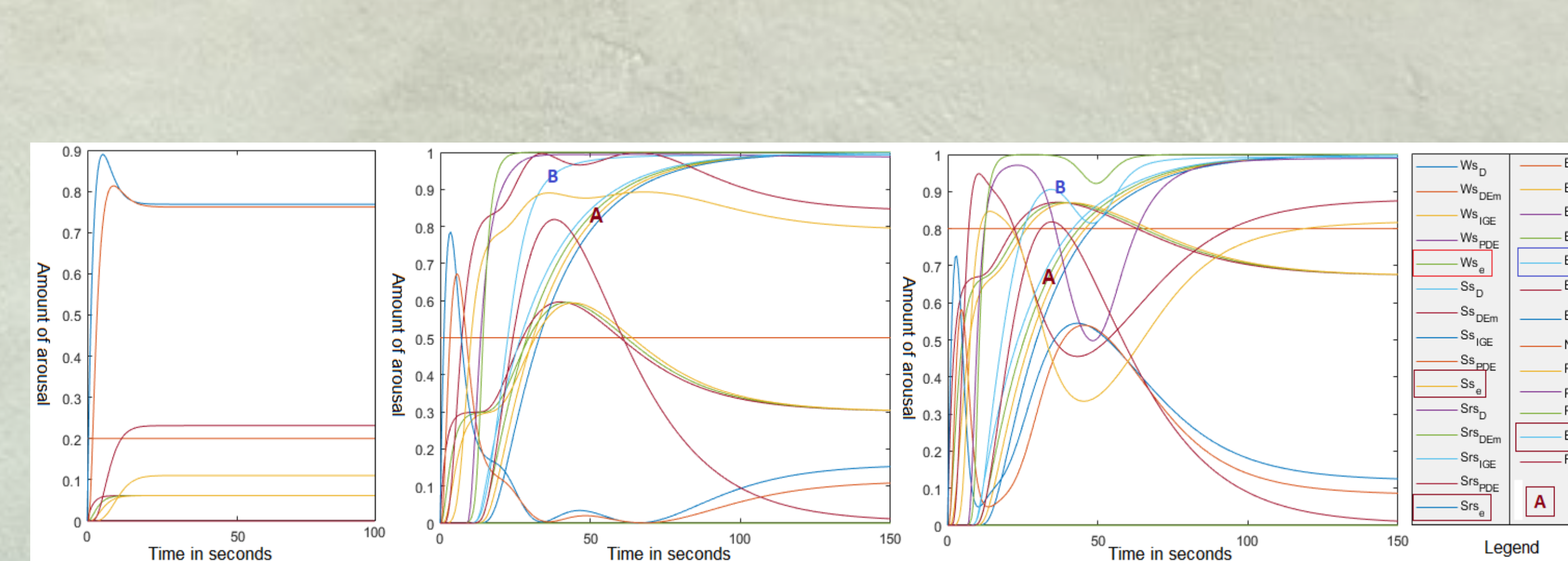


Figure 3. Three different scenarios with DEM=0.2 (left), DEM=0.5 (middle), DEM=0.8 (right)

Simulation Results PDE / IGE

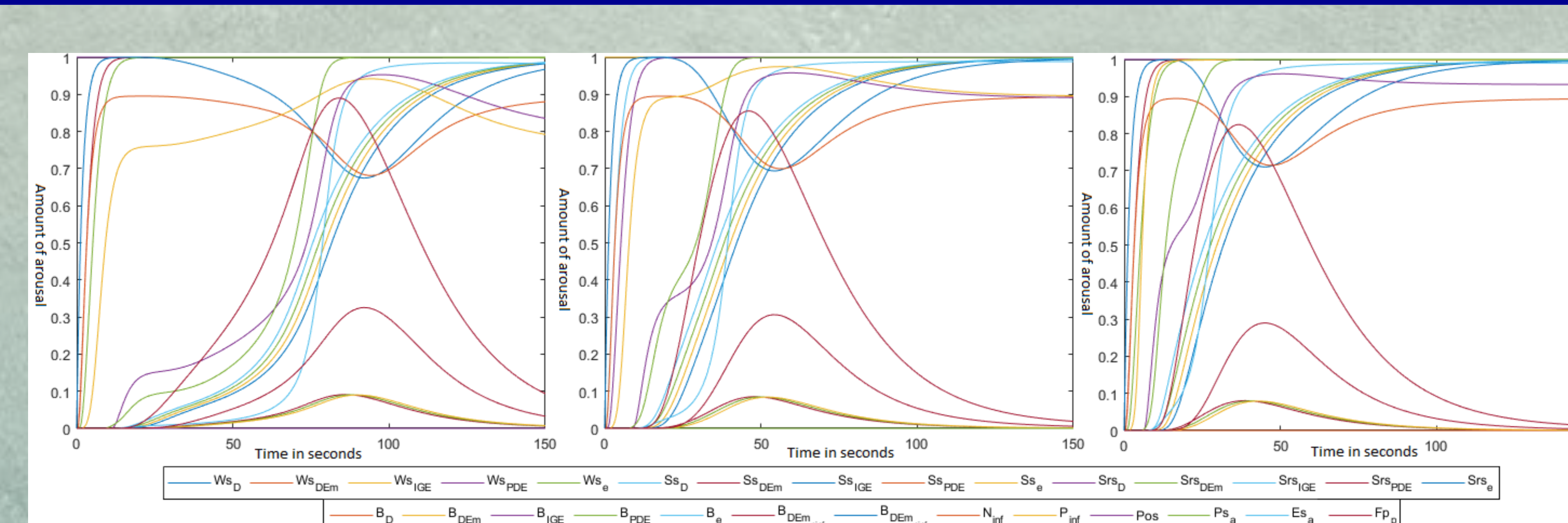
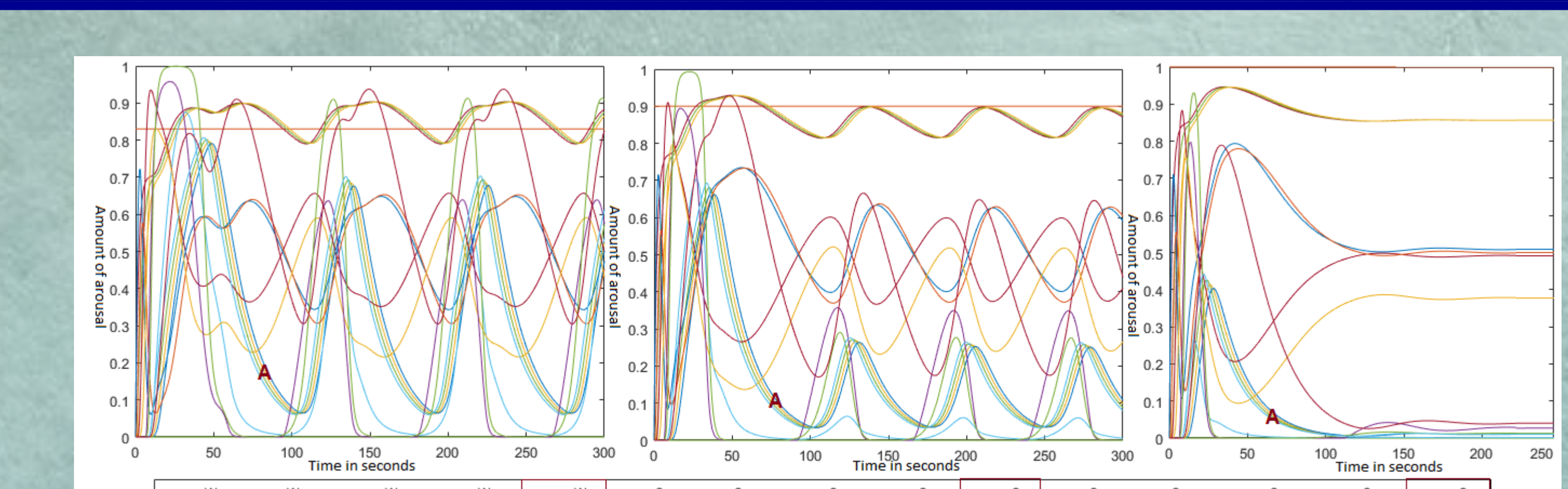


Figure 4. Simulations of different PDE/IGE values with left PDE=0 and IGE=1, in the middle PDE=1 and IGE=0, and right both value one. As shown the bystander intervention occurs faster from right to left.

Tuning the parameters



Discussion

The **three requirements** for the bystander effect are:

1. An increasing dangerous emergency will positively influence the bystander intervention [5];
2. When a person has a strong IGE/PDE, the bystander will intervene in both situations but IGE will be faster than PDE [4];
3. When the costs overpower the rewards, the probability of helping will decrease (and increase when vice versa) [2].

The stated requirements were used to model easy behaviour situations to make more complex situations for the bystander effect. Mathematical **verification** showed that the model is sound. Furthermore, the model was used for a Simulated Annealing algorithm to predict the best fitting parameters of the model. This resulted in certain waves of helping and not helping, see figure below.

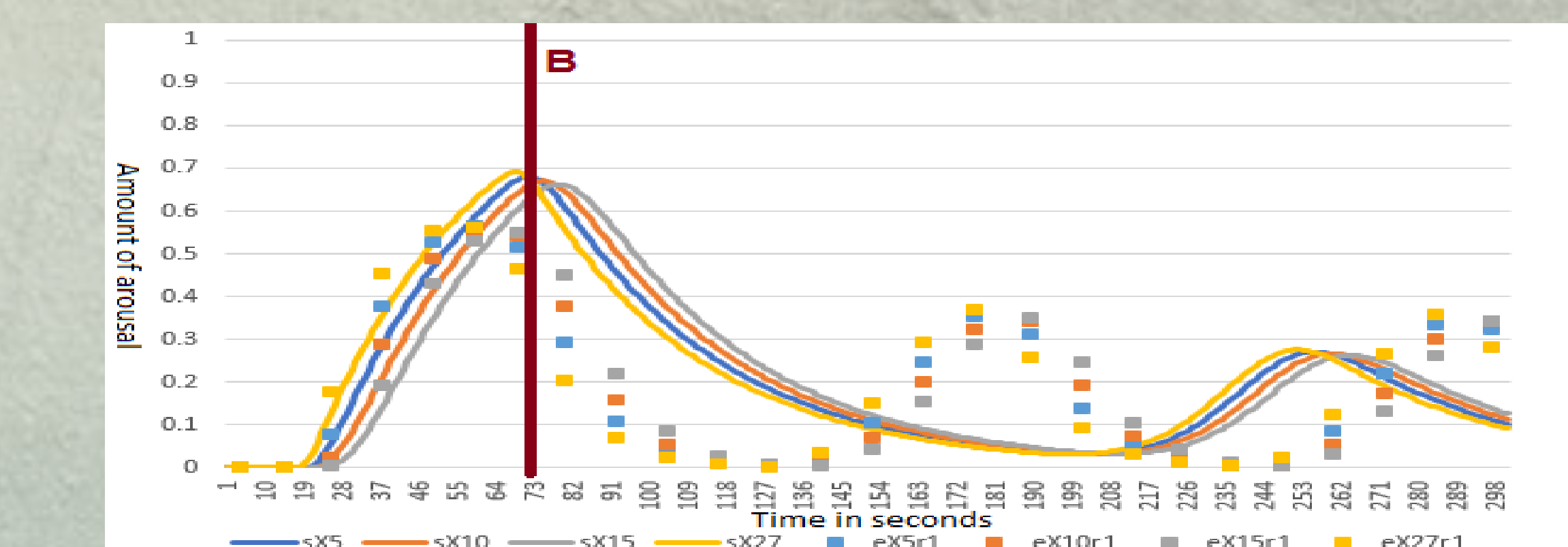


Figure 6: RMSE errors over time for Run 1 in Table 3 with best scoring RMSE=0.096

Further Research

1. More research is needed for weak connections between certain variables. As they might not affect one significantly on itself, it might have a higher effect when combined with multiple weak connections.
2. Real-life data is necessary to validate the model further to ensure the correctness of each chosen parameter setting.
3. The situation is focused on the choice of one person helping. However, this might differ when a larger group considers this question.
4. Other variables can be included to broaden the size of the created model.

References

- [1] Berggren, N., Blonievsky, T., & Derakshan, N. (2015). Enhanced visual detection in trait anxiety. *Emotion*, 15 (4), 477.
- [2] Dovidio, J. F., Piliavin, J. A., Gaertner, S. L., Schroeder, D. A., & Clark III, R. D. (1991). The arousal: Cost-reward model and the process of intervention: A review of the evidence. Newbury Park, CA: Sage Publications, Inc.
- [3] Darley, J. M., & Latané, B. (1968). Bystander intervention in emergencies: Diffusion of responsibility. *Journal of personality and social psychology*, 8 (4p1), 377.
- [4] Erlandsson, A., Björklund, F., & Bäckström, M. (2015). Emotional reactions, perceived impact and perceived responsibility mediate the identifiable victim effect, proportion dominance effect and in-group effect respectively. *Organizational Behavior and Human Decision Processes*, 127, 1–14.

Introduction

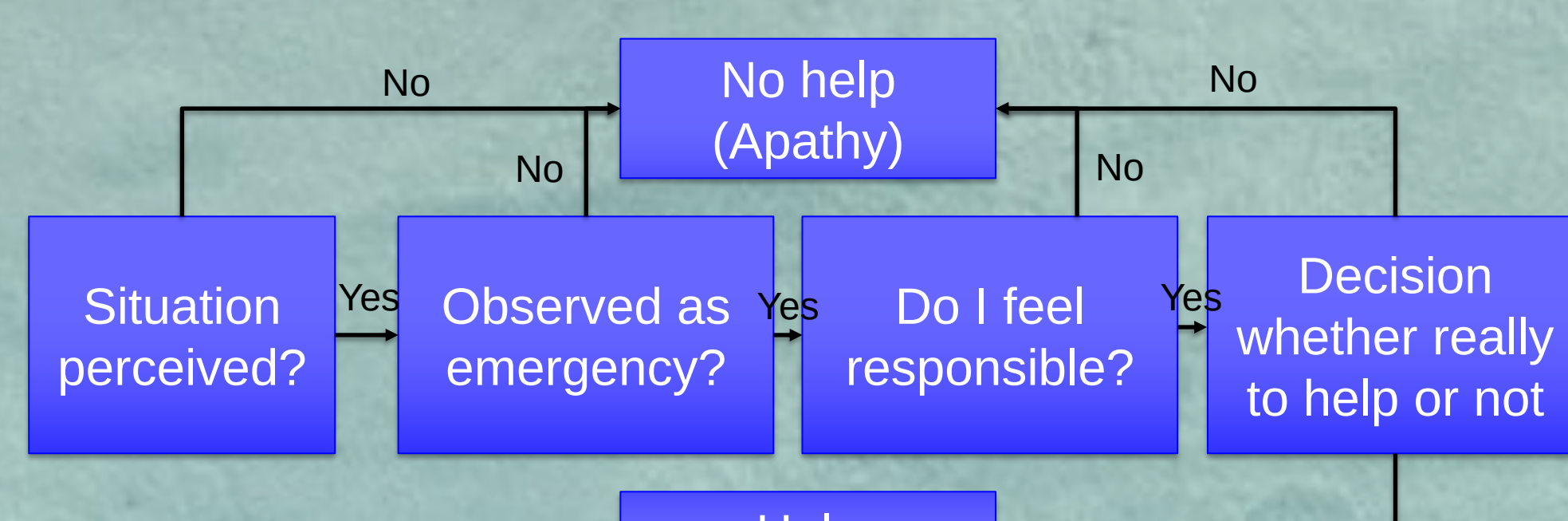
Bystander Effect: Helping other people occurs more frequently when alone than in the company of passive bystanders [3].

Here, help occurs when a bystander offers support to the victim(s), either verbally and/or physically.

Research shows that certain **factors** have a large(r) effect on the bystander effect [1,5]:

- Proportional Dominance Effect (PDE),
- In-Group Effect (IGE),
- Effect Evaluation (E),
- Dangerous emergency (DEm)
- Distress (D).

As these have some impact on the bystander effect, it is necessary to define more precisely how the bystander effect works. A **conceptual model** of [6] for the dynamics was used as starting point (see Figure 1).



Temporal-Causal Network Model

The above network characteristics are used as an **input** for a dedicated software environment in MATLAB.

This automatically transforms these characteristics into a mathematical model based on **difference equations**:

$$Y(t+\Delta t) = Y(t) + \eta_Y [\text{aggimpact}_Y(t) - Y(t)] \Delta t$$

where

$$\text{aggimpact}_Y(t) =$$

$$c_Y(\text{impact}_{X1,Y}(t), \dots, \text{impact}_{XK,Y}(t))$$

with

$$\text{impact}_{X,Y}(t) = \omega_{X,Y} X(t)$$

Or, as a whole:

$$Y(t+\Delta t) = Y(t) +$$

$$\eta_Y [c_Y (\omega_{X1,Y} X_1(t), \dots, \omega_{XK,Y} X_K(t)) - Y(t)] \Delta t.$$