UTC2721 Project
Modelling the bystander effect

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1. Introduction

In 1964, Kitty Genovese was murdered in a stairwell visible to thirty-eight of her neighbours who heard her screams and witnessed the murder. Over the span of 30 minutes from the beginning of the incident, none of the neighbours contacted the police, let alone attempted to help her (Rosenthal, 1999). This is the textbook example of the bystander effect which refers to the social-psychological phenomenon where people are less likely to offer help when there are more people present. There are several posited explanations for the bystander effect such as "apathy, habituation, and fear of reprisal" (Hudson et al., 2004, p. 168) and hence, this paper will attempt to investigate the relative significance of the various factors required for the exhibition of the bystander effect through a cellular automata model written in NetLogo.

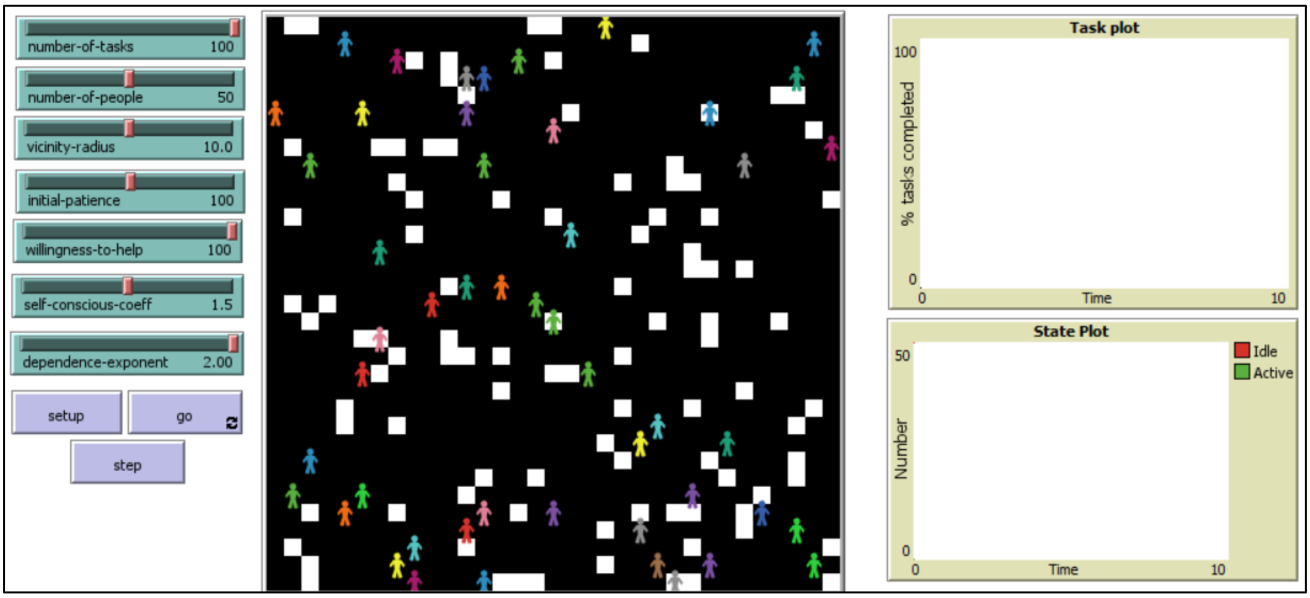
2. Literature Review

Latané and Darley (1968) found that participants reported the incoming smoke upon noticing it most of the time when they are alone. However, when 2 other individuals posing as participants that are tasked to not respond to the smoke are present, participants reported the smoke only 10% of the time. The "likelihood of the emergency victim receiving help at all decreases as the number of bystanders increases" (Hudson et al., 2004, p.169) and Latané and Darley (1970) attribute the phenomena to 4 mechanisms:

1) **Self-awareness:**
   The individual "does not want to appear foolish or inappropriate in front of others" (Hudson et al., 2004, p.170) and hence, would be inhibited from acting.
2) **Social cues:**
   The individual "actively look to one another for cues about how to behave in the situation" (Hudson et al., 2004, p. 170) and will be less likely to act if others do not act as well.
3) **Blocking:**
   The individual is less likely to act when there are multiple bystanders already acting.
4) **Diffuse responsibility:**
   The responsibility is diffused when "only a small percentage of the bystanders can take action" (Hudson et al., 2004, p. 170).

The NetLogo model will draw inspiration from these mechanisms to simulate the bystander effect.

3. Model Design



(Fig 3.1 The NetLogo model after setup has been done)

The bystander effect model comprises of `tasks` (represented by white squares) and `individuals` (represented by the coloured people) as seen in Fig 3.1. During a simulation run, the model will increment in `steps` until completion.

The model comprises 7 modifiable global fields that will determine the behaviour of the model:

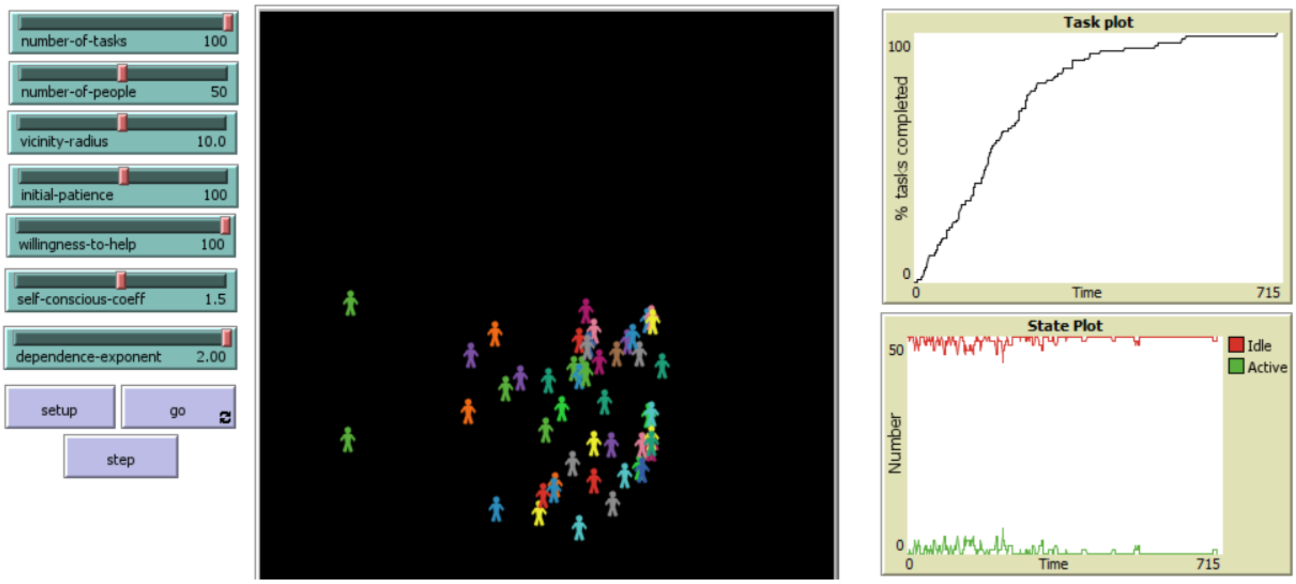
Modifiable global fields	**Description of modifiable global fields**
`number-of-tasks`	The number of `tasks` present in the space
`number-of-people`	The number of `individuals` present in space who can complete the tasks
`vicinity-radius`	The radius around an incomplete `task` that is considered its vicinity. `Individuals` will consider the number of other `individuals` within the vicinity of a `task` before deciding whether to act on and complete the `task`.
`initial-patience`	The number of `steps` in the simulation the `individual` will remain interested in a `task` before deciding to be interested in another random `task`. This new random `task` the `individual` decides on could be the same `task`.
`willingness-to-help`	A parameter ranging from 0 to 100 that describes how willing `individuals` are to complete a `task`.
`self-conscious-coeff`	A parameter with a positive value that describes how sensitive the `individual` is to the number of people in the vicinity of the `task`.
`dependence-exponent`	A parameter that describes how sensitive the `individual` is to a large number of other `individuals` in the vicinity of the `task`.

The `task` would represent an emergency that requires an `individual` to help. Each `individual` will locate the closest `task` and become interested in the `task`. When the `individual` is interested in the `task`, the `individual` will approach the `task` and stop when they are in its vicinity. The `individual` will have limited patience and when its patience runs out, the `individual` will randomly choose another `task` to be interested in. While the `individual` is interested in a `task` and is within the vicinity of said `task`, the probability of the `individual` acting on the `task` is given below:

$$Probability\ of\ acting\ on\ a\ task\ = \frac{W}{100 \cdot (1 + S \cdot N^{D})} \tag{1}$$

where W = `willingness-to-help`,
S = `self-conscious-coeff`,
D = `dependence-exponent`,
N = Number of other `individuals` present within the vicinity of the `task`

As the probability of one lending help to a victim is observed to be negatively related to the number of people present in the vicinity (Hudson et al., 2004), the equation is designed so that the probability of an `individual` acting on a `task` is also negatively related to the number of other `individuals` in the vicinity with 3 degrees of variation possible. When a task is completed, all `individuals` previously interested in said task would look for the next closest `task` to be interested in, repeating the cycle until all `tasks` are completed.



(Fig 3.2 The NetLogo model upon completion of all `tasks`)

4. Findings

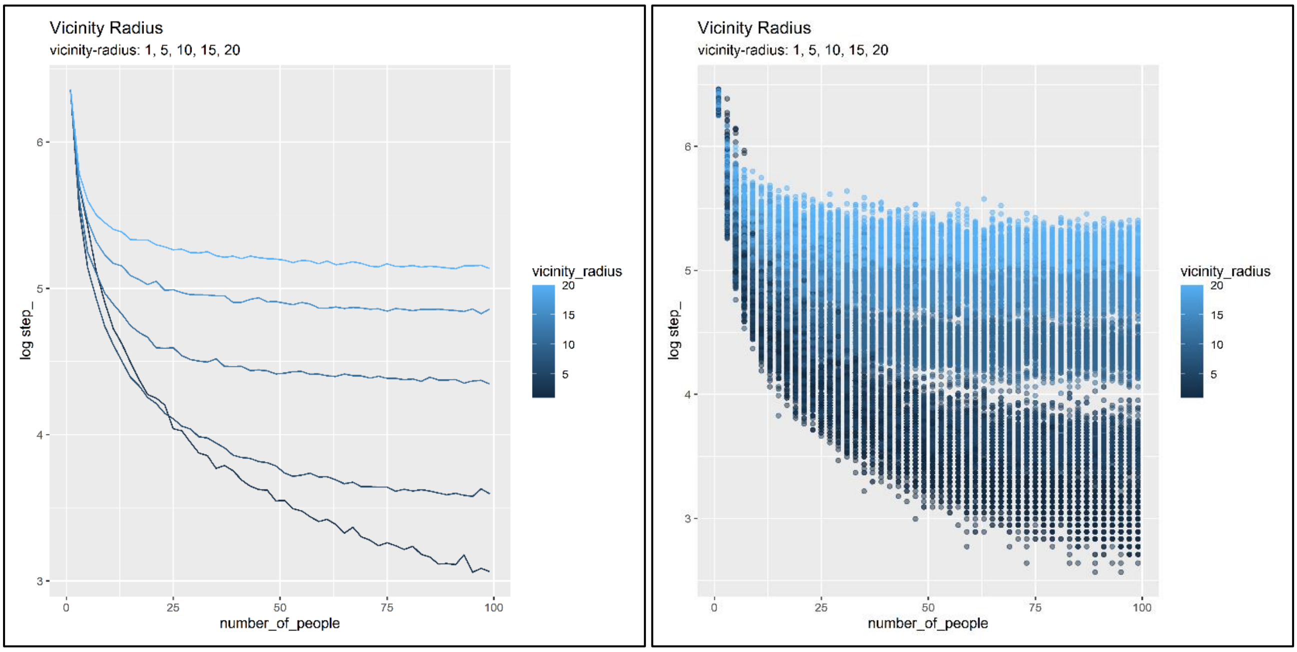
We have taken the following values to be the default values of the modifiable global fields:

Modifiable global fields	**Default values**
`number-of-tasks`	100
`vicinity-radius`	10
`initial-patience`	100
`willingness-to-help`	50
`self-conscious-coeff`	1.0
`dependence-exponent`	1.0

The analysis will involve understanding the relationship between the number of `steps` taken to complete 100 `tasks` and the `number-of-people` under different values of the modifiable global field to attain a better understanding of the role each parameter plays in contributing to the bystander effect.

If otherwise stated, the conditions in the following simulations are performed with the default values and 100 runs are performed for each unique set of conditions.

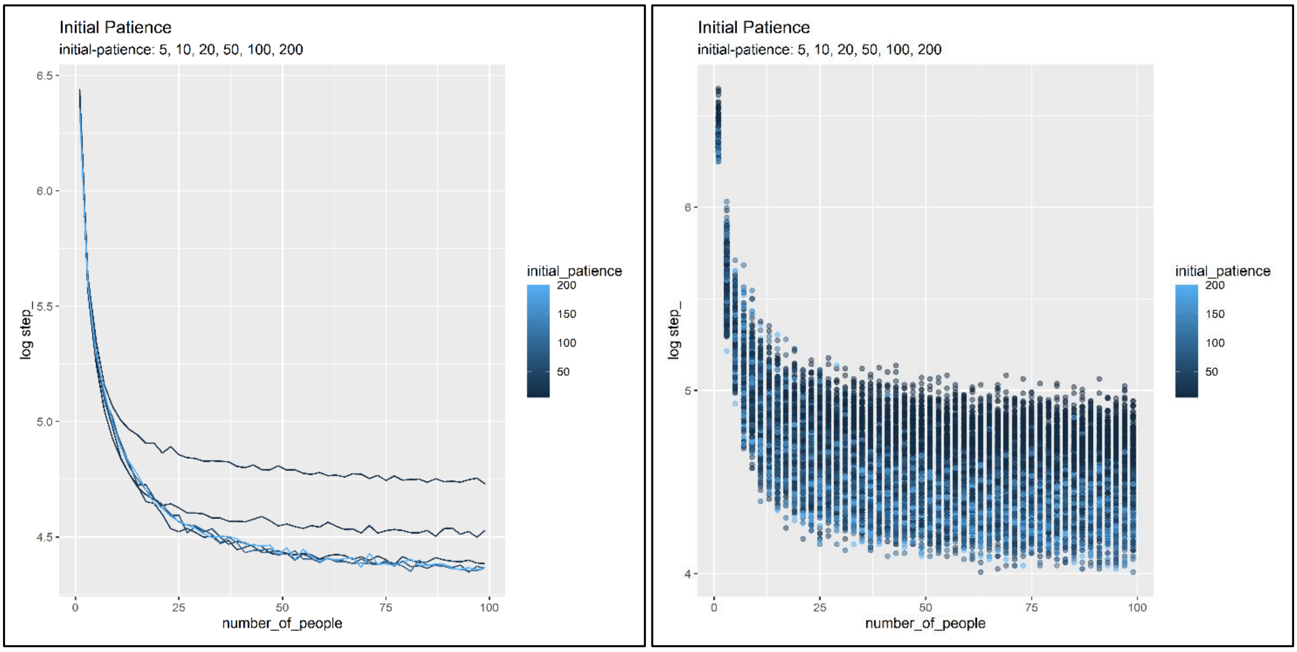
4.1 Effect of `vicinity-radius`



(Fig 4.1.1 Effect of `vicinity-radius`)

The data shows that as the `vicinity-radius` increases, the number of `steps` increases regardless of the `number-of-people`. We also find that the `vicinity-radius` had little effect on the shape of the curve and hence does not drastically alter the relationship between the number of `steps` taken and the `number-of-people`.

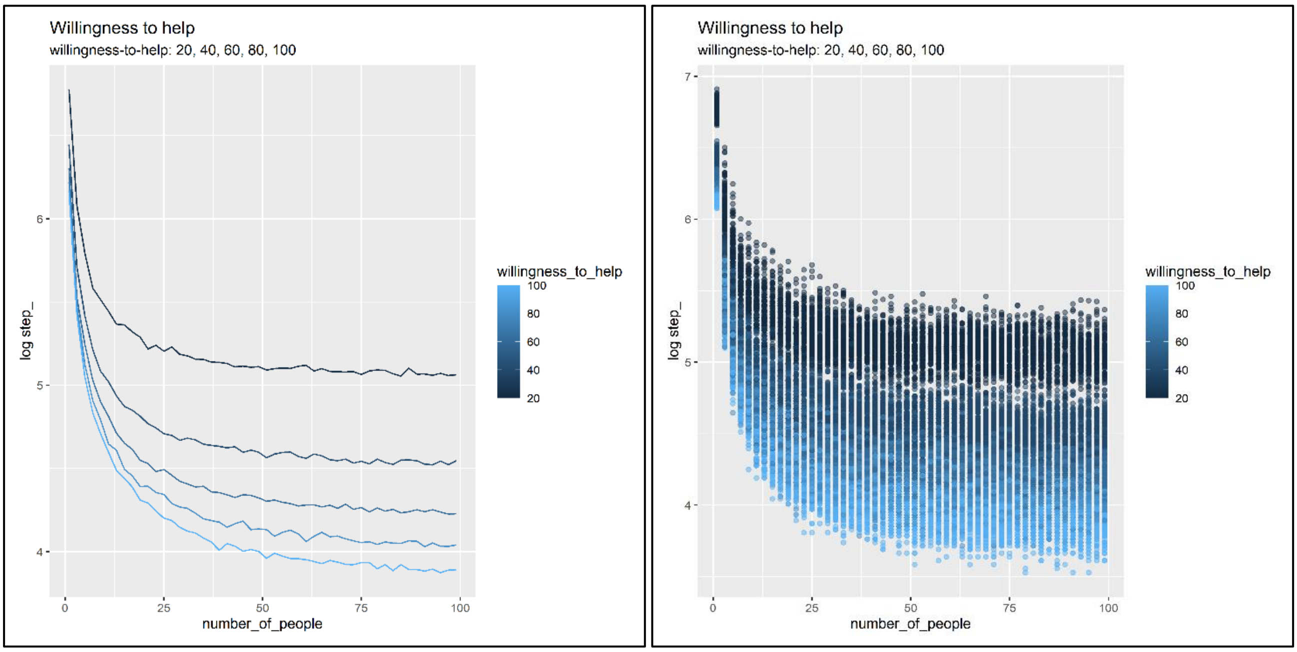
4.2 Effect of `initial-patience`



(Fig 4.2.1 Effect of `initial-patience`)

The data shows that as the `initial-patience` increases, the number of `steps` decreases regardless of the `number-of-people`. However, this is only applicable when `initial-patience` is small in value as beyond a certain threshold, the effect of `initial-patience` is negligible. We also find that the `initial-patience` had little effect on the shape of the curve and hence does not drastically alter the relationship between the number of `steps` taken and the `number-of-people`.

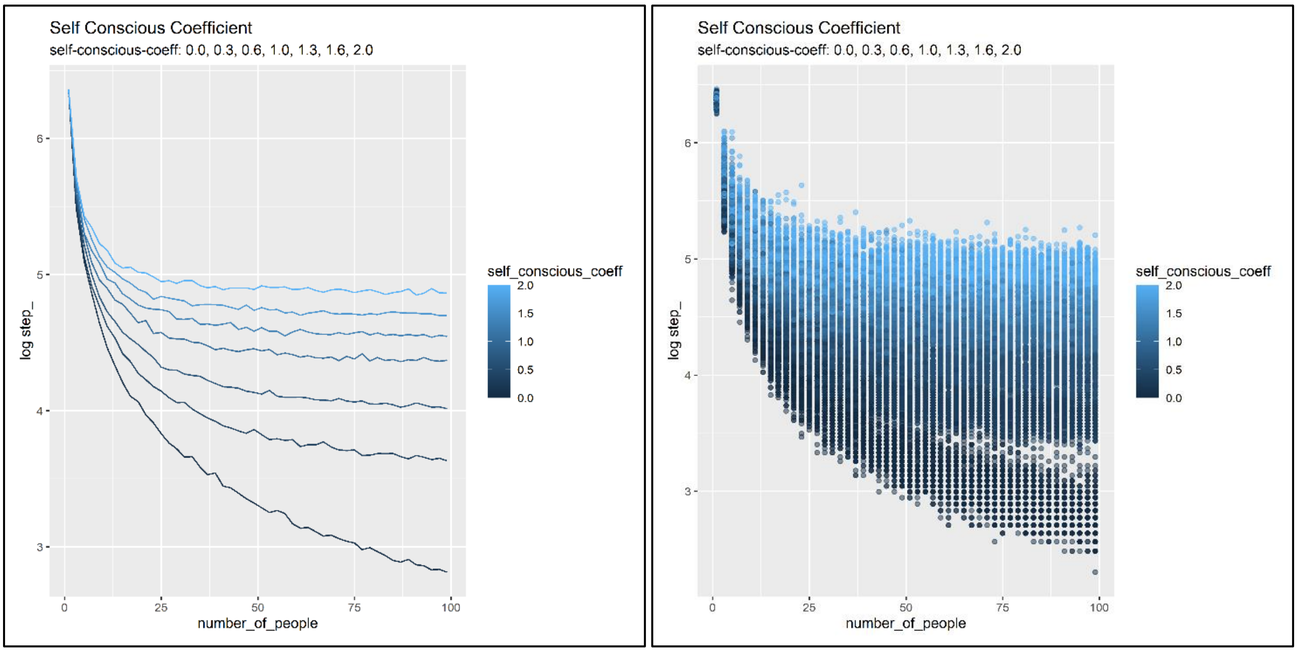
4.3 Effect of `willingness-to-help`



(Fig 4.3.1 Effect of `willingness-to-help`)

The data shows that as the `willingness-to-help` increases, the number of `steps` decreases regardless of the `number-of-people`. We also find that the `willingness-to-help` had little effect on shape of the curve and hence does not drastically alter the relationship between the number of `steps` taken and the `number-of-people`.

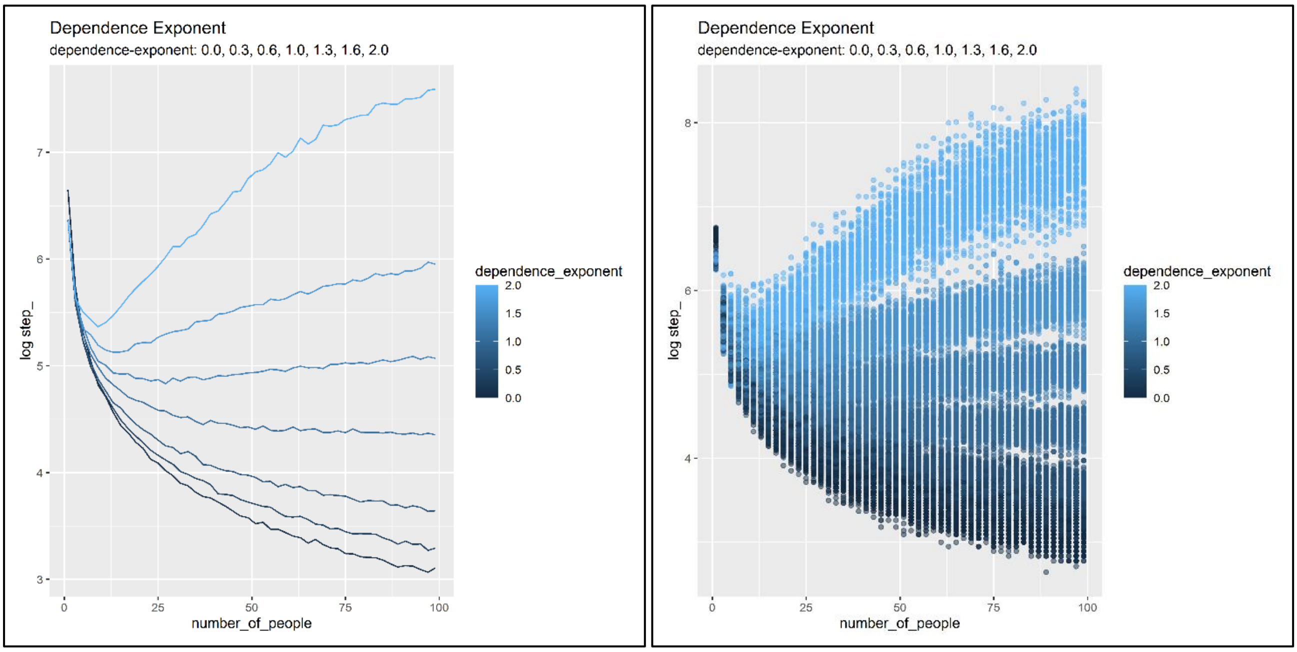
4.4 Effect of `self-conscious-coeff`



(Fig 4.4.1 Effect of `self-conscious-coeff`)

The data shows that as the `self-conscious-coeff` increases, the number of `steps` increases regardless of the `number-of-people`. We also find that the `self-conscious-coeff` had little effect on shape of the curve and hence does not drastically alter the relationship between the number of `steps` taken and the `number-of-people`.

4.5 Effect of `dependence-exponent`



(Fig 4.1.1 Effect of `dependence-exponent`)

The data shows that as the `dependence-exponent` increases, the number of `steps` increases regardless of the `number-of-people`. However, unlike the other fields, `dependence-exponent` drastically alters the shape of the graph. When `dependence-exponent` <= 1.0, the graph is monotonic decreasing which means that number of `steps` taken decreases when the `number-of-people` increases. However, when the `dependence-exponent` > 1, the system exhibits the bystander effect where the number of `steps` taken decreases when the `number-of-people` increases and is small, but the number of `steps` taken increases when the `number-of-people` increases and is large.

4.6 Summary of effects

The analysis shows that the modifiable fields (`vicinity-radius, initial-patience, willingness-to-help, self-conscious-coefficient`) alter the number of `steps` taken to complete one hundred `tasks` but preserve the monotonic relationship between the number of `steps` taken and the `number-of-people`. Hence, these fields are not able to induce the bystander effect in the system. However, only `dependence-exponent` appear to alter and break the monotonic relationship between the number of `steps` taken and the `number-of-people`. When the `dependence-exponent` > 1.0, we find that the monotonic relationship between `number-of-people` and the number of `steps` taken breaks and the bystander effect is exhibited.

5. Discussions

5.1 Diffuse responsibility

Based on our findings, we find that `dependence-exponent` is the key determining factor of whether the bystander effect is exhibited in the system.

Let us define responsibility as a quantity where the responsibility perceived by an individual is inversely proportional to the number of bystanders in the vicinity due to diffuse responsibility.

From this definition, we can form the relationship:

$$R = \frac{k}{(1+n)} \tag{2}$$

where R = responsibility perceived by an individual,

n = number of bystanders in the vicinity not including himself,

k is some arbitrary constant.

Suppose that the probability of an individual acting is directly proportional to the responsibility they perceive.

$$Probability\ of\ acting = \frac{k'}{(1+n)} \text{ for some arbitrary constant k'} \tag{3}$$

Note that equation (3) above shares the same form as equation (1) defined earlier where `dependence-exponent` = 1 which we found to not exhibit the bystander effect. Hence, to exhibit the bystander effect, the supposition made is not correct and the probability of acting is not directly proportional to the responsibility they perceive. This could suggest that diffuse responsibility alone is not sufficient to explain the bystander effect if the definition of responsibility as a quantity is accurate. Hence, it is likely that the other 3 mechanisms proposed by Latané and Darley (1970) are necessary to create the bystander effect namely self-awareness, social cues, and blocking.

5.2 Self-awareness

Hudson et al. (2004) stated that “self-awareness is an individual’s conscious awareness of others making judgments about that individual” and there is nothing about “whether or not others actually make judgments but rather refers to the perception of the individual” (Hudson et al, 2004, p. 185). We will assume that a more self-aware individual will pay attention to the possible judgement of individuals from a larger vicinity. Hence, we will define self-awareness to be positively correlated with `vicinity-radius` in the NetLogo model. Based on our findings, we saw that `vicinity-radius` do not induce the bystander effect but merely amplifies the effect if the phenomena are already present. This could suggest that self-awareness is also not sufficient to explain the bystander effect if our assumption of self-awareness is accurate.

6. Limitations

Our simple model is unable to capture and study the other 2 mechanisms namely social cues and blocking. Hence, the model does not provide insights into the significance of social cues and blocking in the exhibition of the bystander effect. We have also made assumptions on what diffuse responsibility and self-awareness refer to evaluate their importance with the model. Future research might seek to extend this model to better understand the significance of the other 2 mechanisms in the exhibition of the bystander effect.

7. Conclusion

Our simple NetLogo model demonstrates that the `dependence-exponent` parameter is the key determining factor for the exhibition of the bystander effect with other factors merely amplifying or dampening the phenomena. If we were to define responsibility as a quantity that is inversely proportional to the number of people present in the vicinity, we found that diffuse responsibility was not sufficient to create the bystander effect. If we were to take self-awareness as the size of the vicinity where the individual perceives judgement from others, we found that self-awareness was also not sufficient to create the bystander effect. This suggests that the bystander effect could be attributed to other reasons that could include but may not be limited to the other 2 mechanisms proposed by Latané and Darley (1970) namely (1) social cues and (2) blocking.

8. NetLogo Model

Access the NetLogo model and the data generated here:

https://github.com/StanleyNeoh/Bystander-Effect-Model

(1957 words excluding cover page, table of contents and references)

9. References

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