Eliciting opponent behaviour in a crowdsourced game

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ABSTRACT

To combat violent extremism, enhanced understanding of the drivers behind extreme behaviours is necessary. TNO is developing a research platform to experiment with opponent behaviour: the Opponent Immersion Game (OIG). The goal of this game is to gather data on the drivers of conflict on an individual level, which is then combined into group level behaviour. Participants are immersed in a virtual narrative, in circumstances that trigger radical actions. Based on the choices the player makes in this virtual world, we not only learn about the implications and interplay of needs, beliefs, attitudes and emotions on the behaviour of conflict actors, but also how group behaviour is affected by individual actions. By using an online crowdsourced research platform, data can be quickly gathered, analysed and integrated into new models of opponent behaviour. This paper addresses design guidelines for game-based experimental research.

1.0 INTRODUCTION

Recent conflicts, such as the conflict in the Donbass region of Ukraine, the Syria civil war or the situation in Venezuela, have been characterised by the exploitation of animosity and violent tendencies between local groups. These conflicts illustrate the future security environment that the NATO and its allies are facing. The novelty and complexity of the modus operandi require us to acquaint ourselves with the drivers behind the behaviour of the actors involved. Only when we understand disruptive behaviour, can we counter or prevent it. In this paper, we explore the use of games and crowdsourced research as a means to experiment with and to model opponent behaviour.

1.1 Modelling opponent behaviour

In this paper, we explore how modelling opponent behaviour at the individual (micro) level can take form. More specifically, the process leading to grievance-based violence is modelled. To explain how some people turn into (violent) radicals, a process model of radicalisation was developed, based on psychological research: the General Needs and Affect (GNA) Model (Figure 1-1, van den Berg et al., in prep.).

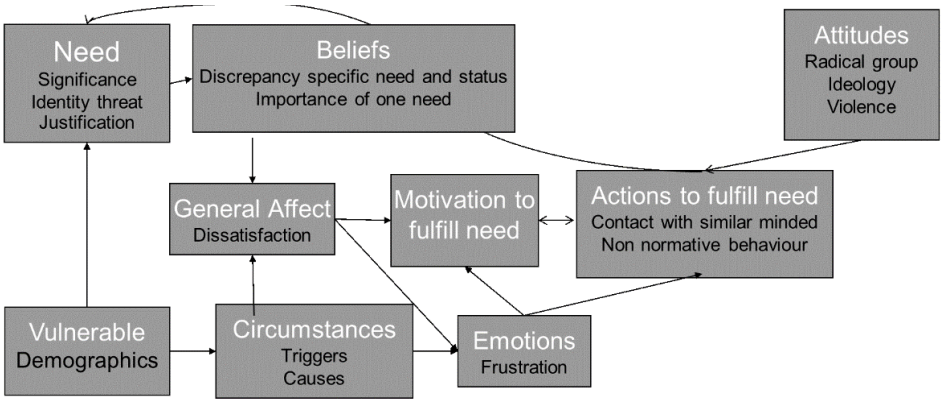

Figure 1-1: Schematic overview of the GNA model

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The GNA process model helps structure interrelated concepts in the path to violence. It serves as a framework to formulate and test hypotheses following relations between concepts . For example, a person with a high *need* for justification, combined with the *belief* of being discriminated through a *circumstance* of being denied a job, may cause the *general affect* of dissatisfaction and a *motivation* to take action. Depending on the *emotions* and *attitudes* towards people or groups at play, this may instigate *violent actions towards groups.*
Will a high need for justification indeed influence the likelihood of violent behaviour of an opponent? Answering such questions would be highly beneficial to future operations. To test hypotheses, there is need for a method to conduct experiments and integrate the results into a behavioural model.

1.2 Crowdsourced research

Developing an experimental method that investigates large numbers of interrelated variables and associated hypotheses requires many participants and quick iterations. Crowdsourcing, or the use of web-based technologies to recruit participants and conduct experiments, is becoming a mainstay in research, and has had a dramatic impact on the speed and scale at which scientific research can be conducted (Chandler & Shapiro, 2016). Behavioural research also benefits from the use of crowdsourced platforms such as Amazon's *Mechanical Turk*, leveraging the aforementioned advantages with low costs and fast iterations between developing theory and conducting experiments (Mason & Suri, 2012). An important consideration is the validity of the behaviour of crowdsourced participants, so called 'workers'. Studies have found that workers can output similar quality as domain experts in text processing tasks (Alonso & Mizzaro, 2009), the judgement and decision making is similar to the population of a university (Paolacci et al., 2010) and that crowdsourced behaviour is similar to that in the laboratory (Horton et al., 2011). As the GNA process model assumes that the same psychological mechanisms are at play when dealing with seemingly peaceful online participants or an edge-case displaying extreme behaviours (Meertens et al., 2006), crowdsourced research seems a promising way of experimenting with opponent behaviour.

1.3 Game-based research

In recent decades, video games have become the third pillar of the digital industry, alongside film and music (Kirriemuir, 2002). The popularity of these games seems to lie in the enjoyment, engagement and challenge that playing these games provides (Csikszentmihalyi, 1992).
Interest in the success of these elements has been gaining traction in various domains, as seen by the growing interest in gamification (Hamari, Koivisto, & Sarsa, 2014) and serious gaming (Young et al., 2012). The aim of gamification is to employ game elements and mechanics in non-game contexts, in order to engage users (Deterding, Dixon, Khaled, & Nacke, 2011; Zichermann & Cunningham, 2011). Reported goals of 'gamifying' a task or service are to increase *user activity*, *social interaction*, or *quality and productivity of actions* (Hamari, 2013), through intrinsically motivating experiences (Huotari & Hamari, 2012).
Not only is gamification increasingly being applied in commercial business (e.g. Hamari & Lehdonvirta, 2010; Zichermann & Cunningham, 2011), but also in education (e.g. Childress & Braswell, 2006) and in the military (e.g. Bonk & Dennen, 2005). In academia, most applications seem to focus on applying gamification to training and education (de Freitas, 2006; Childress & Braswell, 2006). The intervention of interest is gamified, with the goal of increasing participant engagement. Results are promising (Cechanowicz et al., 2013), but very little research has been done on the gamification of data collection methods. Especially in the social sciences, data collection is often done through self-report measures, questionnaires, and surveys (Fowler, 2013). These methods have some inherent weaknesses, such as random responding, speeding, straightlining, and high dropout rates (Keusch & Zhang, 2017). Keusch and Zhang (2017) investigate to what extent gamification of self-report measures can remedy these shortcomings. They conclude that the currently available literature is insufficient to rule in favour or against the gamification of surveys. Instead, they report that including game elements has positive effects on psychological outcomes (e.g. fun, interest and satisfaction).
Where evidence on gamified research mostly concerns the motivational aspect, the domain of Virtual Environments (VE) shows more elaborate findings. According to Kozlov & Johansen (2010) an advantage of using VEs is the potential to elicit real-life behaviour. They found that participants would show authentic behaviour in accordance with social phenomena such as the *bystander effect*, similar to previous experiments

in real-life settings with human actors. Blascovich et al. (2002) argue that VEs offer a better trade-off between experimental control and ecological validity than traditional social experimentation.
The discrepancy of evidence between gamification and virtual environments possibly stems from the difference in approach: either adding game elements to a research design, or adding research elements to a game design. Therefore, in our game design, we opt for the latter approach.

2.0 RESEARCH QUESTIONS

We explore the combination of the above concepts of opponent modelling, crowd-sourced behavioural research and gaming as a generic tool for operational research and analysis. We seek out to answer the following research questions:

- What are design challenges for game-based behavioural research?
- What are guidelines for designing this specific game type?

3.0 THE OPPONENT IMMERSION GAME

To answer the above questions, we introduce an instantiation of the game-based crowdsourced concept: the Opponent Immersion Game (OIG).
The goal of the OIG is to gather data on opponent behaviour, more specifically to identify the triggers that lead to non-normative, violent behaviour. This is done by testing human behaviour in a game environment. Crowd-sourced participants (*players*) are immersed in a virtual narrative (*scenario*), in circumstances that trigger radical actions (*events*). Based on the choices (*actions*) these players make in the virtual game world, and the *interactions* they have with non-player characters (*NPC*), we not only learn about the implications and interplay of needs, beliefs, attitudes and emotions on the behaviour of conflict actors, but also how group behaviour is affected by individual actions (Figure 2-1).

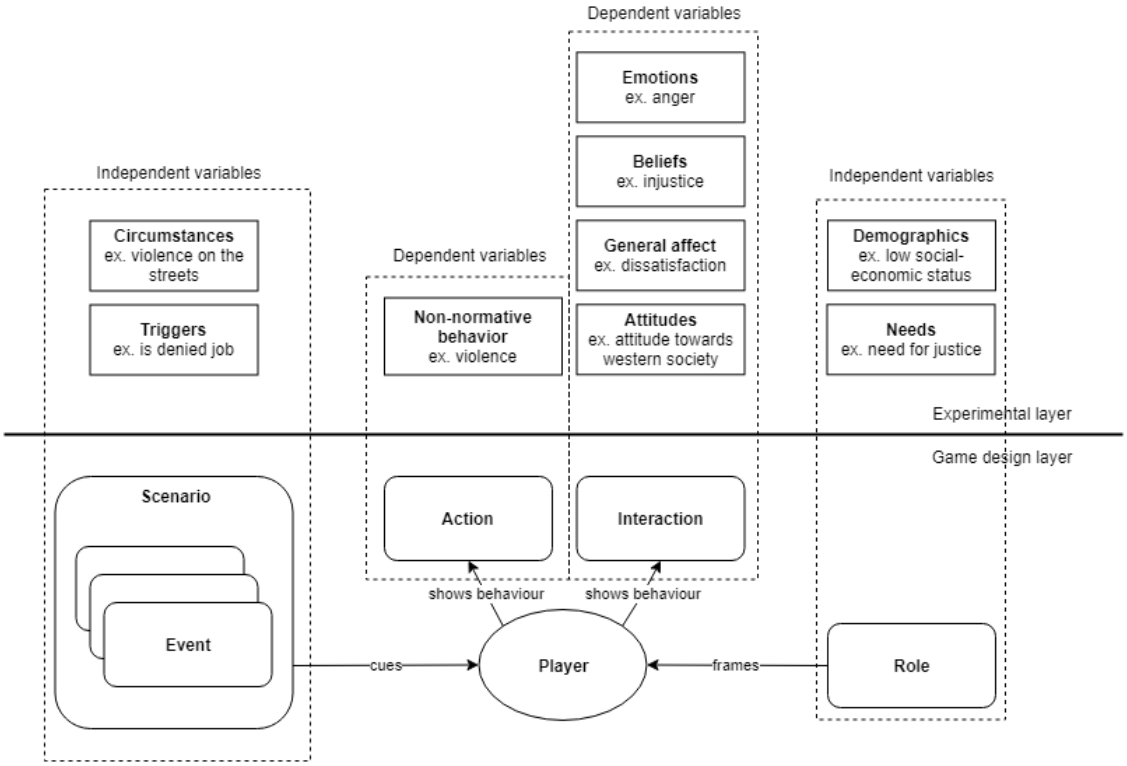

Figure 2-1: Schematic overview of the OIG

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The OIG is driven by the premise that psychological mechanisms at play in opponent behaviour are the same as in any human behaviour (Meertens et al., 2006).
The possible advantages of the OIG for behavioural research are:

- Using crowd-sourced online platforms, a large pool of participants is available and a large number of hypotheses and correlations can be tested in a short timeframe
- Using game immersion in radical circumstances, more authentic behaviour can be recorded by increasing engagement and avoiding boredom
- By modelling the outcomes in a runnable micro agent model, operational analysts can research likely opponent behaviour

4.0 DILEMMAS

When attempting to design a game for behavioural research, we identified two essential dilemmas: the balance between player engagement, the preferred experimental control, and the encouragement of roleplay or natural behaviour.

4.1 Player engagement vs. experimental control

Game elements and mechanics aim to engage the player, intrinsically motivating them to continue playing. Engagement implies that the player is totally involved, engrossed or immersed in the game, depending on the level of engagement (Brown & Cairns, 2004). The flow experience, 'being fully involved in an activity for its own sake', as proposed by Csikszentmihalyi (1992) is hypothesised to predict engagement and immersion (Hamari et al., 2016). In the GameFlow model, this concept was applied to games (Sweetser & Wyeth, 2005), resulting in eight elements that are essential for an engaging game experience. A number of these elements, however, can be in direct opposition of the goal to maintain experimental control:

- **Challenge** is seen as the most important aspect of good game design (Lazarro & Keeker, 2004). The level of challenge should match a player's skill level – where the task at hand threads the lower boundary of boredom and the upper boundary of frustration. By tracking player performance and making individual adaptations to game events, this so called 'flow channel' (Csikszentmihalyi, 1992) can be maintained. However, differences between individual play sessions can be a confounding variable within the experimental design.
- **Agency** is the ability of players to exercise control over their actions and to perceive impact on the game world. For example, a player may decide to meet NPC A, triggering a different course of events than had he chosen to meet NPC B. Or the actions of a player may influence the persistent, evolving state of the game environment. However, this degree of freedom given to the player can make it difficult to compare play sessions as part of an experimental condition, as they may have experienced a different course of events.
- **Feedback** implies that players get meaningful feedback on their progression towards the game goal. Without feedback, actions are consequence free and become trivial. Feedback can take on many forms such as a high score on a leader board or state of the world indicators. However, such feedback can affect subsequent behaviours (Farzan et al., 2008) which may not necessarily be true to nature.
- **Social Interaction** implies that players have opportunities for social interaction. It is proposed as a strong element of enjoyment in games through the dynamics of competition, collaboration and connection (Lazarro, 2004). Social interaction requires more players to be present in the game (multiplayer). However, these players have the ability to influence the course of events or the state of mind of the subject directly or indirectly, limiting the controllability of the experiment.

4.2 Roleplay vs. natural behaviour

The second dilemma concerns the tension between roleplaying and natural behaviour. In classic behavioural research it is expected that participants report to questionnaires or surveys authentically, in line with their

own persona (Fowler, 2013). However, in games, players are often asked to act out the role of a character (Feinstein et al., 2002). This framing of a role and scenario serves to engage the player in a fictional narrative.

When put in a role, people tend to change their behaviour to match the expected behaviour of their role (Haney, Banks & Zimbardo, 1973). To some extent, this also holds true in virtual environments. A famous example of this is the Proteus effect (Yee & Bailenson, 2007), which describes how the behaviour of a player in a virtual world is changed by characteristics of their virtual self-representation (a.k.a. avatar). If players indeed engage in unnatural behaviour due to unintended interpretation of the role, this may threaten external validity.

However, if the experimentation is focused on infrequent naturally occurring behaviours, engaging in a fictional narrative becomes indispensable. As the participants need to know their role in the narrative, it is important to deliberate about: framing a role while still triggering natural behaviour.

5.0 GUIDELINES

To answer the aforementioned dilemmas, design patterns of both entertainment games and serious games were researched. Findings were used to establish the following design-guidelines for game-based behavioural research.

5.1 Provide a sense of agency

To experience agency, players should feel they are making meaningful decisions and influencing the narrative discourse (Björk & Holopainen, 2004). To maintain experimental control, it is possible to provide a *sense* of agency: the player experiences agency, but their actions do not influence the game. This can be done in multiple ways:

a. Provide players with inconsequential choices. For example, players may be asked to choose between responding violently or responding peacefully. Whatever they choose, the next scene of the game will be the same. A pitfall of this method, is that it may become transparent (and thereby demotivating to the player) that the offered 'choice' is not a choice at all, and does not impact the game.

b. Provide players with trivial choices. In this case, whatever the player does has a direct influence on the game, but does not impact any of the experimental variables of interest. For example, the player may be presented with a choice of navigation: walk to the park, or walk to the pier. With either choice, the player is placed in the respective environment (e.g. the background of the game screen changes). However, as long as the location of the player is not a variable of interest, this does not undercut experimental control.

5.2 Purposefully design the feedback mechanism of your game

One should consider the degrees of freedom in the feedback mechanism of the game. Games consist of actions (*decisions*) that may or may not have an effect on the *world state*. New information is provided to the player in the form of *events* on which the player may act, looping back to decisions to be made. Different designs can be identified:

In the linear design of a *scripted* game, decisions have no impact on the world state. A fixed sequence of events and decisions is presented (Figure 3-1).

Figure 3-1: Schematic overview of a scripted game

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In a *decision-tree* game, if a player makes a decision, it determines the next one. A branching sequence of decisions emerges (Figure 3-2).

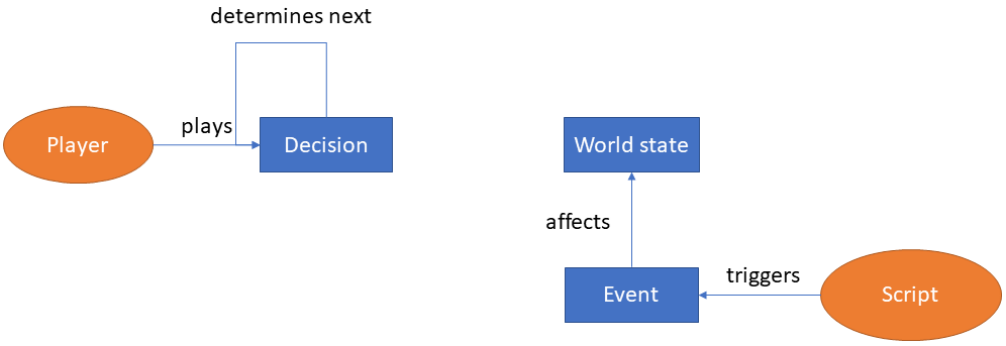

Figure 3-2: Schematic overview of a decision tree game

In a *simulated decision making* game, the world state is driven by a simulation model. This simulation model enables two feedback loops: the world state determining possible player-decisions and the world state triggering new events for the player (Figure 3-3).

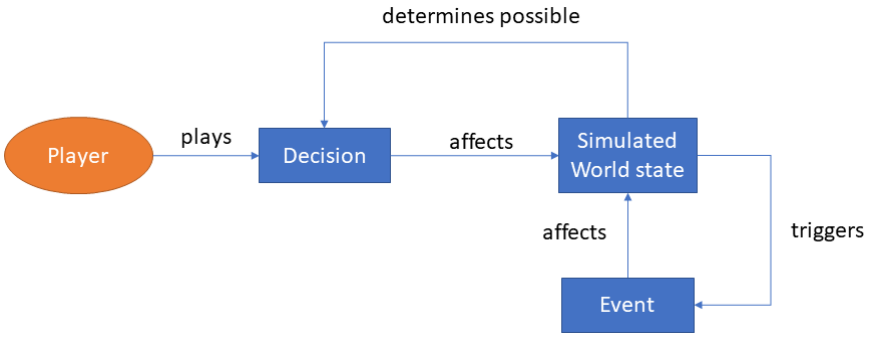

Figure 3-3: Schematic overview of a simulated decision making game

A linear design is most easy to control in experimental designs. This is fitting for hypothesis-driven research that is not interested in the effects of sequential decision making.
However, a linear design can make the game feel trivial and lack incentive for the player to continue. Adding a decision tree in the design adds meaningful feedback, increasing engagement. It can still be used in hypothesis-driven research, but the decisions at the branching point have to be measured and incorporated as a separate condition. If not, it will be difficult to distinguish effects of game structure from effects of variables of interest.
The simulated design allows players the most freedom, and potentially most engagement, but adds an exponential layer of complexity for research, as each branching point in the game is now a potential confound for future game states. For example, suppose a player is presented with the option to either rob a bank, or to take a badly paying job. If the player chooses the former, a future game state may involve imprisonment. If the player chooses the latter, a future game state may involve financial troubles. These outcome states – imprisonment vs. financial troubles – allow for very different follow-up.
The simulated design is most fitting for a data-driven research design. A data driven approach focuses on discerning patterns (i.e. exploratory experimenting) and generates novel hypotheses (Kell & Oliver, 2004)., It is for example relevant for discerning patterns in sequential decisions made by players.

5.3 Choose the framing of the player character

To ensure valid (psychological) measures of natural behaviour, we propose three distinct approaches to roleplay and the framing of the player character.
First, one can simply provide no character. This is especially important when the goal is to measure participants' own beliefs and attitudes. Keeping the narrative free of descriptions of the player's character, and addressing the player directly can prevent confounding effects of role-playing. Instead, one can present

circumstances and events happening to the player. Implications for their emotions, attitudes and beliefs is then up to the player themselves. For example, instead of writing a character that believes the government is the enemy, you present the player with an event where the police intimidates him.
Second, one can include a fictional character as a manipulation. The player is placed in the role of a character, in order to assess the impact of specific character traits on outcomes. It should be noted that in this case, the degree of manipulation can differ per participant, as some may be more resistant to effects such as the Proteus effect, whereas others are not. This can be mitigated by including manipulation checks.
Finally, one can let the player define their character in line with their own persona. This is possible by explicitly asking about their character traits, and representing these in a visual representation (*avatar building*). Another possibility is to ask with which avatar or character description the player identifies most. The advantage of this approach is that the player is actively stimulated to be authentic, decreasing the likelihood of undesired roleplay.

6.0 APPLICATION

Our guidelines were applied while designing the first phase of the Opponent Immersion Game, which is aimed at hypothesis-driven research. Phase two will target data-driven research.

Examples of how the guidelines were applied are:

- Because experimental control is an absolute requirement for hypothesis-driven research, the feedback archetype of a scripted game was chosen for phase one of the OIG.
- Game mechanics were implemented that provided agency, yet did not affect experimental control. Examples are a navigation task where the player chooses the next destination, or bargaining with an NPC for the price of food.
- Participants are given no role description and are asked to act authentic in the experiment intake. Adverse events like impoverishment (unable to buy food) are used to frame ongoing extreme circumstances.

To gather data on behaviour, measurement by dialogue and action choice is utilized:

- After the participant experiences an event, they start a dialogue with a character in the game. For example, the participant meets with their neighbour who asks about their dissatisfaction, corresponding to a 5-point Likert scale.
- After the measurement by dialogue, the participant is presented with the choice to perform an action. For example, if the behaviour of interest is violent behaviour, the participant is presented with several choices such as doing nothing (and be hungry) or participating in an armed robbery.
- In the game, to increase real-life experiences, various scenes of the above event-dialogue-action sequences are played with a potential for gradual increase in violence.

7.0 FUTURE WORK & DISCUSSION

The development of the Opponent Immersion Game is currently in progress. The next step will be a pilot experiment followed by actual experimental trials.
To benefit from the data gathered by the OIG, a computational framework is being developed in which a meso model (organizational level) and micro model (individual level) are combined to simulate the emergence of violent behaviour (van der Vecht et al., 2017). The meso model consists of a system dynamic model, simulating how opponent organizations emerge, develop and structure themselves. The micro model is an agent based simulation, implementing the cause-effect relations involved in the development of violent tendencies described qualitatively in the GNA model. Findings from the Opponent Immersion Game could provide quantitative models needed to implement the micro model. The game design described previously, for example, can be used to quantify how differences in demographics and relative importance of personal needs affect levels of dissatisfaction. Other scenarios can be added to validate and quantify other relations described in the model.

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Once the computational micro model has been tuned and validated, it becomes possible to simulate the actions of individuals with different social-demographic backgrounds, opinions or personal needs. In the next stage, the micro and meso model could be included in a common framework, reinforcing each other; the behaviour of the agents simulated in the meso level can be adjusted according to the results obtained from the micro model, and vice versa. This computational tool can therefore be used to simulate the effectiveness of different (social or political) interventions, both at individual and organisational scale, and to depict and analyse possible future scenarios.

In this paper we have determined that hypothesis-driven research can be at odds with game design elementals, but that it is still possible to integrate gaming and controlled experiments in engaging virtual environment by making the right design choices. In the next phase of the OIG we seek to answer the question how gaming and data-driven research can be exploited.

Additional research questions of interest in future work are:

- Does game-based behavioural research yield more valid results than classical survey research? We look to compare the OIG scenario to a survey scenario by Feddes et al. (unpublished data).
- Does a game-based crowdsourced platform enable quick iterations of behaviour modelling?

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