A Simulation of Political Participation

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Introduction

Participation in political acts often receives attention in sociology. It is mostly, however, political participation in terms of voting at elections that is looked at. This paper will test a specific framework of political participation, as outlined by Milbrath (1965). In order to do so, a computer simulation is used to implement the framework, and the results are tested against existing survey data. The simulation itself is described when the specific conceptualization of political participation is introduced. A number of hypotheses are formulated in order to test the framework using the simulation. The hypotheses are both qualitative and quantitative in nature, allowing a thorough understanding of the viability of the framework. The findings are discussed along with implications on the understanding of political participation.

Political participation is probably the most prominent term in this paper. It can be understood as the "activity by private citizens designed to influence government decision-making" (Huntington & Nelson, 1976, cited in Uhlaner, 2004, p.11078). Political support and electoral activities beyond voting are included in this paper to widen the understanding of political participation to match that of Milbrath (1965). Political participation is nonetheless regarded an individual activity, albeit carried out in a specific context, and whilst interacting with others.

In this paper, participation as such is conceptualized in a hierarchical manner: "[P]ersons who engage in the topmost behaviours are very likely to perform those lower in rank also" (Milbrath, 1965, p.17–8). This results in a cumulative understanding of political participation, often described using the metaphors of pyramids or ladders. People are understood to be involved in all political activities up to a certain threshold. Following Milbrath's framework, this threshold is influenced by external stimuli and interpersonal communication, but notably also individual characteristics, such as sociability or socioeconomic status.

There are conceptual problems with Milbrath's framework that will be addressed in this paper. The framework stipulates a unidimensional approach to political participation: a single hierarchy for all political action. This view has been challenged by many (Verba *et al.*, 1971; Milbrath & Gœl, 1977), and instead participation in different modes is suggested. Part of this paper will address the viability of a unidimensional approach. Although still often cited as a framework (see for example Axford *et al.*, 2002; Zevin, 1999; Plutzer, 2002; Zimmermann, 1999), Milbrath's (1965) approach to political participation unduly emphasizes structures—both at a micro and a macro level. The neglecting of individual agency will be addressed as part of the evaluation of the framework. Using the data output from a computer simulation, this paper seeks to not only address these aspects, but test the viability of Milbrath's framework in general.

First, however, the established literature on political participation will be examined, in order to further the understanding of political participation, and to situate the framework in question in its wider context.

Literature Review

Defining Participation

Political participation is closely linked to the concept of democracy (Prior *et al.*, 1995). Democracy is often defined as the governance by people, but on close inspection, there are different understandings of democracy (Held, 1996). It has been, for instance, highlighted that democracy implies equality between citizens (Verba *et al.*, 1995; Marshall, 2002; Lewis, 2004)—even though the classic example of a democracy in ancient Greece was highly exclusive (Held, 1996). Nagel (1987) makes a crucial distinction between genuine plurality and rule by a passionate minority, questioning whether any real governance by people exists (as did Braud, 1988).

It is often stressed that democracy cannot exist without involving citizens (Osbun, 1985; Held, 1996; Parry *et al.*, 1992, Pennock & Chapman, 1975). By definition, if people have no means to voice their approval or dissent with government, there is no democracy (Verba *et al.*, 1995). Involvement in the political system is in this sense understood as

allowing people—to a certain extent—to shape their own life (Clarke, 1996). Participation in democratic governance involves an acceptance of civic virtue on the part of the citizen, willing to subscribe to both rights and freedoms (Pool, 1998; Dunleavy *et al.*, 2000). Moreover, Wallas (1981) noted as early as 1908 that there is a need for people to imagine themselves as part of the wider community in order to take part—something later popularized by Benedict Anderson as an *imagined community* (Lewis, 2004).

Although most writers agree on the centrality of participation in democracy, and it has become one of the most popular concepts in political science (Pateman, 1970), the exact understanding of what participation means is less clear (Schulz & Adams, 1981). Even though this convention is not always upheld, political participation as such does not include passive attributes, such as beliefs and political knowledge (Nagel, 1987). Political participation is often understood in terms of empowerment: allowing citizens—to a certain extent—to take control of their own lives, and holding government to account (Verba *et al.*, 1993; Kleppner, 1982; Croft & Beresford, 1993). In contrast, it has also been suggested that participation can work to maintain current social divisions (Parry *et al.*, 1992), or as a form of citizen allegiance to the political system (Kleppner, 1982). Scaff (1975) differentiates between political participation as interaction on the one hand, and as instrumental action on the other. Such a distinction, linked with political virtues and civic duties, or maximizing self-interest respectively, is found in one form or another in many contributions to the literature.

The understanding of political participation also underwent changes as the number of domains covered by the concept rose over time (van Deth, 2001). Parry (1972) states that "By 'political participation' I stipulate: sharing in the framing and/or execution of public policies" (p.39), focusing on conventional political processes. Nagel (1987, p.1) removes the tie to political action: "Participation refers to actions through which ordinary members of a political system influence or attempt to influence outcomes," opening the way to applying the concept to related fields, such as volunteering or family life.

It has been noted that the term *political participation* is almost always used in a positive sense (Williams, 1976, cited in Parry *et al.*, 1992), and normative questions are seldom far when discussing involvement in politics (Scaff, 1975). These begin with the ideal of equality, so common that it is today rarely recognized as one (Verba *et al.*, 1995; Birnbaum, 1975). Because of the unspoken assumption that democracy is the best system (Braud, 1988), and the central role of participation in democracy, many authors deal with the question whether citizen have a moral duty to participate (Pennock & Chapman, 1975; Osbun, 1985; Wallas, 1981; Pateman, 1970). Other suggestions include that government should learn from citizens and thus encourage participation (ETA, 1994; Parry *et al.*, 1992), a policy somewhat implemented by *New Labour* in local politics[1] (Sanderson, 1999). In a similar manner, registration laws in the US have not only been described as holding back voter participation, but many authors suggest explicit changes to increase participation (Wolfinger & Rosenstone, 1980).

Understanding Participation

The domain of political participation has grown over the years as political research has shifted its focus (Burdick & Brodbeck, 1959; van Deth, 2001). From a narrow focus on voting in the 1940s and 1950s, political participation has grown to include the domains of first conventional, then unconventional participation, and then to wider applications (ibid.; Verba *et al.*, 1971; Verba *et al.*, 1993; Axford *et al.*, 1997; see figure 1).

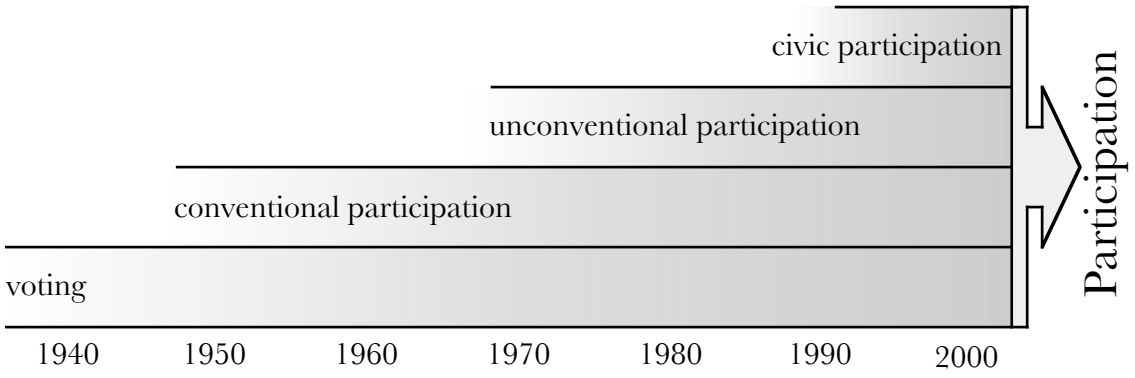

Figure 1 • The expansion of political participation over the years (adapted from van Deth, 2001, p.14).

[1] Participation at a local level allows citizens to *voice* their views, in contrast with the option of *exiting*, common under the Thatcher government, where unsatisfied citizens were encouraged to look elsewhere (Sanderson, 1999).

The original focus of political participation—voting—led to questions, such as *who* participates, and also *why* (Butler, 1969; Berelson *et al.*, 1954). Such concerns are probably rooted in the observation that many people abstain from voting, and also that those who vote are demographically unrepresentative of the wider population (Prior *et al.*, 1995; Pitkin, 1967). Given the view that for many voting is the sole political act (Verba *et al.*, 1995), and the common occurrence of elections, voting is still a key focus of research (Anderson & Zelle, 1998; Crotty, 1991).

Rational choice approaches (RCT) have been widely applied to voting behaviour. Green and Shapiro (1994) outlined a drastic increase in the use of RCT in political science literature[2]. Rational choice is often assumed and defended as a logically coherent approach (Laver, 1997; Bært, 1998): "Every rational man decides to vote just as he makes all other decisions: if the returns outweigh the costs, he votes; if not, he abstains." (Down, 1957, quoted in Wolfinger & Rosenstone, 1980, p.6).

Rational choice approaches, however, have been criticized by many social scientists. A basic paradox RCT struggles with is indeed why anyone would vote at all. Olson (1971) outlined the problem of free-riding: people can benefit from the outcome of a vote without actually voting themselves, whilst individual efficacy is severely limited. To overcome this problem, often benefits of expressive nature—such as maintaining a particular identity—have been suggested, but such solutions are not uncontroversial (Teixeira, 1987; Parry, 1972). Whilst some authors argue that the cost of voting is so low that utility calculations are not applied (Teixeira, 1987; Pennock & Chapman, 1975; Crouch, 1977), or that people participate *because* others do not—which implies particularly high costs—(Oliver, 1984), others have questioned the applicability of RCT in general (Wallas, 1981; Hindess, 1989; Lomborg, 1996; Macy & Skvoretz, 1998). Another challenge to RCT comes from Crouch (1977) who found that there are only a few consistent abstainers. Whilst voting as political participation has been labelled 'overrated' (Schulz & Adams, 1981), issues such as declining voter turnouts keep it on the research agenda (Lane, 1959; Teixeira, 1987).

[2] Green and Shapiro analyzed the proportion of articles in the *American Political Science Review* from 1957 to 1992, finding a steady climb from 0% to almost 40% of all articles.

Conventional participation increasingly appeared in the political literature during the 1950s. This was rooted partly in the insight that there is more to politics than just voting (Osbun, 1985), and partly by the observation that events outside elections affect the propensity of people to vote in an election (Bienen & Morell, 1975). Another factor was the fact that voting is essentially an individual act, and participation in collective action remained uncovered (Verba *et al.*, 1978; Hirschman, 1982). All this helped shift the focus to political acts in between elections, and the recognition that political participation constitutes much more than voting (Verba *et al.*, 1971). Similarly, an analysis of communist systems (Schulz & Adams, 1981) suggested that looking only at elections distorts the understanding of participation.

Conventional participation looks at political acts such as campaigning, donating time and money, or standing for an election. A large number of studies have looked at conventional political participation, often concerned with *who* participates (Birch, 1959; Milbrath, 1960; Milbrath, 1965; Welch & Secret, 1981; Welch, 1977; Butler, 1969). Many studies have examined the effects of the usual suspects: income, class, age, education, sex, race, or religiosity. The effects of education and age are consistently found to be good predictors of political participation. Socioeconomic status (SES), although often used as the standard approach (Verba *et al.*, 1995; Lane, 1959) has been demonstrated to affect participation in its key components: education, income, and status have separate effects (Teixeira, 1987).

As with voting, RCT is a commonly used explanation for conventional participation. The paradox of no benefits is partly removed when looking at nonmaterial aspects (Olson, 1971). A focus on political psychology in terms of looking at individual traits beyond the usual suspects, moved the focus away from rationality to individual characteristics, such as sociability or a willingness to give. These studies also expanded on approaches to electoral behaviour in that they recognized the dynamic nature of political behaviour: feedback loops were introduced into previously static analyses (Milbrath, 1960; Milbrath, 1965;

Verba *et al.*, 1971; Dunleavy *et al.*, 2000; Jones-Correa & Leal, 2001). This not only expanded the domain of where political participation is applied, but also the repertoire of factors looked at. Similarly, insights from behavioural sciences (Hull, 1943; Wallas, 1981) and qualitative research (Lane, 1962) were used to argue that political messages are perceived differently by individuals, further qualifying strict RCT applications.

Soon some limits of the studies on conventional political behaviour became apparent: they did not cater for unconventional political behaviour. Unconventional forms of political behaviour are understood as direct action, and political violence (Parry *et al.*, 1992). Such acts are commonly recognized as political participation because of their goal, and often understood as an extension to analyses of conventional political participation.

Rational choice approaches once again are commonplace when studying unconventional political participation, arguing that people calculate costs and benefits before deciding whether to participate or not. Approaches based on political psychology and individual traits are also common, some of which criticize RCT for failing to explain actual action. Gibson (1997), for instance, outlines the attempted 1991 coup in the Soviet Union, highlighting that RCT fails to explain why people resisted the coup. Protest movements, as well as new social movements (NSM) are increasingly studied as forms of political participation (Barnes & Kaase *et al.*, 1979; van Deth, 1997; Urwin & Patterson, 1990). Some studies find that RCT fails to explain protest movements (Finkel & Muller, 1998), whilst others claim that it is only through RCT that aggressive political action can be understood (Muller, 1979). Developments in tipping models provide alternative explanations of how and why people get involved in protest movements—regarding the actual outcomes largely as unintended consequences (Granovetter, 1978; Lohmann, 1994; Myers, 2000).

The distinction between unconventional and conventional political participation is not always clear. Indeed, as outlined in figure 2, Parry *et al.* (1992) identified both overlaps and unclear cases. They suggest that the term only be used very carefully (ibid.), but in terms of

understanding an expansion of what is studied in political participation, the term is nevertheless useful.

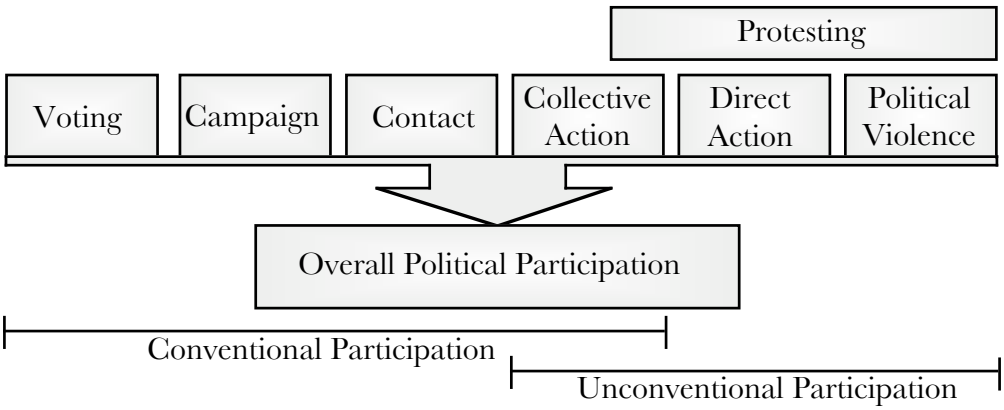

Figure 2 • Conventional and unconventional participation overlap (adapted from Parry *et al.*, 1992, p.61).

Unconventional participation was not the end of the expansion of political participation as a subject. During the 1990s the concept was widened by many political sociologists to include civic participation, as well as social engagement (van Deth, 2001; Putnam, 2000). The boundaries were stretched by focusing on local action in general (Barnes & Kaase, 1979), which opened the door for studies of participation at the workplace (Nagel, 1987; Crouch, 1977). Having stretched the definition to look at power relations as such, the term found its way into managerial discourse (Pennock & Chapman, 1975; Pateman, 1970), and was applied to volunteering (Musick *et al.*, 2000; Wilson & Musick, 1997; Croft & Beresford, 1993) and other fields to the point that it left the realm of the political completely (Upright, 2004). Such extensions of the concept are possible because of shared mechanisms with regards to group participation. Van Deth (2001) argued that political participation is in danger of turning into a 'study of everything.'

Conceptualizing Participation

Conceptualizations of political participation, to a certain extent, underwent developments parallel to the expansion outlined above. Whilst for elections a distinction between more or less informed voters could be made, the focus on rational choice often meant that all persons were treated as rational beings (Uhlaner, 2004).

Once extending political participation to include conventional participation, a conceptualization of participation in a hierarchical manner was established (Benney *et al.*, 1956; Milbrath, 1960; Kuroda, 1965; Froman, 1961). Citizens were understood in terms of the extent to which they are involved in politics. Voting as the most basic kind of involvement forms the bottom of a pyramid of involvement. Different forms of political participation were conceptualized as more or less high in the hierarchy. Milbrath (1965) outlined such a pyramid of political participation in great detail, distinguishing between spectators, transitionals, and gladiators (see figure 3).

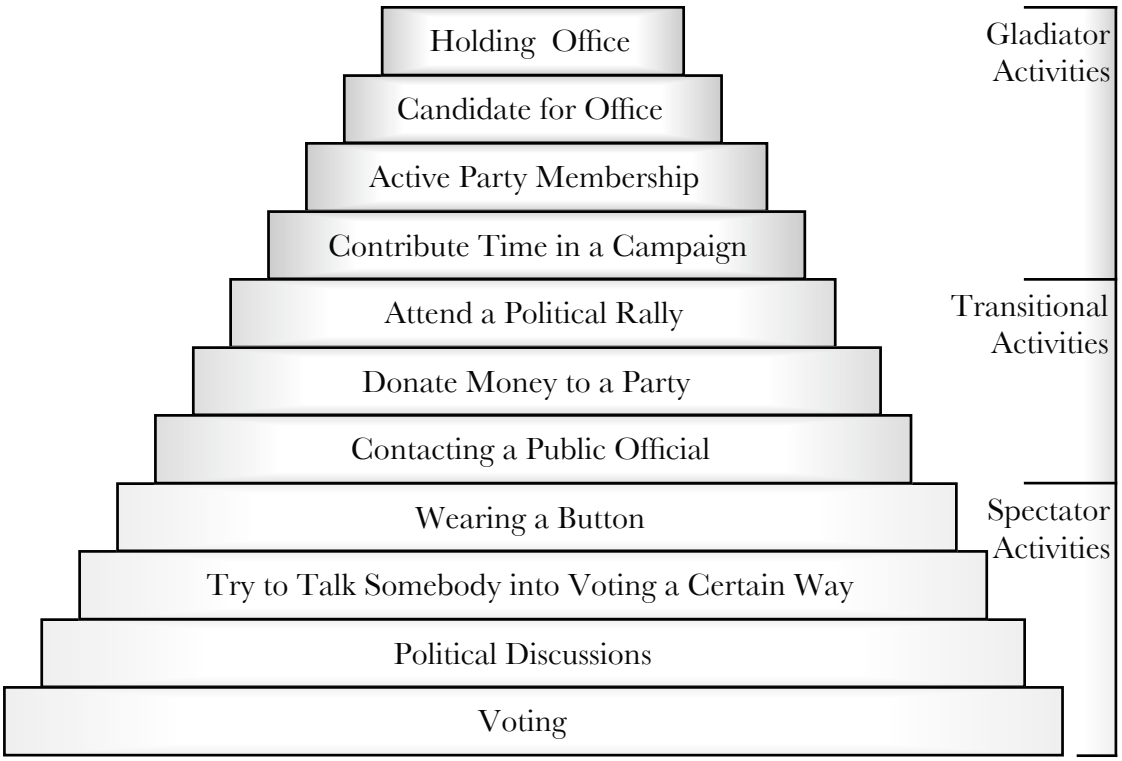

Figure 3 • Political participation can be conceptualized in a hierarchical manner. Political involvement is understood in terms of different levels (adapted from Milbrath,1965, p.18).

The idea put forward by Milbrath (1960; 1965) is that depending on the personal characteristics[3], but also depending on the political environment, individuals are more or less likely to get involved into politics. Involvement is conceptualized in terms of different levels, allowing for a plausible more or less intensive involvement. The metaphor of a pyramid was chosen, because it is thought that every person at a higher level is also, to a

[3] Froman (1961, p.346) used the term *personality* instead, referring to unique patterns of traits: "Each of the traits of a person's personality may affect from none to all of the political behaviours."

certain extent at least, involved in the political activities at the lower levels (ibid.), but also because activities at the bottom of the pyramid are more common.

Parker (1972) identified thresholds in political participation, largely supporting a hierarchical approach. Similarly, Schulz & Adams (1981) support different levels of involvement, but warn that there are also qualitative dimensions, not merely quantitative variations. Scaff (1975), in contrast, is much more pessimistic: He argues that a hierarchical model attempts to wed two inherently different aspects of participation: participation as interaction, and participation as instrumental action.

A major critique to the pyramid emerged with the development of models that included unconventional political participation. Particularly with studies on direct action and protest movements it was found that a single hierarchy of political involvement was not enough. Those involved in unconventional political action often do not engage in other forms of politics, and vice versa (Muller, 1979). Verba *et al.* (1971) were at the forefront arguing for a multidimensional approach. The idea of different levels was kept, but political participation was conceptualized as different ladders, each representing a different mode. They argued that each mode needs different psychological involvement. The four principal modes identified are: voting, taking part in campaign activities, communal activities, and contacting officials directly (ibid.). Verba *et al.* (1987) successfully replicated their research in different countries, but the number and nature of different modes used sometimes varies in other studies (Parry, 1972; Parry *et al.*, 1992; Richardson, 1993). The concept of cross-pressures may be understood as pointing towards different modes of political participation (Wolfinger & Rosenstone, 1980).

The difference between the particular modes is not always as clear as in Verba *et al.*'s original 1971 study. Some studies find that some citizens are indeed more involved overall, and Milbrath's distinction between spectators, transitionals, and gladiators is often applied without distinguishing modes (Parry *et al.*, 1992). Other studies find the unidimensional

model adequate: "[I]n Europe the unidimensional model is a fully appropriate way to proceed" (Marsh & Kaase, in Barnes & Kaase, 1979, p.86).

The fuzzy boundary between conventional and unconventional political participation cannot be wholly resolved with the concept of different modes of political involvement. As outlined in figure 2, even when distinguishing different modes, there is some form of overlap. Indeed, it has been questioned whether all protest movements and acts should be grouped into one, as this may mask the variety of motivations (van Deth, 1997). In terms of conceptualizing political participation, multidimensional approaches are often heralded as more realistic, although some studies value parsimony to the extent that they can defend a unidimensional approach (Barnes & Kaase, 1979). Whether explained using RCT or not, the metaphor of ladders persist, regarding citizens as more or less involved (Laver, 1997; Crouch, 1977).

Related Concepts

By increasing the domains covered by political participation, the number of links to other concepts also increased. Such links can in themselves lead to a wider understanding, but more importantly, can confirm and further the current understandings of the underlying mechanisms in political participation.

The rise of popularity of *social capital* in recent years did not leave political participation unaffected. On a superficial level, the two concepts share the characteristic that they never seem to be used unfavourably (Parry *et al.*, 1992). On a more profound level, the two concepts are linked—although rarely explicitly—through a focus on small groups: primary groups with face-to-face contact (Verba, 1961). Newcomers to a community are said to lack social capital (Coleman, 1990; Turner, 2002), just like newcomers are found to be politically uninvolved for the lack of ties (Lane, 1959). Concepts like civic virtue have been identified as beneficial for involvement, just like social capital was found to enhance community governance (Bowles & Gintis, 2002). The focus on civic skills in some studies (Verba *et al.*, 1995) matches the view of social capital as a resource (Musick *et al.*, 2000).

Similarly, the decline in voter turnout in the US has been linked to an erosion of personal and political ties (Teixeira, 1987), a point of view shared in the social capital literature (Putnam, 2000). Jackman and Miller (1998), however, are wary of such connections: they find that the treatment of social capital in political science has shifted from an endogenous concept to an intangible feature of political culture—exogenous—, confusing two inherently different matters.

There are certain parallels between political participation models and those used in network analysis. Structures of the environment are found to have a substantial impact on political participation. Cohen (1969), for instance, demonstrated that community size affects the characteristics of the political system. Similarly, Verba (1961) found that small groups develop unique political cultures, reinforced by norms and pressures to conform[4]. Just like group-think, as outlined by Stone and Schaffner (1988), this can be understood in terms of network closure (Burt, 2000). Structures of and connectivity within groups (Stocker *et al.*, 2001) are often regarded as important as connections outside the group (Sanderson, 1999). Indeed, the importance of social networks in terms of contacts has been demonstrated (Peterson, 1990; Verba *et al.*, 1995). This links well to concepts like structural holes (Burt, 2000, 1992). These examples illustrate how research in political participation may develop an understanding of *how* people get involved in politics, rather than the prevalent *who* and *why* questions (Wasserman & Faust, 1994).

Culture, in particular political culture, habits, and socialization (Graumann, 1965; Tizard & Hughes, 1984) are further links to other fields in the social sciences. Socialization is understood as

> "the whole process by which an individual, born with behavioural potentialities of enormously wide range, is led to develop actual behaviour which is confined within a much narrower range—the range of what is customary and acceptable for him according to the standards of his group." (Child, 1954, quoted in Froman, 1961, p.341).

This fits with findings by Verba (1961), Beck and Jennings (1982), or Welch (1977). Although they are not tangible, these concepts may be responsible for much what is observed in political participation (ibid.).

[4] Fehr and Fischbacher (2003) use tipping models and computer simulation to demonstrate that conformity and norms in groups may be externalities rather than inherent in groups.

These links can be used to confirm mechanisms identified in political participation, to reinforce old ideas, but also to expand the pool of mechanisms considered when trying to explain political participation. There is, however, a danger to overdo the whole exercise and further weaken the understanding of what is understood by political participation (van Deth, 2001).

Situating this Paper

Traditionally, the number of factors looked at when studying political participation is relatively limited. Education (Peterson, 1990; Parry *et al.*, 1992; Barnes *et al.*, 1979) and socioeconomic status (Lane, 1959; Crouch, 1977; van Deth, 1997; Verba *et al.*, 1971, 1978, 1995; Kuroda, 1965; Anderson & Zelle, 1998; Crotty, 1991; Pateman, 1970) are consistently found to be correlated to political participation, with other factors commonly studied being age, race, sex, religion, or location (Teixeira, 1987; Milbrath, 1965; Lane, 1959, 1962; Welch & Secret, 1981; Richardson, 2000). The simulation used in this paper considers these factors as far as there are enough descriptive details available to include them. A larger part, however, covers psychological aspects: personality traits—as they are increasingly looked at—, such as sociability or being thick-skinned (Froman, 1961; Milbrath, 1965; Kuroda, 1965; Ashford, 1972). The intuition is that depending on the personal characteristics, a person is both more or less likely to get involved, and more or less affected by the political environment and its stimuli. The focus on personality is rooted in developments in behavioural science (Hull, 1943; Lane, 1959), whilst the concept of a *perceptual screen* captures the different experience of the political environment well (Fay, 1975; Andrew, 1991).

Other studies looked at who is interested in politics—and thus looked at psychological engagement—(Verba *et al.*, 1978, 1995; Milbrath, 1965; Burdick & Brodbeck, 1959), or examined the role of neighbourhoods and communities: those with roots in a community are found to be more politically involved (Milbrath, 1965; Peterson, 1990; Lane, 1959; van Deth, 1997; Verba *et al.*, 1995). Such findings are considered in the simulation used in

this paper. Post-materialist values (Anderson & Zelle, 1998; Schmitt, 1990; Peterson, 1990; Harrop & Miller, 1987), and psychoanalytical/psychoemotional aspects from anxiety to frustration or greed (Braud, 1988) are also used in some studies. However, the descriptive details of how these affect political participation are insufficient to be included. Moreover, studies considering such aspects often examine whom people vote for, something not considered in this paper.

The influence of personality and individual traits on political participation is often cited in studies on political behaviour, although rarely investigated (Smith, 1968; Peterson, 1990). Introductory texts to political science cite frameworks such as the one developed by Milbrath (1965; see for instance Axford *et al.*, 2002; Zevin, 1999; Plutzer, 2002; Zimmerman, 1999), but it appears that it has never been tested whether the outlined mechanisms really lead to the outcome we can observe in reality. Theoretically, most work on the influence of personal trait on political participation is solid and plausible. The fact that feedback loops are involved and political participation is essentially a dynamic matter (Milbrath, 1960, 1965; Froman, 1961), aspects more difficult to capture using conventional statistical methods (Abbott, 1988), probably contributed to this lack of confirmation. For cost and convenience reasons many studies in political participation are based on cross-sectional data (Beck & Jennings, 1982), as such in a relatively poor position to support a dynamic process (Gilbert & Troitzsch, 1999). This paper will attempt to fill this gap by testing whether the suggested mechanisms really can lead to the observed outcomes. The framework developed by Milbrath (1965) is used for a number of reasons: it is conceptually clear, relatively well-developed, complete, and often cited. Using a computer simulation, the framework is tested in this paper in terms of whether the described mechanisms lead to the expected results.

This paper is not able to provide a definite answer to questions of the viability of political participation models based on personality. For one, following Milbrath's model, the simulation only includes one mode of participation, and thus largely ignores the

contributions by Verba *et al.* (1971) on different modes of political participation. Although technically not impossible to implement, Verba's approach is conceptually less clear than Milbrath's. Furthermore, for the lack of substantive data and qualitatively described mechanisms, developments in the areas of both post-materialist values, as well as psychoemotional factors will be left out. Finally, the paper will not differentiate between different political stimuli from different media—such as a stimuli from the television, bill posters, or a political rally. It is reasonable to assume that different media affect individuals in different ways (Bartels, 1993), but the current state of research does not provide concrete enough information to add to the model used. Given the limitations already outlined, it would be unwise to add a large number of aspects incompletely or based on assumptions only, since the errors generated may multiply (Weissstein, 2005) and thus completely invalidate the results.

Methodology

Why Simulation

This paper will use a computer simulation in order to test Milbrath's framework. Computer simulation was chosen because of the dynamic nature of the framework, particularly due to the numerous feedback loops. Computer simulation is particularly suited for such problems (Gilbert & Troitzsch, 1999; Epstein & Axtell, 1996). The qualitative description of the mechanisms involved can be used to build a systematic simulation of the framework (Chattoe, 2005), although the choice of numerical values can be crucial (Agar, 2003). The computer simulation approach was chosen over advanced statistical methods due to general limits of such methods. Abbott (1988) outlines many of these limits—assumptions of fixed entities, or singular independent causal patterns—some of which simulations can overcome. Interviews were not chosen as a way to proceed because of the lack of generalizability, and more importantly, since this is already covered in the literature (Andrew, 1991).

The Simulation Process

This paper will follow the suggested approach to computer simulation as outlined by Gilbert and Troitzsch (1999, 2005). Figure 4 describes this approach: Step I describes the abstraction from social processes into a model. Using a computer language, this model is implemented into a program, which estimates parameters (step II) to produce data. At the same time, using conventional methods—such as a survey—data are collected (step III). These data are then compared against the predicted data to make statements of similarity and validity (step IV; ibid.).

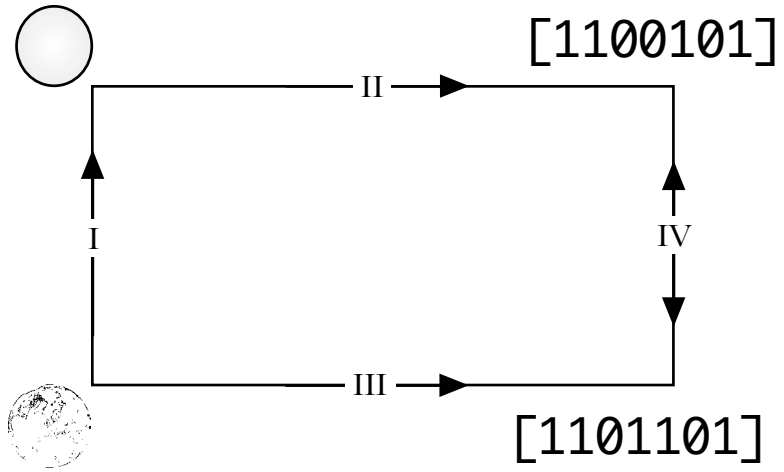

Figure 4 • Computer simulation for the social sciences, showing the different steps involved: (I) abstraction process, (II) the simulation generates data, (III) sampled survey data, (IV) comparison of simulated data against survey data (adapted from Gilbert & Troitzsch, 1999, p.15).

This paper follows this general approach to computer simulation. In step I, the model by Milbrath (1965, see figure 5) is used in a slightly modified version, in order to keep the simulation manageable. In contrast to some of the literature on political participation, the focus in Milbrath's model is on the act, not the decision on *whom* to support when participating in politics. The key elements of the model are (see also figure 6): political participation is an individual affair, individuals communicate with each other, they are also subjected to external political stimuli, people have different characteristics, these characteristics mean that the impact of the stimuli and interaction varies from person to person (perceptual screen).

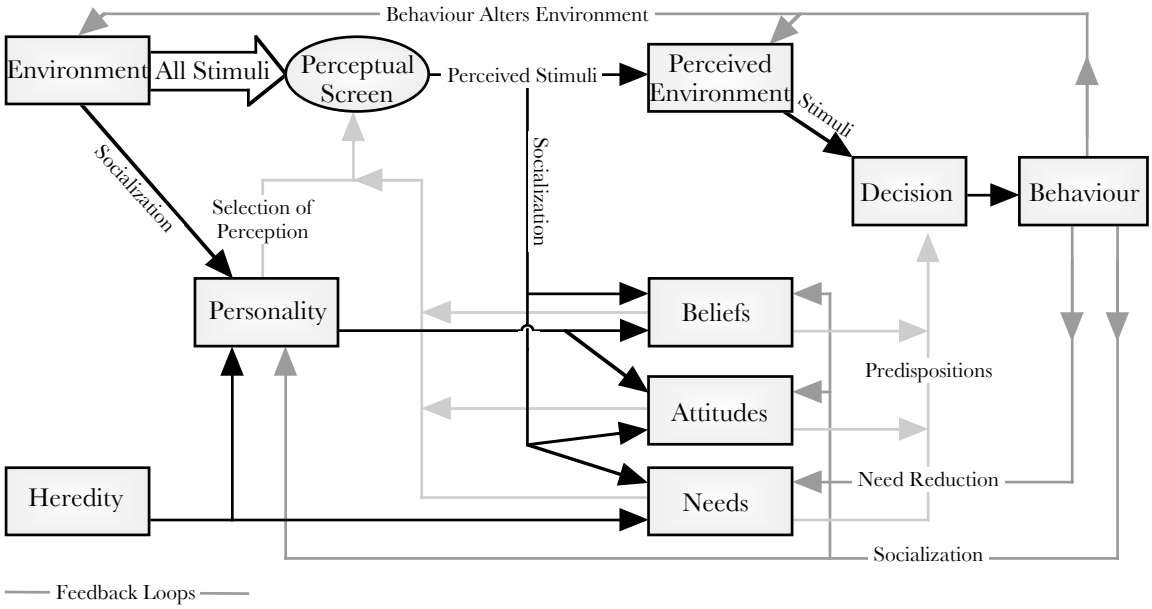

Figure 5 • The framework of political participation as outlined by Milbrath (1965, p.28). Milbrath's model focuses on the *act* of participation, not whom people support. It is characterized by a number of feedback loops. This paper uses a slightly modified form of this model in order to keep the simulation manageable.

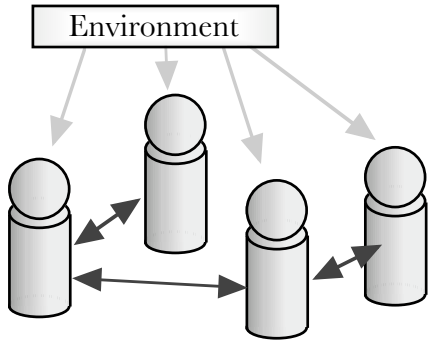

Figure 6 • The understanding of political participation in Milbrath's framework: Individuals interact with each other (dark arrows), but are at the same time subjected to external political stimuli (light arrows). The impact of personal interaction is stronger than that of external stimuli (Milbrath & Gœl, 1977).

In this simulation, following Milbrath (1965), political participation as such is understood in a hierarchical manner: different levels to which individuals are politically involved. This hierarchy was already introduced as figure 3 above, but is used with slightly different levels. Most notably, at the bottom of the hierarchy are added the apathetics, as well as nonvoters who are, however, exposed to stimuli. The distinction between spectators, transitionals, and gladiators is upheld[5].

[5] The other changes are the merging of the two levels of having a discussion and trying to talk somebody into voting a particular way, due to the lack of a clear distinction in the model, and the additional level of soliciting funds to go between being a candidate and being an active party member. Milbrath's original (1965) pyramid also included a level of attending a strategy meeting just above active party membership, but did not treat this item subsequently.

Moving from one level to the next in the hierarchy is dependent on the individual characteristics and understood in terms of thresholds (see also appendix 2). For example, an extremely passive person is unlikely to become involved in politics in the first place, or someone not comfortable with overt political acts is unlikely to put a sticker of the chosen political party on her or his car.

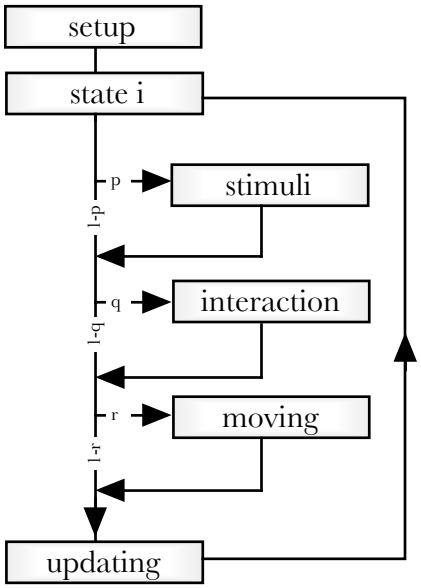

Figure 7 • The basic procedure of the simulation: people interact with a given probability (q) and are exposed to external stimuli with a certain probability (p). Individuals also sometimes move and lose their local contacts (r). After each cycle the level of political participation is recalculated for each individual. The values for p, q, and r are determined by the preset chosen.

As outlined in figure 7, the simulation follows a simple order of events, allowing for feedback loops to work. Each individual starts in a certain state, originally assigned to randomly. This state represents the box *heredity* in figure 5 (see page 18). In each cycle, the individuals are subjected to certain stimuli (p), and also set to interact with a certain probability (q), both of which affect the individuals and their characteristics. With a certain probability (r), individuals also move, meaning that they lose their contacts in the community. As a consequence, the likelihood of moving up or down the ladder of political participation is affected by interpersonal interaction and external stimuli. At the end of each cycle, the level of participation is recalculated for all individuals, based on the changed characteristics. The levels of involvement follow set rules, but stochastic elements are also included.

The values for p, q, and r can be changed to reflect different political environments. The simulation allows manual input for these variables, but also includes a number of presets for reasons of convenience. For example, the fact that political stimuli are more intense before an election (Parry *et al.*, 1991; Pennock & Chapman, 1975) can be reflected by increasing the value for p. Repressive regimes often restrain interaction (Bienen & Morell, 1975), something that can be modelled by reducing the value for q. Table 1 outlines the different steps in the simulation in pseudo-code.

Stimuli	• repeat for all agents • calculate the magnitude of impact depending on the characteristics • add a random number depending on the magnitude to the variable affec • repeat this step for other variables affected
Interaction	• repeat for all agents • if random number based on sociability and overtness exceeds threshol then initiate interaction with a random other agent • if random number based on sociability of agent contacted exceeds threshold, then start interaction • for both agents, calculate the magnitude of the impact depending on characteristics • for both agents, compare individual characteristics according to rul sheet and change accordingly • add 1 to the number of contacts for each agent
Moving	• set number of contacts to 0 • set time spent in community to 0 • set eligibility to 0
Updating	• repeat for all agents • check whether all variable are within the allowed range • check whether agent has become eligible based on time spent in commu • repeat for all levels of involvement, starting from the lowest • if characteristics required at this level and random variable added exceed threshold, then set level to one higher, otherwise stop updat this particular agent • add new level to history of agent's involvement

Table 1 • Pseudo-code of how the different steps of the simulation work and how they affect the individual agents. Appendix 2 outlines which characteristics are considered at the different level changes.

It is in this sense that different political environments can be tested in the simulation, but also by changing the kind of stimuli that are sent: depending on the circumstances individuals are exposed to different kinds of stimuli, affecting different characteristics. For example, a close election encourages active involvement (Pennock & Chapman, 1975). Such a stimulus sent in conjunction with an election does not require a continuous commitment, and indeed it is those with more episodic commitment that are more likely to be affected.

Regulation is another aspect that is considered in the simulation. The different legislations with regards to political participation, such as the need to register, are modelled in a variable controlling eligibility. When an agent moves, his or her eligibility is set to 0, excluding this agent from participation. Depending on the legislation in place, the time needed until an agent is technically eligible can be varied. It is set to 0 where there is no restricting legislation, and an agent is immediately eligible after a move.

Conceptualizing the Agents

In the computer simulation used, agents are conceptualized as individuals with a range of characteristics that affect their propensity to get involved in political acts. With the exception of felt duty to participate, all these characteristics are more or less open to change according to the dynamics of the system. Depending on the individual traits, an agent is more or less prone to such changes. The characteristics modelled are based on Milbrath (1965) as follows, given with their opposites in square brackets: active [passive], overt [covert], autonomous [compliant], approaching [avoiding], continuous [episodic], outtaking [inputting], expressive [instrumental], and social [nonsocial] (see also appendix 1). Each characteristic is modelled as a continuous variable for each agent (see figure 8).

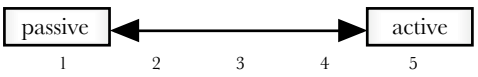

Figure 8 • Representation of characteristics in numerical form. For each agent, the different characteristics are stored as a continuous variable, somewhere between the extreme values.

In addition to the personal characteristics, for each agent a number of factors are recorded: the socioeconomic status (SES), the number of contacts in the community, as well as the time spent in the community. Just like the personality traits, these are understood as a continuum, represented in the simulation as a single floating number. Floating numbers are used so that small influences can accumulate over time. For aspects such as duty or eligibility, a binary variable is used; time and number of contacts in the community are not restricted, although—being sufficient—whole numbers are used. This

results in profiles unique to each agent, as outlined in figure 9. The level of political involvement itself can also be represented as a single number: from 0 for apathetics to 12 for those holding office.

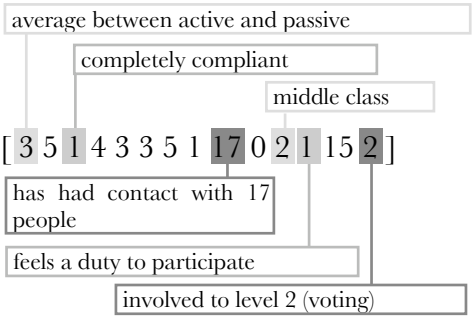

Figure 9 • Example profile of an individual agent with indicators of how to understand the numerical representations. Only some characteristics are highlighted in order to facilitate understanding. In contrast to the simulation, this example profile does not use floating numbers for reasons of legibility.

Hypotheses

The computer simulation is set up in NetLogo[6], testing a number of hypotheses based on Milbrath's 1965 framework. The results of the simulation are used both to test aggregate outcomes, as well as individual histories. The hypotheses are formulated here as alternative hypotheses, given with a number of smaller testable statements.

H_aI Different political environments affect the aggregate outcome.
- a. more stimuli mean more participation (Milbrath, 1965; Milbrath & Gœl, 1977)
- b. more stimuli mean deeper participation (ibid.)
- c. there is more participation in more economically developed countries (Verba *et al.*,1971)
- d. more time in the community leads to more participation (Milbrath, 1965; Milbrath & Gœl, 1977; Crouch, 1977; Lane, 1957, 1962)
- e. regulation has a major impact (Milbrath, 1965; Milbrath & Gœl, 1977)

H_aII SES and education are key factors determining political participation.
- a. low levels of education mean low participation (ibid.)
- b. high SES is linked to high participation (ibid., Lane, 1957)
- c. those with more SES are more likely to donate money (Lane, 1959)

H_aIII The number of personal contacts is a significant factor in political participation.
- a. the more contacts, the higher participation (Berelson, 1954; Lane, 1959)
- b. those with more contacts (opinion leaders) are less swayed and thus have a more stable history (Lane, 1959)

H_aIV Participation in politics is dynamic.
- a. people sometimes miss a vote, but there is relative long-term stability (Crouch, 1977)

[6] The source code of the simulation is included in its whole length as appendix 3.

Hypotheses linked to aggregate outcomes are tested by using different presets which determine the variables of different political environments. Such aggregate outcomes can then be compared to survey data to examine the validity of the results (Gilbert & Troitzsch, 1999; Carmines & Zeller, 1979). Hypotheses linked to individual histories, on the other hand, are compared to life-course accounts from established literature. Again, this should allow to test the validity of the outcomes.

This paper does not test different styles/modes of political participation, because in its current form the simulation is unable to say anything about participation in modes other than the one tested. Cross-pressures, although probably significant (Milbrath & Gœl, 1977; Berelson *et al.*, 1954), cannot be tested for the lack of groups in the simulation[7]. The increased interaction within a group (Burdick *et al.*, 1959; Berelson *et al.*, 1954) is left out for the same reason.

FINDINGS

The following paragraphs describe findings based on the computer simulation. The stipulated hypotheses are tested, and other findings reported. Each different setting was run three times in order to ensure that there is no random effect[8] distorting the findings.

General Observations

Each setting was run with 1500 agents, representative of a population in most cases (Fisher, 2005), and compromised for the speed of the simulation. The simulation shows dynamic features, and that a few weeks can mean a great deal of difference in terms of participation. Events such as an election have immediate (short-term) effects, but long-term effects can also be observed.

All setups were also run with level 5 (contacting), and level 5 and 2 (voting) turned off. The intuition was to see whether by removing these two levels, the simulation provided

[7] For reasons of simplicity, the addition of a spatial dimension to the model is referred to further investigations. The most apparent change when catering for space and groups is that the rules of interaction differ in the following respects: firstly, individuals are more likely to interact with others from the same group, and secondly, individuals from the same group are more influential than strangers, that is their impact will be stronger (Cohen, 1969).

[8] In very rare cases the stochastic elements in the simulation can cumulate to small but notable differences in the results. By running each setup three times, such rare cases should be identified.

more accurate results for one dimension of a multidimensional approach to participation. In all cases, turning off levels led to a further overestimation of the higher levels of participation, and thus did not improve the results.

Null Hypotheses

In order to test H_0I, three different environments were run for 250 cycles[9]. The results are summarized in table 2: it is very unlikely ($p<0.001$) that different political environments have no impact at all.

Preset:	Apathetics:	Spectators:	Transitionals:	Gladiators:
Normal	400.33	954	96.33	49.33
Hard Times	120.67	1215.33	163	1
Frequent Movers	90	1123.33	131.67	155
c^2	435.94	101.65	59.10	273.68
p<	0.001	0.001	0.001	0.001

Table 2 • The number of individuals by level of involvement after 250 cycles. The average of the last 3 cycles was taken in order to counter noise. The result was the same when looking at the different levels individually rather than grouping them as here.

H_0Ia and H_0Ib stipulate that more stimuli have no impact on participation. 250 cycles of the preset *Normal* were compared to 250 cycles of the same preset with stimuli turned off. Figure 10 represents the different distributions. The two cases are significantly different ($p<0.001$ for 10 of the 12 levels). The case with stimuli on, show more involvement at higher levels, not only rejecting H_0Ib (no effect), but in fact inverting the alternative hypothesis H_aIb.

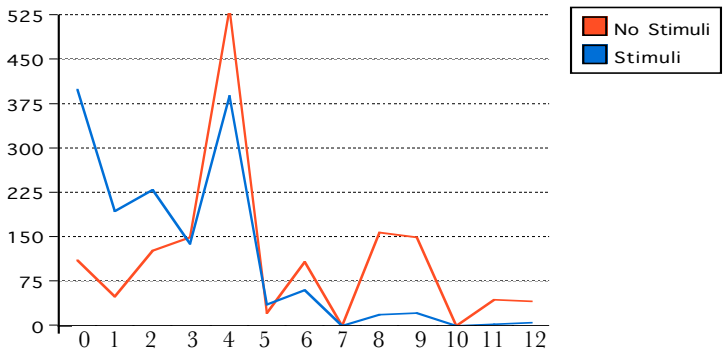

Figure 10 • The different distributions of involvement for the unchanged case (blue), and with stimuli turned off (red) after 250 cycles. Without stimuli, more involvement at higher levels can be observed.

[9] One cycle is assumed to represent 1 week.

H_0Ic stipulates no difference of participation in economically developing countries. To this effect, the *Normal* preset was run against a case where SES was increased continually in order to simulate growing development. The differences are not significant ($p>0.05$). Notable exceptions are voting, which decreased, and donating money, which increased as SES was expanded (see figure 11).

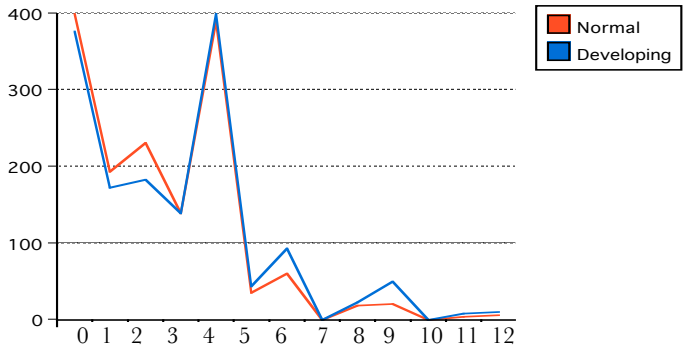

Figure 11 • Results of a developing economy. The differences are statistically not significant ($p>0.05$), with the exception of the levels of voting, as well as that of donating money.

H_0Id was tested by moving individuals at artificially high rates in order to prevent them from establishing roots in the community. Most differences are not significant ($p>0.05$), and the overall pattern of participation does not differ.

In order to test the role of regulation in H_0Ie, the time needed until an individual is allowed to participate was varied. The claim that regulation has no effect can be rejected ($p<0.001$), but not for gladiatorial activities where no significant difference ($p>0.05$) can be found. The difference is only very pronounced for spectator activities.

H_0IIa and H_0IIb cannot be treated separately, as the simulation only includes education as part of its parent concept socioeconomic status. The relationship between levels of participation and socioeconomic status is significant ($p<0.001$). Whereas for those not involved (levels 0 and 1) there is no significant difference, the highest levels are almost exclusively for those with high SES. In the middle levels, a split between different levels of SES can be observed (see table 3).

Level		Low SES	Medium SES	High SES	Total
0 – Apathetic	Count	94	99	109	302
	%	*31.1*	*32.8*	*36.1*	*100*
1 – Exposed	Count	46	50	56	152
	%	*30.3*	*32.9*	*36.8*	*100*
2 – Vote	Count	61	45	41	147
	%	*41.5*	*30.6*	*27.9*	*100*
3 – Discussion	Count	12	18	18	48
	%	*2.5*	*37.5*	*37.5*	*100*
4 – Identification	Count	204	175	195	574
	%	*35.5*	*30.5*	*3.4*	*100*
5 – Contacting	Count	5	7	6	18
	%	*27.8*	*38.9*	*33.3*	*100*
6 – Donation	Count	38	42	46	126
	%	*30.2*	*33.3*	*36.5*	*100*
8 – Campaigning	Count	29	20	1	50
	%	*58*	*40*	*2*	*100*
9 – Membership	Count	12	25	27	64
	%	*18.8*	*39.1*	*42.2*	*100*
11 – Candidate	Count	0	5	8	13
	%	*0*	*38.5*	*61.5*	*100*
12 – Hold office	Count		2	4	6
	%	*0*	*33.3*	*66.7*	*100*
Total	Count	501	488	511	1500
	%	*33.4*	*32.5*	*34.1*	*100*

Table 3 • Cross tabulation between level of participation and socioeconomic status (SES). The data represent the status after 250 cycles of preset *Normal*, with an election every two years. The results are statistically significant (Pearson c^2=52.9; p<0.001). Levels 7 and 10 are excluded because they scored 0 in all cells.

H_0IIc looks at donating money in particular, but the simulated data cannot reject the null hypothesis of no difference: those with higher SES are not more likely to donate money (Pearson c^2=2.2, p=0.33).

H_0IIIa stipulates that those with more contacts are not involved to a higher level, but a significant relationship between the level of involvement and number of contacts in the community (r=0.601; p<0.001) can be observed. If catering for the time spent in the community[10], the correlation even increases to 0.746.

H_aIIIb argues that those with more contacts in a community show fewer fluctuations in their history of political participation. An analysis of the number of level-changes

[10] The time spent in the community as such is only very weakly correlated to the level of participation (r=0.028), statistically not significant to the 0.05 level.

compared to the number of contacts resulted in a weak and statistically insignificant relationship ($r=0.204$; $p>0.05$).

H_0IV stipulates that participation in politics is not dynamic. In the simulated data an average 0.117 changes were observed for every cycle: a change every 8.52 cycles. For any value of *not dynamic* in terms of changes fewer than every 12 cycles, the difference is statistically significant ($p<0.05$).

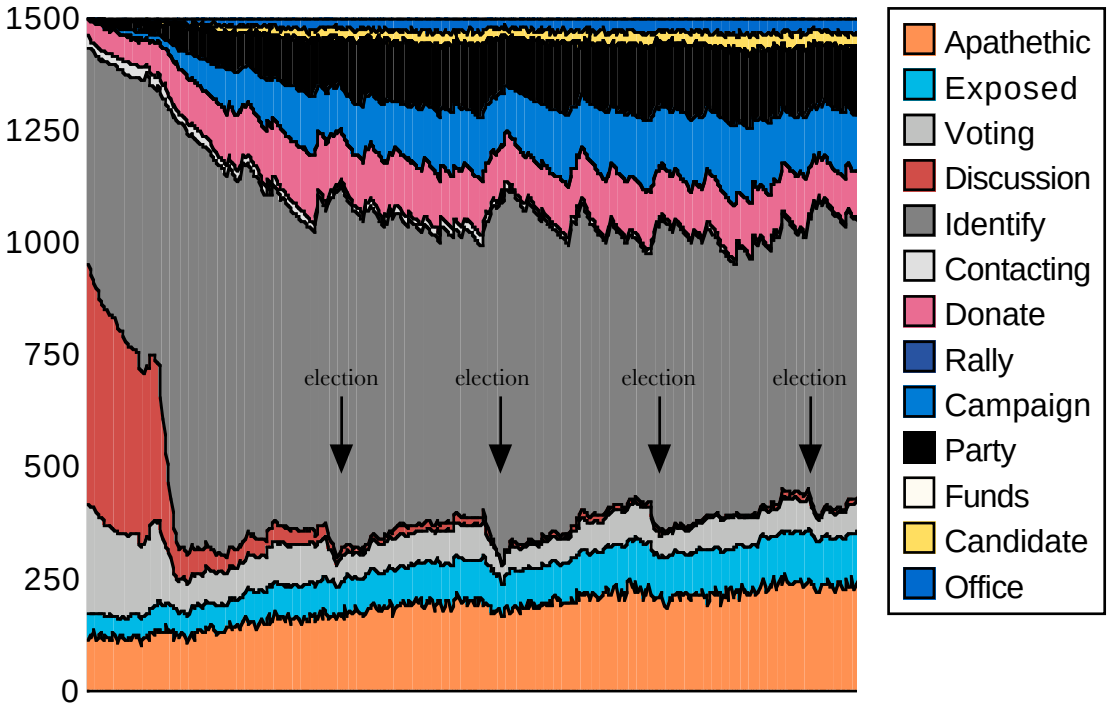

Figure 12 • The distribution of the different levels to which individuals are involved in over the course of a mixture of the preset *Normal* and elections every 2 years. The simulation was run for 500 cycles, leading to a typically observed dynamic equilibrium.

H_0IVa was tested by analyzing the history of individuals over a period of 104 cycles. It was found that 53.3% are always involved to level 2 (voting) or above, whilst 37.4% at some stage fall below that threshold at least once ($c^2=21.809$, $p<0.001$). There are 9.3% persistent abstainers who never reached level 2.

The results of the simulation are also tested in terms of validity (step IV in figure 2, see p. 5). Table 4 summarizes the fit of simulated data against survey data cited in the literature (Milbrath, 1965; Lane, 1959; Birch, 1959; Crouch, 1977; Mabileau *et al.*, 1989; Muller, 1979; Verba *et al.*, 1971, 1978, 1987; Parry *et al.*, 1992).

	0	2	3	4	5	6	7*	8	9	11	12
Model 1	16.4	76.2	71.8	41.2	30.2	29.9	29.9	22.8	14.4	4.1	2.2
Model 2	8.4	87.6	84.6	84.4	—	79.2	79.2	58.4	33.8	15.2	7.4
Model 3	13.8	—	80.0	78.2	—	65.2	65.2	42.5	22.8	8.9	4.4
Literature	10–30	40–94	11-80	81.0	4–38	6–21	6–22	3–14	4–28	3–5	0–2

Table 4 • Summary of how well the simulated data fit survey data. Model 2 differs from model 1 in that level 5 (contacting) was switched off; and in model 3, level 2 (voting) was also switched off. Values in green denote values within the range suggested by the surveys quoted in the literature, those in yellow just outside the range, and those in red, values that do not fit the survey data at all. All numbers are given as percentages. (*) none of the models resulted in any individuals only involved to level 7. Level 10 is excluded from the table due to lack of data in the literature.

When testing the grouped simulation output against the data cited in Milbrath (1965), model 1 is the only one that fits the data—with the notable exception of grossly overestimating gladiators (see table 5).

	Apathetics	Spectators	Transitionals	Gladiators
Model 1	16.4	53.4	7.4	22.8
Model 2	8.4	12.3	20.9	58.4
Model 3	13.8	21.0	22.7	42.5
Milbrath (1965)	10–33	15–70	5–13	1–7

Table 5 • Summary of how well the simulated data fit survey data cited by Milbrath (1965). Values in green denote values within the range, those in yellow just outside the range, and those in red values that do not fit the survey data at all. All numbers are given as percentages, models as in table 4.

A comparison with the *Political Participation in Britain* study (Moyser & Parry, 1989) is less encouraging: only for level 2 there is a match for model 1. For all the other levels the simulation overestimates political participation, at times massively. Overall, the fit of the simulated data is probably saved by the lack of clarity of what the different levels of participation constitute, as well as the wide ranges of possible values cited.

H_0I	Different environments have no effect	reject
a	More stimuli make no difference	reject
b	More stimuli do not lead to deeper involvement	reject
c	Increasing income makes no difference	not reject
d	Time in community is insignificant	not reject
e	Regulation is insignificant	reject
H_0II	SES/education are insignificant factors	reject
c	More SES does not mean more donations	not reject
H_0III	The number of contacts is insignificant	reject
b	The history of participation does not differ for those with many contacts	not reject
H_0IV	Participation is not dynamic	reject
a	People who vote always vote	reject

Table 6 • Summary of the null hypotheses tested. Not all of the hypotheses could be rejected.

Other Findings

For lack of better information, the results of the simulation are based on the assumption that the different characteristics are normally distributed (⩚) in the population, that is the majority is set to the average, and only a few to extreme values. The effect of this assumption as opposed to a uniform distribution (—) of characteristics, however, is statistically significant ($p<0.001$): a linear distribution leads to more participation at higher levels (see figure 13).

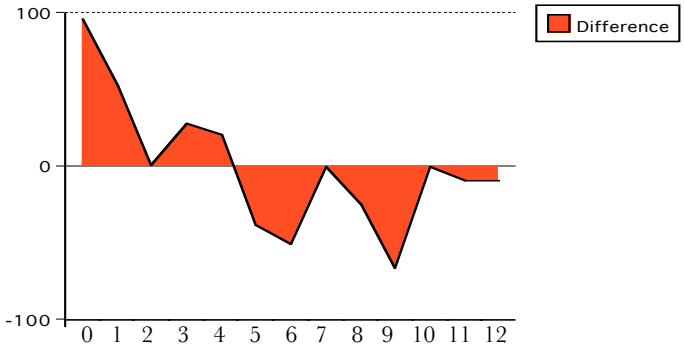

Figure 13 • By comparison to a normal distribution, a uniform distribution of characteristics overrepresents participation at higher levels. The preset *Normal* was run with elections every 2 years for 250 cycles. Neither of the outputs had any individuals only involved to level 7 and 10, thus no difference there.

The simulation can test different political cultures in that the number of people feeling a duty to participate can be varied. The results differ significantly ($p<0.05$), with the level of apathetics (level 0) and voters (2) being affected most. However, significant differences at higher levels can also be found (see figure 14). Although this finding supports the existence of political cultures, the simulated data do not fit well that from surveys. With higher levels of felt duty, the overestimation of participation at higher level grows.

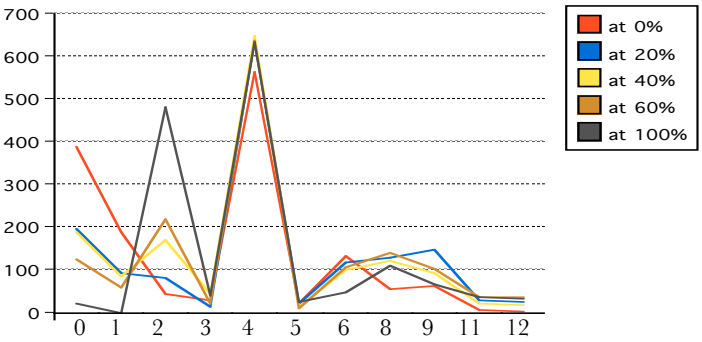

Figure 14 • Varying the variable for duty not only affects participation at the lower levels. Levels 7 and 10 are not included, since they were 0 for all the setups.

By changing the parameters for interaction and how often people move, the simulation can follow the literature that suggests that falling levels of social capital lead to lower voter turnout (Teixeira, 1987). Increasing the likelihood that people move after each cycle, however, shows no significant difference ($p>0.05$). On the other hand, when decreasing the levels of interpersonal interaction after each cycle, the results are very different ($p<0.001$), with the exception of level 5 (contacting). Figure 15 shows that the decline in interaction leads to lower levels of political participation.

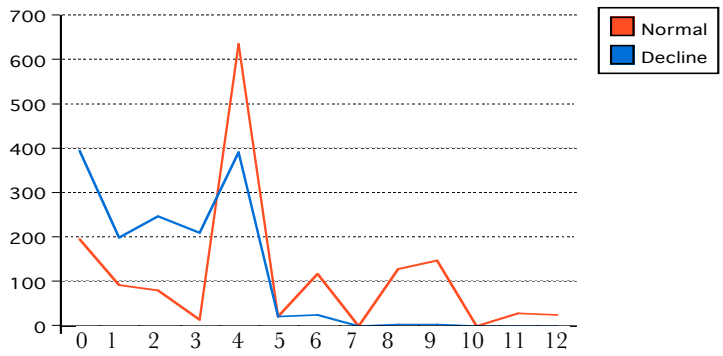

Figure 15 • Reducing interaction between individuals leads to lower levels of political participation. The results are significant ($p<0.001$), except for level 5 (contacting). The preset *Normal* was run with elections every two years for 250 cycles.

Using different presets, different scenarios were tried out and the responsiveness of the simulation was observed. Figure 12 (on page 25), for instance, demonstrates the responsive nature of the simulation: elections are marked by a sharp increase of identification (grey), but the effects of an election decrease over time. Figure 16 shows a similar setup, but with a close election towards the end—with the result that the effects of the election are more pronounced.

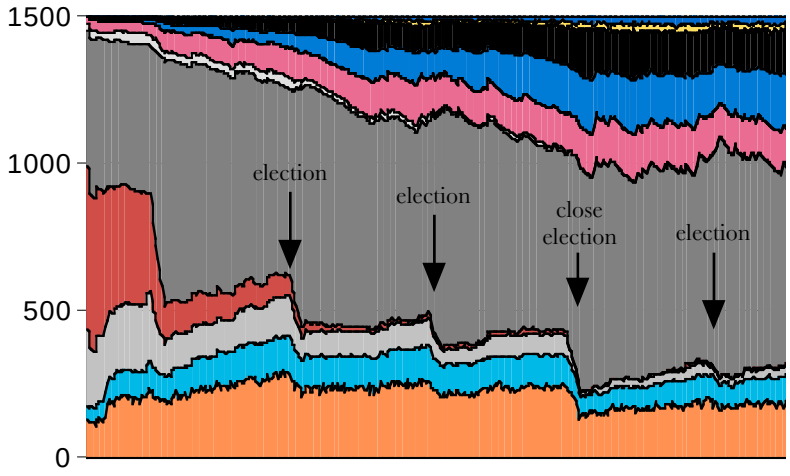

Figure 16 • A close election makes the effects of an election more pronounced. Compare this graph with figure 12 on page 25.

Figure 17 represents the results of having a repressive regime for a period of 2 years. The regime has the result that people are less involved, but also that they choose less visible forms of participation. The simulation does not respond when the repressive regime is removed quietly, with the result that people remain uninvolved. The situation is different when the regime is ended by an assassination: the event sends stimuli and makes people interact intensively. As a result, the state of affairs before the repressive regime is quickly reinstated.

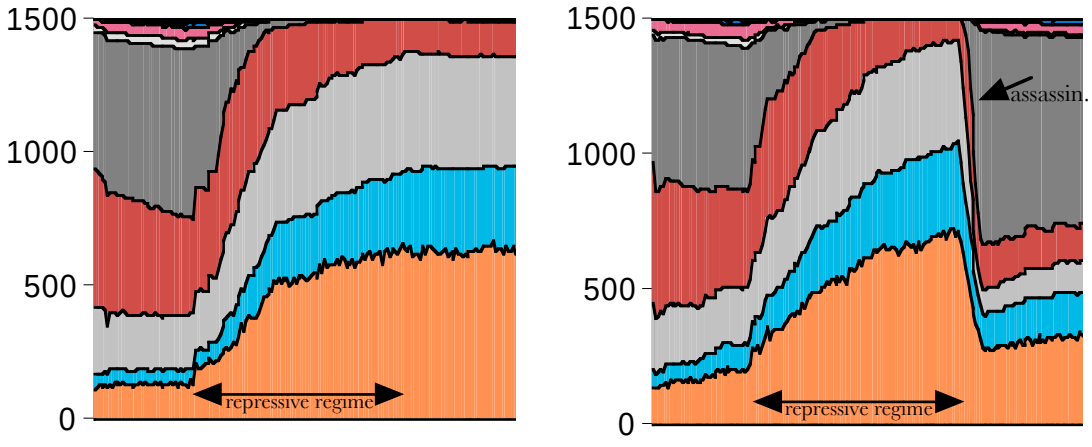

Figure 17 • The results of having a repressive regime for a period of two years. Without further changes, the simulation does not return to the state before: people remain less involved after an election removes the repressive regime (left). An assassination, on the other hand, provides the stimuli for people to get involved into politics again (right). For a key to the colours see figure 12 on page 25.

An analysis of individual histories of political involvement reveals that in the simulation participation in politics usually builds gradually. Large jumps up or down are almost unseen, and many remain on a certain level for a long time. Apathetics are from time to time exposed to political stimuli, but they normally quickly fall back into the former state.

Findings Using a Data Set

Using the data set by Moyser and Parry (1989), a principal component analysis was used to test whether some evidence of different modes of political participation can be identified. The factor analysis indeed suggested four principal components, but in contrast to studies by Verba *et al.* (1971), it was less clear to what these different components stand for. Table 7 represents the different factors.

	1	2	3	4
Contacting	.962	.011	-.231	.147
Clerical work for club	.929	.311	-.200	-.087
Ask others to sign petitions	.962	.012	-.231	.147
Take part in a boycott	.962	.012	-.231	.147
Join a protest march	.962	.012	-.231	.147
Strike	.962	.012	-.231	.147
Attend protest meeting	.441	.833	-.043	-.330
Support work in organization	.590	-.489	.625	-.148
Held office in organization	.770	-.418	.475	-.087
Canvassing	-.316	.929	.123	-.146
Attend rally	.343	.937	-.035	-.044
Fund raising for party	-.316	.929	.123	-.146
Vote	.373	.457	.723	.360
Feels duty (general)	.373	.457	.723	.360
Feels duty (local)	-.481	.363	.779	.174
Influence somebody's vote	.504	.065	.732	-.454
Clerical work for party	-.393	.097	.031	.914

Table 7 • Results of a principal component analysis on different forms of political participation. Based on Moyser and Parry (1989), n=1578. Strong correlations are highlighted.

This section represented the findings of the simulation of political participation used in this paper. Most null hypotheses could be rejected, indicating that the model provides a somewhat valid representation of the processes described in the literature. In terms of substantive numbers, however, the simulation overestimates participation at higher levels. The implications of the findings in this section are discussed in the next section.

Discussion of Findings

A computer simulation provides by definition highly reliable results (Gilbert & Troitzsch, 1999, 2005), but it is the validity of the simulation outputs that is discussed further in this section. The suggestion that political participation should be understood in terms of different modes is addressed, and the overall viability of Milbrath's (1965) framework discussed. This involves linking the findings of the simulation back to the literature on political participation. First, however, the null hypotheses are examined in more detail.

The Hypotheses

The results of H_0I are a promising start for the framework: international comparisons of political participation have indeed suggested that the different political environments are the key to different levels of participation in different places (Almond & Verba, 1989; Verba *et al.*, 1987).

The hypotheses H_0Ia and H_0Ib start examining the causes for such differences by looking at the role of stimuli. Testing H_0Ia, it was successfully rejected that stimuli are without impact, and thus the framework that relies on external stimuli (Milbrath, 1965; Milbrath & Gœl, 1977; see also figure 6 on page 18) is supported. However, when looking at the character of change in H_0Ib, there is no support for the alternative hypothesis H_aIb that more stimuli will lead to deeper levels of involvement (ibid.). A careful look at the source code of the simulation will reveal that this finding is indeed inherent in the simulation and by no means an accident of the preset chosen: although not acknowledged as such by Milbrath (1965), interaction between individuals is implicitly described as a positive feedback, driving those already involved more deeply so. Political stimuli, as described by Milbrath (ibid.), to a large extent work as a way to counter the effects of interaction, so by turning them off, the effects of interaction are enhanced. Figure 18 presents the effects of stimuli with interaction turned off, too. Stimuli on their own can have a different impact, depending on what kind they are. In this sense, there is support

for H_aIb, with the crucial qualification that the kind of stimuli needs to be considered. Such a recognition reflects findings on media effects by Cohen and Young (1973). Milbrath's framework has the advantage of somewhat catering for the fact that people are selective in what kind of messages they receive, an effect often left out in other studies (Huckfeldt *et al.*, 2004; Iyengar & Reeves, 1997).

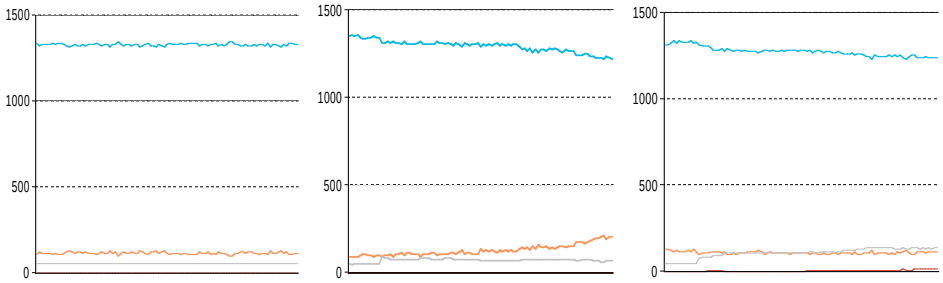

Figure 18 • When interaction is turned off, stimuli can have different effects on participation, depending on the political environment. These graphs present the case of no interaction and no stimuli (left), the preset *Normal* (centre), and the preset *Election* (right), each run for 100 cycles. The latter two presets lead to a slight increase at higher levels: gladiators (red), and transitionals (orange); spectators are represented in blue. The predicted level of apathetics (grey) in the case of elections is puzzling.

The results for H_0Ic are surprising in that Verba *et al.* (1971) provided convincing evidence for the effect of emerging economies. The simulation provides support in the form of the results of H_0II, but it is surprising that increasing socioeconomic status—as a form to emulate increasing wealth and education—remains insignificant. It might be that the effects of increased socioeconomic status need longer to become apparent. A longer run in the simulation, however, was not carried out, as there is evidence that the framework of developed democracies is not applicable in other cases, where the same acts of participation may have different meanings (Rahema, 1992; Uhlaner, 2004; Parry, 1972; Schulz & Adams, 1981, Friedgut, 1979; Shi, 1997; Bienen & Morell, 1975; Isin & Wood, 1999). This highlights the fact that the role of the different characteristics is indeed currently poorly understood. Milbrath (1965) acknowledges the difficulty of measuring personality, but the lack of clarity transgresses problems of measurement. Whereas for many levels of involvement certain characteristics have been identified as increasing the propensity of participation, work on the negative aspects so far appears to have been

neglected—it is not unreasonable to assume that certain characteristics hinder certain forms political action. A further explanation may lie in the criticism of Milbrath's framework that it overemphasizes the role of characteristics (Stone & Schaffner, 1988; Smith, 1968). Since the simulation is modelled on Milbrath's framework, it picks up such an overemphasis, and with this the possibility of underestimating the effect of more significant variables.

The results of H_0Id contradict the established literature (Milbrath, 1965; Milbrath & Gœl, 1977; Crouch, 1977; Lane 1957, 1962) in that no significant differences can be found in the simulation between individuals that stay in a community long enough to settle down and establish roots. This is particularly problematic since psychological analyses of political participation (Stone & Schaffner, 1988; Davidson, 1994; Peterson, 1990; Warr, 1970) and life-course analyses (Andrew, 1991) also support the alternative hypothesis. In this sense the simulation fails to provide a valid model. It is probable that the preoccupation with individual characteristics in Milbrath's model is the cause for this discrepancy: in the model as formulated by Milbrath (1965, 1977), the quality of interactions is probably neglected in that the focus of how interactions are initiated and how they affect the individuals is largely on characteristics and underestimates the importance of roots in the community.

The results of H_0Ie are more encouraging, but maybe only so because there is a lack of specific data to test the predicted data. H_aIe argues that regulation has a major impact on the results, and indeed by varying the variable on regulation, the output generated differs. More and better data are required to test these results in a more substantial way, such as the suggestion put forward by the simulation in this paper that regulation largely affects spectator activities, but higher levels of participation are largely unaffected. Most data available in this regard focus on voting—a spectator activity (Anderson & Zelle, 1998; Bartels, 1993; Burdick & Brodbeck, 1959; Kleppner, 1982).

The findings in H_0IIa and H_0IIb that socioeconomic status (SES) is a key factor fits well with the literature on political participation (Milbrath & Gœl, 1977; Lane, 1957, 1959; Crotty, 1991; Wolfinger & Rosenstone, 1980). The understanding that SES is of great importance has been upheld as studies of political participation evolved (Uhlaner, 2004). The findings here, however, are somewhat marred by the results when testing H_0Ic which failed to respond to increased SES. This may be understood in terms of overemphasis on characteristics and thus negligence of the key drivers in political participation. This may mean that the framework as such is good, but the parameters as suggested in the accompanying literature (Milbrath, 1965; Milbrath & Gœl, 1977) are wrong in substantive terms.

The findings in H_0IIc that people of higher socioeconomic status are not more likely to donate money is not only counterintuitive, but also contradicts established literature and surveys (Verba *et al.*, 1995; Lane, 1959). Interestingly, however, the increase in SES to emulate a developing economy, whilst failing to replicate the expected result of higher participation, did lead to increased participation at level 6 (donating money, see figure 11 on page 25). This would suggest that an overall growth of SES in all spheres of the population increases donations, but that it is not only the richer ones that give more.

The focus on contacts in H_0IIIa leads to an important qualification of the findings in H_0Id: contacts are important when it comes to political participation, time spent in the community is not. In this sense, the simulation can still support the stipulated importance of roots (Berelson, 1954; Lane, 1959; Hemmings *et al.*, 2002; Verba *et al.*, 1995), but suggests that individual characteristics—leading to more contacts—rather than time as such are the most important factor. This might highlight a misconception of what constitutes *roots* in the literature.

Although it is not articulated this way, H_0IIIb looks at *opinion leaders*, those with more contacts (Lane, 1959; Valente, 1996; Scott, 2000). It is thought that opinion leaders are less swayed and thus can be identified by a more stable history of political participation.

The analysis found that this is not the case, which may simply indicate that there is more to a leader than the number of contacts. Such an understanding is important in terms of the increased application of network analysis in political participation (Uhlaner, 2004).

The last hypothesis—H_0IV—may be a strong indication that computer simulation in general is a useful approach to understanding political participation: involvement is of dynamic nature. In particular, the simulation does well replicating the fact that people rarely completely abstain from voting (Crouch, 1977), and even those involved to a deeper level may miss a vote from time to time (ibid.). However, the reason of why this is, is not included in the simulation in this paper, so nothing can be said in terms of the interplay between of the kind of issue and participation, something often suggested as the reason.

Overall, an analysis of the results of the null hypotheses indicates that whilst the simulation may be correct in the direction of its results, and thus the framework viable, it is the substantive terms that are the major shortcoming. Because of the lack of agreement between predicted data and descriptions in the literature, it is impossible to state whether the framework is useful.

Data Output

The simulated data are important indicators of the validity of the simulation (Gilbert & Troitzsch, 1999, 2005). In substantive terms, by and large, the results from testing the null hypothesis provide a bleak picture. The specific comparison of simulated output against a number of survey data does not offer a more encouraging verdict: in substantive terms, the simulation fails. This is particularly discouraging, since the general range of acceptable values was increased by the fact that different sources were used. The match of simulated data is worst when the data used for comparison are restricted to the time of when the framework was formulated: the 1950s and 1960s.

Although the simulation fails in terms of validity, it may be that the model merely underestimates the cost of participation at higher levels. Maybe it is necessary to take the term *gladiator* more literal (Oliver, 1984). It would not be difficult to tweak the simulation

so that the predicted values for higher levels of participation are lower, but this would compromise the method (Gilbert & Troitzsch, 1999; Epstein & Axtell, 1996). A tweaked version compromises the modelling process (step I in figure 4 on page 17) and removes the advantage of simulation of not relying on a black box principle (ibid.). A simulation tweaked to match the output removes the link to what is known about the micro-processes involved; and indeed often it is possible to produce a whole range of models that match certain data. The understanding of how this may work in reality, is lost in such approaches. Instead, better data on the processes involved need to be collected, leading both to a better understanding of political participation, as well as an improved computer model.

Other Findings

In addition to the null hypotheses, a number of other issues were addressed by the simulation of political participation. The testing of the effect of different distributions of characteristics highlighted the importance of certain assumptions in a computer model. Not knowing whether the distribution of character traits is normal or in fact uniform, it is discouraging to learn that the latter leads to a further overrepresentation of higher levels of participation—another step away from valid results. Unfortunately the measuring of characteristics as such is difficult (Milbrath, 1965; Milbrath & Gœl, 1977; Warr, 1970; Froman, 1961; Kuroda, 1965).

The testing of different levels of duty led to the possibly surprising result that a felt duty to participate has implications on other levels than voting (see figure 14 on page 29), even though the variable has no direct impact. The variable only directly affects level 2 (voting) and levels 11 and 12 (seeking and holding office). In this sense the simulation may provide a clue about how different political cultures come to exist in different countries. In terms of the normative questions of increasing participation (Smith, 2004), this finding may not only cater for different electoral turnouts, but also suggest that high levels of participation at higher levels (gladiatorial) as aspired by some writers (von Alemann, 1978; Osbun,

1965) may be hard to achieve, even if levels of civic duty—the lack of which is often blamed (Teixeira, 1987; Nagel, 1987; Opp, 2004; Putnam, 2000)—were high.

Testing Teixeira's (1987) argument that demographic changes lead to lower participation, the simulation can emulate the importance of social capital in political participation. Social capital here is understood in terms of involvement in a community—roots. Two suggestions of why social capital declines in a population, moving more often and interacting less often, were tested. Given that interaction as used in the framework was identified as a positive feedback, driving people into participation, it is only a logical step that reducing interaction between people leads to falling rates of participation. Indeed, psychoemotional studies of participation (Braud, 1988), as well as life-course analyses suggest that personal interaction is a key factor in mobilizing people into political action (see also Nedelmann, 1987). Whether this effect shall be called a decline in social capital is another question (Durlauf, 2002), as is the question whether such a decline occurs in reality (Rotolo & Wilson, 2004), or is indeed a case of *golden glow*.

A number of scenarios were tried out in order to test the overall responsiveness of the model. In most cases, the simulation responded well to changes in the political environment, replicating the direction of changes as described in qualitative accounts. Although there are no direct tests of validity here, for the lack of data to compare the simulated output to, the results of other runs suggest that the substantive dimensions of the output should not be considered accurate. In some cases, the simulation fails to provide results that are in agreement with other studies even in terms of direction. For instance, the simulated data looking at the scenario where a repressive regime is replaced with one less so by means of an election removing the regime, suggests that this change has no effect (see figure 17 on page 31). This stands in stark contrast with Bienen and Morell's (1975) analyses of such changes. It is questionable, however, whether a change from a repressive regime to a less repressive variant comes with no stimuli other than those directly linked to the election to bring about the change. The fact that the simulation responded well in

most cases constitutes a strength of the framework: it can provide a reasonable account for the forms of political participation included. However, alternative approaches may be equally if not better suited to explain some of the changes: For instance, it has been suggested that a close vote changes the ratio of costs and benefits in an election (Braud, 1988; Milbrath & Gœl, 1977) and thus increase participation—an explanation that does not rely on stimuli and interaction at all.

The simulation may provide plausible results in terms of direction, but the lack of substantive accuracy, and the fact that alternative approaches may be equally if not better suited to explain the outcomes, point out some of the weaknesses of the simulation model.

Different Modes

It is now commonly thought that political participation should be understood in terms of different styles or modes (Milbrath & Gœl, 1977; Verba *et al.*, 1971, 1995; Uhlaner, 2004; Peterson, 1990). By leaving out the level of particularized contacting, something generally recognized as a separate mode, it was attempted to cater for different modes by making the simulation a model of one such mode only. The results of this were discouraging, as the resulting changes were large and significant ($p<0.05$), even though a model that incorporates contacting estimates very low levels of participation at this level only. Whilst these results may speak against the model, they do in fact provide evidence for multidimensionality (see figure 19).

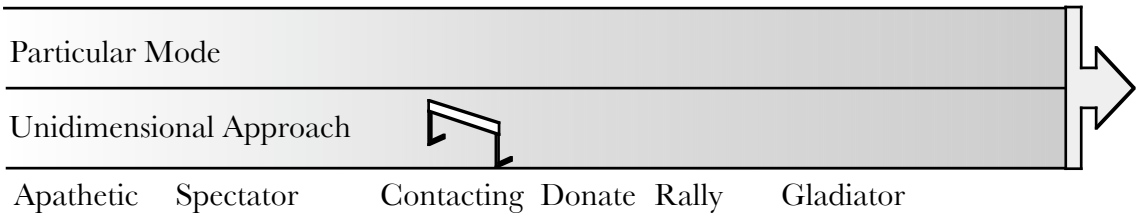

Figure 19 • The results of removing level 5 (contacting) from the simulation may be understood as evidence for multidimensionality. In the unidimensional approach the level of contacting is a hurdle too high for many individuals, and thus they remain on a lower level, even if their characteristics mean that they would participate at a higher level in this particular mode. Is the level removed, and more participation at levels higher than contacting is observed, this can be taken as evidence that the level acted as a hurdle in this particular mode before. Transitional activities are given separately in this figure.

In the original model, level 5 (contacting) acted as a hurdle too high for many individuals. Once the level was removed, more participation at higher levels was observed. This

indicates that level 5 was a hurdle in this particular mode, preventing people from participating at a higher level, in spite of their characteristics. At the same time, this further questions the substantive dimension of the simulation output, as participation at higher levels is further overestimated with level 5 disabled.

Evidence for different modes also comes from a factor analysis on more recent data from the *Political Participation in Britain* survey (Moyser & Parry, 1989). The results, however, suggest that the different modes of political participation, even though they clearly exist, are not that straightforward.

It might well be that such findings helped shift the focus in political participation towards resources. The civic voluntarism model (CVM) by Verba *et al.* (1995) is just one of the recent developments that focus on external resources—most notably socioeconomic status and civic skills—and recruitment. With *civic skills*, the civic voluntarism model still contains an individual component akin the characteristics suggested by Milbrath (1965). At first sight the CVM may strike as very different from Milbrath's framework, but more similarities can be recognized: there are individual variables that act as structures (SES, skills), and personal interaction is important (although only during mobilization in the CVM). What sets the CVM apart from Milbrath's approach is that it probably balances the different structures correctly. In this sense, a framework based so heavily on characteristics as the one used in this paper, is probably doomed to fail.

The civic voluntarism model may still be criticized for its overemphasis of constraints: the focus is on structures, not individual agency. Such agency is provided by rational choice models of political participation, although many such approaches go to the other extreme and neglect constraints on individual acts. The fact that in the simulation some levels—in particular level 7 (rally) and level 10 (soliciting funds)—usually drew zero or close to zero participants, suggests that individual choice may be neglected too much in the model used. In order to understand political participation, it is not only important to get the balance right between different forms of structural constraints—be they macro as

in the law regulating the election, or micro in the sense of civic skills—, but also the balance between said structures and agency. Striking such a balance does not mean dropping the work by previous researchers and purely focusing on rational choice, as done in much contemporary work on political participation (Uhlaner, 2004). This is the case, particularly, because whilst rational choice models offer deductive elegance, they struggle with empirical weaknesses. Rational choice models fail to predict the high levels of political participation—voting in particular is riddled with the free-rider problem. Post hoc explanations using perceived benefits are commonplace, even though Verba *et al.* (1993) suggest that elements like felt duty ("doing my share") are probably the key elements. Furthermore, rational choice models do not differentiate between different extents to which people are involved, despite evidence to the contrary (Scaff, 1975; Fay, 1975; Green & Shapiro, 1994; Laver, 1997; Wallas, 1981).

Summary

The model used in this paper may not excel in terms of elegance, but the inclusion of feedback loops and dynamism make it realistic. There is a focus on context and structures in a limiting sense, something supported by studies on media effects:

> "[T]he media may not only tell us what to think about, they also may tell us how and what to think about, and even what to do about it" (McCombs & Estrada, cited in Iyengar & Reeves, 1997, p.247).

It is for reasons like this that stimuli should not be left out in studies of political participation. The simulation, however, does not cater for the fact that different issues—that is specific cases—are important in terms of mobilizing people. The simulation used in this paper remains too general, and also ignores the different modes of participation that are open to individuals. Furthermore, cross-pressures and network structures are left out, although they probably influence political participation a great deal (Berelson *et al.*, 1954).

Micro-level understandings of participation are important in order to understand *why* people participate in politics, not only *how*. Better and more data in this form undoubtedly could increase the explanatory power of models of political participation in general, and

this computer simulation in particular. Personality as such, however, is probably overstated by Milbrath's framework (Stone & Schaffner, 1988), something redressed in civic voluntarism models.

Although the model used here completely neglects individual choice, it is important not to reject structures on action completely, be they at a micro or a macro level. Despite great shortcomings in substantive terms, the simulation used in this paper was able to make some progress in understanding political participation in terms of the right direction. The fact that it ignores different modes of political action, and the overemphasis of characteristics over factors such as socioeconomic status, however, probably mean that an improvement of the model using better qualitative data is futile.

Conclusion

This paper has used a computer simulation of Milbrath's (1965) framework of political participation, in order to test its viability to understand and explain political participation. The results of the simulation are encouraging in that their direction commonly matches descriptions in the established literature. However, in substantive terms, the simulation fails: the output of the simulation fails to match survey data, despite generous ranges of possible values. This makes the simulation unsuitable, even to illuminate one mode of political participation.

This paper has provided further evidence that political participation should be understood in terms of different modes, and not as a single hierarchy as did Milbrath in 1965. For this reason, and the complete negligence of individual choice, it appears to be futile to improve the simulation with better qualitative data. The recent focus on agency through rational choice models, as well as external structures through the resources in civic voluntarism models, are both good developments. The latter redresses the over-emphasis of characteristics, but whilst it is important not to neglect agency, it is equally important not to overemphasize the structures.

(9739 words)

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Technical Appendices

Appendix 1: The Different Characteristics and Variables

Variable	Opposite	Description
overt	covert	acts in public; more rewards 'open' people
episodic	continuous	act at specific events; act for short times; conscious decision; lower costs
autonomous	compliant	not just in response to a request; is not shy of cost
approaching	avoiding	positive valence; contributes even if not asked
expressive	instrumental	showing allegiance; not about party action
social	nonsocial	involved when interaction is required; extrovert action
inputting	outtaking	accepts costs; not focused on services/benefits in return; regard benefits a externality of costs
active	passive	acts on her/his own
time		time spent in community
contacts		number of contacts made
SES		socioeconomic status
eligible		whether allowed to vote or not (legal)
duty		feels duty to participate; will at least vote if allowed

The following characteristics are not included in the simulation: education on its own, sex, and age. All these characteristics may be significant contributors to political participation, but they are not treated in detail enough in the literature or come with contradicting indications.

Appendix 2: The Characteristics Needed at Different Levels

The following is a table of the different characteristics and their role at the different levels. The different characteristics are described in appendix 1. High values on a variable with a tick have a positive impact, high values on a variable with a cross have a negative impact. Those in light grey have a smaller impact than those in dark grey. The

characteristics needed at each level change are understood in a cumulative manner, and once a certain threshold is reached, the individual is assumed to have reached at least that level of political participation.

	Active	Overt	Auton	Approaching	Contin	Taking	Express	Social	Eligible	Time/ Contact	SES	Duty
0–1									✔			
1–2	✔			✔								✔
2–3	✔	✔		✔				✔		✔		
3–4		✔		✔			✔					
4–5			✔	✔	✘	✔						
5–6	✔			✔		✘	✔	✘		✔		
6–7		✔						✔		✔		✔
7–8	✔	✔		✔		✘	✔	✔		✔		
8–9			✔		✔		✔			✔	✔	
9–10					✔					✔	✔	✔
10–11	✔	✔	✔	✔	✔	✘		✔		✔	✔	
11–12	✔	✔	✔	✔	✔	✘		✔		✔	✔	

Appendix 3: NetLogo Code

The following code is the *NetLogo* code of the simulation used for this paper. Everything after a semicolon (;) is a comment and not interpreted code. All comments were initially inserted for the author, but should help understand the code.

```
globals [     ; declaring global variables
    ; presets ; choose presets of manual input using sliders for p,q,r (probabiliti
    ; normal  ; use of normal distribution for characteristics, set using switch [
              ; false ]
    ; rp      ; probability of stimuli, set using a slider [ 1 .. 1000 ]
    rrp       ; variable as actually used, so that can easily have presets
    ; rq      ; probability of interaction, set using a slider [ 1 .. 1000 ]
    rrq       ; variable as actually used, so that can easily have presets
    ; rr      ; probability of moving, set using a slider [ 1 .. 1000 ]
    rrr       ; variable as actually used, so that can easily have presets
    agentnum  ; number of agents to create, currently set at the beginning of setup
    ; sneed   ; slider value for needed if set manually (i.e. not preset) [ 0 .. 10
    needed    ; time needed in community until an agent can become eligible
    selig     ; percentage of population not eligible to participate (initial)
    ;sduty    ; percentage of population feeling a duty to vote (initial): set usin
!!!!!!!!!!!   ; slider
    time      ; time: number of rounds (** assumed to be 1 week)
    ; a1 a2 a3 a4 a5 a6 ; characteristics affected by stimuli, these variables are
!  !; necessary as such, since
    ; setting the bn to 0.5 has the same effect on average; however, the switches c
!!!!; a quick and easy way
    ; to turn on/off stimuli, hence this way  [ true false ]
    ; b1 b2 b3 b4 b5 b6; stimuli work up or down, with 0.5 = no effect on average?
!!!!; 0.0 .. 1.0 ]
    ]
```

```
breeds [ agents ]  ; don't want to refer to turtles all the time

agents-own [  ; declaring variables unique to agents
    history   ; list of levels (personal history of political participation)
    rnorm     ; random variable needed for setup, could have used a local variable
    level     ; level of participation [ 0 .. 12 ]
    active    ; agent is active (≠ passive)  [ 1 .. 5 ]
    overt     ; agent is overt (≠ covert)  [ 1 .. 5 ]
    auton     ; agent is autonomous (≠ compliant)  [ 1 .. 5 ]
    approach  ; agent is approaching (≠ avoiding)  [ 1 .. 5 ]
    contin    ; agent is continuous (≠ episodic)  [ 1 .. 5 ]
    taking    ; agent is outtaking (≠ inputting)  [ 1 .. 5 ]
    express   ; agent is expressive (≠ instrumental)  [ 1 .. 5 ]
    social    ; agent is social (≠ nonsocial)  [ 1 .. 5 ]
    eligible  ; agent is eligible to participate [ 0 1 ]
    duty      ; agent feels duty to participate [ 0 1 ]
    SES       ; socioeconomic status  [ 1 .. 3 ]
    contacts  ; number of people known in the community
    spent ]   ; time spent in the community

to setup ; setting up the simulation
    ; ***INITIALIZING SIMULATION***
    ca                     ; clear everything to start
    set agentnum 1500      ; number of agents to create: size of community (**)
    set selig 3            ; 3% not eligible to start with
    set-histogram-num-bars 12   ; setup histogram of levels
    action                 ; initial setting of political environment, can be changec
                           ; using the *Action* button during the simulation to study
                           ; effects of shocks etc.

    ; ***CREATING THE AGENTS***
    create-agents agentnum          ; create agents, number set a few lines above
    ask agents [setxy (random screen-size-x) (random screen-size-y)] ; eye candy:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; spread out

    ; ***INITIAL DISTRIBUTIONS*** : characteristics and levels of the agents, set u
!!!!; a slider
    ask agents [ set level 0        ; all apathetics, will change immediately due t
!        !                          ; characteristics
                 set spent 0        ; start as newcomers in community
                 set contacts 0     ; with no contacts so far
                 set history [ ] ]  ; no history of involvement levels
    colorize!!!! ; eye candy: set colour of agents according to level of involvemer

    ; ***SETTING CHARACTERISTICS*** : a choice, set using switch
    ifelse normal = true [ ; set characteristics following a (**) normal distributi
        ask agents [
            randomize    ; get random values according to normal distribution
            set active   rnorm ; [ 1 .. 5 ]
            randomize
            set overt    rnorm
            randomize
            set auton    rnorm
            randomize
            set approach rnorm
            randomize
            set contin   rnorm
            randomize
            set taking   rnorm
            randomize
            set express  rnorm
            randomize
            set social   rnorm  ] ]
```

```
        [ ; set characteristics (**) randomly, with each level equally likely
          ask agents  [
              set active   random 5 + 1 ; [ 1 2 3 4 5 ]
              set overt    random 5 + 1
              set auton    random 5 + 1
              set approach random 5 + 1
              set contin   random 5 + 1
              set taking   random 5 + 1
              set express  random 5 + 1
              set social   random 5 + 1
        ] ]
    ask agents [ ; this part is the same whether randomly or normally distributed
        set eligible 0
        if random 100 > selig [ set eligible 1 ] ; selig % are not eligible (3% set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; above)
        if random 100 < sduty [ set duty     1 ] ; sduty % feel a duty to participa
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; (set using slider)
        set SES random 3 + 1 ] ; [ 1 .. 3 ], all levels equally likely

    set time 1 ; start at the beginning; (**) assumed time frame: 1 round in simula
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; as 1 week
end

to go ; the basic procedure that is repeated
    ; The stimuli are sent to all agents, the interaction/moving only affects a few
    ; agents a time. Using the probabilities, each of these procedures can still be
    ; more or less turned off, by setting the probability to an extremely high
    ; value (see presets for examples).
    if random rrp = 0 [ ask agents [ stimuli ] ]    ; sometimes all agents receive
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; stimuli
    ask agents [                          ; repeat for all agents (always)
        if random rrq = 0 [ interaction ] ; some interact with other agents
        if random rrr = 0 [ moving ]      ; some move
        updating ]                        ; update the levels of involvement
    colorize                              ; set colours of all agents according to
level
    plotting                              ; plot the results after each round
    set time time + 1                     ; time passes
end

to stimuli     ; stimuli are sent to all agents
    locals [ magnitude ] ; declaration of a local variable: the extent to which an
!!!!!!!!!!!!!!!!!!!!!!!!!; agent is affected by
 !!!!!!!!!!!!!!!!!!!    ; the stimuli, includes a stochastic element
    if level > 0 [ ; apathetics not affected since not exposed to stimuli
        ; (1) check if particular characteristic is affected (see presets)
        ; (2) calculate magnitude (**) of impact depending on characteristics and
! !     ; political environment
        ; (3) change.
        if a6 = true [ set magnitude 3 * ( b6 - (random 2)) / ( auton + contin )
                                set approach approach + magnitude ]
        if a5 = true [ set magnitude 3 * ( b5 - (random 2)) / ( auton + contin )
                                set active active + magnitude ]
        if a4 = true [ set magnitude 3 * ( b4 - (random 2)) / ( auton + contin )
                                set overt overt + magnitude ]
        if a3 = true [ set magnitude 3 * ( b3 - (random 2)) / ( auton + contin )
                                set contin contin + magnitude ]
        if a2 = true [ set magnitude 3 * ( b2 - (random 2)) / ( auton + contin )
                                set express express + magnitude ]
        if a1 = true [ set magnitude 3 * ( b1 - (random 2)) / ( auton + contin )
                                set taking taking + magnitude ]
    ]
end
```

```
to interaction        ; some agents interact
    locals [ partner  ; local variable for the interaction partner
    magnitude         ; impact of interaction depending on characteristics
    magnitudeP ]      ; impact of interaction on partner depending on characteristi
    ; (1) determine who interacts
    if ( social + (level / 3 + 1 ) + active + random 2.5 ) > 10 and level >= 3 [
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; initiate
        set partner random-one-of agents         !!!!!!!!!!!!; partner  = anyone
        if social-of partner + active-of partner + approach-of partner + random 2.5
!!!!!!!10 and level-of partner > 0 [
                ; accept invitation to interact:
                ; (2) set magnitude of impact for ego (agent)
                set magnitude (random 2 ) / ( auton + contin )
                if random 50 * ( 4 - SES ) = 0 [ set magnitude magnitude / 10 ]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; cynical: less impact (**)
                if (2.5 * contacts ) / spent > 3 [ set magnitude magnitude / 2 ]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; opinion leader: less impact
                ; (2) set magnitude for alter (partner)
                set magnitudeP (random 2) / ( auton-of partner + contin-of partner
                if random 50 * ( 4 - SES-of partner ) = 0 [set magnitudeP magnitude
!!!!!!!!!!!!!!!!10
!!!!!!!!!!!!!!!!]
                if (2.5 * contacts-of partner ) / spent > 3 [ set magnitudeP magnit
!!!!!!!!!!!!!!!!!!/ !2 ] ; opinion leader
                ; (3) change
                ; approaching variable affected:
                ifelse approach > approach-of partner [set approach-of partner
!!!!!!!!!!!!!!!!approach-of partner + magnitudeP ]
                                            [set approach approach + magnitude ]
                ; active + overt variables affected; contin + express conditionally
                if level > level-of partner [ set active active + magnitude
                                              set overt overt + magnitude
                                              if contin > contin-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!contin-of partner contin-of partne
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!magnitudeP ]
                                              if contin < contin-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!contin-of partner contin-of partne
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!magnitudeP ]
                                              if express > express-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!express-of partner express-of part
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!+!magnitudeP ]
                                              if express < express-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!express-of partner express-of part
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!- magnitudeP ]
                                              ]
                if level < level-of partner [ set active-of partner active-of partn
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!magnitudeP
                                              set overt-of partner overt-of partner
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!magnitudeP
                                              if contin < contin-of partner [set co
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!contin + magnitude ]
                                              if contin > contin-of partner [set co
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!contin - magnitude ]
                                              if express < express-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!express express + magnitude ]
                                              if express > express-of partner [set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!express!express - magnitude ]
                                             ]
                set contacts contacts + 1                        ; add to contacts
                set contacts-of partner contacts-of partner + 1  ; add to partner's
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; contacts
                ]]
end
```

```
to moving            ; some agents move
    set spent 0      ; new place: reset time
    set contacts 0   ; lose contacts
    setxy (random screen-size-x) (random screen-size-y) ; eye candy: move physicall
end

to updating         ; update level of political participation for all agents
    locals [ done ] ; local variable to make sure level only set once agent fails t
reach !!!!!!!!!!!!!!!!!!!!; threshold for next level
    set done false  ; i.e. level not yet determined

    ; check ranges to prevent illegal values for variables
    if active < 1 [ set active 1 ]
    if active > 5 [ set active 5 ]
    if overt < 1 [ set overt 1 ]
    if overt > 5 [ set overt 5 ]
    if auton < 1 [ set auton 1 ]
    if auton > 5 [ set auton 5 ]
    if approach < 1 [ set approach 1 ]
    if approach > 5 [ set approach 5 ]
    if taking < 1 [ set taking 1 ]
    if taking > 5 [ set taking 5 ]
    if express < 1 [ set express 1 ]
    if express > 5 [ set express 5 ]
    if social < 1 [ set social 1 ]
    if social > 5 [ set social 5 ]
    if contin < 1 [ set contin 1 ]
    if contin > 5 [ set contin 5 ]
    if SES < 1 [ set SES 1 ]
    if SES > 3 [ set SES 3 ]
    set spent spent + 1 ; time passes: more time spent in community

    ; the legal bit: eligible to vote?
    ifelse spent >= needed [ set eligible 1 ]   ; spent enough time in community,
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!;!!allowed to participate
    [ set eligible 0 ]
    ; if no such law exists needed is 0 and agents will become eligible immediately
!!!!; after the move.

    ; start at bottom and see if criteria still met (threshold model)
    set level 0
    if eligible = 1 [                    ; not eligible, not involved
        if random 3 = 0 [ set level 1 ]  ; exposed to stimuli, threshold (**)
        ; level 2: voting
        if duty = 1 [ set level 2 ]       ; will always vote if feel a duty to do s
        ; level 2: voting, using characteristics
        ifelse done = false and  active + .5 * approach > 3 [ set level 2 ]
        [ set done true ] ; did not pass threshold, will remain at level currently
!!!!!!!!!!!!!!!!!!!!!!!!!!!; assigned
        ; level 3: discussion
        ifelse done = false and active + overt + approach + social + (2.5 * contact
!!!!!!!!!!/!spent  > 10 [ set level 3 ]
        [ set done true  ]
        ; level 4: button, party identification
        ifelse done = false and overt + .5 * approach + express > 7.5 [ set level 4
        [ set done true  ]
        ; level 5: contact official
        ifelse done = false and  auton + approach - .5 * taking > 6.5 [ set level 5
        [ set done true  ]
        ; level 6: donates money
        ifelse done = false and .5 * active + approach - taking + (2.5 * contacts)
!!!!!!!!!!spent + express - social > 3.5 [ set level 6 ]
        [ set done true  ]
```

```
        ; level 7: attend political rally
        ifelse done = false and .5 * overt + social + (2.5 * contacts ) / spent + c
!!!!!!!!!!> 6.5 [ set level 7 ]
        [ set done true  ]
        ; level 8: time in campaigning
        ifelse done = false and social + active + overt + approach - taking + expre
!!!!!!!!!!12 [ set level 8 ]
        [ set done true  ]
        ; level 9: active member
        ifelse done = false and social + auton + contin + .5 * express + (2.5 *
!!!!!!!!!!contacts) / spent + (5 / 3) * SES > 16.5 [ set level 9 ]
        [ set done true  ]
        ; level 10: solicit funds
        ifelse done = false and contin + (2.5 * contacts) / spent + (5 / 3) * SES +
!!!!!!!!!!duty + random 3 > 10.5 [ set level 10 ]
        [ set done true  ]
        ; level 11: candidate
        ifelse done = false and social + active + overt + auton + 0.5 * approach +
!!!!!!!!!!contin - 0.5 * taking + (2.5 * contacts) / spent + (5 / 3) * SES > 19.5
!!!!!!!!!!set level 11 ]
        [ set done true  ]
        ; level 12: hold office
        if done = false and random 2 = 0 and social + active + overt + auton + appr
!!!!!!!!!!+ contin - taking + (2.5 * contacts) / spent + (5 / 3) * SES > 24 [ set
!!!!!!!!!!level 12 ]
    ]
    set history sentence level history ; record levels of involvement for each ager
end

to plotting    ; plot results after each round
    set-current-plot "Levels" ; this one plots the proportion of all agents in the
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; three main groups and apathetics
        ; this plot gives a rough overview of the changes
        set-current-plot-pen "Gladiators"
            plot count agents with [ level >= 8 ]              ; plot Gladiators
         set-current-plot-pen "Transitionals"
            plot count agents with [ level >= 5 and level < 8 ] ; plot Transitional
         set-current-plot-pen "Spectators"
            plot count agents with [ level < 5 and level > 0 ]  ; plot Spectators
         set-current-plot-pen "Apathetics"
            plot count agents with [ level = 0 ]               ; plot Apathetics
    set-current-plot "Hist" ; plot a histogram showing the distribution of the leve
        ; this plot gives a quick overview of the situation at the moment
        histogram agents [ level ] ; histograms are not kept in the memory
    set-current-plot "Detailed" ; this one plots all the levels (proportions)
        ; this plot keeps the data more accurately, but is messy to look at
        ; apathetics are the remainder (agentnum - (sum of others)); recorded
        ; to export data from this plot
        set-current-plot-pen "L1"
            plot count agents with [ level = 1 ]
        set-current-plot-pen "L2"
            plot count agents with [ level = 2 ]
        set-current-plot-pen "L3"
            plot count agents with [ level = 3 ]
        set-current-plot-pen "L4"
            plot count agents with [ level = 4 ]
        set-current-plot-pen "L5"
            plot count agents with [ level = 5 ]
        set-current-plot-pen "L6"
            plot count agents with [ level = 6 ]
        set-current-plot-pen "L7"
            plot count agents with [ level = 7 ]
```

```
        set-current-plot-pen "L8"
            plot count agents with [ level = 8 ]
        set-current-plot-pen "L9"
            plot count agents with [ level = 9 ]
        set-current-plot-pen "L10"
            plot count agents with [ level = 10 ]
        set-current-plot-pen "L11"
            plot count agents with [ level = 11 ]
        set-current-plot-pen "L12"
            plot count agents with [ level = 12 ]
end

to randomize ; create a random number between 100 and split according to a (**) nor
!!!!!!!!!!!!; distribution
    set rnorm random 100   ; random number [ 0 .. 99 ]
    if rnorm >= 0  and rnorm < 6  [ set rnorm 1 ] ; 6%
    if rnorm >= 6  and rnorm < 31 [ set rnorm 2 ] ; 25%
    if rnorm >= 31 and rnorm < 69 [ set rnorm 3 ] ; 38%
    if rnorm >= 69 and rnorm < 94 [ set rnorm 4 ] ; 25%
    if rnorm >= 94 [ set rnorm 5 ]                ; 6%
end

to colorize ; set colour of agents according to level (eye candy):
    ask agents [ if level = 0 [ set color brown ]                     ; apathetic
                 if member? level [ 1 2 3 4 ] [ set color orange ]    ; spectators
                 if member? level [ 5 6 7 ] [ set color pink ]        ; transitior
                 if member? level [ 8 9 10 11 12 ] [ set color red ] ] ; gladiators
end

to action
    ; This part of the setup is separate so that the environment can be changed whi
    ; the simulation runs (*Action* button from the graphical interface). This allo
!!!!; to study the effect
    ; of things like a close election where different (and more) stimuli are sent.
!!!!; presets are only
    ; implemented for convenience, since everything can be set manually, using slic
!!!!; (preset 'Manual').
    ; Some of these presets logically should only be run for a few weeks, after whi
!!!!; the effects fade in reality (i.e. events)

    ; ***PRESETS***: set different political environments, set using sliders
    if presets = "Manual" [ ; set everything manually, using the sliders on the lef
        set rrp rp       ; stimuli
        set rrq rq       ; interaction
        set rrr rr       ; moving
        set needed sneed ; time needed until eligible
        ]
    if presets = "Normal" [ ; an unexciting world with not much happening
        ; (**) supposedly this is the world where shocks such as elections could be
!!!!!!!!; tried out against
        set a1 true ; taking affected
        set b1 .5   ; up or down (**)
        set a2 true ; express affected
        set b2 .5   ; up or down
        set a3 true ; contin affected
        set b3 .5   ; up or down
        set a4 true ; overt affected
        set b4 .5   ; up or down (**)
        set a5 true ; active affected
        set b5 .4   ; -.1 down (**)
        set a6 true ; approach affected
        set b6 .4   ; -.1 down (**)
        set rrp 8   ; every 8 week (**)
```

```
        set rrq 2   ; every 2 week (**)
        set rrr 260 ; moving every 5 years (**)
        set needed 4 ; time needed until eligible: 1 month (till registration compl
        ]
    if presets = "Repressive State" [ ; regime where dissent is discouraged
        set a1 true ; taking affected
        set b1 .5   ; up or down (**)
        set a2 true ; express affected
        set b2 .3   ; -.2 down (**)
        set a3 true ; contin affected
        set b3 .4   ; -.1 down (**)
        set a4 true ; overt affected
        set b4 .3   ; -.2 down (**)
        set a5 true ; active affected
        set b5 .4   ; -.1 down (**)
        set a6 true ; approach affected
        set b6 .3   ; -.2 down (**)
        set rrp 2   ; every 2 weeks (**)
        set rrq 4   ; every 4 weeks (**)
        ; set rrr 1  ; moving not affected (**)
        set needed 12 ; time needed until eligible (**): 12 weeks (3 months)
        ]
    if presets = "Random World" [ ; for testing and comparison only, everything set
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; randomly
        set a1 true ; taking affected
        set b1 random 1.0   ; [ 0.00 .. 1.00 ]
        set a2 true ; express affected
        set b2 random 1.0   ; [ 0.00 .. 1.00 ]
        set a3 true ; contin affected
        set b3 random 1.0   ; [ 0.00 .. 1.00 ]
        set a4 true ; overt affected
        set b4 random 1.0   ; [ 0.00 .. 1.00 ]
        set a5 true ; active affected
        set b5 random 1.0   ; [ 0.00 .. 1.00 ]
        set a6 true         ; approach affected
        set b6 random 1.0   ; anything within bounds
        set rrp random 4 + 1   ; every [ 1 .. 4 ] weeks
        set rrq random 4 + 1   ; every [ 1 .. 4 ] weeks
        set rrr random 500 + 1 ; every <5 years
        set needed random 52 ; time needed until eligible: max 1 year
        ]
    if presets = "Frequent Movers" [ ; inner city where people move in and out a lo
        set a1 true ; taking affected
        set b1 .6   ; +.1 up (**)
        set a2 true ; express affected
        set b2 .4   ; -.1 down (**)
        set a3 false ; contin not affected (**)
        set a4 false ; overt not affected (**)
        set a5 false ; active not affected (**)
        set a6 false ; approaching not affected
        ; set rrp 2 ; not affected (**)
        ; set rrq 4 ; not affected (**)
        set rrr 52  ; moving every ~1 year (**)
        set needed sneed ; time needed until eligible (**): set manually
        ]
    if presets = "No Movers" [ ; people don't move, for testing
        set a1 true ; taking affected
        set b1 .5   ; up or down (**)
        set a2 true ; express affected
        set b2 .5   ; up or down (**)
        set a3 true ; contin affected
        set b3 .51  ; +.01 up (**), very little
        set a4 false ; overt not affected (**)
```

```
        set a5 false ; active not affected (**)
        set a6 false ; approaching not affected
        ; set rrp 2 ; not affected (**)
        ; set rrq 4 ; not affected (**)
        set rrr 999999999  ; no moving (**)
        set needed 0 ; time needed until eligible (**): 0 (no movers: no point for
!!!!!!!!!!!!!!!!!!!!; variable)
        ]
    if presets = "Election" [ ; an election is about to happen
        set a1 true ; taking affected
        set b1 .5   ; up or down (**)
        set a2 true ; express affected
        set b2 .7   ; +.2 up (**)
        set a3 true ; contin affected
        set b3 .4   ; -.1 down (**)
        set a4 true ; overt affected
        set b4 .7   ; +.2 up (**)
        set a5 true ; active affected
        set b5 .6   ; +.1 up (**)
        set a6 true ; approaching affected
        set b6 .5   ; up or down (**)
        set rrp 1   ; every 1 week (**)
        set rrq 2   ; every 2 weeks (**)
        ; set rrr 1  ; moving not affected
        ]
    if presets = "Close Election" [ ; an election where the result is rather unclea
        set a1 true ; taking affected
        set b1 .4   ; -.1 down (**)
        set a2 true ; express affected
        set b2 1    ; +.5 up (**)
        set a3 true ; contin affected
        set b3 .4   ; -.1 down (**)
        set a4 true ; overt affected
        set b4 1    ; +.5 up (**)
        set a5 true ; active affected
        set b5 .7   ; +.2 up (**)
        set a6 true ; approaching affected
        set b6 .6   ; +.1 up (**)
        set rrp 1   ; every 1 week (**)
        set rrq 1   ; every 1 week (**)
        ; set rrr 1  ; moving not affected
        ]
    if presets = "Assasination" [ ; assassination of a popular leader
        set a1 true ; taking affected (**)
        set b1 .5   ; up or down (**)
        set a2 true ; express affected
        set b2 1    ; +.5 up (**)
        set a3 true ; contin affected
        set b3 .3   ; -.2 down (**)
        set a4 true ; overt affected
        set b4 1    ; +.5 up (**)
        set a5 true ; active affected
        set b5 1    ; +.5 up (**)
        set a6 true ; approaching affected
        set b6 .7   ; +.2 up (**)
        set rrp 1   ; every 1 week (**)
        set rrq 1   ; every 1 week (**)
        ; set rrr 1  ; moving not affected
        ]
    if presets = "Dictatorship" [ ; dictatorship with no tolerance of opposition or
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; much else
        set a1 true ; taking affected
        set b1 .6   ; +.1 up (**)
```

```
        set a2 true ; express affected
        set b2 .2   ; -.3 down (**)
        set a3 true ; contin affected
        set b3 .2   ; -.3 down (**)
        set a4 true ; overt affected
        set b4 .3   ; -.2 down (**)
        set a5 true ; active affected
        set b5 .4   ; -.1 down (**)
        set a6 true ; approaching affected
        set b6 .3   ; -.2 down (**)
        set rrp 1   ; every 1 week (**)
        set rrq 8   ; every 8 weeks (**)
        set rrr 260 ; moving every ~5 years (**)
        set needed 26 ; time needed until eligible (**): half a year (complicated
!!!!!!!!!!!!!!!!!!!!!; regulations)
        ]
    if presets = "Hard Times" [ ; people work hard to get by, little time for polit
        set a1 true ; taking affected
        set b1 .6   ; +.1 up (**)
        set a2 true ; express affected (**)
        set b2 .5   ; up or down (**)
        set a3 true ; contin affected
        set b3 .4   ; -.1 down (**)
        set a4 true ; overt affected (**)
        set b4 .5   ; up or down (**)
        set a5 true ; active affected (**)
        set b5 .5   ; up or down (**)
        set a6 true ; approaching affected
        set b6 .6   ; +.1 up (**)
        set rrp 2   ; every 2 weeks (**)
        set rrq 25  ; every half year (**)
        set rrr 260 ; moving every ~5 years (**)
        set needed 12 ; time needed until eligible (**): 3 months, has no time to
!!!!!!!!!!!!!!!!!!!!!; register before
        ]
    if presets = "Stimuli Only" [        ; only stimuli can happen, for testing onl
        set rrp 1         ; always       ; other values as set manually (unaffectec
        set rrq 999999999 ; off
        set rrr 999999999 ; off
        set needed 0 ]
    if presets = "Interaction Only" [    ; only interaction can happen, for testinç
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; only
        set rrp 999999999 ; off          ; other values as set manually (unaffectec
        set rrq 1         ; always
        set rrr 999999999 ; off
        set needed 0 ]
end

to modernize ; this simulates modernization (development) by increasing SES of the
!!!!!!!!!!!!!; agents (using an action button from the graphical interface)
    ask agents [
        if random 10 = 4 [ set SES SES + .1
                           if SES > 3 [ set SES 3 ]]]
end
```

```
to polarize ; this simulates modernization where only the richer (high SES) get mor
!!!!!!!!!!!!; and those lower stay down
    ; (using an action button from the graphical interface)
    ask agents [
        if random 10 = 4 [if SES > 1 and SES < 2 [ set SES SES - .1 ; remove from t
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; lower
                            if SES < 1 [ set SES 1 ]]
                          if SES > 2 and SES < 3 [ set SES SES + .1  ; add to those
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!; higher
                            if SES > 3 [ set SES 3 ]]
                          if SES = 2 [ set SES SES - (.1 - (random 2) / 5 ) ; lotter
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! ; or down, but do not
                            ]]]
end

to exportdata ; this procedure exports the history of all agents to a text file whic
!!!!!!!!!!!!!!; can then be opened in Excel (etc.) for data analysis (using a buttc
!!!!!!!!!!!!!!; from the graphical interface)
    locals [ i ]                    ; count variable
    clear-output                    ; in case something was exported before
    set i 0
    repeat agentnum [               ; for all agents
        print history-of turtle i
        set i i + 1 ]
    export-output "ppart.txt"       ; write to file
end
```

Index of Keywords