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TOWARDS A RECONCEPTUALIZATION OF SIMULATION: FROM REPRESENTATION TO REALITY

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Abstract: An attempt is made in this article to redefine some of the central concepts related to simulation. These are discussed in relation to two perspectives, termed 'representational' and 'reality'.

Within the representational perspective the authors look at such concepts as: system, model, rule, simulator, simulation, role play, game. Although there has been much discussion on these concepts, they need to be re-examined. Simulation remains defined as a special kind of model, representing a 'real' system. However, the essential nature of this 'special' is often glossed over. Two basic criteria (error consequence and the nature of rules and strategy) help to highlight distinctions between the above concepts.

Introduction

A simulator is seen as a model that has the potential of being 'brought to life'. Rules contained in a simulator determine the specific pattern of the simulation, while the strategic selection of moves made during the performance allow it to evolve. Only rules may be represented in a simulator, whereas both rules and strategies operate in a simulation. Games in the strict sense are seen to be the converse of simulation, though (perhaps paradoxically) simulation is able to incorporate game elements. Simulation is taken as a general category, which may contain elements of role play and/or games. Role play is seen as simply one aspect of simulation; simulation may not always incorporate role play, but a role play is always a simulation.

Simulation is usually seen as somehow representing some real-worldly system, as a symbol with a referent, and thereby drawing its essential meaning from that referent. However, during performance participants do not necessarily see things in this way. For them simulation is a very real experience; it develops its own reality and becomes discontinuous, during performance, with any other world or system. In this lies the essential nature of the reality perspective. Simulation is often defined as real by participants, and it may thus be conceived as a 'real world' in its own right.

A re-examination of the representational concepts not only provides links with the reality perspective, it also points the way towards seeing

the latter as an equally powerful explanation of the nature of simulation. The two perspectives are not necessarily incompatible. Neither is sufficient and both are necessary for a full understanding of what constitutes simulation. Debriefing is seen as an essential link between the two perspectives, allowing parallels to be drawn between the reality of the simulation performance and that of the 'real' (non-simulation) world.

Perspectives and applications

Most of this paper is devoted to the question: 'What is simulation?' The relationships between the concepts discussed are summed up in the Figure. An introduction to some of the major concepts in simulation will inevitably involve, within a limited space, some over-generalization and the omission of various issues. Some of the following discussion is based on 'standard' theory, but some of it is more exploratory and speculative (though couched in perhaps overly dogmatic terms).

The following discussion aims to integrate two broad and seemingly irreconcilable perspectives on simulation and in so doing attempts to redefine some of the central concepts of simulation. There seem to be two main ways of viewing simulations. One perspective sees them as

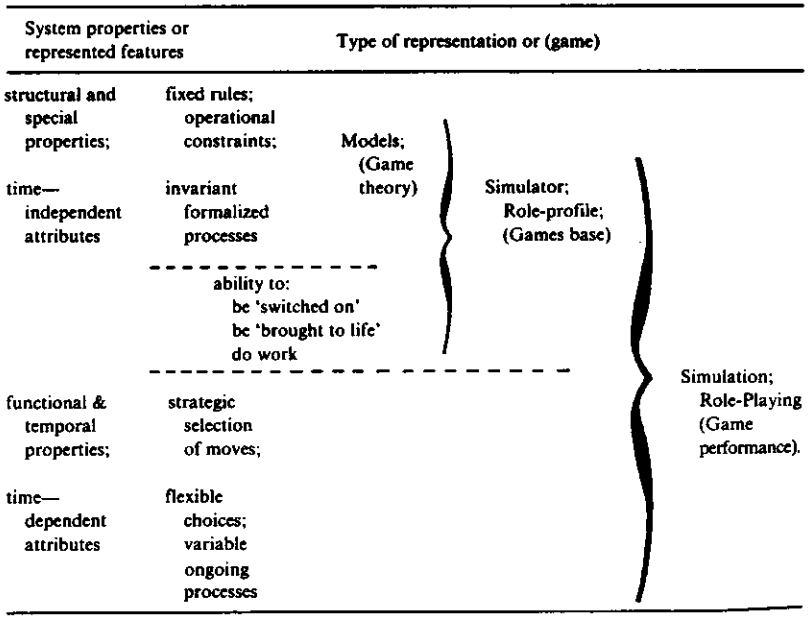

Figure: Relationships among systems, models, simulations and games.

'merely' representations of some other 'real worldly' system. This has been called the "representational" viewpoint, although other useful epithets are "objective", "designer/organizer-oriented", "rational", and "positivist". It is probably the most commonly adopted stance, and derives from a 'scientific' analysis and system-modelling.

Another less common view, however, sees simulations as "operating realities" in their own right, *ie* as not necessarily having direct or explicit representational power or value. This may be termed the "simulation-as-reality-in-its-own-right" or the "reality" perspective. In contrast to the representational viewpoint, the reality perspective can be conceived as 'intersubjective', 'participant-oriented', 'non-rational', and 'non-positivist'. It is intellectually grounded, partially at least, in such non-positivist perspectives on human relations as phenomenology and ethnomethodology, and emphasizes the participants' own perceptions and experiences.

Are these perspectives really irreconcilable? Are the concepts associated with each of these perspectives mutually exclusive? Or, on the other hand, can these perspectives and their associated concepts be viewed, Janus-like, as two complementary and necessary sides of the story of simulation? Can simulation be seen, through the act of creative imagination, as what Koestler would call a "bisociation" of the perspectives? Do some simulation concepts in fact belong to both perspectives, instead of just one or the other? These are some of the questions addressed here.

A reconceptualization of some of the well-worn concepts within the representational perspective has consequences for its juxtaposing with the reality perspective. In other words, a re-examination of the concepts in the representational view is not only useful within that view, but also allows greater compatibility between the two perspectives. In attempting to mesh strands of both perspectives we hope to provide a blueprint for a reconceptualization of simulation.

Within the representational perspective we find such concepts as: system, model, rule, simulator, simulation, role-play, and game. Although there has been much discussion on these concepts, we feel that they need to be re-examined. Simulation remains defined as a special kind of model, representing a 'real' system. However, the essential nature of this specialness is often glossed over. A closer examination not only reveals aspects of this specialness that are overlooked in the literature, but also allows us to pinpoint two basic criteria (*error consequence* and the *nature of rules and strategy*) which allow us to make coherent distinctions between the concepts of model, simulation, role-play, and game.

The re-examination of these and other concepts provides a more cogent explanation of the representational perspective and also indicates where we might start in establishing relations between the two perspectives. At first sight they would seem to be irreconcilable, insofar as the conclusions drawn from adopting one or the other perspective contradict each other, at least superficially. We hope to show that, while it may not be possible to combine both perspectives into a coherent, over-arching theory, they should be seen as complementary; both are necessary for a comprehensive understanding of simulation. A reconceptualization of some of the representational concepts has consequences for our understanding of the reality perspective. We suspect, therefore, that a fresh view of system, model, rule, and the like can provide a much needed bridge between the representational perspective and the reality perspective — hence our subtitle.

Richard Duke has called simulation a "language". Both simulation and language have their own syntax, meaning systems, and analytic tools. Both are also, at one and the same time, representational phenomena and productive of their own realities. Simulation however is particularly powerful, and allows us, like language, to explore the world about us. We learn about the world in learning a language, and likewise simulation helps us to learn about the world. Three ways of learning about the world correspond to three main areas of simulation application: education, training and research. While the reasons for using simulation may differ from area to area, underlying them is a common belief (for any methodology ultimately requires an act of faith) that simulation enables us to achieve certain objectives and do certain things that other techniques cannot. However, this requires that we understand the nature of simulation. The objectives are often referred to as the 'advantages' of simulation. In education and training, three interrelated reasons are often cited. Simulation motivates and is fun; it is more congruent with the learning process; and it is more like the 'real' world than the traditional classroom. It is thus considered to result in improved performance, greater retention, and better understanding of complexity. In research, simulations may be used to generate data (often implying statistical analysis), as objects of study in themselves (to learn about what happens in them), as measuring instruments (to test students), and as predictors (to see how people will perform in a given situation, or to gain insight into possible futures). Even with such clear-cut objectives, the validity and reliability of simulations as representations often leave much to be desired. However, as we move from a representational to a reality perspective, we note that a simulation performance can well be perceived by participants as displaying fairly high face validity.

We wish in most of this paper to re-examine some of our currently

accepted concepts and categories used within the representational perspective, including 'simulation', 'game' and 'role-play'. In so doing, we hope to provide a sharper basis for their redefinition, and thus for stronger links to be established with the reality perspective. A re-examination of representational concepts will make it easier to establish closer links later in this paper to such a notion as 'reality' within the reality perspective. We now turn to some of the specific concepts that constitute the representational perspective, and begin with a discussion on the relationships between models and simulation.

Models and simulation

A major area of concern over the years has been the relationship between a model and a simulation, and it is here that our attempt at reconceptualization starts. A common assertion is that "a simulation is a 'special' kind of model of a system". A model is like a map; indeed the process of building a model is sometimes called "mapping". The two main uses of models are to *represent* various features of a 'real world' system, and thereby to *reduce the cost of error* for that system. As these two features also belong to simulation, the question arises 'What is the difference between them?'. To provide an answer, though, we need first to examine the above two features (representivity and error cost) in more detail and as concepts in their own right, distinguish between simulators and simulations, and discuss how rules and strategies are differentially used in models and simulators/simulations.

Representivity

A model or map is essentially a representation of a system. The term 'represent' can be taken in two ways: (i) 'stand in place of' or 'depict', and (ii) 'make present' or 'bring to life'. Later we will attempt to show that only the first interpretation applies to models, while both can be applied to simulation, and that the first sense remains within the representational view, but that the second moves towards the reality view.

Representation (in the first sense) is achieved through three processes: abstraction, symbolization, resemblance. A model *abstracts* from the real system by way of conceptualization, selection and simplification. A model necessarily embodies a theory about the system it maps; the system must be conceptualized before a model is built. This allows the selection of certain features to be mapped (or transferred) from the system into the model, and in so doing it *simplifies* those features and/or their relations. The features abstracted from the system are mapped into the model by means of *symbols*. A model is a symbolic representation, or a metaphor, of a system; it is a kind of (artificial) language, which implies social agreement about signified meanings; *ie* about detonations

and connotations. A simulation is a meta-system. Finally, the model in some way resembles the system; it is *isomorphic* with the system. Thus, a model shows abstract and symbolic resemblance to the system. These three types of representivity also characterize simulations. The second sense of 'representivity' ('bring to life') will be discussed later.

Error, punishment and risk

The second characteristic of models (and simulations) is the relatively low *cost* of an error in the model, compared to that of the 'same' error in the 'real' system. It is often said that models and simulations are "error free", "punishment free" and/or "risk free". This is a gross over-simplification. Some models have to be abandoned because they are *error* ridden; *ie* their representative value does not satisfy the constructor. A participant does not necessarily escape *punishment* (either from within, *eg* a feeling of failure; or from without, *eg* reproach, or loss of face). If it is true that we learn, in part, from our mistakes, then this is precisely because we recognize them as such. This recognition includes some form of 'retributional' feeling, otherwise termed "punishment" — a normative and rather negative term.

Models and simulations are not *risk* free either; indeed, if they were, no mistakes could be made. One of the reasons why they are built and run is precisely the considerable leeway they allow for taking risks, making mistakes, and asking 'what if . . .?'. It would be a strange simulation indeed if it was risk free; participants would be gliding through an 'ideal' and rather boring world. The point is that risk, error and punishment remain largely within the model or simulation, and generally have relatively little impact on the 'real-worldly' system being represented.

One of the purposes of a simulation is to broaden and deepen participants' perceptions and interpretations of the 'real' world, while another is to refine their skills. Both cases constitute learning. Indeed, these are the major reasons why simulations are used in education and training. When a simulation is run, it is hoped that the lasting consequences for the participant will be positive and memorable. One of the purposes of debriefing is to allow mistakes to be discussed openly and dispassionately, and thus to encourage positive consequences in the 'real' world rather than negative costs.

The drawback of performing 'for real' is that the learner is prone to making mistakes which may be costly for the system (including the learner him/herself). S/he may also be cramped by the fear of making such an error, which may actually increase the chances of an error being made. Two interrelated elements thus need to be distinguished here: the cost of a mistake and the fear of making one.

Thus the spirit of a simulation should allow, even encourage,

participants to risk making mistakes, with the aim of gaining confidence through practice. An example of encouraged risk for learning is pilots who take their simulated aircraft to points of no return (*eg* stalling), which they could not do in real planes. This can be applied, *mutatis mutandis*, to many other 'safe' learning situations. If a trainee pilot crashes in a real aircraft, not only will the insurance company manager develop an extra ulcer, but the chances are that the pilot will no longer be around to learn from his/her mistake. So we replace the system with a replica.

Simulation thus protects people from otherwise severe consequences of their mistakes, and yet in so doing allows these mistakes to be examined. It provides learners with a relatively 'safe' (or non-threatening) learning environment. The mistakes are made in the simulation, not in the 'outside' world. However, a learner does not lose all fear of making a mistake just because s/he is in a simulation, for a simulation can become a totally real situation for participants. Although these aspects are usually discussed within the representational perspective, the justification being that, as a representation, simulation is not the 'real' or 'outside' world, in fact they operate precisely because they are (part of) the participants' reality, and become operational and educationally beneficial within the reality perspective. Error, punishment and risk thus provide important links between the two perspectives.

Simulations and simulators

A distinction is often drawn between two 'modes of existence' of simulations. A *simulator* is the structural basis of a simulation. It is the machine and the program, the form and the content, existing in latent state (*eg* the pilot's simulator switched off, or the kit of materials for BAFA BAFA, or the computer networks and scenario in ICONS). A *simulation* is the actualization of the simulator, the operation or experience of it, the on-going, 'live' performance (*eg* the trainee pilot operating the simulator, or the on-going intercultural communication between groups, or a team of foreign policy students making decisions).

A simulator may thus provide the basis for any number of simulation performances. This may be likened to a published script for a play, and to a stage performance in which the lines are acted out. A simulator might also be likened to language competence or usage as an unapplied body of symbols (lexicon) and relational rules (grammar), while a simulation might correspond to the meaningful use of that language in a given instance of discourse (communicative and appropriate performance). A simulator is comparable to a genetic code, and a simulation to the realization of that code in a living organism.

Simulation thereby brings a simulator 'to life', and this can only be achieved by participants. In being activated, it takes on a reality of its

own, and leaves the domain of 'pure' representivity. During a simulation the notion or feeling of representivity is lost or distilled, as the simulation begins to take on a life of its own (second meaning of represent). It is only within a simulation, as opposed to simulator, that risks can be taken and errors experienced. (Indeed modelling errors in the simulator often surface during simulation performance.) The distinction between simulator and simulation thus provides one link between our two perspectives of 'representivity' and of 'reality'. Having noted the difference between (unactivated) simulators and (activated) simulations, we are now able to make some further contrasts between models and simulators/simulations.

Model v simulator/simulation

Since both models and simulators/simulations are conceived here as representations of systems, and have low error consequence for those systems, these two features do not furnish us with sufficiently powerful criteria for differentiating between model and simulation. Since both models and simulators represent certain aspects of a system, it should be possible, from an examination of those system aspects, to derive an analysis of what exactly is represented in each case.

We argue that models can represent only certain properties of systems, while simulators are able to represent most aspects of systems. The aspects of a system which a model cannot represent are those which would 'disappear' were the system to be momentarily frozen in time. In order to determine exactly what properties 'disappear' under such hypothetical (time-independent) conditions, and so distinguish between models and simulations, a short journey into Systems Theory will be necessary; but this excursion will introduce us to two fundamental concepts — those of 'rules' and 'strategies'. These, again, provide crucial links between the two perspectives.

Rules and strategies: a glimpse

Behaviour and processes in a system are governed by fixed sets of rules, yet display flexible, variable strategies. The *rules* determine the system's coherence and more stable properties (its structural configurations, functional patterns and meaningful units); they define the range and type of permissible moves in the system's activities or behaviour. The *strategic selection* of the actual move in a given instance from among the available choices is guided by feedback from the environment (and influenced by the players' styles, motivations, *etc*). As Ryle (1964) reminds us, even though we know the rules, it is impossible at the start of a game of CHESS to predict exactly what moves will take place and what the outcomes will be — these are decided by strategy. The course of play will also be affected by such things as the players' previous experiences, their mutual familiarity, and their desire to win.

Simulators are able to represent both rules and strategies, whereas models cannot incorporate strategic selection. Flexible behavioural modes and strategic selection cannot be accommodated in a model, but are charactertistics typically built into a simulator, whose potential will be actualized in a simulation performance; *ie* 'represented' in the second sense of the term — 'brought to life'.

The distinction made earlier on between simulators and simulations also allows us to distinguish between model and simulator. Unlike a simulator, a model cannot be made to operate in a fashion similar to the system it represents; it cannot so easily be 'switched on' or 'brought to life'. A model is rather like a pilot's simulator with no provision for a pilot. Thus, a simulator may be operated by 'live' people, but a model cannot, and so only simulations provide direct, first-hand experience; hence the term 'experiential learning' often used for the kind of activity provided by simulations. We say that people "take part (participate) in a simulation", but not "in a model".

In short, a model, like a simulator, represents an open system's invariant properties, while a simulator also has the *potential*, during performance (as a simulation) to represent the system's flexible, variable strategies and properties deployed during, and commonly associated with, the course of action. However, a model, unlike a simulator, has no trigger mechanism — it cannot be made to operate 'like' a 'real' system. Indeed, we often have a series of models, each representing a stage in the system's evolution.

It is the notion of rules and strategies that forms a key link between our two perspectives. Indeed, it is rules and strategies that make it possible for a simulation to work at all, and that make the reality perspective plausible. Under this view, moreover, we shall see that simulators, being only potential triggers for action, cannot include all types of rules, for many rules derive properly from the reality of the simulation performance itself. Rules and strategies also have their place in role play, which is discussed next, as a facet of simulation.

Role play

It is useful to consider role play as a component embedded within simulation, rather than as a totally separate (albeit similar) type of activity. A role play is always a simulation, but a simulation need not necessarily involve any significant role-playing. Role play is usually defined as a social or human activity in which participants 'take on' and 'act out' specified 'roles', often within a predefined social framework or situational blueprint. (The term 'scenario' is often used to refer to this general description of the situation to be depicted by — represented in — the performance). This view, however, does not explicitly express the

simulation aspect of role play, and sees role play as the over-arching category, rather than as a particular aspect of a more general activity — that of simulation. The previously discussed concepts provide tools for analysing role play.

Role-profile and role(-playing) performance

The distinction made above between simulator and simulation can be applied in similar fashion to role play. The role-profile has the same basic features as simulators; it represents some real (or imaginary) person or role-set. When the profile is actualized or brought to life by a participant, this is a 'role(-playing) performance', which simulates the acting out of 'real' world behaviours. Also, as in simulation, errors 'committed' during the role performance have relatively little impact on the 'real world' of other people. The scenario, likewise, resembles the simulator in establishing the context in which action will take place.

Rules and strategies

The role-profile and scenario (which together constitute the simulator) determine the stable properties of the role play situation to be enacted. However, when the role-profile is being realized in a given performance, the participant is officially allowed a degree of freedom to make strategic choices from within those permitted by the profile framework; the participant is able to select moves from among the choices permitted by the profile. Thus, role performance is able to evolve in much the same way as simulation evolves, and so represents social actors evolving 'through' or experiencing their 'real' everyday world. The usual focus for such role play is on the enactment of rules, and exploration of alternative strategies, for such practices as social skills, conversation, and social order.

Role play and simulation

Thus a role play is always a simulation, and a role-profile (and scenario) is always a simulator. The participant in a role play performance is simulating some 'real-world' person or person-type. The interaction between participants in the role-playing performance is a simulation of a social situation. However, another complementary question must also be addressed: is a simulation always a role play?

Operators

The answer to the above question depends on whether simulations must always involve human operators. This, in turn, depends on what status they are deemed to have in that performance. A distinction can be made between internal and external human operators in a simulation. Internal operators work within the ongoing simulation performance as full-fledged participants. This is usually the case in simulations of various types of social situations. Examples of external operators are the

researcher who feeds in data to the weather simulation, and the student who asks 'what if ...?' in a computerized statistics simulation.

People who participate as an integral part of an ongoing simulation performance must always take on something of a role, even if the degree of role-taking is, to all intents and purposes, negligible. The distinction between the concept of role-profile and that of simulator, between role-performance and simulation, or between role play simulation and 'straight', non-role play simulation, is a question of degree, not of kind.

Role play elements

The question of how much role-playing is involved in any one specific simulation performance raises a number of issues concerning the relationship between four interrelated aspects of a role play simulation. These are:

a) *The individual (or society member)*: The personality, identity, self-concept and typical behavioural patterns, *etc* which characterize the 'real worldly' society member as potential participant role-player; in other words the human operator as s/he 'is' outside of the role play performance.
b) *The represented person*: The 'real worldly' person to be simulated; *ie* the person-type or role-set in the real system, and described or represented by the profile. The represented person is the referent of the role-profile. In the real world we all play roles, which may be individual (*eg* Jimmy), social (*eg* plumber, young person), or institutional (*eg* minister, teacher). The represented person may also be imaginary, *eg* a character in an adventure game. These persons or person-types are those which are translated into a role-profile by the modelling process.
c) *The role-profile*: The model or representation of the real world person, existing in latent state, waiting to be 'switched on', or brought to life. The role-profile is a representation, and thus a simulator of a 'real worldly' person or person type. The role-profile contains selected features which are representative of aspects of the system, in this case of a 'real' person or of a category of person. The degree of representivity can vary from a theoretical maximum (where the profile contains almost every conceivable detail of the represented real-world person/type) to an ideal minimum (where the profile contains the barest information, *eg* 'You are a minister').
d) *The participant (or role-player)*: The individual as s/he 'is' during the simulation performance. In entering into a role play performance an individual 'brings to life' the role-profile as a participant, and thus simulates the 'real' person.

We can summarize the above four entities with a dramaturgical analogy. Dame Sybill Thorndike (the individual) might brilliantly play (as a

participant) the part of an ambitious, ruthless, and cunning, but later tormented wife (the represented person) as represented by Lady Macbeth (the role-profile).

Congruence

The relationships between the first three entities can be discussed in terms of 'degrees of fit' or 'congruence', varying from maximum to minimum. Together they shape the kind of participant and role-performance, or (in other words) the face validity of that performance. The effectiveness of role play within a simulation depends on the degree of congruence between the individual and the role s/he is asked to play. For example, a reluctant teenage boy asked to play the role of a grandmother might find this relatively difficult and unappealing, whereas an accountant playing the role of Chancellor of the Exchequer might relish the challenge. Even the greatest actors find certain parts more to their liking than others, and in such roles often give their greatest performances.

Each of the above relationships will, in turn, vary interdependently along three broad dimensions: cognition (knowledge), affectivity (emotion) and behaviour (performance). All these determine how easily a given individual actualizes or enacts the role profile as a participant. Cognitive profile specifications (*eg* 'you are a news editor') do not impose demands on the participant in the same way or to the same extent as affective specifications (*eg* 'you strongly dislike ...'). Acting out another set of feelings or values than one's own needs greater ability to empathize and extemporize than expressing one's own personal convictions. In sum, the more detailed the role-profile, the greater the role-taking, the greater the likelihood of incongruence with the individual, and possibly the less convincing the participant.

A 'full-blown' role play may thus be loosely defined as a simulation in which the degree of congruence (between profile and individual) is such that the participant has to display feelings, beliefs, values, attitudes, *etc* which have little to do with the individual's identity and self-image. It is a simulation in which the rules laid down in the profile define the form and content of public behaviour to the extent that the participant has to abandon essential elements of his/her 'real' self-concept. Non-role play, or 'straight', simulation is where there is maximum congruence between individual and profile, *ie* where role-taking is minimal and the role-player is not required to be significantly different to the individual. If the individual is to all intents and purposes him/her (social) self, *ie* 'feels at home', surely the degree of role-taking (in a simulation) can be considered as negligible and inconsequential.

But this sounds suspiciously vague and also begs a series of questions. In a pilot's simulator there is, to all intents and purposes, no role-profile,

so, can the trainee pilot (as individual) be said to be playing a role (as participant in the flight simulation)? It can be argued that the trainee pilot (as participant) is in fact playing a 'role', that of a future pilot, since s/he is not yet fully operational. But this is precisely the role s/he would play in 'real' life (as represented person), when s/he does become a pilot. However, the trainee is not yet a 'real' pilot, otherwise s/he would not be in the simulator. The arguments are circular, but still beg the question: How far is the trainee pilot really him/herself when s/he is in the simulator, perspiring profusely while trying to land without getting killed? Pilot's simulators are intensely 'real' things, and some novices do wet themselves. To sum up, simulations of social situations inevitably contain social actors and therefore must involve an element, however small, of role-playing.

This is hardly surprising, for we all play varied roles in our ordinary everyday lives, and if these are built into a model or translated into a profile, we find it relatively easy to carry over our real-life role-playing competencies to the role play simulation. Sometimes we encounter known and already experienced real-life roles within simulation contexts, and these are easier to act out than roles we have had little experience of. The amount of role-playing in simulation depends on our knowledge and experience of the world as well as the characteristics of the role profile. It is this carrying over and into process that will shortly lead us towards the reality perspective. To anticipate such dicussion, role play simulations become projective events that allow participants to create and explore their own social realities.

Games

We have discussed models, simulations, and role plays — all traditionally linked with the representational viewpoint. Now we re-examine games within that viewpoint.

As in simulation, the term 'game' covers two modes: the material(s) and the live performance. There are no words in current usage to distinguish between the two, except perhaps the term 'play' (for the live performance). This highlights the relationship between games and the rehearsal functions of play in animal and human development. For present purposes, it is useful to reserve the term 'play' for particular types of enjoyable behaviour, one of the chief functions of which is rehearsal, and which it should be remembered, are found both in everyday life as well as in games and simulations. Indeed, there is more than a passing resemblance between play behaviour in simulation and in ordinary life.

This again provides a bridge between the representational and the reality perspectives on simulation. If we can behave playfully in a

simulation, it is because we have learned this behavioural mode elsewhere. Indeed, play as a universal behavioural mode can be considered as a kind of real-life rehearsal simulation. In the meanwhile, within our present context of purposefully conceived and expressly structured activities we call 'simulation', we adopt here the terms 'game-base' and 'game performance'.

Game features

We wish here, again, to establish criteria which will allow us to distinguish games from simulations. To do this we first need to see whether any of the features usually attributed to games will allow such a distinction to be made on that basis. Games contain many features, some of which are:

a) *Hardware*. Examples are: cards, pawns, boards, dice, and forms. Other, more advanced technological paraphernalia such as computers and modems are to be included here.

b) *Software or rules*. This consists of formalized compulsory and/or permissible procedures which, respectively, must or can be followed during the game performance. These are usually written in the form of explicit rules, which govern such elements as time constraints, termination (win) criteria, and number of players.

c) *Strategy and evolution*. Players are allowed varying degrees of choice within the dictates of the rules. The rules determine the stability of the game as a recognizable activity distinct from another (CHESS is not DRAUGHTS), but within those rules players are able to make strategic selections from among a number of permissible moves.

d) *Termination, goal and winning*. The termination criteria are usually formulated as a goal towards which the players strive, and this often (but not always) implies competition with one or more winners. The winning criteria are expressed in terms of attaining a certain predefined advantage; *eg* better position (CHESS), obtaining more points (BRIDGE), solving the problem or accomplishing the task (PATIENCE).

e) *Competition/cooperation*. Players often compete in different ways to reach the specified goal. Competition may be between players or teams, or between a player and the goal (PATIENCE). They may also cooperate, usually within a team. Some games (*eg* PRISONERS' DILEMMA) require cooperation for all players to win.

f) *Chance*. A chance factor is present in varying degrees, from nil (CHESS), through some (BRIDGE), to maximum or complete (SNAKES & LADDERS). In games where moves are governed wholly by chance there can hardly be any strategy building, nor evolution. Indeed, the players are merely physical manipulators of buttons on some kind of board. One might hesitate calling

SNAKES & LADDERS a game, but everyday usage has it that it is. Where chance is less of a factor, individual and group strategy takes on greater significance.

Game performance bears more than a passing resemblance to simulation. We also speak about 'playing a game' and 'playing a role', but not about 'playing a simulation'. Since all of the above game features can be found in varying combinations and degrees in simulations (with the possible exception of a complete chance factor), none of them allow a distinction to be drawn, and we have to look elsewhere. Thus, the fundamental difference between games (in the strict, technical sense) and simulations lies in the two major features discussed above, *ie* representivity and negligible error consequence. In terms of representivity and error cost, games show almost the contrary effects to simulations. In contrast to a simulation, a game (in our technical sense) is not intended to *represent* any 'real-world' system, and there can be high consequences to game errors for the 'real' world. Both are related; consequences arise precisely because a game is not a representation.

Representivity

A game (in the strict sense) does not purport to represent (abstract from, symbolize) any part of another system; it has no 'real-life' referent, and so is a 'real-world' system in its own right. CHESS was originally conceived as a simulation (though its inventors were probably not explicitly aware of this), but over the centuries it lost all quality or power of representivity. A game is formally constructed as a kind of mini-system, which takes place or 'happens' along with other social (sub-) systems whereas a simulation is a bracket, a hiatus, within the ongoing 'real-world' (sub-)systems. A game is a formalized system in its own right, while a simulation is a formalized representation of another system; a game is a 'real' system, a simulation a meta-system.

It is worth noting that one can have a simulation of a game, but not a game of a simulation. The idea of simulating a game is not as far-fetched as might appear, *eg* computer sports programs. Just as role-playing is an activity that takes place in 'real' life, but also in a simulation, so games take place in 'real' life, but can also be used in a simulation. Some activities usually referred to as 'games' (or experiential activities) actually simulate processes, and their substantive area is relatively unimportant. For instance, although decisions are made in artificial contexts that might never be encountered in 'real' life, decision making itself is part and parcel of our day-to-day existence.

Thus, many games aim to mirror various social activities or processes; this is the usual sense of the term, not the technical one. General usage allows the terms 'urban gaming' and 'business game' but these should

often strictly be regarded as simulation. 'War games' are games or simulations, depending on the perceived importance of their representative value.

Game and simulation

Since all the above game features can be found in simulations, the question is what then is the difference between these and games? In many cases the term 'game' is used to refer to simulation, but not the other way about; and many instances of use require no distinction to be made — in which case the term 'gaming' is often used. Where we do not need to make the distinction, then interchangeability is acceptable.

In some cases, however, we need to establish distinguishing criteria. This is particularly important when examining exactly what it is that people are doing during these activities, or what it is we expect them to achieve, or what relationships hold between the activity, the participants and the 'real' world. There are, then, two interpretations of the term 'game': a broad, everyday one (where 'game' is equated with 'simulation'), and a strict, technical one (where they are different but complementary concepts).

Some simulation/games containing substantial game components are often considered as 'just' games, *eg* MONOPOLY. However, when participant perceptions involve inferences to 'real-world' referents, then the activity should properly be regarded as simulation, albeit with 'heavy' gaming components, and probably relatively low representivity. Whereas MONOPOLY was conceived 'simulation-like', a performance may be regarded as a game, a simulation/game or a simulation. It depends on the reasons for which it is played/performed in any one instance, *eg* learning about a (chancy!) free economy, developing strategy, experiencing bankruptcy, or simply having fun. It is interesting that, during performance, MONOPOLY often develops from a game-like activity (concern with where the dice will land you) into simulation-like behaviour (buying and selling property).

Error cost

An error committed during a game may have costly consequences for the 'real world' (*eg* losing money at POKER). The cost of an error in a game is not necessarily high, but the point is that it usually has that potential. This is readily admitted by all who play or watch games; a classic example is the nationalist fervour generated by the Olympic Games, which is expressed, not only by those actually taking part, but well beyond the games themselves, by 'fans', sponsors, and the like.

Summary

If a game takes on representational value it should properly be regarded as simulation; while game elements can be incorporated within

simulation. Games thus have certain characteristics in common with simulations. However, in contrast to simulation, a game is a full-fledged part of life, a sub-system in its own right embedded in the everyday life systems of the 'real world', and in which often consequential errors may be made. Both games and simulations are characterized by rules, and in their performance these allow strategies to be deployed. However, games, being part of the 'real world', are their own source of strategies, whereas simulation draws on at least three, as we shall now see as we turn to the reality perspective.

Rules and strategies: towards reality

We have touched on the notions of rules and strategies several times, and have seen that they are essential to an understanding of simulations and games within the representational perspective. We now want to show how these same notions can also help us in building a bridge with the reality perspective. Indeed, the notions are just as essential here to an understanding of what simulation is for the participant.

Rules are usually lumped together as being the 'game elements'. However, this can lead to confusion about what a simulation is supposed to simulate. As we saw above, rules deemed to exist in a 'real' system can be represented by symbolic rules in a simulation (*eg* voting rules in an EEC simulation). In a simulation, rules may arise from at least three major sources:

1 *Simulator rules*: Representations of real-world rules; rules simulating rules; symbol rules.
2 *Game rules*: Non-representative rules formulated for procedural reasons, in order to structure the simulation activity and to allow strategy building within limits known to all (*eg* 'If you get a 6 you can have another go', 'Each team must issue a communique twice a week').
3 *Imported rules*: The rules that participants import into the simulation by virtue of the fact that in everyday life they are culturally competent, rule-using members who know the procedural practices of their society (*eg* 'You can't do that, it's not fair'). These may also be termed implied or taken-for-granted rules.

The first type of rule belongs to the simulator; the second is part of the game-base used in simulation; the third is triggered by participation in the simulation performance. It is important to make these distinctions, as not all rules in a simulation (indeed far fewer than we might believe) have anything at all to do with games (as we have defined them above).

One universal feature of social life is rule-governed behaviour, from subconscious 'mechanistic' actions or skills (*eg* walking) to socially constructed and institutionalized conventions (*eg* language use, or

hand-shaking or other rituals). These are all governed by rules and allow flexibility of action.

Since simulation represents a social system, the underlying model must contain certain system rules. But there are limitations. Even assuming that specifying all the rules was possible, the manual for such a simulation, even if simple, would require several volumes and thus defeat its own purpose.

A second limitation is that many system rules are as yet unknown. Some approaches within the social sciences, such as pragmatics, ethnography, ethnomethodology, and social psychology, attempt to understand the way people view and relate to each other. However, we are far from establishing an explicit, exhaustive and comprehensive set of rules for every conceivable type of everyday conduct, let alone specific instances of it. Indeed it is recognized that no model, however comprehensive, can possibly predict most instances of behaviour. Moreover, rules are negotiated and negotiable, which obviously makes them subject to amendment. Even more complex is the recognition and repair of rule breaking. Thus, a simulator cannot spell out all the system rules in advance, let alone specify how such rules are to be implemented in any one simulation performance.

These limitations on rule specification then raise the question of how participants actually manage to interact and accomplish their tasks. Any casual observation of a simulation will show that participants are following rules and displaying behavioural patterns that have in no way been specified in the initial materials. Most of what goes on during a simulation is made possible because participants bring with them to the performance their knowledge of the world and how it works. Most of what takes place in a simulation derives from participants importing their knowledge of procedural rules of social competency into the simulation performance. We do not loose our social shackles that easily; there is always a resistance to acting inappropriately (breaking rules), even in a simulation which has the precise aim of allowing what would in 'ordinary' circumstances be held as untoward behaviour.

The simulator manual may specify a number of simulation and game rules, and these essentially make it recognizable as a particular simulator, as opposed to another; BAFA BAFA is not STARPOWER. But only by outlining the most general rule framework, can the actual simulation performance work; only by allowing players to import their own already learned rules and rule-using competencies can a simulation work. The actual performance of a simulation will vary greatly depending on what participants as culturally competent society members actually bring to it and do during it. In other words, it is the third, imported, type of rule which allows simulation to come to life and

to become reality in and of itself, but it may often be difficult to distinguish between the three types of rules. It is nevertheless important, from a design as well as an educational view, to recognize that without imported rules, simulation could not work.

For example, in a simulation of intergroup conflict, the simulator rules will specify the overall organizational conditions or framework, which *potentially* leads to intergroup activity. Such rules cannot attempt to dictate that participants *must* engage in intergroup behaviour, and even less to specify precisely *how* they will behave. Even if it were possible to put all the knowledge accumulated through the work of social psychologists into a manual, it could only specify the most general procedures to follow in this *type* of situation, not in this specific instance under these specific circumstances with these specific people. However, once a situation has been created which potentially leads to intergroup behaviour, participants to that situation (whether in the 'real world' or in a simulation) are likely to engage in such behaviour. From a simulation participant perspective, such behaviour will actually constitute intergroup behaviour; this will be their reality, just as it is in the 'real world'.

A simulator may thus be seen as much more a sort of 'framework' than a precise, and scientifically defined or definable, behavioural model. It is a trigger, which once activated by participants leads to action, which is decided by strategy within a framework of rules. A simulation from an outsider's viewpoint will resemble similar non-simulation situations, but it is a situation which becomes the paramount reality for the insider, the participant. Only by allowing participants to use their own rules and strategies can a simulation happen and become a real situation for those participants. It is to this that we now turn.

Reality

In our discussion of reality, let us continue with our example of a simulation of intergroup behaviour. The actual intergroup rivalry comes from participants importing into the simulation all those taken-for-granted behavioural dispositions, attitudinal orientations, and the like which would lead to intergroup rivalry in *any* circumstance, whether or not it is termed a simulation. The very real emotions engendered by such a simulation demonstrate that it is hardly a simulation, but the real thing — except that participants have made certain pre-simulation agreements, which bound the simulation activity of rivalry and mark it off as somehow only relevant for the purposes of the simulation, and which for the time being render it discontinuous with other contexts and relationships. In so doing, this marking out of simulation in space and time does not allow it to generate the error costs to be found in the 'real' world. By defining and demarcating such behaviour as belonging within

certain bounds and through knowing that they will be able in most cases to 'drop out' of it when the organizer gives the word that the simulation has come to an end, participants are able to embrace the exercise in a realistic fashion, *ie* to live out and through such behaviour realistically. Nevertheless emotions do not come and go in an instant; they have a certain inertia. Many who come away from a particularly powerful simulation will still feel the pinch, though knowing intellectually that it was 'only real' for that particular simulation performance. Simulation thus has the power to involve and to mark people, hence their motivating value. People actually feel, think and do things, rather than being told about them. It is in this sense that simulation is reality.

John Keats said that "nothing ever becomes real till it is experienced". In more positive terms, Thomas' famous aphorism asserts that a situation is defined as real if it is real in its consequences. One might broaden this to say that a situation is defined as real if you are involved in it. This does not invalidate the above argument on error consequence, rather it supports it. The very real consequences, though, remain largely within the bounds of the simulation activity. Because consequences of simulation actions are real to participants, they define the simulation activity as real. Participants are able to experiment (test out hypotheses and behaviours) in the simulation without the fear that any errors will have the same consequences as they would in the 'real' (non-simulation) world, and yet at the same time they are able to experience, as well as examine, those consequences.

At the outset of a simulation participants may feel uneasy about the simulation; this arises not necessarily because of some inherent feature of simulation as a mode of being, but mainly and simply because it presents a new situation, and as such is uncertain. Any new or novel situation is problematic for parties to it — and this is one of the major values of simulation. The unease arises from the fact that a simulation is in some ways fundamentally different at the outset from ordinary situations. A simulation generally has no history, the roles are new, the (non-imported) rules have to be learned and are not yet taken for granted, and the general perception of the situation may be different to any previously experienced. In order words a simulation at the outset can be a fairly threatening situation for some people. In simulation, participants have to cope with all the uncertainties inherent in novel situations. At the start, participants will be concerned with reducing this uncertainty about themselves, others and the newly evolving social structures plus the nature of relationships.

Given that the simulation situation is initially uncertain, it presents a broader array of plausible alternative behaviours and interpretations, a greater uncertainty about the rules, their interpretation, and about the ways in which others are likely to behave. Initially participants have

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relatively little information or knowledge about the various beliefs and attitudes fellow participants hold; indeed many performances involve getting acquainted with people who were even strangers at the start. The major problem faced by participants, especially initially, is to reduce uncertainty, so that they can select appropriate strategies and behave accordingly in the particular situation they find themselves. If uncertainty is reduced then interaction will proceed smoothly; if not, interaction will be halting and less co-ordinated, but possibly more spontaneous, exploratory, creative, and even comic. However, the greater the anxiety associated with the unknown simulation, the greater the tendency to import and use known elements from the non-simulation world. In a game with people we know, one is often more at ease, because one set of uncertainties is already reduced. It is precisely in getting to know the situation and reducing the initial start-up uncertainty that participants are constructing it, and thus contributing to making it a taken-for-granted, run-of-the-mill, everyday, ordinarily encountered situation.

Thus a simulation context is just as real as a non-simulation one. Indeed, by way of its novelty, its uncertainty, and their consequences within the simulation, they are probably 'more real' than ordinary situations. Participants know that they have come with a certain disposition, in that it is a planned activity. People know that others (and they know that others know that they) have come to the simulation with a common purpose, but knowing little of what is to happen. People know that divergent non-conformist behaviours are to be expected and accepted, and yet they wish to avoid it, precisely because they remain first and foremost people.

It is in the debriefing that 'ex-participants' can reflect on and examine what happened. Debriefing allows parallels to be drawn between simulation realities and 'real' realities; it allows realities to be examined in a new, more 'realistic' light. Participants can then export the learning and insights gained to their other 'real' (non-simulation) world. During simulation, participants may occasionally think of the other (non-simulation) world, but essentially they will be, as it were, locked into the simulation reality mode; that situation will be their paramount reality. In the debriefing, however, participants are asked to step back from the simulation and toward the 'real' world. Here they will consider the experience from both the representational and the reality perspectives, and thus attempt to tie the two together in a creative and insightful appraisal of both realities, that of the simulation and that of the 'real' world.

In order to consider simulation as representation we must *first* ask ourselves what exactly happens in them — if the model upon which a simulation is based can be conceived as in some way representing some

portion of the real world, it does not necessarily and automatically follow that a simulation performance based upon that model retains, either for the performers/participants or indeed for the attentive analyst, the same correspondence relationships and algorithms. Simulation takes on a life and reality of its own, and organizers involved in these activities will ignore this perspective at their, and crucially their participants', peril.

Our two perspectives should not be seen as mutually exclusive but as complementary. The perspective adopted will depend on both structural and functional factors. The term 'simulator' is essentially representational, while 'simulation' is more oriented towards the reality perspective. Rules belong to both perspectives, but their source will vary according to types of rules being used. System referent rules are representational, but imported rules are part of the reality-defining process that happens in the thick of simulation. Strategies too can be considered from either perspective, but properly should be seen as part of the ongoing reality of simulation rather than as being built into the model. Error consequence too has traditionally been seen from within the representational perspective, but this rightly belongs to the very real experiences of participants.

Concerning the personnel involved in simulation, they too will see it from different stances. The representational view is that usually held by designers, and by many organizers. The reality view will be held by participants (at least during the ongoing performance), as well as by some organizers. In other words, reality for the designer is not always the same reality for the participant; for the designer 'reality' usually refers to the modelled world, *ie* the world 'out there', but for the player it means the simulation world, *ie* the 'here and now'. For the designer, consequences are ultimately irrelevant, or at least secondary — the main concern is mapping some perceived and conceptualized world into a model. Thus designers will above all adopt a representational perspective, but will keep in mind the practicalities of how the simulation will actually run, especially if the goal is educational. Designers must ultimately take account of how the game is brought to life. Participants will, of course, be almost totally immersed in their own reality during performance, but will consider the representational aspects during debriefing. Organizers, probably more than the two previous types, tend to see both perspectives, one eye towards the representational when considering whether to use a simulation and during debriefing, and the other eye looking at the ongoing reality during performance. An organizer sits on the fence and intuitively recognizes that there is a whole lot more to a simulation than the materials produced by the designer. An organizer is thus uniquely suited to directing the debriefing process, through which s/he encourages the

participants to take a Janus-faced view of things. It is important that we all be aware of which perspective is prominent at any given point in the simulation process.

Conclusion

What exactly is and happens in simulations determines both what these things are, what they can be used for, and how effective they can be. Their effectiveness has not been overwhelmingly demonstrated; many variables intervene. But, it seems that what these things actually are and what really goes on in them are vital questions which must be posed in any attempt at systematic assessment as to their 'effectiveness'. If, as we have attempted to show, they are not entirely what we think, or are inclined to think, then the measuring instruments we have been using to evaluate them are probably not the right ones. If we are trying to measure simulations (or their effect on the participants) in terms of their representivity, but realize that their greatest impact is in terms of their reality, then we are measuring the wrong thing, or rather we are trying to measure temperature with a barometer.

Participants often report very high levels of motivation, but traditional evaluations show that simulations do not always do better than classic methods, especially in the learning of facts. How easy is it to make accurate and consistent measures of such things as empathy, the reality-defining and negotiation processes, insight into complex relations, broadening horizons, and a whole host of ordinary everyday experiences? And why would we normally wish or even need to measure them? If, as we suggest, the answer to the first question is "not at all easy", then we need to recognize that we have a learning technique which we can only argue for, not prove. If the answer to the second question is: "because we wish to please the educational administrators", then we are fighting a losing battle. Both questions address the issues from a representational angle, but the meaningful answers can only be provided from within the reality perspective.

A simulation, like any social situation, is socially constructed and thus open to varying interpretation through negotiation. A real situation, whether simulation or any other, is one in which participants are personally involved, and in which they may 'live through' its dynamics — its social relations, issues, problems. There are many simulations which have quite outrageous starting data, but which may quickly evolve into a quite real world of their own. In fact, many simulations would be 'incredible' and 'unreal' if taken literally; simulations are essentially metaphorical. The fact that fantasy games quickly take on a reality and credibility of their own arises because participants develop their own world, despite such 'silly' features as demons and pixies.

Indeed, during a performance, participants may not be explicitly aware

of 'simulating', they do not continually ask themselves "what does this represent?" in terms of the 'real' world. This is precisely because they get involved, and the performance becomes very real in its own terms; it is the paramount, taken-for-granted reality. Just as in the 'real' world, simulation participants define their own simulation meanings, and meanings form the bedrock of socially negotiated realities.

Some simulations should properly be reconceptualized as 'operating realities' in their own right (rather like games?). Simulations involving social situations consist of the very same fundamental constituent and constitutive components (people, behaviours, meanings) as their 'real world' referents, and like these, once set up, take on a 'full life' of their own. Simulations bring themselves to life. If simulation is regarded and treated as a 'reality' taken for granted in its own right, the experiences of participants become 'real', and they are able to live through and live out one of the fundamental aspects of social life — that of the reality-defining process.

Indeed, much of what happens in a simulation is a result of what participants 'import' from the 'real' world by virtue of the fact that most simulations, being social situations, naturally mobilize participants' commonsense cultural understandings and competencies as ordinary society members. The participants themselves both make the situation real and respond to that reality. This is because, as social actors, we are all individually and collectively both producers and products of our socially defined and negotiated realities, whether this be in 'society' or in those short episodes we call simulation.

Note

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