

# Worlds Before and Beyond Words: Virtual Formality for Virtual Reality?

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## Acknowledgements

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## Introduction

Our agenda

- have developed computer-based modelling method
- differs from classical language-based models
- analysis suggests potential for VR
- demands a metaphysical account

... about reality

- what really happens at a cricket match?
- reality associated with keyboard skills
- "I cannot bite the day to the core"

... our primary motivation has been the engineer's reality

Michael Heim: The Metaphysics of Virtual Reality

"7 divergent concepts guiding VR research"

**simulation** - realism in images and sound

photorealistic real-time texture-mapped images etc

**interaction** - existence through appropriate interaction

[electronic] representation with which can interact

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## About Reality

- *what really happens at a cricket match?*
  - viewpoint, focus of attention, interpretation
- *reality associated with keyboard skills*
  - personal knowledge and skill
  - adaptation to environment
- *"I cannot bite the day to the core"*
  - transcendent quality of experience
  - inexhaustibility in experiential terms

cf. Heim's "**3 hooks on reality anchor**"

- mortality - never to be repeated
- temporality - never to be revoked
- possibility of harm - demanding care

... our primary motivation has been the engineer's reality

reality of engineering products seems "self-evident"

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## Is VR a 20th Century phenomenon?

### Separation of concerns

- technology to imitate sensory experience  
*what does a cat look like? feel / sound / smell like?*
- insight into the scope for interaction  
*what sort of experiences can we have with a cat?  
exploratory nature of the cat concept*

NB want more than a circumscribed aspect of catness

### Elaboration

*fooling the senses*

Cf in former times:

artist's impression, photograph, stuffed cat, china cat  
... but now we can construct a hologram

.... can't so easily imitate cat smell?

*fooling the mind*

VR concerned with simulating interaction with a cat,  
exploiting technology to construct a cat-like agent

### Reflections

Means to evoke current state of cat from particular  
perception is prerequisite for constructing VR model

BUT is not by any means *sufficient*

Realism in interaction has a deep conceptual aspect  
of TopCat, Tom and Jerry, Cats musical

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## Constructed Models

Peter Naur:

Knowing and the Mystique of Logic and Rules

a **constructed model** is a part of the world,  
understood commonly by several people  
to have a peculiar relation, that of **modelling**,  
to another part of the world, the **modellee**

## The Theoretical Perspective

model as aid to communication

cf. orrery to represent planets

correspondence preconceived, limited in scope

serves a particular goal

association between model and modellee not explicit

hence cultural, mediated by language

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## Realistically imitating state vs realistically capturing behaviour

### Issue

to what extent does power to fool the senses assist  
representation of behaviour in interaction?

### Considerations

- VR and the 16th century mind-set

*would VR lead to animation of the Chain of Being?  
what degree of realism is there in such a model?*

- observables in modern science

*how is VR bound up with other than patent realism?  
what **can** be directly experienced as fn of what **can't***

Need modelling techniques to ...

- represent what I/we directly experience  
"what I/we observe"  
*without this ingredient VR is not realistic*

- express what I/we think happens / expect to happen  
"what I/we believe"  
*without this ingredient VR does not admit interaction*

draw on **empirical & theoretical** strands in engineering

conceptual design as dialogue between

what we **observe** to be true  
and  
what we **believe** to be true

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## The Theoretical Framework

Behaviour of model is **what can be inferred from theory**

e.g. mathematical model

computer program

logical specification

... appropriate interaction is circumscribed by real-world  
knowledge that informed theory

Two aspects to a theory (conviction / communication):

- look no further, needn't experiment (personal)
- common knowledge (public theory)

Only VR in a limited sense?

- doesn't admit unrestricted exploration as of a reality  
cf goal-oriented model: needs no further exploration

Pipedream for VR: **The Theory of Everything**

Is there a framework for observation within which all  
phenomena can be consistently explained?

e.g. can we explain emergent properties perceived at a  
high-level of abstraction by modelling at the level of  
fundamental particles? [cf Cohen and Stewart]

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## Issues for a Theoretical Framework

Experiments with a virtual knife

*what can it cut?*

*can it be sharpened?*

*at what temperature will it melt?*

*can it be used as a screwdriver?*

*when will it cast a reflection on the ceiling?*

*would it be funny if used in mock knighting ceremony?*

*would it frighten someone if brandished?*

... improbable that all are consequences of one theory

### Implication

... motivation for a mode of modelling in which

*the VR environment is indefinitely refined as it is explored and developed through observation and experiment ...*

*refinement process involves introducing both empirical and theoretical ingredients*

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## Closed-world Computational Models

Church-Turing thesis: every algorithmic process can in principle be executed on a Turing machine

Turing machine state: tape with symbols

*cf. Virtual Reality / constructed model state*

computation interpreted as experience

- mediated through symbols
- with preconceived input / output relation
- via circumscribed rules for transformation

state-change in Turing machine not visible or interpreted

*cf. Virtual Reality: presentation of states that invite unrestricted human interaction and interpretation*

closed-world view pertains in theoretical model:  
faithful to circumscribed experience

BUT

doesn't meet challenge of **ignorance representation**  
cf Gooding on empirical foundations of physical theory

... need some new foundation to justify VR?

"Virtual Formality"

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## Closed world vs. open development cultures in engineering .... [Brödner]

One position, ... the *closed world* paradigm, suggests that all real-world phenomena, the properties and relations of its objects, can ultimately, and at least in principle, be transformed by human cognition into objectified, explicitly stated, propositional knowledge.

The counterposition, ... the *open development* paradigm ... contests the completeness of this knowledge. In contrast, it assumes the primary existence of practical experience, a body of tacit knowledge grown with a person's acting in the world. This can be transformed into explicit theoretical knowledge under specific circumstances and to a principally limited extent only .... Human interaction with the environment, thus, unfolds a dialectic of form and process through which practical experience is partly formalized and objectified as language, tools or machines (i.e. form) the use of which, in turn, produces new experience (i.e. process) as basis for further objectification.

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## John Keats on Negative Capability

... several things dovetailed in my mind, and at once it struck me what quality went to form a Man of Achievement ... - I mean Negative Capability, that is when a man is capable of being in Uncertainties, Mysteries, Doubts without any irritable reaching after fact and reason ...

Letter to George and Thomas Keats  
December 1817

... a Challenge and a Caution!

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## David Gooding on Science and Philosophy

Most received philosophies of science focus so exclusively on the literary world of representations that they cannot begin to address the philosophical problems arising from the interaction of these worlds: empirical access as a source of knowledge, meaning and reference, and, of course, realism.

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## Empirical Modelling Principles

realism as in sensory impression

vs.

expectations about potential interaction and response

"mental model" of latent characteristics of environment

same degree of realism but very different expectations  
of Elizabethan age vs 21st century

Empirical Modelling as a thesis re how such expectations  
are most appropriately represented and expressed

- observables: primitive identities
- dependency: indivisibly linked change
- agency: centres of state-change
- stimulus response patterns: reliable mechanisms

negotiate an explanation by adapting model and referent  
"nothing is true without circumscription of context"

no objective standpoint in general: many viewpoints

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## The Empirical Modelling Framework

Characteristic idea: directly correlate two experiences  
e.g. measure edge of a brick by cutting a string to length  
make a scale model of an engineering mechanism  
create a spreadsheet  
develop a scientific instrument  
acquire a practical skill

Establish corr. between two sets of **observables**:

real-world observables of interest    *situation*  
reference set of observables            *model*

Correlated so that:

way in which observables are indivisibly linked in  
change is identical in situation and model

BUT

correlation doesn't presume similar mode of experience  
of altimeter vs. perception of height in aeroplane  
debatable whether this is obligatory feature of VR

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## Empirical Modelling Constructs

observable: entity with an identity

feature e.g. corner of table  
attribute e.g. length of table  
property e.g. is antique  
event e.g. ball hits ball

dependency: correlation between observables in change

mathematical relationship e.g.  $\text{area} = w \cdot l$   
mechanical link e.g. lever releases brake  
semantic link e.g. signature buys house

"definitive notations"

agency: coincident association of observables  
as entity to which attribute state-change

human, sensory, electro-mechanical compt  
environmental ingredient: time, gravity

stimulus-response patterns: reliable interactions  
privileges [cf. C16-C20]

behaviour of computer / electro-mechanical device  
cf. person answering the telephone

"LSD + ADM"

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# Empirical Modelling Illustration

## The Vehicle Cruise Control Simulation

### observables:

- speedo characteristics
- vehicle characteristics
- dynamics of vehicle

### dependencies:

- speedometer display on measured speed
- traction force and accelerator position
- orientation of vehicle and position on hill

### agents:

- driver, cruise-controller, speed transducer
- speedometer, designers, user of model

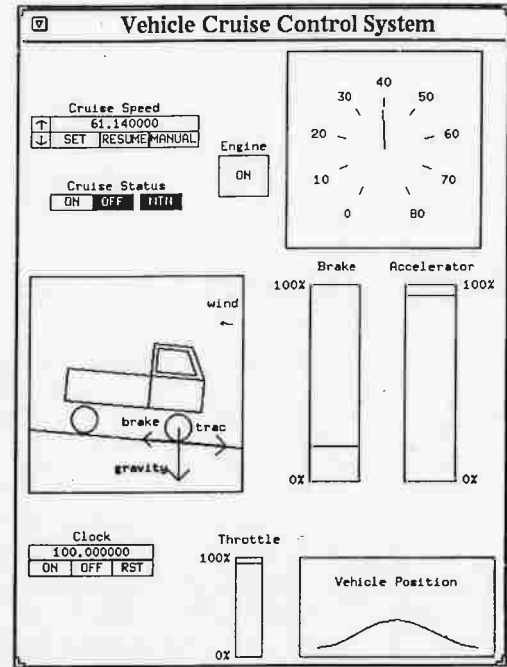
### stimulus-response patterns:

- speed transducer reports measured speed
- braking triggers cruise cutout

### Circumscription:

- Newtonian model, uniform gravity
- cf. vehicle length depends on speed
- change road profile: maintain cruise speed

**Viewpoints:** designer, engineer, driver ... "superuser"  
 Experimental context for each can be made explicit ...



Sample Output of the Vehicle Cruise Control Simulation

## Our Empirical Modelling process ....

whilst model is improving {

by correlating  
 experience of the referent  
 and experience of the model

where  
 experience = observation + experiment

identify

- observables
  - identities perceptible by agents
- indivisible relationships
- patterns of observables
- atomically linked in change
- agents
  - centres of state-change
  - stimulus-response patterns

and refine context for experience by  
 adapting model and referent

}

derive specification by an act of commitment

/\* commitment eliminates the modeller as agent \*/  
 /\* result is a 0-agent model \*/

## Characteristics of Empirical Models

Presented with two states and means to interact:  
 communication via environment rather than document

Hence can use empirical modelling where  
 no comprehension of state  
 no circumscription of interaction *before words*

Suited to VR in respect of realism in **interaction**

**physical model can faithfully reflect** both immediate and  
**cumulative experience of the situation** via interaction  
*beyond words*

apprehension of model can be **private & non-linguistic**

NB to construct model may use language / communication  
 apprehension of object associated with user role  
 construction with the designer / programmer role

BUT

can also devise physical object to reliably imitate / reflect  
 its context as a 'model' of its 'situation' *by serendipity*

... need not be *computer-based* e.g. the sundial

Hence

*worlds before and beyond words*

“... the metaphysical account”

### VR from the Private Perspective: 1-agent model

Concerned with correlating two sets of observables  
**model and situation**

perform experiments in both model and the situation

process involves identifying new observables  
recognising dependencies between observables

dependency = way of reliably determining value  
of one observable from others

determination means

- reliable interaction *within an independent situation*
- input/output convention for  
supplying stimulus and interpreting response  
cf. "use of a calculator"

reliable interactions of this kind = theory (possibly private)  
consider e.g. personal way we each perform a calculation

- experimental context and actions, pre-articulate, prior to conviction, are difficult to repeat and identify
- independent concerns  
"acquiring conviction" and "communicating"

### Illustrative example

Private mental models we acquire to exercise a skill  
e.g. correlating body movement and intended tennis shot

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### VR from the Private Perspective: multi-agent

#### Two concerns

- identifying other agents within the model *private*
- communication to other human agents *public*  
as if in sharing experience

#### Other agents within the model

by experiment identify the extent of our own actions  
(dependency expresses this)

leads us to speculate on, and gain conviction about

- constraints between observables
- other agents responsible for change

Important element in perception of reality e.g. identify

- which observables are constant
- which are subject to change
- what we deem to be plausible and what miraculous

#### Scientific Instruments and Observables

instrument = component perceived to respond reliably in  
a manner correlated to its context

... supplies basis for extension of concept of observable

experiment leads to identification of auxiliary observables  
e.g. movement of needle in presence of magnetic field

can correlate actions of agents with such observables

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### VR from the Public Perspective: multi-agent

#### Communication with other human agents

reality as consensus vs reality as personal experience

Two forms of communication

- sharing experience, teaching a skill: "let me show you"  
e.g. demonstrate mental model behind tennis shot
- attach symbols to reliably perceived elts of experience  
perform expt in (situation + symbols in context)

agent articulating symbol emulates scientific instrument

#### Role of Projection

Where reliability presumed, can do without actual expt

Dialogue takes place in imaginary world: "if we were to do  
the following, we should observe thus ...."

... language takes place of interaction with environment

cf document animated in the reader's imagination

#### Implication

account of intersubjectivity

metaphysical position in respect of reality

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### Summary

VR aspires to fool the senses and the mind by achieving  
realism and interaction in the exploratory sense

... this can't be done within closed modelling systems

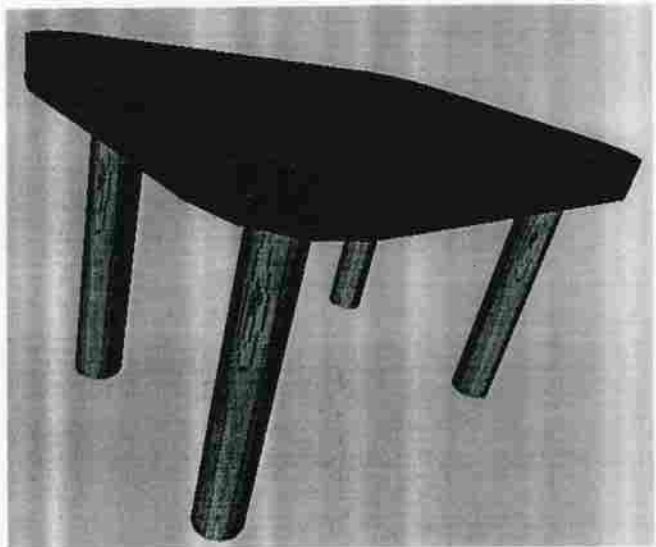
... can't be done on the basis of preconceived  
interpretation of symbolic actions alone

... modelling process must be open-ended and rooted in  
personal immediate experience

... Empirical Modelling offers promise as practical and  
principled approach

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"In this mechanical picture of the world the essential, one might even say **definitive**, event was the concept of a law as a **dependence** between **variable quantities**."

Fyodor A Medvedev - a Russian historian

*Scenes from the History of Real Functions,*  
Science Networks - Historical Studies Vol. 7,  
Birkhäuser-Verlag 1991