

“Computational modelling of attachment”

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Contents

- John Bowlby was a modeller
 - formulating the attachment control system
- Mary Ainsworth was too
 - investigating different kinds of attachment context for infants
- Modelling infant-carer dyads
 - how adult models are part of the context for infant models
- Fractionating the attachment control system
 - Attachment scripts are part of the attachment control system



John Bowlby was the first attachment modeller

What kind of attachment models did Bowlby formulate?

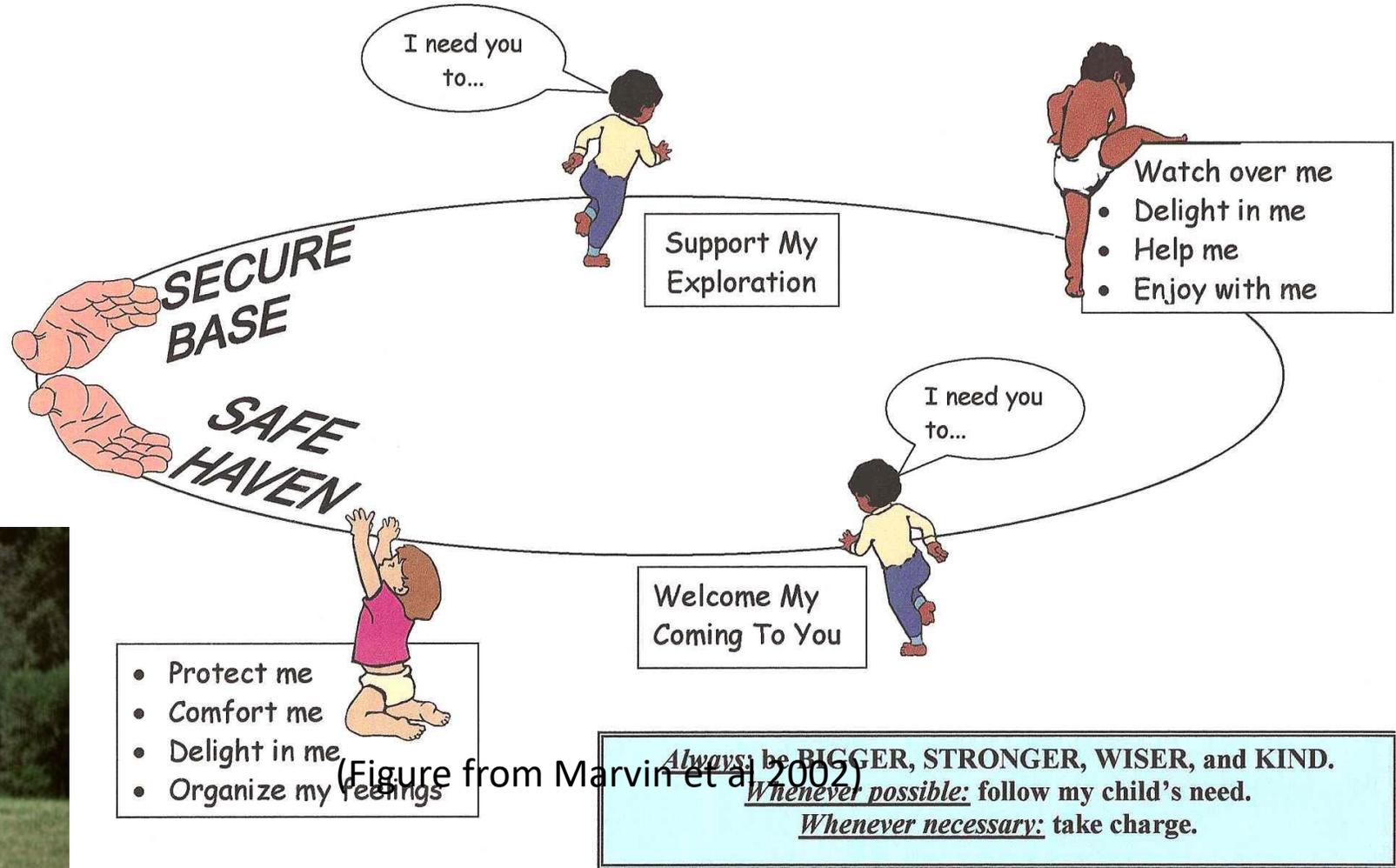
- Different kinds of models
 - Statistical models
 - Mathematical models
 - Computational (process) models
 - Models of attachment that detail internal mental structures, processes, mechanisms and representations that give rise to externally observable behaviour
- Scientists creating models of organisms in their environment which themselves create models of self and environment

Introduction to Attachment Theory

- **Behavioural component**
 - The Strange Situation Procedure
 - Attachment Q sort
 - Measures in later childhood; adolescence; adult romantic relationships;
 - Adult Attachment Interview (AAI); Secure-base scripts in adults
- **Cognitive component**
 - behaviour systems: from ethological 'behaviours' to cybernetics, control systems, hierarchical plans, Internal Working Models, and natural language
 - Bischof (1974) Petters (2006, 2010)
- **Experiential component**
 - When attachment figure is close feel good/secure;
 - when separated feel anxious, sad, lonely

Security versus exploration

CIRCLE OF SECURITY PARENT ATTENDING TO THE CHILD'S NEEDS



The Architecture of Bowlby's Attachment Control System

- Hierarchical planning
 - Low level actions and higher level declarative plans
- Internal Working Models
 - Analogue versus symbolic
- Defensive Processes
 - Psychopathology from conflicting IWMs and defensive exclusion
 - Earlier primitive and unaware and later open to reflection
- Consciousness
 - Allows revising, extending, and checking
- Therapy as meta-management
 - We can adopt IWMs from others

Any
Questions
?



Mary Ainsworth focused on context changes

From naturalistic observations to a controlled 'Strange Situation'

- The Strange Situation Experiment arose from comparing Ugandan and US infant attachment behaviours
- Involves 3 separation/re-union stages
- Each new stage increases the amount of anxiety they produce
- Looking for pattern iss between home behaviour of mother and infant and infant behaviour in SS

Strange Situation Experiment behaviour—eight episodes of three minute duration

1. mother, infant, experimenter (<1minute)
2. mother, infant
3. mother, infant, stranger
4. infant, stranger
5. mother, infant
6. infant
7. infant, stranger
8. mother, infant

Different kinds of context

- Home context
- Unfamiliar context
- Increasing stress context

- Separations and reunions and a friendly stranger

Strange Situation Procedure

- Compare home and laboratory behavioural patterns– 3 clusters of response found
- Three main clusters of response found (with a 4th minor cluster later characterized)
- Secure
 - Type B, positive, greeting, being comforted
- Insecure
 - Avoidant - Type A, not seeking contact, avoiding gaze
 - Ambivalent/resistant – Type C, not comforted, overly passive, show anger
 - Disorganised - Type D, totally disorganised and confused
- A key link found between home behaviour of mother and infant; and infant behaviour on final re-union episode in the SS
- Reunion not separation is key – how does infant represent carer as secure base

Behaviour in reunion episodes

Type A - Described as insecure-avoidant. Not seeking contact, avoiding mother's gaze or physical contact with her, returning quickly to play and exploration but with less concentration than secure children. Whilst playing they stay close to and keep an eye on their carer. They received care at home which was rated as insensitive, rejecting, and interfering or ignoring.

Type B - Described as securely attached. Response to mothers was: positive, greeting, approaching, making or accepting contact with, or being comforted by her. Returned to play and exploration in the room sooner. Received care at home which was rated as sensitive, accepting, cooperative and accessible.

Type C - Described as insecure-resistant/ambivalent. Response to their mothers on reunion was: not being comforted and overly passive or showing anger towards their mothers. Do not return quickly to exploration and play. They received care at home which was rated as insensitive, only moderately accepting and moderately cooperative and often ignoring.

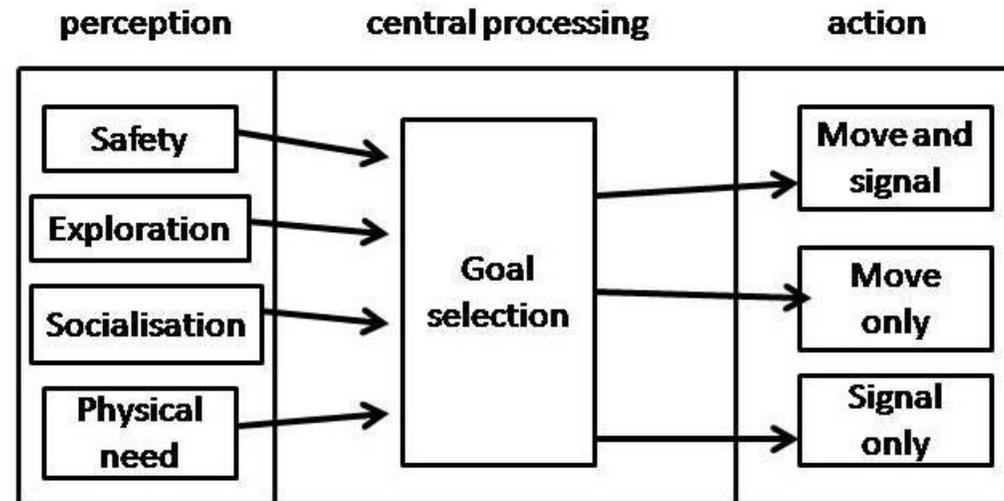
Type D - Described as insecure-disorganised. Response to their mothers was: totally disorganised and confused. The home environment of behaviour for this very small proportion of infants has been found to be often dysfunctional

Maternal home behaviour prior to the SS vs subgroups

SS subgroups Maternal Behaviour\	B1	B2/B3	C1	C2	A2	A1
Sensitivity	7.36	4.50	2.50	2.25	2.50	2.75
Acceptance	8.00	6.75	5.50	5.25	4.25	3.50
Co-operation	7.66	6.50	4.00	4.50	5.50	2.63
Accessibility	7.39	4.88	4.50	2.50	2.25	4.63
Lack of emotion*	2.17	3.88	4.25	2.75	6.50	6.00
Rigidity*	1.89	2.75	2.00	3.50	3.50	4.50

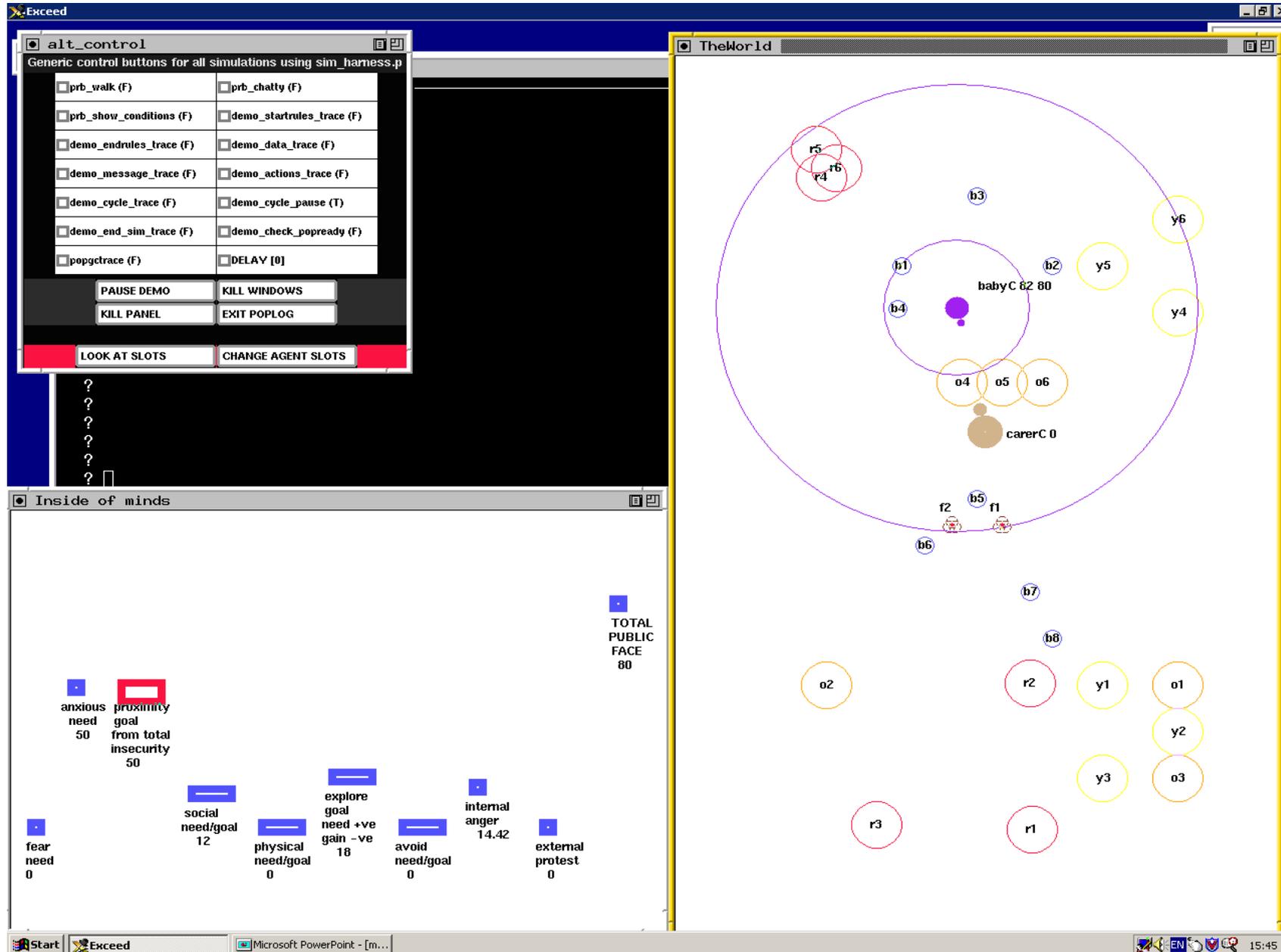
Infant agent architecture to simulate the SS

- Behaviour systems that set goals
- Goals compete with each other
- Winner take all architecture
- A goal is selected every time slice over many thousands of time slices



- Petters (2006, 2010)

An ambivalent infant agent



Exceed

alt_control
Generic control buttons for all simulations using sim_harness.p

<input type="checkbox"/> prb_walk (F)	<input type="checkbox"/> prb_chatty (F)
<input type="checkbox"/> prb_show_conditions (F)	<input type="checkbox"/> demo_startrules_trace (F)
<input type="checkbox"/> demo_endrules_trace (F)	<input type="checkbox"/> demo_data_trace (F)
<input type="checkbox"/> demo_message_trace (F)	<input type="checkbox"/> demo_actions_trace (F)
<input type="checkbox"/> demo_cycle_trace (F)	<input type="checkbox"/> demo_cycle_pause (T)
<input type="checkbox"/> demo_end_sim_trace (F)	<input type="checkbox"/> demo_check_popready (F)
<input type="checkbox"/> popgctrace (F)	<input type="checkbox"/> DELAY [0]

PAUSE DEMO KILL WINDOWS
KILL PANEL EXIT POPLOG

LOOK AT SLOTS CHANGE AGENT SLOTS

Inside of minds

<input type="checkbox"/> fear need 0	<input type="checkbox"/> anxious need 0	<input type="checkbox"/> proximity goal from total insecurity 0	<input type="checkbox"/> social need/goal 1	<input type="checkbox"/> physical need/goal 0	<input checked="" type="checkbox"/> explore goal need +ve gain -ve -8	<input type="checkbox"/> avoid need/goal 0	<input type="checkbox"/> internal anger 0	<input type="checkbox"/> external protest 0	<input type="checkbox"/> TOTAL PUBLIC FACE -7
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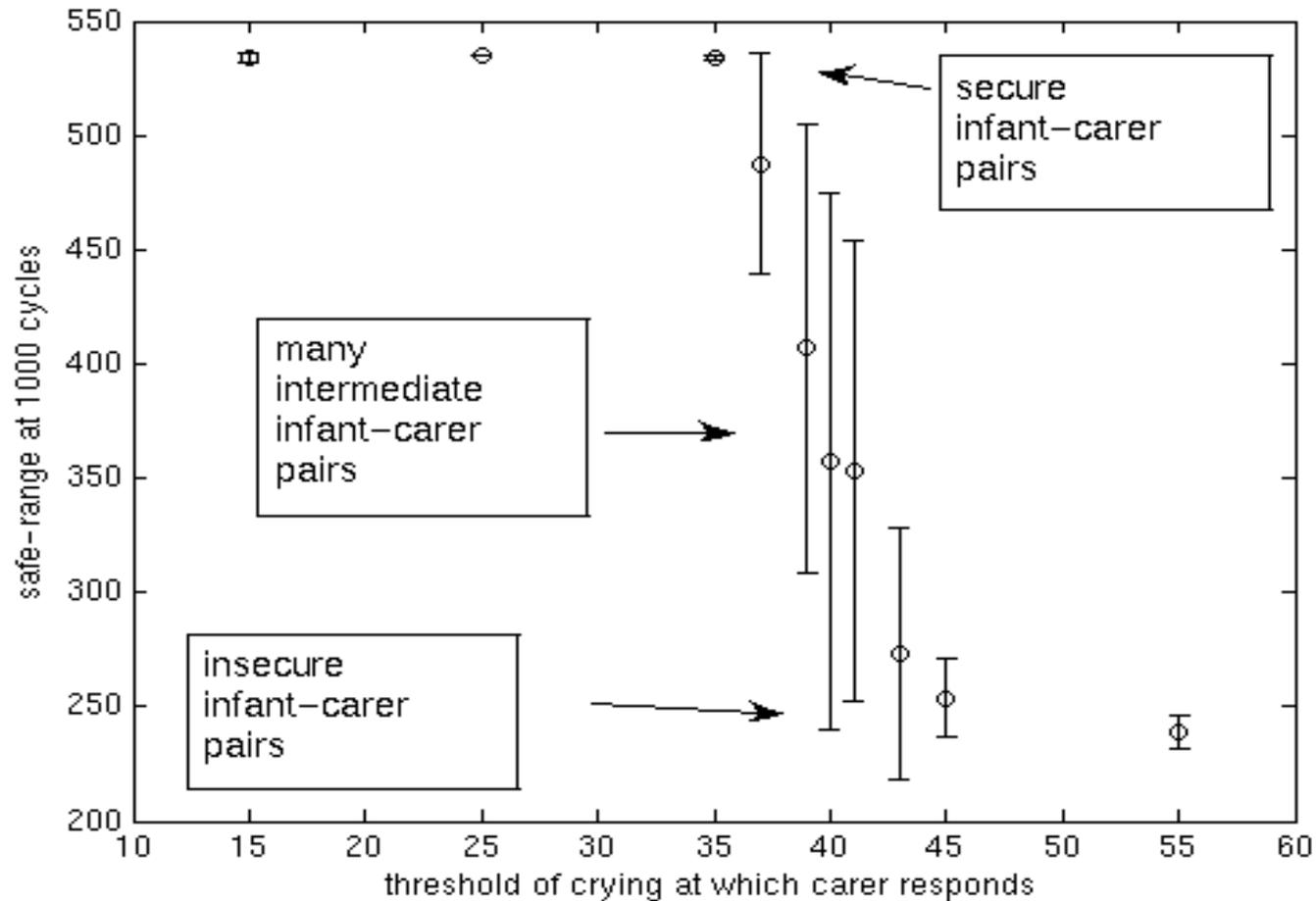
TheWorld

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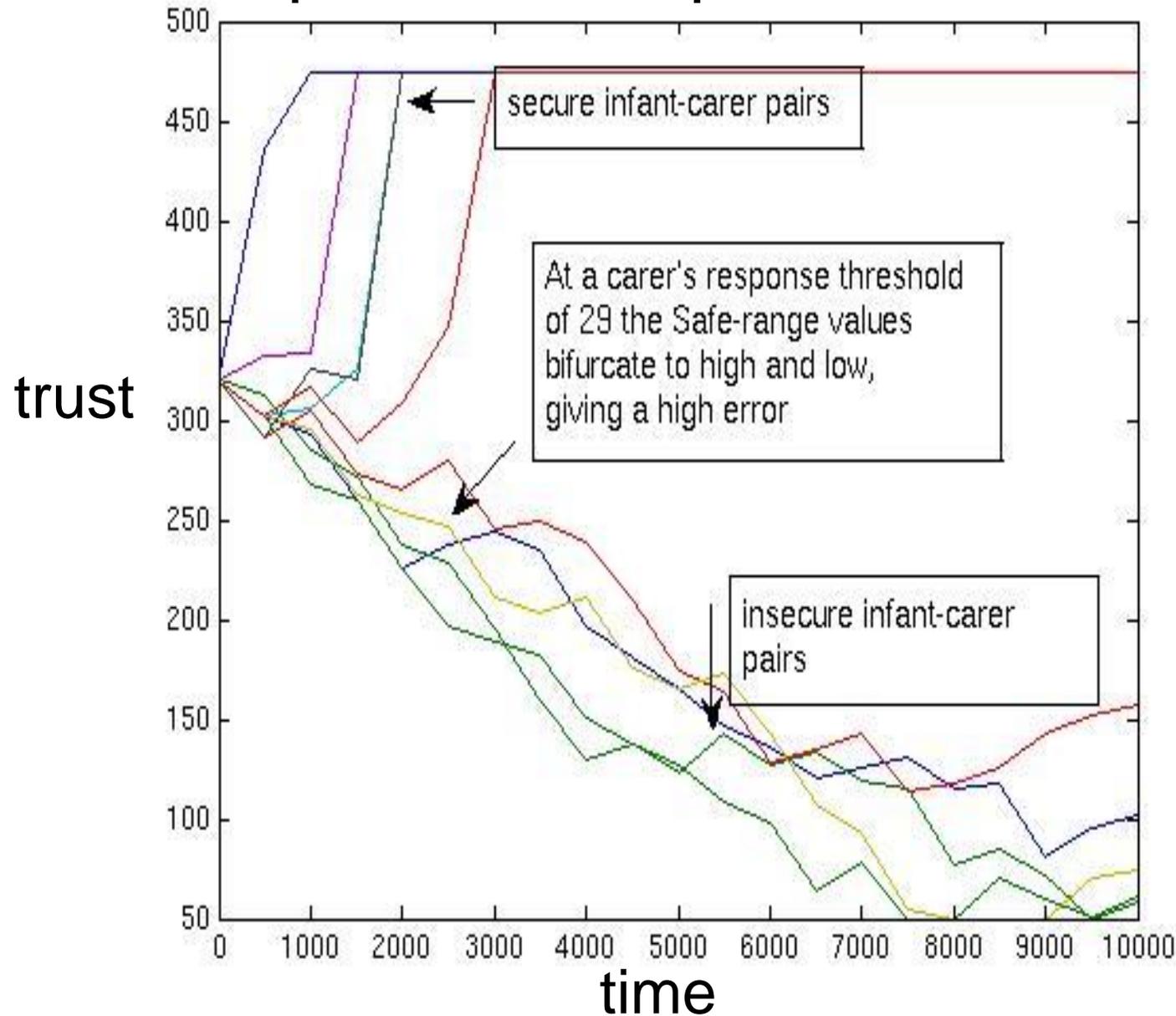
A
Secure
infant
agent

Computational experiments

Learning from responses to socialising



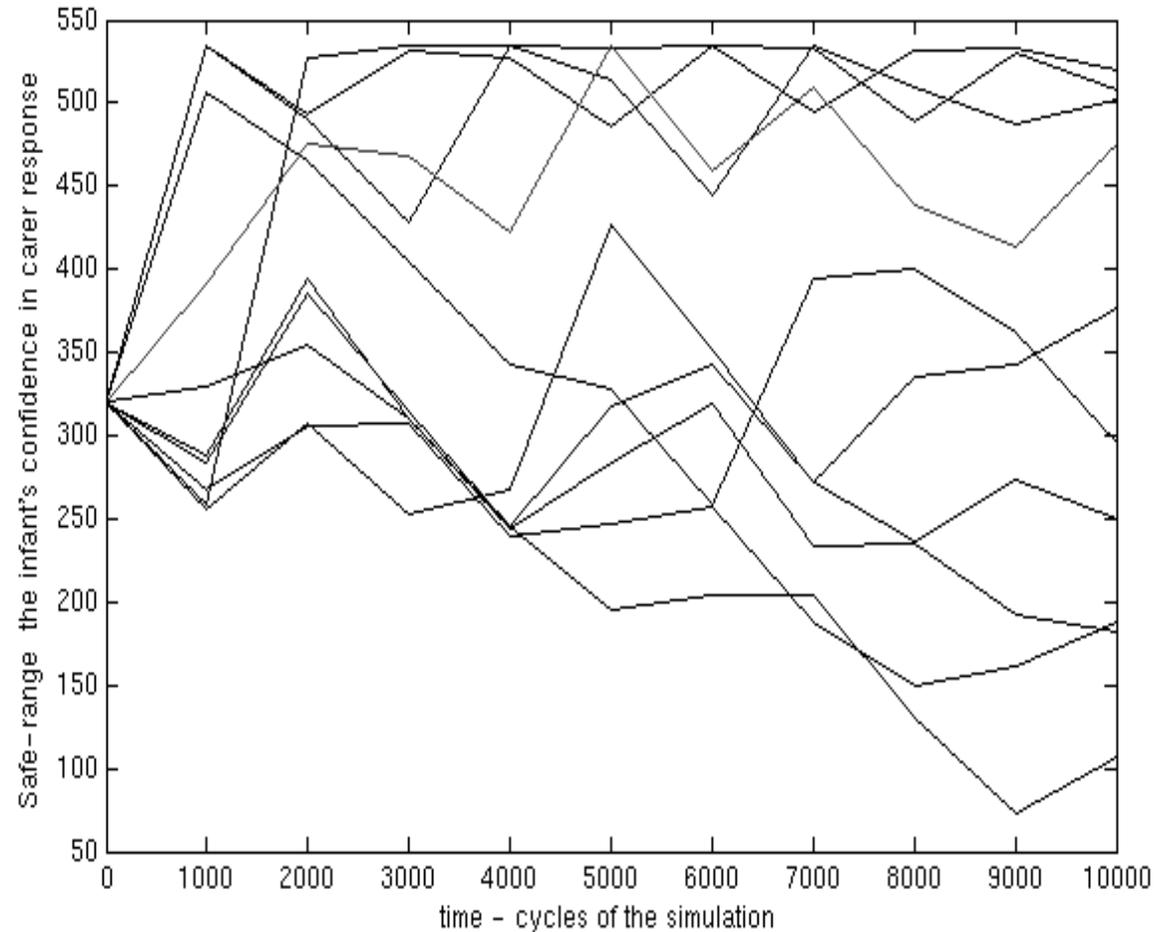
Computational experiments



- same carer sensitivity leads to two infant outcome patterns with no intermediate cases

Computational experiments

Learning from responses to socialising



The D category

The D category

- Issue of best fit
 - Before D category often best fit B but poor positive attempts to gain proximity or explore
- individuals with behaviour which seemed to lack a readily observable goal, intention or other explanation
 - approaching but with head averted, stilling, freezing, or disorganised in more abstract sense as not fitting expectable temporal ordering
 - Stereotypes/stilling/freezing observed but relationship specific, for example d pattern only found with one parent

The D category

- d in high risk samples plus d in low risk samples, with carers with unresolved loss
 - frightening/frightened hypothesis
- But perhaps multiple causes of disorganisation/disorder?
- Longitudinal studies conducted
 - But lack of studies that make multiple tests for disorganisation near to point in time when first measured

The Strange Situation and Mental Health

- Substantial evidence that gaining secure attachment status confers advantages in social competence
- Attachment and psychopathology
 - Risk factors approach
 - No direct link of SS insecure status to psychopathology
 - No 'main effect' with development of later illness
 - No 1:1 relationships,- multiple risks, multiple outcomes
- But D category is different
 - Low frequency in typical populations
 - Strong links to suboptimal outcomes
- Purpose of modelling
 - stress physiology vs models at psychological level

Any
Questions
?



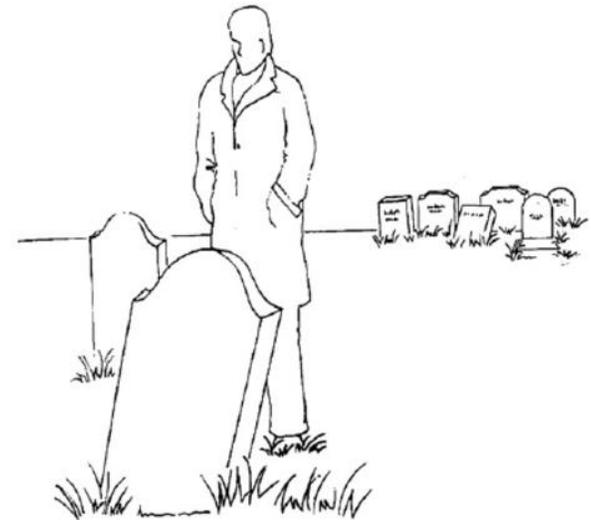
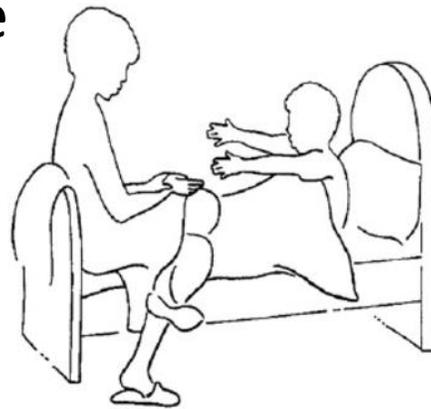
Modelling infant-carer dyads

Move to the level of representation

- Main *“A move to the level of representation”*—testing of infant/carer at 1 year—retesting at 6 years—study dialogues concerned with prospective two week separation—short separation and response to photographs—drawing pictures of the family—AAI on parent of 6 year olds
- •Kobak(1993)—Teenagers studied using AAI and Q sorts—Investigating how teenagers regulate their emotionsReview

The Adult Attachment Interview (AAI)

- Measures security/secure-base stance
 - Related to the infant 'Strange Situation Procedure'
 - A kind of stress test
- Attentional flexibility
 - Focus away from past experiences
 - Focus towards past experiences
- Four categories
 - Autonomous –secure
 - Dismissing –avoidant
 - Preoccupied - resistant/ambivalent
 - Unresolved - disorganised



Similarities and differences

- Strange Situation
 - Secure (go back to play) VS insecure
 - Organised vs disorganised (e.g. stereotypies)
 - A kind of stress test
 - Described by physical behaviour, movements of body, face and gaze
- AAI
 - Secure (full balanced coherent recall) VS insecure
 - Organised vs disorganised (e.g. loss)
 - A kind of stress test
 - Described by discourse properties (Grice's maxims)

Match Grice's Maxims of Discourse to the four AAI categories

- AAI Four categories
 - Autonomous –secure
 - Dismissing –avoidant
 - Preoccupied - resistant/ambivalent
 - Unresolved - disorganised
- AAI measures whether parent discourse shows
 - Quality
 - truthfulness, consistency
 - Quantity
 - succinct and complete
 - Relation
 - relevance to topic
 - Manner
 - clear and orderly

Abstracting from real data

- Question 3 in the AAI asks the participant to
 - *“Think of five adjectives, words, or phrases that would best describe your relationship with your mother during childhood- say, between ages of 5 and 12, but even earlier if you can remember. Take a minute to think, and then I am going to ask you why you chose them.”*
- The following three responses chose ‘loving’

A secure adult

- *“My mom would stick up for me to the teacher, or to a kid’s parent, or... anybody, really. I could put it another way, too. I just knew where I stood with her, and that she’d be comforting if I was upset or crying or something. Oh, maybe you wanted a specific example. Um, that time I set fire to the garage, using my brother’s chemistry set, I absolutely positively wasn’t supposed to use... came running when the neighbours phoned the fire department about the smoke. I expected to get the life lectured out of me, but she just ran straight for me and picked me up and hugged me real hard. Guess she was so scared and glad to see me, she just forgot the lecture.”*
- 130 words

Insecure dismissing/avoidant adult

- “I don’t remember...(5 second pause). Well, because she was caring and supportive. [interviewer prompt] Well....(5 second pause), I guess like, well you know, she drive me to school, and I was always really proud of her, I mean, she was really pretty, and she always took care of her appearance.”
- 50 words

Insecure preoccupied adult

- *“Uh, yeah, sort of very loving at times, like people were in the old days- uh, my youth, lot of changes since then. I remember home, and home was good and that. And uh, loving, my wife is loving with [child] - taking him out to the movies tonight, special thing he's been wanting to see all week, dadadada. Actually, it's been more like a month, that turtle movie, don't like it too much myself. too many turtles- where are they from, outer space? saw it, though, now, when was it, um, maybe 6 months ago. Yeah she's very loving with [child].' [Interviewer probe] 'Really great things, felt really special, really grateful to her for that. my childhood, I remember just sitting on the porch, rocking, rocking back and forth, watching my parents, or maybe having some lemonade- or, you know, this, that, and the other. special sorts of things, just me and her. I wasn't easy, my temperament was hard on her, kind of hard. Me and my cousins from [Town] going down soon - really big birthday, she gonna be 80, gives my age away (continues).”*

- **187 words**

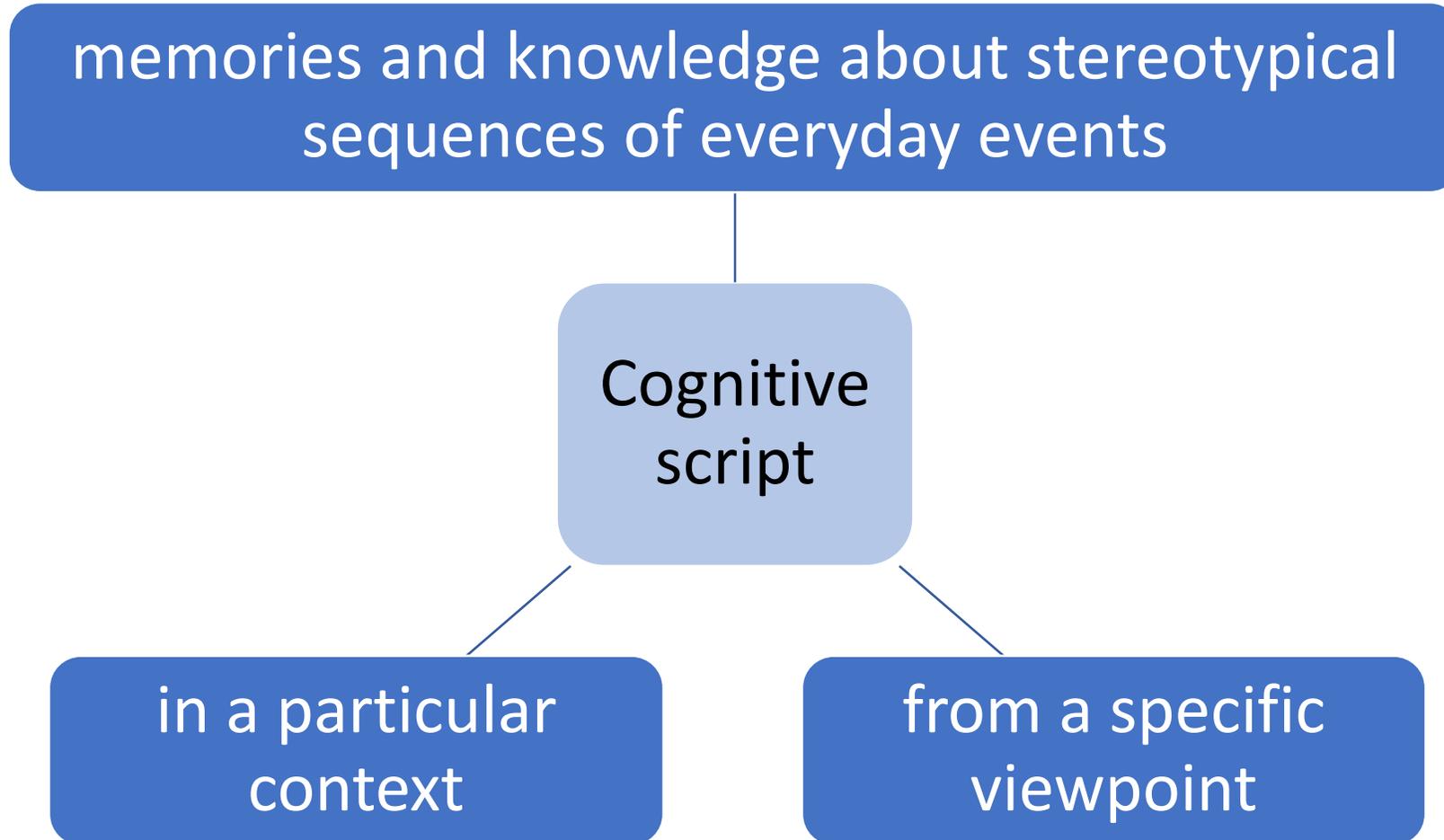
Any
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The attachment script assessment

- Prompt words that used to form stories
- Stories then assessed for presence of secure base script

Cognitive scripts



What does the ASA assess?

Secure base script content (underpins felt security and secure attachment behaviours)	Engagement in constructive activity
	A challenge disrupts the activity and leads to distress
	Attached individual signals for assistance
	Attachment figure recognises the signal and responds
	Assistance is accepted
	Assistance resolves the challenge
	Comforting behaviours
	Attached individual resumes constructive activity

Bretherton, Prentiss, and Ridgeway, (1990); Waters and Waters (2006)

Example of an Attachment Script Assessment (ASA) prompt word list

Baby's morning

mother

hug

teddy bear

baby

smile

lost

play

story

found

blanket

pretend

nap

Example 2 of an Attachment Script Assessment (ASA) prompt word list

The doctor's office

Tommy

hurry

mother

bike

doctor

toy

hurt

cry

stop

mother

injection

hold

Example 3 of an Attachment Script Assessment (ASA) prompt word list

The Party

Friday night

sulk

blockbuster

party

couch

film

uninvited

mum

popcorn

miserable

talk

smile

Assessing script security: Secure base behaviour themes

strategies

- Select and implement strategies for getting things back to normal
- Facilitate transitions to other activities
- Provide explanations

reconfiguration

- Reconfiguration of the other person's representation to focus on the positive (e.g. point out the bright side)
- Diffusion of negative emotions

interpersonal focus

- Awareness of the other person's psychological/emotional state
- Interaction
- Responsive to behavioural cues and requests
- Give and take/teamwork
- Emotional give and take

Any
Questions
?



references

- D. Petters (2019). [The Attachment Control System and Computational Modeling: Origins and Prospects](#) *Developmental Psychology* 55, 2, 227-239. DOI: 10.1037/dev0000647
- D. Petters (2016). [An Encounter Between 4e Cognition and Attachment Theory](#). *Connection Science*, 28, 4, 387-409
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