An encounter between Attachment Theory and 4e Cognition

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Abstract.

A number of research questions arise from an encounter between the elements of 4e cognition and Attachment Theory. These include: (1) whether the Attachment Theory concept of Internal Working Models should be understood in terms of analogue representations more in line with embodied cognition, in addition to traditional cognitivist representations like linguistically mediated narrative measures of attachment meaning?; (2) are infant-carer dyads best thought of as environments of contextual embedding for infant cognition or as an arrangement where the carer can actually extend the infant mind?; and (3) are attachment phenomena best thought of in traditional representational terms or should the attachment control system be reframed in enactive terms where traditional cognitivist representations are: (3i) substituted for sensorimotor skill-focused mediating representations, (3ii) viewed as arising from autopoietic living organism and/or (3iii) mostly composed from the non-contentful mechanisms of basic minds?; A theme that cross-cuts these research questions is how representations for capturing meaning, and structures for adaptive control, are both required to explain the full range of behaviour of interest to Attachment Theory researchers. Implications are considered for future empirical and computational modelling research, and clinical interventions.

1 INTRODUCTION

The infant-caregiver relationship not only plays a central role in social and emotional development, but also in exploration and learning [3, 9, 10]. A traditional cognitivist approach to explaining these phenomena would emphasise internal information processing, located within the individual mind. So this approach in Attachment Theory would focus on what is or should be in the infant's head. A theoretical approach that keeps cognition within the infant is seductive because of its conceptual simplicity and because this approach is more easily implemented in cognitive models that focus on the creation and transformation of internal representations [18, 19, 20]. The elements of 4e cognition - viewing cognition as embodied, embedded, extended, and enacted - all reject or radically reconfigure traditional cognitivism [16]. Whilst the core ideas in Attachment Theory were set out by John Bowlby in a series of papers and books between 1958 and 1982 [2, 3, 5, 6], the elements of 4e cognition are more recently defined [16], but have many earlier conceptual antecedents [8, 11, 29].

How should Attachment Theory respond when viewed through the lense provided by 4e cognition approaches in cognitive science? And which elements of 4e cognition provide the best match for the requirements of a theoretical revision for Attachment Theory?

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Concepts from Systems Theory [8] as well as from Developmental Psychology, are key antecedents for contemporary Situated Cognition ([9] p 35). As Clarke notes:

> "developmental psychologists were probably among the very first to notice the true intimacy of internal and external factors in determining cognitive success and change. In this respect, theorists such as Jean Piaget, James Gibson, Lev Vygotsky, and Jerome Bruner, although differing widely in their approaches, actively anticapted many of the more radical-sounding ideas now being pursued in situated robotics" ([9] p 35)

The dialogic nature of the infant-mother relationship is exemplified by many types of interaction, including: the infant's active participation in co-operative games, the infant directing the mother's attention to acts by itself, use of objects as topics in infant-mother dialogues, and social and emotional referencing. The mutually contingent nature of these dialogues is demonstrated by experimental studies which perturb the contingency caregiver or infant responses, and in observational research of infant interactivity with depressed mothers [25]. Whilst Bowlby's formulation of Attachment Theory includes cognitivist constructs, like Internal Working Models (IWMs) and hierarchical plans, through which relationship patterns are represented internally, he was also inspired by Systems Theory [3], emphasising that an infant's main caregiver is the most salient part of the infant's environment. So Attachment Theory conceptualises infant-mother relationship as being between two active partners. Therefore, contemporary approaches from situated cognition can form a natural updating for Bowlby's systems approach, and may also help refocus cognitivist elements that Bowlby proposed within Attachment Theory.

The embodied approach views the body and physical world as the context or milieu" for cognition, rather than cognition conceived as the operation of disembodied algorithms [21]. So an encounter between Attachment Theory and embodied cognition asks how attachment representations should be conceptualised, and whether the cognitive component of Attachment Theory could then be *"augmented with the incorporation of bodily sensations, physiological responses, and analogue computations that rely on the physical substrate within the attachment control system"* [21]?

The hypotheses of embedded and extended cognition are competing theories in situated cognition that both give greater emphasis to the role that situations and context play in human cognition than traditional cognitivism. The extended approach is more radical, claiming that external supports become part of a person's cognitive apparatus. The embedded approach is still strongly anti-cognitivist, but sees cognition embedded in external support rather than constituted

of external structures. A key question is: whether attachment relationships can sometimes be conceived as extending cognition or are better thought of as embedding cognition?

The enactivist approach views psychological activity as occurring in the dynamic engagement between organisms and their physical and social context rather than within themselves [15]. The mind and subjective experience are not seen as inherent in, or arising from, the individual, but as emerging, from the interaction between organisms and their surroundings [15]. So another key question include: is en-action, rather than traditional forms of representation, a better way to think about how previous experiences mediates ongoing adaptive behaviour, and can the attachment control system be revised to act as an enactive "lived experiential structure" ([21, 28] p xvi)?

The intention in challenging Attachment Theory with recent ideas from 4e cognition is to revise rather than replace or reject it, and also see which diverse elements from 4e cognition can operate in 'joint purpose', motivating a progressive revision of a well established theory.

1.1 Bowlby formulated the attachment control system concept but did not specify it in detail

John Bowlby rejected psychoanalytic theory as a basis for explaining social and emotional development. Instead, he formulated a new explanatory framework by combining scientifically respectable ideas that originated across different disciplines. In his first presentation of Attachment Theory, in 1958, Bowlby provided an alternative motivational basis for attachment by replacing a psychoanalytic explanation based on Freudian instincts with a motivation framework based on ethological behaviours. Whilst this framework was too simple to explain different stages in attachment development it could be augmented further with other scientific concepts. In 1969, in the first volume of his Attachment Trilogy, Bowlby's theoretical revisionism included a much broader range of currently popular concepts, bound together in the attachment control system framework. So Bowlby's concept of an attachment control system replaced Freuds concept of psychical energy and its discharge ([3], p 18) and wove together constructs from: Piagetian theory; Cybernetics; Artificial Intelligence; and Systems Theory. He presented reflex behaviours and behavioral chaining of fixed action patterns as an example of a simple organizing principle for control systems, and hierarchical planning as much more complex and flexible ([3], p 76). Internal Working Models (IWMs) and natural language allowed higher level processes of integration and control. Then in the second and third parts of the attachment trilogy Bowlby invoked concepts from cognitive psychology. For example, he explained Freudian defensive processes in terms of selective attention ([6], chapter 4), and explained recall, reflection and potential internal conflict in self image in terms of the distinction between episodic and semantic memory ([6], p 61-64). Figure 1 shows illustrates how the 'theoretical borrowings' that Bowlby made changed with what were the prominent ideas of the day.

However, in none of his descriptions of the attachment control system did Bowlby set-down precise enough arrangements for how varied information processing elements might be organised in a running simulation. This is not a surprise, at the time that Bowlby formulated Attachment Theory, there existed no simulation technology to combine information processing elements such as ethological behaviours, IWMs and hierarchical plans within a single information processing architecture.
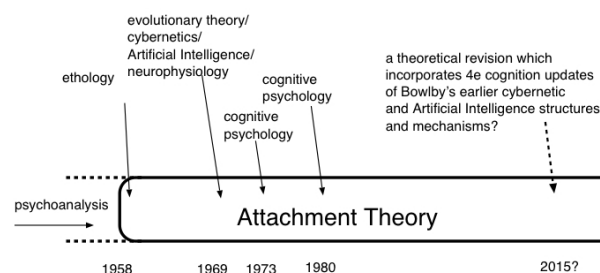

Figure 1. Diagram showing influences from other disciplines on Attachment Theory over time.

2 SHOULD INTERNAL WORKING MODELS BE VIEWABLE AS ANALOGUE IN ADDITION TO SYMBOLIC REPRESENTATIONS?

Internal Working Models are described by Bowlby as higher level representational forms which integrate and exert control over lower level control systems. Their principal information processing function is to allow predictions to be made about the likely outcomes of taking actions within a given environment. IWMs transmit, store and manipulate information and allow the individual to *"conduct small scale experiments within the head"* (([3], p 81). Their function, in terms of Bowlbys agenda of reforming psychoanalytic theory, was to take the place of the internal worlds of traditional psychoanalytic theory. Bowlby emphasizes the requirements for Internal Working Models to be updated. He also briefly observes that pathological sequelae of separation and bereavement can be understood in terms of out of date models or half revised models which may contain consistencies and confusions (Bowlby 1969 page 82). Bowlby invokes Internal Working Models at early stages in development also later on, when linguistic skills and conscious reflection can enable models to become more adequate ([3], p 84).

In contemporary reviews, IWMs are presented as transforming from sensorimotor representations in pre-linguistic infants to manipulable internal simulations in older children and adults that can enable short-term predictions, and conscious reflections on past, ongoing and future relationships ([7], p 102). Current research investigates IWMs through studies of memory talk, narrative completion, semi-projective measures and story-telling, with adults and children [7] - naturally linking IWMS to symbolic constructs from Artificial Intelligence like schemas and scripts. In his later writing Bowlby described IWMs in symbolic terms, for example:

"In reaching the decision to utilise certain actions rather than others the attachment system is conceived as drawing on the symbolic representations or working models, of the attachment figure, the general environment and the self, which are already stored and available to the system" ([4], p. 373).

However, links have also been drawn with IWMs and recent neuroscience research based upon mirror-neurons which presents IWMs as affording embodied simulation of the intentions of others ([7], p 109). Though research viewing IWMs as embodied simulations is very much in the minority in contemporary attachment research on IWMs ([7, 24], this section will argue that it is not only fully in the 'spirit' of Bowlby's original conception for IWMs, but also matches the 'word' of what he wrote about IWMs when he first introduced them. Bowlby did not use the term 'embodied simulation' but he did compare IWMs to analogue representations. For example, in his 1969 formulation of IWMs, Bowlby suggests that they can be used to

conduct 'small-scale experiments within the head' and notes that this notion would be an obvious possibility to electrical engineers familiar with analogue computers. Bowlby also refers to how anti-aircraft guns operate ([3], p 44) to exemplify how analogue control systems can set their own goals.

Looking back prior to 1969 to Bowlbys sources for the IWM concept provides added detail on how analogue representations can be conceived as mental models. Bowlby adopted the concept of Internal Working Models from the biologist J.Z. Young [31], whose treatment of Working Models is decidedly unambiguous in its preference for analogue over digital representations as a basis for Working Models in natural systems. As Young noted:

"[In an analogue computer] *the pattern of connections that determines what computation is made is part of the structure or pattern of the machine. These features at once suggest to the biologist, and especially the anatomist, that the nervous system is likely to work at least in part on analogue principles. What we commonly call the structure of the nervous system determines what it does. It is not a general purpose computer at all, but consists of a number of analogues set up to perform a few particular tasks. [] One of the great advantages of an analogue machine is that it can receive information directly from particular environments. That is to say, the machine maybe itself a representation of the environment and its parts are pre-selected to perform certain calculations in relations to the latter."* ([31], p 39)

J.Z. Young acquired the working model concept from its original source - the cybernetician Kenneth Craik. In The Nature of Explanation [12], Craik first discussed how working models can be used in science. Physical systems can act as models which help scientists explain natural phenomena because their physical operation captures key aspects of how the target system operates:

"*By a model we thus mean any physical or chemical system which has a similar relation-structure to that of the processes it imitates. By 'relation-structure' I do not mean some obscure non-physical entity which attends the model, but the fact that it is a physical working model which works in the same way as the process it parallels, in the aspects under consideration at any moment. Thus, the model need not resemble the real object pictorially; Kelvin's tide-predictor, which consists of a number of pulleys on levers, does not resemble a tide in appearance, but it works in the same way in certain essential respects*" ([12], p 51)

So in Craik's working models, although these systems can be argued to represent reality, when used by scientists to enable them to better explain and predict natural phenomena, it is by their physical properties rather than with abstract or arbitrary symbols that they represent other systems. Craik then made the significant leap to suggest that organisms can hold within their minds working models which operate in the same way. So living organisms can possess working models which represent their self and environment, and can run forward in time to make predictions or imagine the results of differing actions. Working models can also be configured to act as memories of past events.

The distinction between analogue and symbolic (discrete and digital) representations is important because analogue representations are much less flexible and are tied to the physical (embodied) properties of the medium in which they are implemented. Analogue systems carry out computational operations using continuously varying data. Data in analogue devices is also transferred around these machines from input to output in continuous form and is bound to the physical form of the computational medium. So analogue computation relies on a physical or embodied substrate in a manner in which discrete symbol processing computations do not. These distinctions certainly matter to the growing number of researchers engaged in computational modelling of attachment behaviour, who actually want to implement running simulations of the attachent control sytems. In addition, how IWMs represent self and environment will also be of interest to clinicians who are concerned to activate, de-activate or transform attachment representations as part of therapy.

That Bowlby would invoke analogue computation and representations in his first formulation of IWMs might seem surprising given the contemporary predominance of the linguistic/symbolic approach to IWMs in Attachment Theory. It is in part explained by the waining popularity of analogue computers. In the period between the end of the second world war and the late 1960s when Bowlbys initially adoption of the working models concept, analogue computing remained a significant alternative to digital computing and the rise and domination of digital computing in the post-war years was not viewed as a foregone conclusion [27]. In addition, the seeming change in emphasis from analogue representations in 1969 to symbolic in 1982 may not represent a completely radical change in Bowlby's conceptualisation because Bowlby was vague in the representational details he proposed. As Bretherton and Mulholland note, Bowlby's formulation of the representational basis for attachment *"was a promising conceptual framework to be filled in by others"* ([7], p 103). However, perhaps the key issue was that in the 1960s Artificial Intelligence was less prominent in comparison with Cybernetics than it would be in the future. So the cybernetic view on issues like meaning and control held greater sway. This was consequential because researchers in Cybernetics under-emphasized representational distinctions and the challenges arising from consideration of high level processes. As Boden notes:

"*most cyberneticians seemed to see no difference between pure self-equilibration (as in homeostasis), purposive behaviour directed to some observable object (as in guided missiles), and goal seeking directed to some intentional end (as in human deliberation and planning)*"([1], p 220)

The eclipse of Cybernetics by Artificial Intelligence may have led to Bowlby's switch from invoking an analogue basis for IWM in 1969 to symbolic basis for IWMs in 1982. More recent developments have shown movement towards an integrative approach which might guide the process of bringing diverse representational forms together in the attachment control system, bringing back together a cybernetic approach to adaptive control and an Artificial Intelligence approach to fully intentional thought and reasoning [24, 22].

3 ARE INFANT-CARER DYADS BEST DESCRIBED IN TERMS OF COGNITIVE EMBEDDING OR COGNITIVE EXTENSION?

The idea that infants, older children and even adult attachment partners all look to their carers as information sources about the broader world is a familiar one. For example, from the perspective of the socially situated mind, infant social referencing and joint attention between infant and carer may be seen as physical actions that make the infant's mental computations faster, more reliable or less effortful

by intimately linking internal infant cognition with external support [23]. So taking a situated cognition approach enrichs attachment theory by providing a more complete view of how infants gain information about environments from their caregivers.

Caregivers provide support to infant cognition in very many ways. They help to label, conceptualise, and structure information ([23, 10], p 44). Caregivers and infants are also situated within some of the same action loops that criss-cross close-coupled individuals and the environment [30, 9]. In such systems, caregivers can support 'soft assembly' of developing attachment competencies because secure attachment patterns are described in terms of response to set-goals rather than set actions ([9], p 44). Caregivers help scaffolding infant development by directing the child toward a correct/established outcome/solution/attitude or belief. When co-constructing they help the child take a course toward own-defined ends or end points. In addition, Bowlby describes how caregivers support infants by manipulating the environment and providing information directly through language use so that *"instead of each one of us having to build his environmental and organismic models entirely for himself, he can draw on models built by others"* ([3], p 82).

The hypotheses of embedded and extended cognition are competing and mutually exclusive explanations for how caregivers provide cognitive support. The hypothesis of extended cognition suggests that in some of the above examples, if the infant's ongoing computational needs are met by sensitive and timely support from his or her carer in such a way that the infant treats this support as part of their own cognitive processes then we might say that the carers cognitive support has become part of the infant's extended mind. For these examples to count as mind extension, caregiver cognitive support and information provision to the infant must be strongly trusted, relied upon and accessible. If these criteria are met then what is occuring is extension of mental states from an infant onto their caregiver. So in this view, the carer is actually extending the infant mind by incorporating the carer's help within the infant's cognitive operations - the carer's help becomes part of the infant's mind [3]. For these same examples of intimately integrated interactions between infant cognition and carer support, the hypothesis of embedded cognition views infant cognition and carer support of that cognition as clearly demarcated and separate. This hypothesis considers that *"cognitive processes depend very heavily, in hitherto unexpected ways, on organismically external props and on the structure of the external environment in which cognition takes place"* ([26] p 393). and that *"certain cognitive processes lean heavily on environmental structures and scaffoldings but not thereby include those structures and scaffoldings themselves"* ([10], p 111).

We should be more accepting of claims to extended cognition in infants and younger children, because the caregiver's interactions are more long-lasting, they are relied upon more, and when there are less infant cognitive resources and routines for not believing [13]. So making acceptance of information from the carer as if it were an infant's own beliefs easier and more likely.

Two main reasons for preferring embedded explanations over extended explanations arise from considering non-social cognitive extension [10]. Most examples of extended cognition involve inorganic objects in the environment (such as a mathematician doing their 'working' on paper) providing the cognitive extension. The first criticism of extended cognition highlights the profound differences that appear to distinguish inner and outer contributions in extended cog-

nition when cognition is extended onto such inorganic objects [10]. However, this criticism is much weaker when applied to the social case as it is a carer that does the extending. So there are not such profound differences in the supporting substrate for cognition between cognition inside the infant's brain and cognitive support originating from inside the carer's brain. A second criticism is the apparent scientific cost of any wholesale endorsement of extended cognition onto a motley collection of inorganic objects because it gives undue attention to transient external props and aids. In this view, following the extended mind hypothesis means scientists are not researching a suite of integrated persisting organismically grounded capacities [10, 30], and looking at developmental examples of cognitive extension onto inorganic objects is a series of separated developmental segments with external cognition onto different objects. So using a ball or balance beam may be a good example of mind extension at one age, but a year later the best example may involve a completely different object in a different task or action. Again, the social case of mind extension mitigates this criticism. Extended cognition does not only deal with transient external props and aids when the carer provides enduring support and continuity between otherwise disparate contexts.

If we accept the hypothesis of extended cognition over the hypothesis of embedded cognition this has important implications for computational modelling and in clinical interventions. Caregiving relationships are often very durable and reliable and if socially extended cognition occurs we can expect typical interactions and development to include micro and macro instances. Micro extension effects are described by Clark: *"The child is surrounded by exemplars of mind-reading in action, she is nudged by cultural interventions such as the use of simplified narratives, prompted by parental rehearsal of her own intentions, and provided with a rich palate of linguistic tools such as words for mental states"* ([10], p67). Macro effects occurs when children absorb complex ideas wholesale through the conduit of cognitive extension. Their caregivers can simply present beliefs which the children then adopt. Over the long-term caregivers attempt to socialise and indoctrinate infants in many ways that will impact the developing meaning a child gains of their attachment history. Two types of problems can occur: (1) relationships are not reliable or durable enough so infants and children do not gain the benefits of cognitive extension; and (2) pathological extension occurs, so instead of acting to scaffold or co-construct, a caregiver uses their power to extend an infant's mind to introduce (or put more strongly 'infiltrate' or 'hack' [17]) unhealthy or pathological beliefs about the infant's self and relationships into the infant's mind.

4 ENACTIVISING ATTACHMENT THEORY

Where the extended/embedded question highlighted the requirement for attachment structures and mechanisms that support narrative meaning making the three flavours of enactivism highlight different aspects of adaptive control and subjective experience in the attachment domain.

4.1 Attachment Theory encounters Sensorimotor Enactivism

Sensorimotor enactivism criticises the view that perception results in inner images or mental representations being produced. In the sensorimotor view, perception, action, and subjective perceptual experiences are all inescapably connected [14]. This approach allows that perceptual experience is grounded in knowledge and is therefore

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[3] [23] presents a more detailed case that the infant carer dyad is an examplar of extended mind cognition, with the infant's cognition extended by their caregiver.

representationally contentful. But the kind of mediating knowledge in sensorimotor enactivist accounts is more like procedural or skill-based knowledge. It is 'know-how' rather than 'know-that', a kind of knowledge demonstrated by the skilled performance of its deployment rather than an independently queriable knowledge base [14].

Viewing attachent behavioural patterns in this enactivist manner - as social skills rather than arising as a result of internal representations - may provide a powerful spur towards new research hypotheses and clinical interventions. When individuals with insecure attachment gain secure status they can be viewed as gaining a skill which they can then use in other relationships.

4.2 Autopoeisis and representation from social interaction

According to autopoietic enactivism, cognition, mentality and subjective experience all emerge from the self-organising and self-creating activities of autonomous entities [14]. This activity is intimately spread between organism and environment. Enactivisits suggest that, because factors from 'within' and 'without' play equally important and necessary roles in creating cognition and behaviour, the distinction between organism and environment is viewed as only having a heuristic value rather than being a true metaphysical division [14].

Autopoiesis is a special case of homeostasis and it takes the position that metabolism and life is essential for grounding intentional categories like cognition, consciousness, and emotions [1]. In the second Volume of the Attachment Trilogy, Bowlby adopted the biological concept of homeostatis and applied it to behavioral as well as physiological control systems. In this view, physiological homeostasis which regulates food and sleep are an inner ring of control in the attachent control system. Attachment behavioural patterns constitutes an outer behavioral ring which is a complement to this inner physiological control system (Bowlby 1973, chapter 9). However, Bowlby did not set out how the intimate engagement of these two rings could give rise to phenomenoligical experience. He did describe attachment feelings, but within an emotional appraisal framework ([3], chapter 7). So viewing Attachment Theory through the lens of autopoietic enactivism can act as a spur for a more comprehensive approach that unifies behaviour, cognition, and subjective experience in a single explanatory framework.

4.3 A Radical Enactivist Manifesto for Attachment Theory?

Hutto and Myin propose the thesis of radical enactive cognition (REC) that is a variant of enactivism that states that only a small proportion of cognitive processing is mediated by contentful representations. In their view, the majority of human cognition is basic and non-contentful information processing that controls behaviour for adaptive purposes but does not possess truth bearing properties like reference, accuracy or implication. According to REC, contentful representations do mediate some cognition, but these representations play a minor role in cognition overall, *"emerging late in phylogeny and ontogeny, being dependent in special sorts of shared practices.* ([14], p 13). So what Hutto and Myin have proposed is a novel variant of a dual process approach to cognition, with linguistically mediated representations that can interpret or receive narrative meanings, and basic structures and mechanisms that carry out adaptive control [22]. However, whilst other dual process approaches make a distinction between self-reflective thought which is linguistically mediated

and conscious, and processing which is not linguistically mediated and inaccessible to consciousness, REC 'carves things up' in a very different way [22]. As Hutto and Myin note, *"Enactivists are concerned to defend the view that our most elementary ways of engaging with the world and others - including our basic forms of perception and perceptual experience - are mindful in the sense of being phenomenally charged and intentionally directed, despite being non-representational and content-free* ([14], p 13). So according to a REC approach to Attachment Theory, an IWM that is formed early in ontogeny and has become inaccessible to linguistic self-reflection is not 'hidden', or at 'behind' or 'beneath' other more linguistically accessible IWMs. Instead, REC reframes inaccessibility - so in REC this is just linguistic inaccessibility - so such inaccessible structures are still at the forefront of mind and are phenomenally charged and conscious. This reframing can turn therapeutic ideas right around. Instead of therapy uncovering hidden structures it is about understanding how context and behavioural predispositions enact these structures in the moments they occur.

In addition, REC holds that an organism's current behavioural tendencies are not explained or structured by representations of the past but influenced more directly, just by its *"history of active engagement."* with the world ([14], p 11-12). So an organism's behavioural predispositions do *"not inherently "say" anything about how things stand in the world"* ([14], p 19). Rather, according to Hutto and Myin, *"a truly radical enactivism - REC - holds that it is possible to explain a creature's capacity to perceive, keep track of, and act appropriately with respect to some object or property without positing internal structures that function to represent, refer to, or stand for the object or property in question"* ([14], p 82)

So if Attachment Theory follows REC it might reconceive internal states like working models to be just control states and break the link with the reality they are supposed to represent. An attachment control system that proposes internal control states are not truthful representations of reality is a profound shift from current Attachment Theory. No longer would attachment interventions be concerned to assess how individuals represented their past relationships but instead they would be more focused on how to move towards more adaptive behaviour patterns.

5 Conclusion

In breaking from psychoanalysis Bowlby was a revolutionary, but at heart he was also a conservative, because he wanted to save the core and most valuable findings of Freud's psychoanalytic framework. These were insights about the highly active and interactive nature of social and emotional development in infancy. Since Bowlby was an eager 'borrower' of scientific concepts from the ideas which were popular at the time he formulated Attachment Theory, he might today look to incorporate the diverse insights of 4e cognition in a revised framework for the attachment control system. In section 2 we asked whether IWMs in adults are linked both to processes of shared meaning making and interpretation, and to processes of adaptive control, that is, whether they should not only be conceived in linguistic or symbolic form, but also conceived as analogue or embodied information processing structures [24]. In section 3 we showed how extended cognition provides a possible explanation for how infants derive narrative meaning about their attachment relationships from their caregivers. Then in in section 4 we considered how an enactivist approach can help explain subjective experiences in attachment interactions, and how internal control structures can direct future actions without a link to 'truthful' representations of past events. Con-

sidering issues of embodiment, cognitive extension, and enactivism together has a major benefit because these three approaches pull in different directions. So together they provide a balanced reformulation. Considering IWMs as analogue in addition to symbolic keeps the IWM construct tied to an individual. The extended cognition approach reminds us of the dialogic nature of attachment and the enactive approach forces us to question our representational assumptions. Taken together these three perspectives complement each other. We can never really know how Bowlby would have responded to the questions posed by 4e cognition but we can act to make revisions to Attachment Theory that conserve his key theoretical insights.

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