What is Attention? Adverbialist Theories

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1) The Claims of Adverbialism

Adverbialist theories of attention start from a claim that might seem tautological: that a creature is paying attention if, and only if, it is doing something attentively (Mole, 2011, Ch. 2). While this might seem undeniable, taking it as our starting point subverts psychology's usual explanatory practices.

Those practices approach the explanation of attention by attempting to identify some process that takes place in all and only the cases where someone is attentive, or, if no *one* such process can be found, by identifying some family of attention processes, perhaps via the identification of the neural circuitry, mechanism, or network that implements them (see Maunsell, 2015, for a progress report on attempts to implement this approach).

Psychologists adopting this approach have often assumed that it *must* be practicable if attention is to be in good scientific standing: When the approach proves ineffective – whether because quite different processes are involved in different contexts where attention is paid, or because the neural circuitry that is involved in attention seems also to be involved in various other things – this is taken to indicate that the concept of attention is in some way defective (van der Heijden & Bem, 1997; Parasuraman, 1998; Di Lollo, 2018). Some theorists go so far as to

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suggest that, strictly speaking, there is no such thing as attention (Anderson, 2011; 2021; Hommel *et al*, 2019).

The adverbialist rejects such impugnments by showing how the concept of attention can refer to a real phenomenon – with unimpeachable naturalistic credentials and an important explanatory role – even if there is no one process, nor any family of processes, that it denotes. When we fail to find such processes adverbialism claims that the fault lies, not with the concept of attention, but with psychology's process-identifying approach to its explanation.

Rather than attempting to identify a *process* of attention, the adverbialist proposes that attention should be explained by identifying a *manner* of occurrence that can be instantiated by quite various processes, and that might therefore have no distinctive neural signature.

This treats the question "What is attention?" as if it were similar to the question "What is haste?", or "What is practice?" (Mole, 2011, following White, 1964). There is no one process that takes place in all and only the cases where someone is being hasty: a hasty person might be performing hasty arithmetic; or hasty proof-reading, or the hasty sewing-on of a button. We cannot tell *which* processes are taking place, either at the personal or the subpersonal level, if we know only that haste was instantiated. Nor is there any implication running in the opposite direction: we cannot tell whether haste was instantiated if we know only that a button was sewn on, or that arithmetic was performed, whether these processes are identified in personal terms or neurological ones. This is because facts about haste are not facts about *which* processes are taking place, nor about some broad family of processes any one of which might be taking place. They are about the *way* in which processes occur, whatever processes those happen to be.

'Practice' and 'haste' are not defective concepts. They denote real phenomena, the explanation of which proceeds adverbially, rather than via the identification of the processes constituting them. These phenomena are not disqualified from doing explanatory work of their own. A person's practice or haste might explain various features of their current and future behaviour, without those explanations telling us which processes they, or their brains, instantiate. So it is,

the adverbialist says, for attention: the fact that someone is paying attention plays an indispensable role in explaining the efficacy, persistence, speed, and accuracy of that person's behavioural and cognitive performances, while telling us little about *which* processes might be taking place at the personal or at the neuronal level. Rather, it tells us about the manner in which some of those processes occur.

2) The Explanatory Import of Adverbialism for Contemporary Attention Research

Because adverbialism denies that instances of attention must involve any particular process, it tells us that we should not look for any circuit, mechanism, or network in the brain that implements this process. More generally, it suggests that we should not expect the instances of attention to share the properties that they inherit directly from the processes which implement those instances: just as instances of hasty arithmetic have a *timescale* that is quite different from the timescale of hasty sewing, so the instances of attentive colour discrimination may have a timescale that is quite different from the timescale of attentive visual search, or of attentive action. Adverbialism therefore offers a distinctively *metaphysical* diagnosis of why it is that certain questions about attention have proven to be empirically recalcitrant (for a recent example, see Mole, 2020), but this is not because the adverbialist rejects psychology's research methods. It contests the standard construal of the facts that those methods reveal, but also gives a positive specification of the metaphysical position that is implicit within one prominent branch of recent psychological theorizing. By making that position explicit, adverbialism gives its own positive account of the way in which this theorizing accomplishes its explanatory work, thereby enabling some persistent confusions to be identified and avoided.

That positive account can be seen, together with the confusions that it identifies, by considering adverbialism's perspective on the biased competition theory of attention (Desimone & Duncan, 1995; Duncan, 1996; Scolari & Awl, 2019). This theory takes attention to arise from competitive interactions within and between different levels of the brain's processing hierarchy. In its original formulation, the theory suggested that these competitions could be biased by signals

originating from any number of other competitions. Competitions between visual stimuli could be biased by other competitive processes taking place in the visual cortex, and competitions between higher-level representations could be biased by other competitive processes taking place in the more cognitive parts of the cortex, but in neither case were these local influences taken to be the only ones at work. Instead the theory supposed that the outcome of any competition could exert an influence, more or less directly, on any number of others, from the bottom up or from the top down, so that: "Competition, finally, is integrated between components of the sensorimotor network … As an object gains dominance in *any* one system, responses to this same object are supported elsewhere." (Duncan, 1998, p. 1308, emphasis added).

A psychologist who was wedded to the process-identifying mode of explanation might try to see the biased competition theory as conforming to it, by saying that the theory does identify a specific process from which attention always arises: the process of competition-biasing. This construal of the theory faces a difficulty: it conflates the theory's claims about attention with its claims about attention's causal antecedents. If attention were to be *identified* with the process by which competitions are biased (as the process-based construal alleges), then attention would be identical to that process whereby other stimuli make unsuccessful attempts to suppress the attended stimulus. This process of unsuccessful suppression by unattended stimuli occurs, according to the biased-competition theory, whenever attention is paid to a stimulus. Indeed, some suppression is said to be taking place whenever multiple stimuli are in view. However, it is not the presence of this process that explains the distinctive way in which attended stimuli are processed. To explain *that* the theory must appeal to the dominant manner in which attended stimuli are processed when the biased competition is being won. Whereas the biasing process explains why it is that some of the processes taking place in the brain instantiate competitive dominance over others, it is that property of dominance that gives the theory its account of what attention *is*. But knowing that a process is dominant does not tell us *which* process it is. It tells us about the way in which that process happens. And so the biased competition theory is, on this construal, a version of adverbialism.

Insisting on this interpretation of the theory might strike some readers as mere pedantry, but it enables us to avoid some confusions concerning the questions which the theory's advocates need to address. It is often supposed that the theory faces a particularly difficult question about the origin of the biasing signals that it postulates. This is taken to be an embarrassment for the theory, because one might think that attention itself must have the role of selecting the stimuli in favour of which competitions will be biased. One might therefore think that, without an account of these biasing signals' origin, the theory stops short of explaining attention itself, instead telling us only about the mechanism through which its influence is mediated. On the adverbialist construal, this objection has no force. The answer to the question of where the biasing signals come from is, according to the adverbialists' construal of the biased competition theory, that they can come from anywhere. Attention is not identified by enumerating the sources of those signals, but by identifying the characteristic manner in which processing that is subject to such influences takes place.

Despite claiming that the resolution of any competition can potentially contribute a source of bias to any other competition in the processing hierarchy, the adverbialist construal of the biased competition theory is consistent with holding that certain sources of bias will be especially influential in particular contexts. For example, Duncan and colleagues acknowledge the special importance of a pair of overlapping networks in the frontal and parietal brain regions, the activation of which is related to the maintenance in working memory of the subject's task set. Rather than interpreting these brain regions as a specialized attentional circuit, as some researchers operating within the biased competition framework have done (e.g., Kastner, 2009), Duncan and colleagues interpret them as one notable source of bias within a thoroughly distributed competitive interaction. In doing so, they interpret the role of these source regions in agreement with the adverbialist's thesis that attentiveness emerges when certain stimuli or ideas come to dominate in a competition in which various processes participate.

It is not only in connection with the biased competition theory that adverbialism rejects certain questions that would otherwise seem to be pressing. Something similar can be seen in

connection with debates about the relation of attention to working memory. There is good evidence that the maintenance of information in working memory can influence one's performance of tasks requiring attention to stimuli that are perceived in one's immediate environment (Oh & Kim, 2004; Woodman & Luck, 2004). Since the brain regions activated in these tasks overlap substantially with the regions that are activated during working memory tasks (Mayer *et al*, 2007; Tsubomi *et al*, 2013), the interference between them has suggested to some researchers that a single limited-capacity process explains the limitations of working memory and also the limitations on the division of our attention (e.g., Cowan, 2001). There are, however, ways in which the influence of visual attention on visual working memory looks *unlike* a case in which two processes are competing for a single processing-resource. Notably, not *all* tasks requiring the subject to maintain information in working memory appear to interfere with tasks requiring that she direct her attention elsewhere (Fougnie & Marois, 2006; Rerko, Souza, & Oberauer, 2014; Souza & Oberauer, 2017). It is a matter of controversy how to reconcile this seemingly contradictory pattern of findings.

Olivers and Roelfsema (2020) have recently advanced a framework that promises to account for the specific conditions under which attention and working memory tasks interfere. They argue that we can account for these disparate findings by claiming that attention is required, not to maintain information in visual working memory, but only to use this information to act, whether overtly or covertly. In doing so, Olivers and Roelfsema argue that attention is 'selection for action' (Allport, 1987; Neumann, 1987). As we argue below, this thesis, appropriately interpreted, is consistent with adverbialism. However, from the adverbialist's perspective, Olivers and Roelfsema make a tactical mistake when they claim to "avoid some definitional conundrums", "by linking attention to clearly defined and neurophysiologically plausible mechanisms" (Olivers & Roelfsema, 2020, p. 180). This is a mistake, in part, because avoiding the 'definitional conundrums' to which they refer does not *require* identifying specific neural mechanisms to implement attention. To avoid those conundrums, it is sufficient to give some non-circular specification of the manner in which particular processes occur when and only when subjects attend. Olivers and Roelfsema do just this when they propose to understand attention as the "emergent property of sensory-action coupling" (ibid. p. 181), and to explain

the distinctive performance benefit associated with recently attended sensory information in terms of attention's causal contribution to reinforcement learning (or "credit assignment") (*ibid*. p. 182-3). In light of these features of their account, their attempt to identify attention with a particular neurophysiological process seems unmotivated. It is also, according to the adverbialist, ill-advised. The attentiveness of the subject who pays attention to a perceptual task may be explained by the manner of occurrence of processes that enable this subject to perform that task, just as the attentiveness of one who is paying attention to a memory task may be explained by the manner of occurrence of the processes that enable him to perform that. These two sets of processes may sometimes intersect, in ways that cause these tasks to interfere with one another, without any of the neurophysiological mechanisms implementing those processes having any particular link to attention. (Compare the fact that hasty mental arithmetic might sometimes interfere with hasty visual search: a fact that is not to be explained by identifying *haste* with any subset of the arithmetic-implementing mechanisms.)

3) Some Adverbialist Theories

The biased competition theory tells us that a subject's perception of (or thinking about) a stimulus is attentive if and only if that stimulus is dominant in a biased competition. Other theories that take an adverbialist approach give a somewhat different account of the attentive manner, but some themes are common to many of these theories. The theory developed in Mole (2011) has (by design) much in common with the biased competition approach. According to Mole, the fact that someone is paying attention is a fact about the absence of distractions that might occupy the cognitive resources that this person could bring to bear in doing whatever it is that they happen to be doing. This theory treats attention as if it were analogous to unison, saying that attention has no seat in the brain just as unison has no seat in the orchestra, and adding that, just as arbitrarily different melodies can be performed in unison, so arbitrarily different tasks can be performed attentively. It implies that the cognitive processes implementing attention in one context might take place in another context where no attention was paid, just as any one of the instruments that contributes to an instance of orchestral unison

might also have been playing (and playing the very same thing) on an occasion where the orchestra was not instantiating unison.

The unison theory has been criticized on the grounds that it sets too high a bar on attention, counting most cases of attentiveness as merely *partial* attention. A related complaint is that it allows attention to be *divided* only in a rather circumscribed range of cases, so that two tasks can simultaneously receive full attention only if there is no overlap in the sets of cognitive resources that could serve them (unless the resources that fall in this overlap can somehow make an equal contribution to both tasks by doing some one thing, see Mole, 2011, §4.12).

Partly in order to avoid these difficulties, Philipp Koralus has proposed that attentive task performance should be modelled as determining a *question* that is used to monitor the subject's progress in completing that task (Koralus, 2014). Other adverbialist theories offer different analyses of what it is for something to be done attentively. They have tended to share a commitment to the idea that attentive subjects are never merely passive recipients of perceptual information. Attentiveness is exhibited by activities in which the attentive subject is involved *as an agent*, perhaps because they are actively enquiring into *where* things are, or *what* they are, or perhaps because they are involved in some business that manifests itself more immediately in their outward behaviour.

4) Selection for Action

Their emphasis on the activity of the attentive perceiver creates a natural affinity between these versions of adverbialism and the theories that have identified attention with 'selection for action'. Like Koralus's erotetic theory, the selection-for-action theories depict attentive subjects as putting their perceptual states to active use in the service of answering a question (Allport, 1987, Neumann, 1987, Castiello, 1996). On the erotetic theory, the question that the attentive subject brings to perception is concerned with how matters stand in the world (including whether the goal of this subject's task has yet been achieved). On the selection-for-action theory the question is more immediately *practical*: it is distinctive of the attentive perceiver that

they use information from perception in determining the manner in which they will move – e.g., in resolving such fine-grained questions of implementation as how to prehend one's hand when reaching for a cup.

The erotetic and unison theories have been explicitly formulated under the adverbialist banner, but inclusion of the selection-for-action theory within the adverbialist framework depends on how one develops that theory. In particular, care is required in specifying the *agential role* that is attributed to attention on the theory (Henry 2019), and it is useful to distinguish two versions of it.

According to the first version, which is found in the work of Wayne Wu (2011; 2014), the paying of attention consists in the selection of one out of many alternative behavioural possibilities: attentional selection occurs when and only when an agent acts, and an agent acts when and only when the agent traverses 'behavioural space' – a space consisting in the set of alternate behavioural possibilities that are open to the agent at a time, given the many possible targets of response and the many ways in which the agent can possibly respond to each target. This takes the paying of attention to consist in the selection of one of many possible target-response pairings – a selection that constitutes the agent's traversing of behavioural space and thus, Wu claims, their *acting* rather than responding reflexively and passively. This view takes attention to be necessary for action because agents always have the option of behaving differently.

The second version of the theory, which Henry (2019) defends, develops the claim that attention is selection for action within the context of an understanding of action as an ongoing process in which agents continually *guide* their behaviour in light of their goals or priorities (cf. Frankfurt 1978). On this version, attention endows its possessor with the capacity to coherently and flexibly navigate an informationally rich environment by compensating for the interference that would otherwise result from the processing of distracting stimuli and information. As Henry notes, such an ability to adjust for the deleterious effects of distractors during action, and so to prioritize what is currently most relevant, is one that an agent must possess *whether or not* it was possible for them to attend and act otherwise than they do in a given circumstance, *pace* Wu. For example, it is at least questionable whether more automatic deployments of

attention, including those that, on some views, are essential to the guidance of skilled performances, are such that the agent was in fact capable of directing her attention differently than she in fact did.

These two interpretations of the agentive role of attention on the selection-for-action theory suggest different assessments of adverbialism. Wu's version of the theory plausibly entails a conception of attentional selection as the exercise of a causal power – namely, the power to take one behavioural path rather than another one. This places the agent's 'selection' in the metaphysical category of an occurrence – e.g., an event, process, or activity – rather than, as adverbialists maintain, a manner of occurrence. Henry's version lacks this consequence. On that version it is possible (and perhaps preferable) to understand attention, not as an event or process of selection (e.g., as that which causes the removal of distractor interference within the cognitive basis of the agent's task performance), but as the resultant *selectiveness with which* agents guide their conduct, and so do whatever it is they do. On this version of the view, attention is a property of an agent's unfolding cognitive and motor activities (i.e., of their manner), rather than a distinct cognitive process or activity alongside others.

5) Distraction and Attention

Following a suggestion in the work of William James, adverbialists have tended to understand attention as contrary to distraction (James, 1890/1950). On the unison view, for example, just as an orchestra's unison consists in the absence of any members playing different melodies, so the subject's state of attention consists in the absence of task-irrelevant processing in the cognitive resources that could serve her performance. This leads to an objection (raised by Watzl, 2011, and Levy, 2017). Instead of taking distraction to be incompatible with attention, one might instead take it to be attention of one particular misdirected sort. A theory of attention that does not apply to cases of distraction would then be extensionally inadequate.

It may be possible for the adverbialist to meet this challenge by giving a more nuanced account of the sense in which attention and distraction are opposed, and thereby showing how their

theory can cast some explanatory light on distraction, while still maintaining that the distracted person is not attentive. This account might take distraction to stand in a relation to attention that is similar to the relation of counterfeit money to true currency: for something to be counterfeit money, it must be capable of engaging in money-like interactions, while nonetheless being something other than the real thing, and therefore falling outside the scope of a theory that attempts to tell us what money is. The adverbialist might say that cases of distraction fall outside the proper scope of their theory, while showing a similarly essential tendency to have an attention-like role in the mental economy. Considerable work would be needed to turn this suggestive simile into something more theoretically satisfactory.

A more thoroughly worked-out account of the opposition between attention and distraction can be found in Henry (2019). Henry accepts the characterization of distraction as a genuine instance of attention, while also accepting the adverbialist's characterization of attention as fundamentally opposed to distraction. To render these claims consistent, he interprets the opposition between attention and distraction, not as a relation of metaphysical incompatibility, but as a consequence of attention's constitutive aim. To grasp this proposal, it is useful to consider some examples of other cognitive phenomena that possess a constitutive aim, and that therefore admit of a distinction between successful and defective instances. For example, it is widely agreed that a false belief is a defective mental state insofar as it fails to achieve the constitutive aim or role proper to belief – namely, truth or knowledge (Williams 1974; Velleman 2000). Henry suggests, similarly, that instances of distracted attention are defective because they fail to achieve the constitutive aim of attention: the elimination of distraction, or (what one might take to be equivalent) the 'prioritizing' of what is currently most relevant to the agent in light of her goals or priorities. In cases of distracted attention, how the agent attends is incongruent with what is relevant to her in the circumstances. Accordingly, the constitutive aim of attention is not fulfilled, and the subject attends imperfectly. When we combine this view of distracted attention with the adverbialist's thesis that attention is a manner of acting, we arrive at the claim that distracted attention is an imperfect manner of acting. This coheres with the observation that states of distracted attention manifest overtly in imperfect task performances – e.g., in mistakes like pressing the wrong key, or attempting to grasp with the wrong grip-size.

On this account, it is true both that the subject's suboptimal performance is attentive (to the degree that it is selective), and that its defects are defects of attention. This suggests one way that states of attention stand opposed to states of distraction, without the combination of attention and distraction therefore being impossible.

The correct handling of attention's relation to distraction is just one of the conceptual issues that adverbialists will need to address before their account of attention is complete. Even while some of those issues remain open, adverbialism offers a viable account of the sort of thing that attention is, and gives a distinctive theory of the way in which attention relates to the processes that take place in the brain of the attentive subject.

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