Agential capacities: a capacity to guide[1]

Abstract: In paradigm exercises of agency, individuals guide their activities toward some goal. A central challenge for action theory is to explain how individuals guide. This challenge is an instance of the more general problem of how to accommodate individuals and their actions in the natural world, as explained by natural science. Two dominant traditions – primitivism and the causal theory – fail to address the challenge in a satisfying way. *Causal theorists* appeal to causation by an intention, through a feedback mechanism, in explaining guidance. *Primitivists* postulate primitive agential capacities in their explanations. The latter neglect to explain how primitive capacities integrate with findings from natural science. The former do not explain why some feedback mechanism's activity amounts to the *agent's* guidance. In this paper I argue that both traditions should acknowledge a capacity to guide, as actually constituted by the executive system. I argue that appeals to this empirically discovered psychological system explain how individuals guide in a way that integrates with explanations from cognitive science. Individuals' capacity to guide is embedded in the natural world through the activity of its constituent (mechanistic) components.

Words: 9408

1 The problem of guidance

In central exercises of agency, individuals guide their activities toward some goal. I am interested in better understanding how individuals guide their activities. I believe that better understanding individuals' guidance will further our understanding of agency more generally.[2]

Consider the following three cases. A birder, out in the woods, searches for robins. She stands still, shifting her attention across the crowns of the trees, until she has found the bird perched on a branch. A barista is making coffee. He leans over to his right, moving his hand past the coffee machine, and grasps a large mug. A pianist plays the beginning of *Les Adieux*. She presses the opening chords with her right hand, then has her left hand join in with the bass line.

Each of these individuals guides her or his activities toward a goal, in so acting. What marks such guidance? Roughly, when an individual guides, she flexibly

[1] Special thanks to Tyler Burge. Thanks also to Ned Block, Martin Davies, Thor Grünbaum, Pam Hieronymi, Kevin Lande, Al Mele, Elisabeth Pacherie, Chris Peacocke, Ian Phillips, Josh Shepherd, Helen Steward, Sebastian Watzl, Hong Yu Wong, Wayne Wu, as well as audiences at UCLA, NYU, UNAM, the Universities of Antwerp, Barcelona, Bloomington, Leeds, Paris, Tübingen, and York. Finally, thanks to a reviewer for this journal for their comments.

[2] Sometimes it is said that solving the problem of guidance is *the* fundamental problem in action theory. (Frankfurt 1978; Thalberg 1984; Bishop 1989) I do not commit to this claim.

coordinates activities of her parts, so as to attain her goal. Such *coordination* has both synchronic and diachronic aspects. The birder may activate an image of the bird, while she searches for its likeness in the trees, and simultaneously keeps her posture still. The barista first bends his torso, then moves out his arm. The pianist first moves her right, then her left hand, all the while listening carefully to the sound she creates. Furthermore, in so coordinating, these individuals rely on information *integrated* from a wide range of sources. The barista integrates vision with proprioception to inform his reach, while the pianist relies on audition and proprioception for her play. The birder uses information from vision and memory to direct her attention. Finally, these individuals coordinate flexibly: they *compensate* for interference and adjust activities in light of incoming information. The pianist may press keys with less force, if the bass line is too loud. The barista may adjust the trajectory of his hand mid-air, if the mug slides off the shelf. The birder may ignore a distracting bright light when shifting attention from one location to the next. Importantly, when individuals guide, they *make* this flexible coordination of their activities. But their coordinating, integrating, and compensating, in basic cases, is not itself a further act. It rather helps constitute the individual's action.

How do individuals make such flexible, goal-directed coordination of their activities? We confront the

> *Problem of guidance:*[3] to offer conditions that explain how individuals guide their activities toward their goals.

The problem has two components. One is to specify explanatory conditions under which activities are flexibly coordinated toward some goal. The other is to specify explanatory conditions under which this coordination is *the individual's*.

In this paper I take steps toward solving this problem. I argue that human individuals have at least one primitive capacity to guide – to flexibly coordinate activities toward attaining their goal. This is a capacity to guide shifts of visual attention. I argue for the proposal on the basis of findings from empirical psychology. My claim is that a psychological sub-system – the executive system – actually constitutes this capacity. More specifically, I argue that

[3] What I say here closely tracks Frankfurt's exposition. (1978, 74)

> *Capacity to guide:* Individuals have a capacity to guide their activities toward their goals, which is actually constituted by the executive system.

While I will focus, in what follows, on the kind of agency exercised in shifting attention, I do believe that the proposal extends to other, possibly all, kinds of human agency as well. So even though here I will only argue that the executive system constitutes *a* capacity to guide, I believe that it may actually constitute *the* capacity to guide to be found in human agents. Reflection on this psychological system not merely shows that individuals have such a capacity. Such reflection will also help us address the explanatory challenge just formulated. Indeed, addressing this challenge I believe that we can gain insight into another deep issue: how individuals and their actions are embedded in a world as described by the natural sciences. I will address each of these points in the course of the paper.

While questions concerning agency are in the foreground, there is a methodological point in the background of this paper. Action theory has tended to cast its explanations horizontally, in terms of individual-level states, events, and capacities. I propose to make explanatory progress by moving vertically, appealing to the sub-individual constitution of an individual-level capacity to guide. Even readers that disagree with my substantive points about agency may find this method fruitful.

In what follows I will first, in section 2, briefly discuss the resources for addressing the problem of guidance, provided by two influential competing traditions in action theory – causal and primitivist theories of action. I will point to shortcomings in each. In sections 3 – 5 I offer a positive argument for my proposal. Section 3 offers a preliminary characterization of the executive system. In section 4 I present a case study of guided visual attention, showing (a) how questions about guidance arise in this context and (b) how psychologists explain guidance by appeal to the executive system. In section 5 I argue that the executive system actually constitutes a capacity to guide visual attention. In section 6 I conclude by explaining how we have made progress in understanding agency, and I gesture towards progress on the issue of accommodating individuals and their actions in the natural world.

2 Primitivist and causal theories of action

What resources does action theory provide for addressing the problem of guidance? Two major traditions, going back at least to Kant and Hume respectively,[4] have dominated action theory: primitivist and causal theories. Both, I will argue now, are importantly incomplete. In the rest of the paper I suggest that they should acknowledge a capacity to guide.

Actions are fundamentally doings by individuals. When individuals act, they make things happen. These happenings occur in the natural world. Often, individuals control occurrences in the natural world, when they act. The traditions clash over the question of how it is that individual agents make happen events in the natural world. The question is often motivated by a puzzle. Maybe the most fundamental version of the puzzle observes that our best causal explanations come from natural science.[5] Such explanations apparently do not appeal to individuals' making things happen. Instead, they appeal to physical, biochemical, or physiological states, events, and processes; they appeal to neural or psychological states, events, and processes – whether they occur in individuals' sub-systems, or at the level of whole individuals. If our best causal explanations do not appeal to individuals and their actions, the latter apparently play no causal role in the natural world. But then how can individuals make things happen in it – how can they act?

Primitivists maintain that we must acknowledge primitive, *sui generis*, capacities to act. They deny that such capacities must or indeed can be found in explanations by natural science. Primitivists address the puzzle by rejecting the idea that explanations in science are the only respectable causal explanations. Causal theorists, on the other hand, contend that such a position flies in the face of a naturalistic, scientific world-view, and is

[4] Hume, *Enquiry*, Section VII, pt. 1; Kant, *Critique of pure reason*, B 130/40.

[5] Different philosophers formulate the puzzle in different ways. Sometimes, they contrast ideas of free or responsible action with conceptions of the natural world as deterministic. (Pereboom 2004) Others formulate the puzzle in terms of a clash between primitive agent-causation and scientifically respectable event-causation. (Bishop 1989; Velleman 1992; Hornsby 1996) Yet others formulate the puzzle as a clash between the ontology that natural science is committed to and an ontology acknowledging agents and their acts. (Nagel 1986; Bishop 1989; Hornsby 2004; Steward 2012) I focus on the third formulation of the puzzle.

thus untenable. They attempt to solve the puzzle by reducing individuals' actions to the states, events, and processes that natural science appeals to.[6]

The problem of guidance is just one instance of the more general puzzle about agency in the natural world. When individuals guide their activities toward some goal, they control occurrences in the natural world. Such individuals make happen the relevant flexible, goal-directed coordination of their activities. What resources do the two traditions provide for addressing the problem of guidance?

Standard versions of the causal theory maintain that a behavioral event is an action of some kind just in case that behavioral event has been caused by an individual's intention to perform an action of this kind. (Davidson 1971; Goldman 1970; Searle 1983) Early on, philosophers have pointed out that an intention may cause an event of the right kind deviantly, such that the event does not constitute action, despite its being caused by an intention. (Davidson 1973, 79) The challenge from causal deviance is to specify the right kind of causal connection between intention and behavioral event, presence of which would be *sufficient* for an event to be an action.

Attempting to address this challenge, theorists have supplemented the bare-bones version of a causal theory in different ways. The most influential proposals have it that intentions must not merely cause, but causally sustain the behavioral process that constitutes the action.[7] (Bishop 1989, 172; Adams & Mele 1989; Mele 1992, 130ff.; Mele 2000; Enc 2003) The intention's sustaining the behavior involves its monitoring and guiding it. An intention's guidance here consists in its feeding instructions as to what behavior to perform, derived from the intention's representational content, into the individual's sub-systems. An entire hierarchy of intention-like states may be generated in this process. (Pacherie 2008) An intention's monitoring consists in its comparing sensory feedback about the behavior, coming from effector- and other sub-systems, to the intention's representational content. A servo-, or feedback-mechanism is said to implement these two roles of intentions.

Philosophers widely agree that no extant proposal satisfyingly resolves the challenge from causal deviance. But my interest is not in *that* challenge. I want to ask

[6] Not all causal theorists stake their view on the possibility of reduction.
[7] Other influential proposals are those by Peacocke 1979, Thalberg 1984, and Brand 1984. More recent contributions include Schlosser 2007, Shepherd 2014, and Wu 2016.

whether the proposals provide resources for addressing the problem of guidance. Do they?

Causal theories are attractive because they commit to integrating their proposals with our best scientific causal explanations.[8] How, on their view, are activities of the pianist flexibly coordinated toward attaining her goal? The pianist's intention specifies her goal, to play the first bars. A feedback mechanism interacts with processes and events in psychological and other sub-systems. The mechanism feeds instructions into a motor control system that computes motor commands for moving the limbs. (Wolpert 1997) These commands also coordinate movements of the left and right hand, for instance. The feedback mechanism furthermore monitors proprioceptive feedback about the hands' movements and compares it with what the individual intends. If the movements deviate from the intention, the mechanism may initiate compensatory processes. If they do not deviate from the intention, the mechanism may signal successful completion of the action to higher cognitive centers. The proposals, of course, offer no more than a sketch. No one has ever attempted to explain more fully how the relevant flexible coordination comes about. But the sketch does promise to provide conditions that explain this coordination in ways that integrate with explanations of these processes from natural science.

These proposals do not establish conditions on guidance by *the individual*, however. Causal theories maintain that causation by an intention through the operation of a servo-, or feedback-mechanism constitutes a sufficient condition for action. Individuals' guidance might accordingly be said to consist in the coordination of sub-systems by the relevant feedback mechanism. But not *any* causal process generating behavior that matches an intention's content constitutes an individual's action. Similarly, not any process that involves an intention's guiding and monitoring behavior through some feedback mechanism constitutes action. We find feedback mechanisms in thermostats and the endocrine system, for example.[9] It is highly questionable that *these* feedback mechanisms would be of the right kind to constitute an individual's guidance, even if they helped implement an individual's intention. What feedback mechanisms are? Bishop

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[8] This is what makes causalist theories especially attractive in the present context. As a reviewer rightly points out, many causalists would rather emphasize that causation is essential to action as the most fundamental attraction of causal theories.

[9] Bishop acknowledges this threat in his discussion of 'heteromesial' cases, in which feedback mechanisms connect to other agent's brains. (Bishop 1989, 169ff.)

adds that the feedback mechanism must be connected to an individual's 'central' states and events.[10] He offers no specification of 'central' that would allow evaluating his claim. (Bishop 1989, 171) What property of some feedback mechanism might explain that it is of the right kind to constitute the *individual's* guidance? Strikingly, no extant causal theory even addresses this question. Extant causal theories underspecify conditions under which the operation of a feedback mechanism constitutes an individual's guidance of her activities.

The resources provided by causal theories for formulating explanatory conditions on individuals' guidance are thus importantly incomplete.

Primitivists have noted these shortcomings in causal theories. They maintain that any account of action must acknowledge an active role for the whole individual throughout an action's execution. Standard versions of the primitivist approach maintain that actions constitutively are exercises of agential capacities or powers. To explain exercises of agency, we must explore individuals' agential capacities. (Alvarez & Hyman 1998, 221 & 233; Hornsby 2004; Steward 2012; Hyman 2015, 43)[11] Different proposals emphasize different capacities. Some proposals appeal to generic capacities to act. (Alvarez & Hyman 1992; Steward 2012; Hyman 2015) Others appeal to very specific capacities to engage in types of action, such as walking or reaching. (Hornsby 2004)

Primitivist proposals are attractive because there can be little doubt that they establish conditions on guidance by the individual. Acknowledging an active role for the individual is, after all, central to these approaches to agency. How, on these views, might the individual guide activities toward some goal? The pianist exercises her capacity to act, when she plays the sonata. She may be said to exercise her agential capacities to play the piano, to play chords and scales, and to move her arms, wrists, and fingers while playing. Indeed, the primitivist might maintain that the individual exercises a primitive agential capacity to guide – to flexibly coordinate activities of her parts, such as arms, hands, and torso, so as to attain some goal, such as playing the piece. Exercises of any of

[10] Steward 2012, 55ff. makes a similar point.

[11] Two alternative primitivist approaches hold that actions are events caused by agents (Chisholm 1964; O'Connor 2000), or events caused by primitive agential events (O'Shaughnessy 1980; Hornsby 1980; Peacocke 2007).

these capacities entail an active role for the individual because the capacities are stipulated to be an individual's capacities to act.

But these conditions are not sufficiently independent of their explanandum to be fully *explanatory*. To make explanatory progress we need to provide fuller characterizations of the relevant capacities: Should we postulate a generic capacity to act? Should we acknowledge a capacity to guide activities toward goals? Or should we rather introduce a range of different capacities to carry out specific actions? How should we characterize such capacities? What constrains such characterizations? On what basis can we confirm or disconfirm characterizations of such capacities, or their attributions to an individual? Extant primitivist proposals do not provide answers to these questions. But unless they do so, they have not offered a sufficiently independent, explanatory condition on how individuals guide.

What is worse, extant primitivist accounts do not offer even the beginnings of an explanation as to how exercises of individuals' capacities to act *integrate with our best scientific explanations* of these episodes. When the pianist plays a chord, her perceptual system processes visual information about the keys, her motor system computes her arm's trajectory, and her vestibular system operates so as for her to keep her balance. Psychology explains these processes in terms of the operation of the respective sub-systems. Flexible coordination of activities across these sub-systems is required for the pianist to play. How do capacities to act, to guide, or to play the piano relate to processes in the sub-systems discovered by psychology? How do exercises of such capacities bring about the occurrence of these processes, and their flexible coordination toward attaining some goal? Exercises of primitive agential capacities are *also* occurrences in the natural world. Any explanation of how processes are flexibly coordinated toward attaining some goal must integrate with our best scientific explanations of such occurrences. This constraint applies *even to non-reductive*, primitivist accounts of guidance. Not only does no extant primitivist proposal attempt to explain this integration. Some primitivists even deny that such integration is possible.[12] No extant primitivist proposal hence provides a satisfyingly explanatory condition on the flexible, goal-directed coordination that marks individuals' guidance.

[12] Hornsby 1996, 2000 & 2004.

The resources provided by this second approach thus are importantly incomplete, too.

Both approaches are in need of elaboration, if we want to explain how individuals guide. Causal theories hold promise for explaining how characteristic flexible coordination of individuals' sub-systems comes about, in a way that integrates with science. But they neglect to explain under what conditions it is individuals that make such flexible coordination. Primitivists emphasize individuals' role in guidance. But they do not offer even the beginnings of an independent characterization of individuals' agential capacities that integrates with our best scientific explanations of these processes.

Both approaches should acknowledge a capacity to guide. I will now provide an extended argument for the existence of one such capacity – a capacity to guide visual attention. This capacity is actually constituted by an empirically discovered psychological sub-system – the executive system. Appealing to this system, we can offer independent, non-circular, explanatory conditions on *individuals'* guidance, and do so in a way that integrates with our knowledge from empirical science.

3 The executive system: a sketch

I will argue that individuals' capacity to guide visual attention is actually constituted by their executive system. So what is the executive system?[13] As a first approximation, the executive system is an empirically discovered psychological sub-system for the control of processes in other psychological sub-systems. Cognitive scientists tend to think of individuals' psychologies as roughly hierarchically structured, containing a range of sub-systems devoted to ever more specialized tasks, including perceptual, memory, and motor systems. The executive system accesses and regulates a wide range of these sub-systems. The system functions to organize activity in these sub-systems for the completion of tasks that the whole individual faces.

The system's operation is marked by the exercise of competencies for controlling representational processes: the executive functions of switching, maintenance, resource-

[13] My notion of an executive system derives from the specific strand of research documented in the main text, without committing to all details of the models. I believe that it constitutes a fairly uncontroversial regimentation of parts of the literature on cognitive control.

allocation, and inhibition.[14] *Executive switching* activates the suite of representations and abilities pertinent to carrying out some task (sometimes called the "task set"). The mechanism underlying switching determines which representations and abilities are relevant to some task, initiates, and fixes parameters for such processing in light of the individual's goal. *Executive maintenance* encodes information into working memory and maintains it active during the execution of a task. Such maintenance relies on mechanisms for determining which information is relevant for the task at hand. *Executive resource-allocation* involves the deployment of executive processing resources for the execution of a task. These resources function to enhance the processing to which they are allocated. A mechanism determines what processes to flexibly allocate them to. *Executive inhibition*, finally, is a competence for suppressing the influence of distractors or

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[14] Compare: "There is general agreement that there are three core EFs …: inhibition … (behavioral inhibition) and interference control (selective attention and cognitive inhibition), working memory (WM), and cognitive flexibility (also called set shifting …)." (Diamond 2013, 136) Diamond counts three executive functions, instead of four, since she does not distinguish between selective attention and cognitive inhibition. I refrain from using the term "attention," since resource-allocation by the executive system often seems to involve some non-attentional processing-enhancing bias. Compare also what neuroscientists write: "Cognitive control stems from the active maintenance of patterns of activity in the prefrontal cortex that represents goals and the means to achieve them. They provide bias signals to other brain structures whose net effect is to guide the flow of activity along neural pathways that establish the proper mappings between inputs, internal states, and outputs needed to perform a given task." (Miller & Cohen 2001, 167) Similarly: "There appear to be at least two types of top-down signal, one that serves to enhance task-relevant information and another that serves to suppress task-relevant information." (D'Esposito 2007, 768) Computational modelers write that the system "is responsible for the active maintenance (representation in working memory) of task information (responsible for the execution of goal-directed behavior) that is particularly critical when task-relevant behavior demands that interference from distracting source of information be ignored (attention) and/or competing response tendencies be overcome (inhibition)." (Botvinick & Cohen 2014, 1255)

What motivates focusing on these executive functions? "First, they seem to be relatively circumscribed, lower level functions … and hence can be operationally defined in a fairly precise manner. Second, for these three executive functions, a number of well-studied, relatively simple cognitive tasks that we believed would primarily tap each target function were available. Third, and perhaps most importantly, the three target functions are likely to be implicated in the performance of more complex, conventional executive tests." (Miyake et al. 2000, 54/5) Neuroscientists have found evidence for neural mechanisms constituting these functions in the brain. (Gazzaniga et al. 2014) And modelers have shown that they are required to devise networks that replicate human goal-directed behavior. (Botvinick & Cohen 2014, 1264; Rougier et al. 2005)

Why should we think of them as constituting a "system"? First, already Miyake et al. 2000 found that the executive functions "are separable but moderately correlated constructs, thus indicating both unity and diversity of executive functions." (*Ibid*., 87) Second, the executive functions are jointly realized by fairly closely connected networks in PFC. Finally, they share a common function – that of controlling other psychological sub-systems. But while standard in cognitive science, not too much should be read into this term.

The characterization of the executive system in the main text is intended to be flexible enough to accommodate empirical advances. Thanks to a reviewer for prompting clarification.

prepotent responses on ongoing activity. It relies on mechanisms that determine processing of which stimuli or impulses constitutes interference with the current task, and that suppress processing of such stimuli.

Appeal to these four executive functions serves to characterize the executive system, to identify its operations, its contribution to processes, and to guide theorizing about it. They are signatures of this system. (Miyake et al. 2000; Miller & Cohen 2001; Baddeley 2007; Diamond 2013; Goldstein et al. 2014; Botvinick & Cohen 2014; Gazzaniga et al. 2014; Fuster et al. 2015)

These executive functions typically cooperate to control processes. The executive system thus accesses and regulates processing in other relevant sub-systems, in light of instructions maintained in working memory, to ensure successful attainment of the goal. The system, on might say, oversees and steers independent processing in other sub-systems. But importantly, not all four competencies must always be engaged for the executive system to exert its control over other sub-systems.

Characterizations of the executive functions together offer a cognitive model of the executive system. (Weiskopf 2018) This model derives from behavioral studies in psychology.[15] The cognitive model of the executive system became ever more refined over the course of the years. These advances in turn allowed increasing integration of behavioral research with neuroscientific studies and computational modeling. (Miller & Buschman 2013; Gazzaniga et al. 2014; D'Esposito & Postle 2015; Rougier et al. 2005; Botvinick & Cohen 2014)

In short, findings from across different disciplines and spanning different explanatory levels and approaches – psychological, neuroscientific, computational modeling – present us with a detailed, sophisticated cognitive model, even a partial mechanism sketch, of the executive system and the ways in which it accesses and regulates processing across the hierarchy of psychological sub-systems. In what follows I will rely on this model.

4 Guidance of visual attention

[15] Early milestones of this behavioral research include work on cognitive control by Posner & Snyder 1975, Shiffrin & Schneider 1977, Norman & Shallice 1986, and especially Baddeley's model of working memory (Baddeley 1986, 2007).

In this section I discuss how visual attention shifts. I ask, how does empirical psychology distinguish between guided and non-guided shifts of visual attention?[16] I show that exercises of individuals' guidance correlate with the regulation of processing by the executive system. In the next section, I will use this result to argue that executive functioning actually constitutes individuals' guidance of visual attention.

4.1 Outline of the attentional system

How does visual attention shift? We can shift attention actively, as when we form an intention to study a painting and guide visual attention to its place on a wall. Attention can shift passively, as when a bright flash captures attention when we are trying to focus on the painting.

How does empirical psychology distinguish between guided and non-guided shifts? According to all major theories, a priority map of the visual scene effects attention shifts, active and passive alike. The priority map is a map-like, topographical representational structure that assigns priority values to locations in the scene. Attention shifts to the location with the highest priority value. (Zelinsky 2015)

What determines priority for locations? Psychology distinguishes between the exogenous and the endogenous systems for orienting attention. Both systems assign priority on the map, but do so in distinct ways.

The exogenous system primarily reacts to physically or practically salient stimuli, such as an abruptly appearing bright light. Roughly, saliency is a measure of the extent to which a stimulus stands out from its immediate surroundings. The system shifts attention to the salient stimulus rapidly, within only 120 ms. Where attention shifts exogenously is largely independent of individuals' current goals and expectations. Indeed, individuals cannot suppress orientation to a salient stimulus even when they know that it is a distractor and *try to ignore it*. (Theeuwes 2010)

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[16] Attention has been said to consist in our mental capacities' cognitive unison (Mole 2011), the selection of a stimulus for a response by the individual (Wu 2014), the regulation of priority structures (Watzl 2017), the making-available of information to thought (Smithies 2011) and to working memory (Prinz 2012). What I say about visual attention is, as far as I can see, compatible with each of these accounts.

The endogenous system operates in support of individuals' goals and intentions. This system shifts attention in light of a goal to find a bird, or a decision to fixate some location on a wall. The system orients attention slowly, taking about 300 ms to do so. If given sufficient time, individuals can decide to fixate some location – and not be distracted by *even the most salient distractor*. (Yantis & Jonides 1990)

Psychology tends to characterize shifts effected by the endogenous system as active, voluntary, and shifts effected by the exogenous system as passive, involuntary shifts. This tendency suggests explaining guided attention by appeal to the endogenous system's operation alone. Passive, non-guided shifts would be effected by the exogenous system. (Posner 1980; Wright & Ward 2008; Carrasco 2011) Can we, then, explain individuals' guidance of visual attention as effected by the endogenous system alone? No. In central cases of guided attention-shifts, the endogenous and exogenous systems interact to determine priority on the map for shifting attention. Furthermore, not all endogenous factors correlate with and explain individuals' guidance. The phenomenon of drawn attention illustrates both points.

4.2 Visual search and drawn attention

Attention-shifts during visual search are paradigm instances of actively guided attention-shifts. In visual search, individuals set a goal-representation of a search-target, they initiate and drive attention-shifts in search of their goal, and they direct attention to locations to be searched. The case of the birder illustrates visual search. The birder sets out to search for robins. She shifts attention systematically across the visual scene, until she finds those birds. Normally, she will rapidly and efficiently complete her search.

However, often during visual search, attention is drawn to distractor-stimuli.

> *Drawn attention*: a factor draws visual attention when it interferes with, but does not fully disrupt or override an individual's guidance of attention-shifts toward a target.

Salient or practically highly relevant stimuli – exogenous factors – can draw attention. Suppose that we instruct a subject to search for a green diamond-symbol in a display. Further suppose that the display contains a number of non-target distractors that the subject must ignore to successfully complete her search. These distractors are all green circles, except one – a red diamond. The latter item, of course, is physically salient in the display. It stands out, due to its different color. In such situations, the physically salient item influences computations of priority for visual search. Distractors boost priority for locations containing them. In doing so, distractors interfere with individuals' guidance of their search. The priority map indicates distractor-locations as to be visited. Such priority assignments require additional processing to suppress. They may cause mistaken shifts of attention to those locations. They may slow subjects' search down. Subjects' saccades often exhibit trajectories that are curiously bent toward the distractor, suggesting that it attracts attention, before its influence is suppressed midway by some other process. (Walker & Sorley 2008; Theeuwes 2010) In each case, individuals search less efficiently. Nevertheless, individuals seem to still guide attention: it is their search-goal that drives the search, and they direct where attention goes. In such cases, the endogenous and exogenous systems interact to determine where attention shifts. Such cases suggest that we cannot explain individuals' guidance by appeal to the role of the endogenous system alone.

Different forms of implicit memory similarly draw attention. These factors are components of the endogenous system. Consider priming, for example. If a subject repeatedly searches displays for green diamond shapes, then priority for stimuli of that type will be boosted by default. The subject will be faster and more accurate at detecting green diamond shapes. This effect lasts, even when her search goal changes. So even if now she attempts to find a red circle shape in a display, green diamond shapes will tend to attract her attention. The effect will slow down her search, she will make more errors, and may shift attention to the green distractor. (Kristjanson & Campana 2010)

The same effect has been found for stimuli associated with rewards, such as food, which tend to attract subjects' attention even after weeks, and without the subjects' knowledge. (Anderson 2013) The effect has been found for implicit memories of scene configurations, such as the co-occurrence of a target with a certain geometric arrangement in a scene, which will lead subjects to attend to locations in the arrangement that used to feature a target. (Chun 2003) And similarly, memories of scene-gist or typical locations for objects in scenes tend to make subjects attend to locations that do not, at present, contain the search target. (Torralba et al. 2006; Hollingworth 2014)[17]

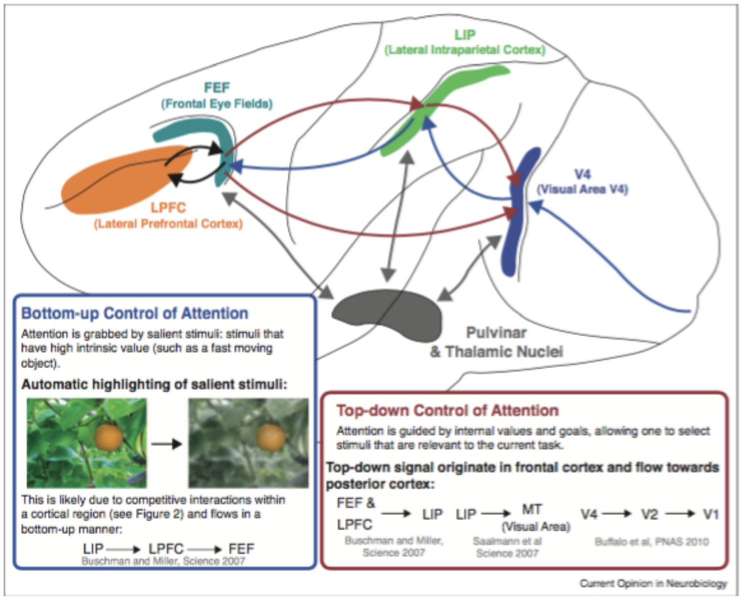
In each of the above cases, factors draw attention: because they interfere with individuals' guidance by influencing assignments of priority on the map for shifting attention. Reflection on drawn attention suggests that we cannot explain guided attention-shifts as effected by the endogenous system alone: First, even in guided attention-shifts, the endogenous and exogenous systems interact. We must explain guided shifts while allowing that they might be generated based on the interaction of the different systems. Second, endogenous factors, too, can interfere with individuals' guidance. Not all endogenous factors correlate with and explain individuals' guidance. We must identify the endogenous factor that does.

How does visual attention get to the right place? Empirical psychology appeals to regulation by the executive system to answer this question. (Awh et al. 2012; Tsotsos & Kruijne 2014)

4.3 Guided attention

Executive functioning regulates assignments of priority on the priority map in light of the individual's goals. Executive functioning plays a twofold regulatory role. First, it helps set goals and provide goal-input to the computations determining priority on the map. Second, it enhances and inhibits influences on priority computations throughout the execution of the search, depending on whether they would increase or interfere with the likelihood of finding the search-target.

[17] Even irrelevant items stored in working memory can interfere with subjects' search. (Soto et al. 2005)



[The executive system, as implemented by frontal and prefrontal cortex, accessing and regulating processing in other sub-systems for shifting attention. (Miller & Buschman 2013)]

Remember the birder in the woods, looking for robins. Let me illustrate how executive functioning regulates priority-assignments in light of her goal to find the bird. In light of her search-goal, executive switching helps set the search target, by encoding a representation of the target – a red, white, and brownish, thrush-shaped animal – into visual working memory. (Vickery & Jiang 2005) Executive maintenance holds this representation in working memory throughout the search, so as to provide top-down input to priority computations, enabling processes of template-matching. (Zelinsky 2008; Duncan & Humphreys 1989; Carlisle et al. 2011) Suppose that the birder also holds an irrelevant representation of a yellow warbler in visual working memory. Yellow objects in the scene should hence tend to draw her attention, interfere with her search. To counteract such interference, executive allocation of processing resources may boost the activation of the search target memory, thereby increasing its influence on priority computations. (Olivers & Eimer 2011) Alternatively, executive inhibition may suppress the influence of a drawing factor, such as a flower whose yellow color matches that of the irrelevant working memory item. (Sawaki & Luck 2011) Executive functioning takes time and relies on limited resources to establish its regulatory influence on priority computations. When the individual has insufficient time, or if interfering factors override executive regulation, we obtain the phenomenon of drawn attention. (Han & Kim 2009)

Visual attention shifts to locations or items with highest priority on the priority map. A goal to find some search-target initiates priority-computations for where to shift attention next. It provides goal-information as input to these computations. But throughout visual search, a wide range of sub-systems – processing visual information about the scene, implicit or explicit memories, and individuals' goals and expectations – *also* contributes to assignments of priority on the priority map. Many of these influences can draw attention; they potentially interfere with individuals' guidance of their search. Successful visual search requires regulating the influence of these factors on priority computations. Executive functioning – through switching, maintenance, allocation of processing resources, and inhibition – regulates these sub-systems' influence on assigning priority, in light of individuals' goals. Such regulation is absent from passive, non-guided shifts. Executive functioning thus correlates with individuals' guidance at the level of psychological sub-systems. Psychology appeals to the executive system when explaining how attention shifts are guided toward individuals' goals.

5 The executive system as capacity to guide

I will now argue that the executive system actually constitutes a capacity to guide visual attention. The different executive functions are components of this capacity. (Some of) these components' causal interactions constitute exercises of the individual's capacity to guide. The arguments of this section thus conclude my case for the target claim. In the following, last section, I return to the problem of guidance, and the dispute between primitivists and causal theorists.

5.1 Actual constitution

I claim that the executive system actually constitutes an individual's capacity to guide visual attention – to guide her attentional activities toward her goal. To *actually constitute* a capacity, the executive functions must be components of that capacity. To be components of the capacity, the executive functions must figure in a componential explanation of individuals' capacity to guide.

> *Componential explanation*: The explanation of a target phenomenon by decomposition into its components, whose organized causal interaction generates the target phenomenon.[18]

Componential explanation roughly resembles what has been called functional explanation, mechanistic explanation, or explanation by cognitive models. (Cummins 1983; Craver 2007; Bechtel 2008; Weiskopf 2011 & 2018) It aims to explain how some target phenomenon can arise, given the causal structure of the actual world. It is arguably the dominant mode of explanation to be found in psychology and the life sciences. Componential explanation helps us understand the capacity to guide by explaining how to build such a capacity given the nomological structure of the actual world. The executive functions are components of individuals' actual capacity to guide their activities – their activity of shifting attention in particular – toward their goals.

My use of 'constitutes' here differs from some uses in the literature.[19] Claims about actual constitution differ, for instance, from those concerning metaphysical constitution. I do not make any modal claims. In particular, I do not claim that executive functioning is a necessary or sufficient condition on individuals' guidance, across organisms and possible worlds. Claims about actual constitution also differ from claims concerning supervenience, implementation, or realization. (Kim 1998) Claims about actual constitution are both weaker and stronger. They are weaker in that they do not purport to provide reductive sufficient conditions on guidance, even in the nomological sense. They are stronger in that they maintain that the actually constitutive conditions componentially explain individuals' guidance, given the nomological structure of the actual world.

I will now argue that the executive system indeed actually constitutes individuals' capacity to guide their attention-shifts. This argument has two components. First, for the executive system to constitute a capacity to guide, the executive functions must be real components of a capacity to guide: they must be robust, and they must exhibit mutual manipulability with the explanandum. I explain that the executive functions meet both criteria in the following sub-section. I thereby directly establish that the executive system is the psychological structure that actually constitutes individuals' capacity to guide

[18] This characterization relies on Craver 2007, esp. chapter 4, and Weiskopf 2018.
[19] Kim 1998; Burge 2010

visual attention. Next, I argue that executive functioning gives rise to marks of guidance: coordination, integration, and compensation in light of the individual's goal, which exhibit marks of individual-level states and events. These arguments further support the claim about constitution: since the executive system is the only psychological structure that generates marks of guidance, it plausibly constitutes individuals' capacity to guide visual attention. The arguments will also put me in a position to discharge demands for conditions that *explain* individuals' guidance. Both sets of arguments rely on the role for executive functioning in visual search that I described in the last section.

5.2 Componential explanation

I now want to show how we can directly establish that the executive system actually constitutes individuals' capacity to guide. To figure in componential explanation, or to be real components of a capacity, components must be robust, and they must play an actual causal role in generating the target phenomenon. (Craver 2007, 4.5 & 4.8; Weiskopf 2018) The executive functions meet both criteria. I here rely on the empirical facts laid out in section 4.

Real components tend to be *robust*: they have a stable cluster of properties, and are detectable in a variety of causally and theoretically independent ways. (Craver 2007, 132) Consider maintenance and inhibition as examples.

Executive working memory maintenance exhibits fairly stable capacity limits of around four items. (Vogel et al. 2001) It exhibits characteristic time-courses for encoding information (20 – 100 ms per item). (Bays et al. 2011) Executive maintenance characteristically fractionates into stores for visual, spatial, action-related, and verbal information, stores that operate on different types of representations. (Baddeley 2007) Modulation of processing in different brain areas by dorsolateral prefrontal cortex implements working memory maintenance. (D'Esposito & Postle 2015)

Executive inhibition, too, exhibits capacity limits. We find characteristic breakdown-patterns of inhibition depending on strength of distractor-salience, and perceptual or executive load induced in dual-task paradigms. (Lavie & Dalton 2014; Han 2015) Inhibition exhibits characteristic time-courses of operation. Thus executive inhibition takes about 500-750 ms to fully establish its control over distractors or prepotent responses across paradigms. (Han & Kim 2009) Characteristic neural mechanisms globally suppress or differentially enhance neural activity in specialized areas of the brain. (Munakata et al. 2011)

Both competencies are detectable in a variety of independent ways. A vast range of behavioral paradigms test working memory stores, including delay-period, n-back paradigms, or dual task paradigms. Inhibition is investigated through Stroop, Simon, or Antisaccade tasks, for instance. (Diamond 2013) Computational models study and yield predictions about characteristics of both competencies. (Botvinick & Cohen 2014) A range of neuroscientific methods such as ERP-studies helps identify the competencies' operation.[20] (Miller & Buschman 2013)

So the executive functions are robust, or meet criteria for being real components of a capacity to guide.

The executive functions play an actual causal role in individuals' guidance of their activities toward their goals: individuals' guidance and executive functioning are mutually manipulable. (Craver 2007, 139ff.; Campbell 2008; Weiskopf 2018)

> *Mutual manipulability*: the target component is a part of the capacity and (i) interventions on exercises of the target capacity change activities of its components, and (ii) interventions on the activities of components change exercises of the target capacity.

Executive functioning and individuals' guidance are indeed mutually manipulable in this sense, and we have already seen some of the evidence. Let us again focus on executive maintenance and inhibition as illustrations.

First consider executive maintenance. As we have seen, if an individual guides visual attention during visual search toward finding a green diamond, then a representation of the green diamond-shape will be stored in working memory. ERP studies show CDA-activity for such search paradigms. (Carlisle et al. 2011) This activity constitutes a neural signatures of working memory storage. So activating the target capacity activates the component – working memory, in this case.

[20] Similar arguments can be given for resource-allocation and switching. (Kiesel et al. 2010; Ansorge et al. 2014)

But similarly, intervening on working memory load affects the efficiency with which an individual guides her visual attention toward finding a green diamond target. Thus there is evidence that load on spatial working memory or visual working memory increases reaction times and the extent to which distractors draw attention. (Han & Kim 2004) So interfering with working memory activity interferes with the individual's goal-directed guidance.

The same is true for executive inhibition. If an individual guides visual attention in search for a green diamond shape, then her guidance will involve inhibition of distractors in the display. Evidence from ERP-studies shows that such search activates a Pd-component in the ERP-wave, which implements the inhibition of distractors. (Sawaki & Luck 2011) So the individual's engagement in goal-directed guidance of attention in visual search activates executive inhibition.

And again, interfering with the inhibitory component yields interference with the individual's guidance of her search. We know that some inhibitory effects depend on information held in working memory. Loading working memory yields interference with inhibition of distractors. And such interference negatively affects individuals' guidance of their search: reaction times increase, errors increase, and individuals orient attention more often to irrelevant distractors. (Beck et al. 2012; Lu et al. 2017) So interfering with executive inhibition we interfere with individuals' goal-directed guidance.[21]

I conclude that the executive functions are components of individuals' capacity to guide their visual attention shifts. By relying on empirical methods such as mutual manipulability, we can *directly establish* that the executive functions are an explanatory condition on – indeed, actually constitute – an individual's capacity to guide attention.

5.3 Flexible goal-directed coordination

[21] Would not damage to V1 interfere with individual's guidance of their attention shifts as well? Or damage to the priority map-mechanism? Both types of interference would be too unspecific to indicate that either sub-system helps constitute individuals' capacity to guide. If we damaged V1, visual information could not serve as input to computations of priority. In many cases, lack of this information would indeed interfere with individuals' search. But such damage affects not merely the individual's actively guided attention-shifts, but many passive attention-shifts as well. Similarly for damage to the priority map-mechanism. The argument about capacity-constitution in this section relies on the argument in section 4, to the effect that the available evidence supports the claim that executive regulation most closely correlates with individuals' guidance of their attention-shifts. .

Executive functioning helps generate marks of guided processes that I identified earlier:[22] coordination, integration, and compensation in light of the individual's goal. We can thus explain how activities are flexibly coordinated toward some goal by appealing to the role of executive functioning.

Note that marks do not constitute (elements of) a definition. Nor are they necessary or sufficient for what they mark. They rather characterize goal-directed guidance in paradigmatic, central cases.

Consider the fact that many guided processes exhibit coordination, integration, and compensation in light of *the individual's goal*. Executive switching and maintenance help generate and explain a process's goal-directedness. When the birder engages in visual search for a robin, she forms a goal-representation of a bird of certain coloring and shape. Executive switching helps establish a set for searching the bird. Switching thus contributes to encoding a goal-representation into working memory – maybe a visual representation of a thrush-shape and a color-pattern. Executive maintenance holds active in working memory the representation of the search goal. Both switching and maintenance contribute to continuously providing a goal-input for computations determining priority on the map for shifting attention. Appeal to the two competencies helps explain how guided processes are directed toward individuals' goals.

Next consider the fact that when individuals guide their activities, processes in a vast range of different sub-systems tend to be *coordinated* for attaining the goal. The executive functions help generate this mark. Executive switching activates pertinent capacities, such as computations of priority for the priority map, relevant memories, or motor capacities for shifting the eyes. Executive resource-allocation enhances processing in pertinent sub-systems and strengthens their influence on priority computations for the map. Such resource-allocation might, for instance, boost the goal-representation's influence on priority computations. Resource-allocation thus contributes to coordinating activities by enhancing those that promote individuals' goal-attainment at the expense of processes that interfere with such goal-direction. Executive inhibition contributes to coordination by playing the opposite role. Inhibition suppresses processing in non-pertinent sub-systems and their influence on priority computations that might interfere

[22] Cf. section 1, p. 1

with attaining the goal. Thus inhibition might suppress processing of a distractor matching an irrelevant memory of a former search-goal. Inhibition suppresses such detrimental processes to the advantage of processing that furthers goal-direction.

When individuals guide their activities, information from a wide range of perceptual, sensory, and cognitive sources tends to be *integrated* for executing the action. The executive functions help generate this mark. They do so, on one hand, by regulating the flow of information that contributes to priority computations. Executive switching, resource-allocation, and inhibition help determine which sensory, perceptual, or memory systems affect assignments of priority on the map. They thus effectively help regulate the integration of information for shifting attention. On the other hand, the information in light of which the executive functions themselves operate is often integrated from a vast range of perceptual and other sub-systems. What stimuli in a visual display executive inhibition will suppress depends not merely on information from a goal-representation stored in working memory. It will also integrate information about attention's current location and whether stimuli of this type have in the past tended to interfere with search. What sub-systems executive switching activates depends not merely on the goal stored in working memory, but memories about strategies that reliably underlie goal-attainment and, for instance, information that monitors the sub-system's functional status.

Finally, guided processes exhibit *compensation for interference* with them. Executive inhibition and allocation help generate this mark in a straightforward way. Suppose that the visual scene contains a particularly salient item, such as a bright light. Executive inhibition functions to suppress the influence of this light on computations of priority. Similarly, executive inhibition functions to suppress prepotent, interfering behaviors. Thus it may be involved in quelling the birder's urge to walk away from the bushes and have a drink of water. Executive allocation can compensate for interference by boosting the influence of a beneficial process on priority computations. Thus it might boost the influence of the search-goal over that of a possibly interfering working memory distractor. Executive switching may compensate for interference by switching which sub-systems or strategies are activated for attaining the goal. A search strategy to look in the crowns of the trees may be abandoned because it turns out to be inefficient.

The executive functions thus interact with processes in other sub-systems across the individual's psychology to generate the coordination, integration, and compensation in light of an individual's goal, that characterize guided activity. We can explain these marks of guided activity by appealing to the executive system's role in generating them.

5.4 Guidance *by the individual*

Executive functioning helps generate marks of individual-level states and processes. We can explain how exercises of guidance by the individual exhibit these marks, by appealing to the role of executive functioning.

What marks states and events of a whole individual, as opposed to merely her sub-systems? Individual-level states and events are attributed to whole individuals, not merely to their sub-systems. Examples of individual-level states/events are actions, intentions, beliefs, emotions, and perceptions. Not all such states/events are active. They contrast with states/events that occur at the level of sub-systems alone: the computation of edges in the early visual system, the firing of a neuron in the retina, the pumping of blood by the heart, or the transport of nutrients in the bloodstream.

I am not aware of a full explication of this distinction. But several attempts have been made to say what marks individual-level states/events in contrast to those at the level of sub-systems alone. I focus on two such marks that are widely acknowledged: individual-level states/events are typically *integrated with the individual's central states/events*, and they exhibit *characteristic whole-individual coordination* of the activities of individuals' parts.[23]

Central states include beliefs, intentions, and desires, for example. These states tend to be accessible for report, for use in reasoning, and the rational control of action. Individual-level states/events are integrated with such states in that they can (rationally) affect them or be affected by them. An individual-level perception can cause and ground

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[23] The literature acknowledges *three* marks of individual-level states and events. The third mark is their being phenomenally conscious. Since I reject a functional explanation of phenomenal consciousness, I do not think that appeals to executive functioning explain states and events' being conscious in any interesting sense. For this reason I relegate the third mark of individual-level states and events to this footnote. See Burge 2010, 369ff.; on consciousness cf. Dennett 1968; on integration cf. Stich 1978; Fodor 1983; Burge 2009; on coordination cf. Frankfurt 1978; Burge 2009; Hyman 2015. For a critical discussion of this distinction, see Drayson 2012 & 2014.

an individual's beliefs. Her emotional state, in turn, may underlie the formation of her intention. Both are examples of integration with central states/events.

Individual-level states/events exhibit characteristic whole-individual coordination. When the whole individual acts, e.g. walks down the street, her posture coordinates with the movements of her limbs and head. When she undergoes a spasm or knee-jerk, her movements are not normally thus coordinated. The very idea of an activity by the whole individual typically carries with it some commitment that all – or at least sufficiently many – of the individual's parts are involved in the activity. But this involvement cannot be random or haphazard. The involvement must exhibit a certain kind of whole-individual coordination.

Note, again, that these marks do not constitute a definition, necessary, or sufficient for being individual-level. The marks characterize individual-level states and events in paradigmatic, central cases.

We find these marks in guidance-events during visual search. When the birder guides her visual attention in search for a robin, her guidance is typically integrated with her central states. Thus, the birder's guidance is toward her goal – finding the robin. Her intentions, beliefs, expectations, perceptions, and so forth, help determine where and how she searches for the berries. Rational deliberation about search-strategy may affect the pattern of attention-shifts, much as will visual information about the birder's surroundings. A change in her goals will affect how she guides her search – she may decide to abandon search and walk away. Visual search similarly exhibits characteristic whole-individual coordination. Processing of information about potential targets – their visual properties, say – coordinates with processing of information about the target from memory, such as its likely locations, changes in appearance due to lighting, or what locations the birder has already searched. Such processing coordinates with movements of her body – with shifts of the eyes, movements of the torso, and overall posture of the rest of the body.

Executive functioning helps generate the marks of individual-level states/events just identified. We can explain these marks by appealing to the role of executive functioning in visual search.

First, appeals to executive functioning explain why guidance-events in visual search are typically *integrated with individuals' central states/events*. This explanation appeals to the fact that the executive system functions to access and regulate a wide range of psychological systems. Its activity thus characteristically integrates with that of a wide range of other sub-systems. They include systems to be regulated as well as systems that inform the executive system's regulation. The integration may be rational integration, or of some more primitive kind. The integration includes integration with central states and events, such as beliefs, intentions, desires, and so forth. For example, what kind of search-goal the executive system sets depends on the individual's goals and intentions. What representational states and competencies the executive system activates depends on the individual's goals, intentions, memories, beliefs, and perceptions. *How* she guides her visual attention shifts depends on her executive system's continuously regulating the influence of each of these different kinds of central states on priority-computations. Thus, executive functioning may increase the influence on priority-computations of a belief to the effect that the target is in some specific location; or suppress the influence of a salient stimulus because the individual believes that the stimulus is a distractor. In each case, the executive system's integration with – its accessing and regulating – other sub-systems helps generate the characteristic integration of individual-level states and events with individuals' other central states and events for the case of guided attention-shifts.

Second, appeals to executive functioning explain how guidance-events in visual search typically exhibit *characteristic whole-individual coordination* of individuals' parts. We saw how the executive system generates goal-directed guidance of visual search. Such direction involves a kind of coordination. When the individual guides her attention-shifts in search for a robin, her executive system activates the relevant set by switching into it. Switching achieves coordination by activating pertinent sub-systems and de-activating others. The executive system regulates other sub-systems through allocation of resources to processes in support of goal-attainment, and inhibition of processing of interfering stimuli. But what coordination is of the right kind to mark *individual*-level states and events? I do not have a general characterization of this kind of coordination. Nevertheless, coordination that is both in light of the *individual's* goal, and that is of activities across (more or less) *all* of the individual's sub-systems (and other parts), plausibly is an instance of such coordination. The executive system does regulate a wide range of different sub-systems, across the individual's parts. These sub-systems include cognitive, perceptual, memory, and motor systems. The executive system thus does coordinate activity not merely of a narrowly circumscribed range of sub-systems, but arguably of sub-systems across the entire individual. Indeed, the executive system is the only known psychological structure that both coordinates activity across such a wide range of an individuals' parts, and in light of her own goals. So executive functioning plausibly helps generate at least one kind of characteristic whole-individual coordination of an individual's parts.

In each of these ways appeals to executive functioning explain why instances of individuals' guidance in visual search carry marks of individual-level states/events.

5.5 Summing up

This concludes my argument for the claim that the executive system actually constitutes a capacity to guide visual attention. In the previous section I argued that, for visual attention, individual's guidance correlates with the regulative operation of the executive system. In this section, I first argued that we can directly establish that the executive functions are components of a capacity to guide visual attention. I next argued that executive functioning generates the characteristic flexible coordination of activities toward the individual's goal, as well as the properties characteristic of individual-level states/events that we find in this flexible coordination. Indeed, the executive system is the only known psychological structure that does both. We thus can explain both guidance's flexible coordination and its being achieved by the individual, by appealing to the executive system's regulation. But these just are the conditions on actual constitution. Therefore, the executive system actually constitutes a capacity to guide.

6 Guidance, primitivism, and the causal theory

I have argued for the claim that

> *Capacity to guide:* Individuals have a capacity to guide their activities toward their goals, which is actually constituted by the executive system.

I first argued that executive functioning correlates with instances of individuals' guidance of visual attention. Next I directly established that the executive functions actually constitute a capacity to guide visual attention. Finally I agued that executive functioning generates the flexible coordination of activities toward an individual's goal, as well as the integration with individuals' central states/events and characteristic whole-individual coordination, that mark individuals' guidance.

At the beginning of this paper, I identified the

> *Problem of guidance:* to offer conditions that explain how individuals guide their activities toward their goals.

as a central challenge in action theory. The challenge to provide explanatory conditions would *not* be discharged by an argument that merely established the exercise of a primitive capacity to guide as a condition on individuals' guidance. Appeals to such a capacity alone would not be sufficiently independent of their explanandum to yield non-circular explanation. My proposal, however, does discharge the challenge since it provides conditions at the level of an individual's sub-systems. These conditions *explain how* individuals guide, by offering components of a psychological competence, indeed, partial neural mechanisms, whose causal interactions actually constitute individuals' guidance. The conditions explain how interactions of executive functioning with other sub-systems generate coordination, integration, and compensation in light of the individual's goal. The conditions furthermore explain how executive functioning generates marks of individual-level states and events. These are the marks that a process constituting an individual's guidance paradigmatically exhibits. We can thus appeal to executive functioning to both specify explanatory conditions under which activities are *flexibly coordinated toward some goal*, and under which this coordination is *the individual's*. But these are the two explanatory demands, addressing which the problem of guidance consists in. In neither case do these conditions explain circularly. The executive functions are independently characterized psychological competencies: their characterization does not essentially appeal to individuals' guidance or individuals' agency more generally. This characterization allows us to specify causal law-like regularities governing their interactions, as well as the interaction of executive functions with other psychological sub-systems. In both cases, we can rely on independently established methods in psychology and cognitive neuroscience in our explanations. We thus have the beginnings of a solution to the problem of guidance.

The proposal constitutes progress over both primitivism and the causal theory. Causal theorists did not establish that they had identified an explanatory condition on guidance by the *individual*. My proposal constitutes progress over causal theories, because it can be directly established that the executive system is the right kind of structure to explain how the individual herself guides activities toward some goal. The claim is established by empirically testing for mutual manipulability. Furthermore, appeal to executive functioning is explanatory of guidance *by the individual*. My proposal identifies independent, robust, actual components of a capacity to guide, explaining guidance by appeals to their interaction. The proposal does not rely on tacit appeal to individuals' guidance or control for its explanations.

Primitivist theories, too, did not offer sufficiently independent, explanatory conditions on how it is that individuals' guide. Indeed, their notion of an agential capacity seemed entirely unconstrained. Furthermore, primitivist proposals either did not attempt to explain, or rejected the possibility of explaining, how individuals' agential capacities integrate with our best explanations from natural science. My proposal constitutes progress over primitivist theories, because appeals to the executive system are sufficiently independent from the explanandum to provide non-circular explanation: they not merely provide evidence for the existence of a capacity to guide, help characterize this capacity, and explain its possibility; they also suggest ways to constrain characterizations of primitive agential capacities. Such characterizations must respond to what empirical science discovers about their psychological or neural underpinnings. Similarly, my proposal suggests how agential capacities may be integrated with explanations from natural science. The executive system is a structure discovered by empirical psychology. This psychological structure integrates with our knowledge about individual agents from neuroscience, biochemistry, and biology in the way mechanistic explanations describe. Appeals to a capacity to guide in turn integrate with the natural sciences because structures in those sciences – the executive system – help actually constitute it.

Both primitivists and causal theorists might hence welcome my proposal. The causal theorist might elaborate on the kind of causal structure that marks exercises of agency by reflecting on the executive system that we find in actual human agents. The primitivist might elaborate on the primitive agential capacity required for guided action in the same way. While acknowledging such a capacity seems compatible with either approach, neither would be complete without it.

My proposal also makes a start on the puzzle of how individual and their agency might be embedded in the natural world. The proposal focuses on one kind of individual agency: guided action, paradigmatically involving the flexible, goal-directed coordination of activities in individuals' parts. We can explain the relevant kind of flexible coordination by appealing to a structure, discovered by empirical psychology, that itself regulates other structures, discovered by other natural sciences. In doing so we provide a componential account of a capacity, as well as a partial mechanism sketch. Different natural sciences – psychology, neuroscience, biochemistry, and so forth – describe different levels of the capacity and mechanism that actually constitutes an individual's capacity to guide. Exercises of this capacity partly consist in the processes that occur at different levels of the competence and mechanism. We can thus begin to understand how individual agency is embedded in the natural world.

We obtained this understanding without first providing a reduction of, or necessary or sufficient conditions on, individuals' guidance. The proposal suggests that these issues turn into the question of whether appeals to some given psychological competence or mechanism such as the executive system will allow us to provide a reduction of individual agents and their actions. But the proposal does not take a stand on the question of whether individual agency can, or must be, reduced to other entities. It is compatible with a view according to which the causal laws discovered by natural science do not exhaust the causal laws that there are. It is also compatible with a view according to which natural science does, after all, discover causal laws that involve individuals and their actions. I leave this issue open.

My proposal in this paper is modest. I have argued that actual human agents have a capacity to guide visual attention. I have argued that the executive system constitutes this capacity. I have argued that we can better understand how these individuals guide by appealing to the operation of this system. And I have suggested that reflection on how this system actually constitutes individuals' capacity to guide allows us to better understand how individual agency is embedded in the natural world. I do believe that these results constitute a first step toward understanding agency more generally, but that larger project will have to wait for another occasion.

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