Epistemic action, extended knowledge and metacognition

Joëlle Proust (Institut Jean-Nicod, Ecole Normale Supérieure, Paris)

Abstract

How should one attribute epistemic credit to an agent, and hence, knowledge, when cognitive processes include an extensive use of human or mechanical enhancers, informational tools, and devices which allow one to complement or modify one's own cognitive system? The concept of integration of a cognitive system has been used to address this question. For true belief to be creditable to a person's ability, it is claimed, the relevant informational processes must be or become part of the cognitive character of the agent, as a result of a process of enculturation. We argue that this view does not capture the role of sensitivity to epistemic norms in forming true beliefs. An analysis of epistemic actions, basic and extended, is proposed as offering an appropriate framework for crediting an agent with knowledge.

In recent articles,[1] the issue has been raised of whether, and in which sense, one can credit someone with the true belief that *P*, when the cognitive processes used to form beliefs about *P* are essentially extended.[2] The possibility of extended knowledge is derived from *the extended cognition thesis*, which is closely related to, but different from, *the extended mind thesis*.[3] The latter thesis claims that the mind does not respect the "demarcations of skin and skull", but extends to parts of the environment. The former thesis makes the narrower claim that the processes involved in human cognition (i.e. perception, memory and reasoning) tend to "lean heavily" on external supports and instruments, such as eyeglasses, notebooks, telescopes, computers, or neural implants. Granting, however, that these external processes are used by agents to acquire beliefs (and other epistemic states) that would not have been acquired otherwise, epistemic credit for forming true beliefs on their basis should not be confined to the individual agent's skills. It should be broadened to include these external processes that have been functionally involved in extracting, combining or reorganising the information relevant to the agents' cognitive goals. Hence a problem arises involving attribution to the agent of the true beliefs so generated, and of her role in generating them. The present proposal

---

[1] See Menary (2006, 2012), Palermos (2011), Palermos & Pritchard (2013), Pritchard (2010).

[2] The Credit Theory of Knowledge claims that a necessary and sufficient, or alternatively: a necessary condition for knowledge is that the cognitive agent should be creditable for forming the corresponding true belief (Greco, 2003, Pritchard, 2010, Riggs, 2009). In this article, this view will be taken as a background assumption. For a critical approach, see Lackey (2009).

[3] Clark & Chalmers (1998), Clark (2007, 2010).

will rely simultaneously on conceptual considerations and experimental evidence to address this issue.

1. Active coupling

Clark & Chalmers (1998) present *the extended cognition thesis* as a form of "active externalism", where cognition depends on "manipulations of the environment". Active externalism, they claim, refers to a coupled system gaining a causal role in governing an agent's behaviour. There are several ways, however, of capturing activity in such a system. On a conservative construal, the agent is actively changing the environment to suit her own prior epistemic needs, thereby being the initiator of a particular coupled system. For example, an agent decides to follow the directions of her GPS while driving. This approach is conservative in that, when she allows a GPS to guide her driving, it is the agent who is manipulating her own cognitive environment. When so conceived, active externalism merely offers an exemplification of an agent's instrumental rationality, which consists in relying on dynamic, activity-coupled models of the world in order to facilitate or enhance her own cognitive capacities. An agent is not manipulated or shaped by her abacus, or her GPS. He or she remains in control of her decisions to act, and selects the means that are the most appropriate to her independently formed ends. On this first interpretation, the classical construal of agents in individualistic terms is fully compatible with the occasional selection of cognitive enhancers.

On a second construal, however, individual agency is deeply transformed by recurrent couplings with enhancers. On this revisionist construal, the coupled agent-environment system is jointly shaping new cognitive routines. This second type of interpretation seems to be closer to Clark & Chalmers' view: "All the components of the system", they write, "play an active causal role, and they jointly govern behaviour in the same sort of way that cognition usually does". This interpretation seems also to be favoured by Kirsh and Maglio,[4] who first coined the term "epistemic actions", to designate manipulations of the environment that agents use in order to diminish the load on their working memory:

> Thus, when physically rotating the zoid for its computational effect, the external world
> functions not as a passive memory buffer, simply holding information to be picked up

---

[4] See Kirsh and Maglio (1994), Maglio and Kirsh (1996).

by looking, but the world in interaction with the agent functions more like a working memory system, that is, like an interactive visuospatial sketchpad. (Maglio & Kirsh, 1996).

As suggested in this quotation, an agent is not, strictly speaking, deciding to use particular manipulations. Rather, it is the interactive, coupled system formed by the agent and the moving shapes of the Tetris game that allows a given problem-solving strategy to emerge from activity-dependent feedback. More generally, the added processing power gained through dynamic coupling may either facilitate or enhance the individual's perception or memory, but it can also replace the individual's skills or even create new abilities -- new ways of sensing, thinking, communicating, which in turn determine new epistemic and instrumental goals and new motivations. Enhancement technologies, furthermore, are backed up by institutions, advertising firms, competition for resources, professional constraints, views about art, religion or the future of our species:[5] In other terms, enhanced processing is itself dynamically coupled with additional adaptive systems, which together also have an "active causal role" in the individual's behaviour.

Such a view applies to cognition in a broader sense, involving not only belief acquisition or problem solving, but also motivation and emotion.[6] On this view of the activity involved in extended cognition, it is the whole set of context-dependent systems coupling agents and their environments which, at the human end of the system, shape and trigger activity, i.e., create motivations to act, and enhance sensitivity to particular values. On this view, agents are at least as much manipulated by their environment as they manipulate it. Think, for example, of the world-wide influence -- on social cognition and access to knowledge -- of iphones and facebook-type internet operators. How can we distinguish, in any principled way, the manipulator from the manipulated? Some philosophers and social psychologists even contend that individual agents (and the corresponding self-attributed identities) actually are constituted by a repertoire of skills, motivations to act, and representations originating in the socio-cultural, institutional, and technological dynamic systems they interact with.[7] On such a view, epistemic agency spreads to all the systems that have been coupled with the cognitive system of an individual to produce cognitive outputs. They include, beyond the cognitive subject, the persons who transmitted true beliefs to her, the inventors and producers of various perceptual,

---

[5] See for example the performance artist Stelarc, Kurzweil (2005), Warwick (2004).

[6] For a convincing interpretation of this broad understanding of extended cognition based on cultural variability, see Markus & Kitayama (1991).

[7] Dennett (1991) and discussion in Ismael (2006).

memory, and computing tools, the institutions that allowed specific epistemic goals to be formed, the cultural preferences that made such goals motivating, etc.

Because it undermines the central notions of classical individualist psychology, the second interpretation of the extended cognition thesis also affects the epistemology that has been built on its basis. If human subjects are thinking and acting as part of the coupled systems they interact with, what we call "an epistemic agent" no longer seems to be characterizable through individual properties or virtues. If appraisal is supposed to spread to the entire set of systems that together make an activity adaptive, notions such as epistemic or even moral credit (or discredit) seem to lose their ordinary sense: Who is supposed to conduct the appraisal? Is it another set of coupled systems, and if so, which one? If environments are co-constructing and co-controlling situated agents, by imposing typical ways of wanting, judging and behaving, by instilling moral values for self- and other-evaluation, ingroup/outgroup stereotypes, and a sensitivity to particular epistemic standards (such as reaching a consensus, or consulting evidence), why should agents remain the proper sources and targets of appraisal?

Let us take stock. In the first interpretation, epistemic agency is taken to be exclusively controlled from within. An agent uses instrumental means to enhance her cognition, but when her cognitive processes include cognitive tool use, the instruments being used do not count as bona fide cognitive processes. This interpretation clearly downplays the constitutive role of epistemic tools in numerous forms of belief fixation, and their active role as information processors. In the second interpretation, epistemic agency is controlled from without. Enhancers, scaffolders and doxastic groups are taken to organize, augment and structure a subject's cognitive processes and her motivations. In this picture, cognitive agency dissolves into a property distributed across coupled systems, where the contribution of individual subjects is blurred into social and environmental forces; as a result, the attribution of epistemic credit to an individual looks arbitrary and pointless. For individuals to be creditable for at least part of their true beliefs, another route must be found avoiding the Charybdis of hyper-individualism and the Scylla of epistemic irresponsibility.[8]

2. From cognitive integration to epistemic agency

---

[8] For the related contrast between Goldman individualism and Fuller's revisionism, see Goldman (2010), Fuller (2012), and the discussion in Palermos & Pritchard (2013).

To resist interpretation 2 or, at least, limit its revisionist epistemological consequences, while also acknowledging the extensive use of cognitive tools in belief formation, a specific strategy based on the concept of 'integration of a cognitive system' has been proposed. First meant to address the puzzles of the extended cognition thesis raised by philosophers of mind, the property of cognitive integration has also been used to explain how extended cognition can be a source of extended knowledge despite the difficulties emphasized above concerning who can be granted epistemic credit, and how much.

The idea is that, for knowledge to be creditable to a person's abilities, the relevant informational processes must be reliable, form typical dispositions in the agent, and be or have become part of her cognitive character, for example, as a result of a process of enculturation (through which dynamic patterns of practice are routinely used to acquire information, as with writing or reading).[9] Integration with the agent's cognitive character is supposed to be a key to epistemic agency, because cognitive success, then, is due to a belief-forming process that is not only reliable, but also stable, i.e., due to cognitive ability rather than to some form of epistemic luck.[10] Two forms of cognitive integration have been contrasted: one in which cognitive success is "primarily creditable" to the subjects' cognitive agency (strong requirement) or another where it is creditable "to a significant degree" (weak requirement).[11] The latter is deemed to be more appropriate in the case of extended knowledge, because it accommodates the externalist intuition that a subject may reliably use devices, socially transmitted practices, artifacts, or external informants in order to form true beliefs even though she does not reflectively question (and even is not cognitively able to question) the reliability of these informational mediations.

This strategy is indeed an important step toward a clarification of how cognitive character can be a source of epistemic agency even in the case where cognitive processes are externalized. The notion that epistemic credit should be graded is intuitive, and seems to be sufficiently flexible to apply to the multifarious ways in which instruments, spatial models, processing devices and other agents can mediate knowledge acquisition. A major problem with this strategy, however, is that the sufficiency of the condition can be questioned. One can think of specific agents' abilities passing the test of reliability, stability and integration while clearly failing the test of agency. Cases of cognitively integrated processes that lack agency,

---

[9] Clark (2010), Greco (2010), Menary (2006, 2010, 2011), Palermos (2011), Pritchard (2010).
[10] Pritchard (2005a, 2010). See also Sosa (2007): "Belief amounts to knowledge when apt: that is to say, when its correctness is attributable to a competence exercised in appropriate conditions". (92)
[11] Pritchard (2010).

however, are common-place. Most of our beliefs, whether from a perceptual, memorial or testimonial source, are passively acquired. For example, when sensing that it is raining on the basis of visual, auditory, or proprioceptive information, a perceiver does not perform a cognitive action. She merely registers a fact, or even not even a fact: just a relation that she has to a positive or negative opportunity.[12] The step from sensing to judging is an automatic one, i.e., one which requires no cognitive control, and hence, does not involve any norm sensitivity in the agent.

It will undoubtedly be objected that contemporary epistemology has offered good reasons for claiming that what is called here "informational registering", when correct, constitutes genuine knowledge, also referred to as "animal knowledge".[13] If a dog registers an intruder, and if John, the dog's owner, combines various types of perceptual evidence to infer that there is an intruder, there is some fact that they both know. As long as their perceptual processes are reliable, i.e., express a stable perceptual competence, both the dog and his owner have gained perceptual knowledge. The present proposal runs against this view. Perceptual learning can be based on a series of registrations, which track the regularities in the world, and in the long run form associative bonds with other registerings. But registering, in its more basic form, is not subject to animal-level critical evaluation, which is a crucial competence for the kind of cognitive integration we are after in knowledge attribution. By that it is meant that a belief gained by perceptual registering is not appraised for its informational quality, i.e., not metacognitively monitored. This means that an animal does not have a way of resisting misinformation, nor to reject an epistemic decision in the presence of insufficient discriminatory power or evidence. Second, the representational format used in registering does not need to be propositional. Nonconceptual, emotional registerings target situations as opportunities in a featural format, which is relational, but not objective (it is not referential). A non-propositional format, however, cannot, properly speaking, represent facts.[14] In summary, attributing knowledge to an animal on the basis of the apparent parity between John and his dog misses the fact that knowledge involves sensitivity to epistemic norms, and that such sensitivity needs to be expressed by appropriately controlling one's epistemic states. On this proposal, however, there still is room for genuine animal, non-reflective knowledge. Such

---

[12] See Proust (2013, submitted).

[13] Passive registering is considered in Sosa's (2007, 2009)) to constitute "animal knowledge". This idea, however, will be resisted. Animal knowledge will be proposed to be generated by controlled processes of perception and memory, which rely on a form of affective sensitivity to epistemic norms.

[14] A nonpropositional registering can indicate a fact, not represent it as a fact. Cf. Proust (2009, 2013, submitted).

knowledge is non-reflective, in the sense that the animal, while able to control some epistemic states, being thus sensitive to epistemic norms, does not know that it is. The sensitivity to epistemic norms that is required for any kind of knowledge to be gained, is realised in animal knowledge through specialised feelings, rather than through meta-beliefs.[15]

The upshot is that, assuming that epistemic agency is supposed to play a central role in forms of reliabilism that aim to preserve the role of agents in knowledge acquisition,[16] cognitive integration must further be specified in order to secure epistemic agency. A higher degree of cognitive integration is obtained, obviously, when a believer can represent for herself and others how her evaluation coheres with her background beliefs. But again, as will be shown below, such further integration presupposes epistemic agency, and does not constitute it.

One might object that the concept of cognitive integration has been further analysed through the "manipulation thesis". Does not this additional exploration of the concept render justice to the fact that agents, in interaction with their environments, are sensitive to norms, and are modifying the environment while also being themselves cognitively modified by their normative engagement with the world? "Cognitive manipulations, it is claimed, are bodily engagements with the niche that are regulated by norms".[17] Reference to norms is an interesting addition in this analysis. By norms, however, are meant in the quotation above, not objective informational constraints governing knowledge acquisition, but rather alternative practical, reliable methods for obtaining an expected cognitive outcome in a first-order task. As a consequence of this emphasis, nothing is said yet of the epistemic status of manipulations. Although a manipulation is, in its essence, agentive, what makes it epistemically agentive is unclear. John's learning how to manipulate his GPS, for example, in accordance with the booklet instructions, does not make the GPS *epistemically* integrated with John's cognitive system. If the agent merely uses her GPS to reach a destination by blindly following its commands, without critically questioning any of them with respect to his/her own epistemic goal, it does not seem that the GPS, although integrated with John's driving, qualifies as integrated with John's epistemic dispositions. Even though the GPS may be conducive to action success, its role seems at first blush merely instrumental. If this is

---

[15] On the role of feelings in gaining awareness to epistemic norms, see Hookway (2003). For a review of studies on animal metacognition, see Couchman et al. (2012), Proust (2013).

[16] As Pritchard (2005b) notes: "One can regard agent reliabilism as re-introducing the epistemic importance of the agent while at the same time avoiding the pitfalls associated with the egocentric approach to knowledge (..) inherent in internalist epistemology". See, however, the difficulty of deriving epistemic virtue from mere agent reliabilism in Pritchard (2005a), 7.2.

[17] Menary (2010).

correct, arguing that "the norms [the practices on which the bodily manipulations are based] are cognitive because they are aimed at completing cognitive tasks" does not automatically amount to claiming that they are governed by epistemic norms in our sense of the word.[18] But if this is not the case, then no epistemic credit need be attributed to the agent. There are many cognitive tasks such as counting, rote learning, writing, following a GPS, that may be performed for the sake of the activity or for some instrumental end, rather than in the pursuit of a purely epistemic goal. The difference between the two kinds of cases, as we will now see, has to do with the role that an epistemic norm, understood this time as the informational dimension under which a subject epistemically evaluates her output (or under which a subject's output is epistemically evaluated by others), is supposed to play in determining the satisfaction conditions of her current manipulation activity.

If these considerations are on the right track, two questions must be addressed in order to complete our articulation of the concept of cognitive integration. First, how should passive and active (i.e. "agentive") epistemic processes be distinguished? Second, how is this contrast to be applied to the case of extended cognitive processes?

3. Passive vs. active epistemic processes

Registering, as described above, is typically "stimulus-dependent". In other words, attention is automatically drawn to the fact about to be registered, rather than being controlled by a planning or interested subject. As long as the information is coherent with stored beliefs and non-relevant to current plans, the updated information has no particular downstream cognitive effect. Informational reliance is of a non-critical kind, and does not engage further controlled resources. In contrast, for a basic epistemic action to be performed, i.e., for an agent to be creditable for a given correct epistemic outcome in ordinary, non-extended cognition, a thinker must minimally 1) be able to activate the corresponding command (e.g., know how to search her memory), 2) want to achieve the associated cognitive result by deciding to activate this command (i.e., decide to acquire or retrieve an informational property that is not presently available to her, for example: retrieve a proper name), and 3) be sensitive to the correctness or incorrectness of the result once it is achieved.

This third condition is of major epistemological relevance, because it provides a

---

[18] Menary (2010) distinguishes five varieties in cognitive norms, purposive, corrective, manipulative, interpretative and creative. These varieties suggest that normative evaluation of a manipulation is not confined to the epistemic ("corrective") domain.

normative constraint that determines the epistemic nature of cognitive action through its correctness conditions, to which an epistemic agent needs to be sensitive. The very existence and potential success of an epistemic action minimally presuppose that the agent is able to evaluate the outcome of her action, whatever the source of feedback available. For any epistemic action, fulfilment of this third condition is monitored through metacognitive processes (as will be seen later, monitoring may be internal to the agent, or externally provided, by tutoring systems, teachers, etc.). Only agents endowed with a sensitivity to epistemic norms can predict their cognitive success, i.e., know (at least procedurally) that their actions have correctness conditions, and be able to determine, in a given case, whether the present action can generate the kind of knowledge that is desired in the given context, independently of the gains or losses associated with success and failure. Claiming that success of an epistemic act is exclusively a matter of epistemic correctness does not amount to claiming that epistemic success does not have pragmatic implications for the success of world-directed actions based in part on that act. It does. But the distinction between epistemic norms and norms of rationality is needed to clearly differentiate the constraints that apply to thinking, and those that apply to acting on the world. In contrast with the kind of match expected in the case of a world-directed action, which is based on present perceptual cues as compared to stored ones, epistemic success can be appreciated purely internally. Evidence suggests, however, that sensitivity to epistemic feedback needs to be trained over time -- by comparing an epistemic outcome (for example a name that comes to mind) with an expected one. There is no reason to deny that agents might be sensitive to an epistemic norm when coupled with an adequate, external provider of feedback. For example, a computer can help a student learn arithmetic by providing contextual feedback. The ability to use this feedback in learning arithmetic indicates that the person meets the third condition for performing a cognitive action.

A familiar externalist worry, here, is that agents should be granted epistemic credit even in the absence of meta-beliefs allowing them to consciously articulate their grounds for forming a belief, or for evaluating, on this basis, their chances in forming a true belief. As suggested above, this worry should be alleviated, however, by the ability of agents to form epistemic appraisals on the basis of their affective experience. As experimental research has shown, sensitivity to epistemic norms is not expressed only by conjuring up and weighting arguments for or against a given epistemic decision. In domains such as perceptual or memorial control, the ability to predict or retrodict correct performance in a first-order

cognitive task (such as remembering an icon among distracters) is similar in non-human primates and in humans.[19] A plausible hypothesis is that metacognitive monitoring first evolved as an association between task cues and unconsciously formed heuristics that allowed organisms to evaluate what they know, perceive, remember, without having any grasp of the associated concepts.[20] "Noetic feelings" (such as the "feeling of knowing", or the "feeling of being right"), contextually generated by dynamic cues in the cerebral and behavioural activity of an agent during performance, allow her to reliably monitor her current epistemic action. Interestingly, these feelings encourage the agent to use, or discourage the agent from using, the belief so gained to act on the world. Monkeys who do not remember well what they saw prefer to opt out from the corresponding cognitive task. Feelings directed at the cognitive task currently performed thus enable the cognitive agents to "know how" to act in a way that makes epistemic sense before it makes instrumental sense. In summary: evidence indicates that at least some epistemic norms do not need to be represented as norms by cognitive agents to control their epistemic decisions.

Our three conditions above for epistemic agency can be used to examine in a more fine-grained way how cognitive agency and cognitive character are related both in traditionally conceived and in extended knowledge. Two additional observations are in order when conducting this exploration. First, as we saw above, every epistemic action is constituted by an epistemic norm that determines its success or failure. A given epistemic norm consists of the correctness conditions that apply to the associated epistemic action. In other words: every epistemic action generates a form of acceptance under a particular norm. Accuracy or truth is a norm of wide application, whose typical acceptance is called belief (understood, in contrast to mere registering, as issuing from deliberation and critical appraisal). It is not the only epistemic norm there is, however. One can try to remember exhaustively rather than accurately (the conditions of correctness for exhaustiveness tolerate false alarms, and ban omissions, while for truth, they tolerate omissions, but ban false alarms). When reading fiction, one is interested in coherence and informativeness rather than truth.[21] Now a second observation explains why several epistemic norms are needed in conducting our daily thinking. Different norms regulate our acceptances because there are different ways in which information can be used. One may need to exactly remember the forgotten list, or be happy

---

[19] Cf. Couchman et al. (2012).
[20] Proust (2013).
[21] For a defense of the plurality of epistemic norms involved in cognitive actions, see Proust (2012).

with an exhaustive reconstruction (including false items). We may need to know (as an anthropologist or a politician, say) what is the common opinion in a group about a given issue: we may then subject our acceptance to consensus rather than accuracy (accuracy might qualify as the metanorm about the "correct" or objective consensus in the group at the time). We may need to figure out if a given explanation is plausible given the evidence. Thus, in spite of the autonomy of epistemic norms vis-à-vis instrumental norms in their conditions of correction, the selection of a given epistemic action, i.e. also of the norm to which this action is subjected, is guided by instrumental considerations. This is easily explained by the fact already noted that epistemic actions are generally embedded in instrumental, or world-directed actions. Various epistemic properties are of interest across contexts of action: shopping, conversing, doing science, writing a peace treaty. An important task for epistemologists consists in determining whether the concept of knowledge can accommodate these various types of epistemic properties.[22]

In summary: Knowledge of an active kind can be expected (when true beliefs are formed) when a specific epistemic goal is motivating enough for a thinker - already trained in attentional control- to actively orient to a promising source of information, (e.g. by searching her memory), and to evaluate how valid the outcome of the command is. A goal is epistemic when it consists in determining through perception, memory, or others' testimony what needs to be learned – not: what needs to be believed ("whether *P*", not: "that *P*"). Salient cases are perceptual discrimination, controlled memory, or critical use of testimony. In these cases, epistemic agency consists in controlling informational processes that can also automatically deliver information. Other domains of epistemic achievements only have active types, because the epistemic outputs they generate can only be gained when an epistemic goal has been deliberately selected: problem-solving, or deliberating, or judging about one's learning, for example, cannot be automatically performed.

We can now see why integration of a cognitive system fails to fully capture the notion of a "cognitive character". If a thinker was deprived of any way (internal or external) of evaluating her own cognitive outputs, one could not credit her with more than successful passive registerings, even though these outputs coincide with true beliefs that have been

---

[22] Epistemologists generally treat these various evaluative dimensions as "epistemic desiderata" (Alston, 2005) or "epistemic values" (Sosa, 2009), which are more or less dependent on the overarching norm of truth. The concept of an epistemic action constituted by its own conditions of correction, however, does not seem to justify this hierarchy, except for the fact, already noted, that the conditions of correction are themselves subjected to a meta-norm of truth.

generated by her own stable, integrated cognitive processes. [23] No epistemic agency would be involved. An epistemic agent does not merely consist in a set of integrated, stable and well-functioning mechanisms for registering how the world is. An epistemic agent should be able to monitor the epistemic value of her epistemic productions. She also needs to flexibly integrate her informational needs with her instrumental goals.

4. Classes of extended epistemic actions

The problem we now need to address concerns how extended cognitive agency impacts epistemic responsibility: If a subject tries to learn whether *P* through a mediator, external device or agent, the true beliefs so acquired do not seem to be fully creditable to her own cognitive system. Against this intuition, however, the following argument can be offered. Basic epistemic actions, as we saw in section 3, are normally embedded in instrumental actions. In the extended variety, instrumental cognitive-like actions are, in addition, embedded in epistemic actions, and made to serve epistemic ends. An important step in both cases, which is constitutive of epistemic agency, consists in assessing the epistemic value of the output before endorsing it, and subsequently deciding to act on its basis. Here is the punch line. Rejecting or limiting agentive credit in the case of extended cognition might seem to be as myopic as rejecting agentive credit in the case of extended instrumental action, such as taking a bus to attend a meeting. This parallel, however, is highly misleading: as will be seen, the epistemic value of the mediator needs to be epistemically appraised, while the type of bus used to attend a meeting is irrelevant to the embedding action.

What makes, in addition, the issue of epistemic credit particularly thorny in this case is that, as will be seen shortly, there are two types of ends that can be pursued in extended cognition, each of which is relevant to evaluating cognitive character, and to attributing credit for knowledge. One can decide to use a (short-term) informational mediation in order to enhance one's epistemic performance. Alternatively (or in a complementary way), the agent's epistemic competences can be intentionally modified, over time, (by herself or by others) in order to enhance or augment her performances by making new competences available to her.

---

[23] This observation illustrates the complexity of the question of whether registering may generate knowledge. It may if the following functional condition is fulfilled: the cognitive agent must be independently sensitive to epistemic norms. Insofar as this disposition does not need to be exercised in each cognitive operation, perceptual or memorial operations, when reliable, stable and creditable, can be recognized as generating a passive form of knowledge. This specification does not alter the main line of our argument about cognitive integration.

This complication of having several time-scaled goals deserves attention, as it opens new perspectives on epistemic credit.

It may be useful to stress again that an extended epistemic action differs from a basic epistemic action, because it contains an instrumental sequence, where a tool is selected and put to work (or "manipulated") in order to produce an expected epistemic outcome. From there, the epistemic action proceeds "as usual", first evaluating the mediator's outcome, and then using this outcome to complete the overarching instrumental action (meant to change the world). To further clarify the embedded sequence in extended cognition, different types of goals and associated tools (i.e. external mediators) should be distinguished.

a. Using physically external representational vehicles to facilitate achievement of a given epistemic task by reorganizing the relevant information and making its processing easier and more surveyable (e.g., writing a mathematical demonstration, a computer program, drawing flow-charts, organizing the environment to enhance memory efficiency): these are *epistemic enhancing* tools (or, for short: *enhancers*).

b. Relying on optical instruments, machines, books, computers, or people to either perceive, learn, or retrieve facts, and solve problems, that would not be easily available or solvable otherwise (e.g. consulting a dictionary, Otto's notebook, Wikipedia): these are *informational tools.*

c. Relying on machines or people to acquire new epistemic skills, that would not be available otherwise (e.g. attending a course in mathematics, practicing meditation or neural feedback training to enhance one's attentional abilities): these are *self-modifying* tools.

d. Modifying one's own cognitive abilities through medication (e.g. ampakines for long term potentiation of neurons) or implanted devices (e.g., sensory substitution): these are *self-augmenting tools.*

e. Relying on devices or people to achieve epistemic outcomes that cannot be obtained (due to incompetence or lack of time) by one's own cognitive system through methods (a) to (d) (e.g. monitoring physiological variables of interest through implanted electrodes, using software for summarizing a text: these are *outsourcing* tools.

How do our prior conditions for epistemic action fare given these five extended varieties? Let us immediately observe that by outsourcing an epistemic task, an agent either willingly

abandons responsibility for completing the task, or accepts that new epistemic abilities will be developed to attain a desirable end she is unable to monitor. Information so gained will be entirely passively acquired. We will therefore no longer discuss the question of the epistemic credit to be associated with this decision.

Motivation

It is clear that, in cases a-d, condition 2 is easily accommodated. A subject might be motivated to achieve any of the cognitive outcomes listed above, and might engage in the corresponding extended action because she desires, or is "motivationally scaffolded" to achieve this outcome. Note, however, that the motivations engaged are very different, respectively, i) when the goal is merely one of favouring task completion (a and b) or one of self-directed cognitive melioration (b and c), and ii) when the means considered for completing the goal include new processing and learning methods (a, b, c) or long-term transformations through medical and brain engineering (d).

Ability

Condition 1, concerning the ability to activate a command (i.e. have it in one's repertoire), requires more careful scrutiny. An agent, even in the basic case, usually has an epistemic ability based on the prior scaffolding of other agents, institutions, and favourable physical environments. As suggested in section 1, such scaffolding may not be only causal in developing an epistemic ability: it may be constitutive of it. For example, a constitutive aspect of forming true beliefs is that there are physical and social regularities in the world. Another constitutive scaffolding for basic epistemic actions, however, consists in the salience socially attributed to valuable types of epistemic action. A norm of consensus (e.g. epistemic deference to seniors), rather than a norm of truth (i.e., individual evidence-based judgment) can be preferred in certain social groups. Scaffolding plays a still larger constitutive role in the ability to use enhancers and informational tools than it does in basic epistemic actions. Reading and writing are obvious long-term preconditions for using informational tools, preconditions which educational institutions usually provide. Enhancers (*a* mediators) typically require prior specialized long-term training to be at all selected and efficiently used (e.g., in mathematics, engineering, computer graphics); simpler forms require at least some short-term familiarisation with the corresponding practice (e.g., abacus, pocket calculator), what Menary (2012) calls "cultural practices".

Should scaffolding in all these cases modulate the epistemic credit accorded to an agent's ability to gain true beliefs? Decreasing epistemic credit to an agent by invoking the

facilitation provided to her by social scaffolding seems to go against common intuitions.[24] Take the case of Sally, a successful experimental psychologist. One might claim that, had Sally not been properly instructed as a child, not motivated to study in college, not have enjoyed an epistemically favourable environment (and so on), she would have been unable to use MatLab (among other epistemic mediators), and hence, would not have produced the same true beliefs on the basis of her experiments (she might have either failed to produce them, or produced false beliefs instead). The upshot is: epistemic credit should be spread to all the agents, machines and software that contributed to her mind being shaped "in the right way" for significant outcomes to be produced.

This conclusion might be opposed through the following objection. It only holds if we look at scaffolding as not only partly constitutive of agentive control, but as pre-empting individual leeway in selecting and conducting epistemic actions. Scaffolding, at least in Western societies, means that some practices are more salient, or more easily reproducible, not that they are constraining epistemic agency in some deterministic way. Note, however, that, by transforming an issue about the constituents of agency into a question about the causal determinants of action selection, the objection misses the deeper issue that this chapter tries to explore. On the third view delineated in section 1, technological use in cognition is not merely instrumental: it constitutes in part the cognitive processes that will deliver an epistemic output. Similarly, social-educational scaffolding is not merely causal: it may be taken to constitute in part an individual's epistemic abilities, her dispositions to manifest them in a context, and her motivations for performing a given cognitive action rather than another. Vernacular languages offer a wealth of examples for such diversity in epistemic scaffolding: while certain languages invite careful discrimination between degrees of certainty of one's beliefs (epistemic modals), as opposed to lying, or including one's sources of evidence in one's verbal reports, others do not distinguish uttering a false belief from lying. [25] The motivational role of a cultural conception of one's own self (either as an independent or as an interdependent entity) has been documented in social psychology. The notion of a cognitive character as reflecting an individual's internal, stable dispositions, and as being a source of self-esteem and a target for epistemic credit, is itself clearly scaffolded by a culture where selves are perceived as independent entities.[26] Having such a notion in one's repertoire is itself partly constitutive of the epistemic awareness that motivates individuals to act

---

[24] For a full discussion of this point, see Pritchard (2010)
[25] See Aikhenvald (2006), Danziger (2006).
[26] Markus & Kitayama (1991).

epistemically as independent agents. Far from diluting the concept of agent, recognition of such cultural scaffolding may rather reveal what allowed epistemic agents to emerge at all.

Another consideration, however, is worth discussing at this point. Granting that a precondition for using a task-directed mediator involves learning how to use it, such learning presupposes that specialised competences have been mastered. Agents, thus, need to plan (and be encouraged to plan) their own epistemic development. The contrast between task-directed enhancers and self-directed modifiers (the a and c groups of mediators) suggests that, when attributing epistemic character to an agent, it is not sufficient to check her ability to reach predetermined epistemic goals, in a context that may or not be favourable. The goal itself, the methods used to attain it, as well as their time-scale, should also be rationally appraised as being proportioned to the epistemic or instrumental requirements of a given situation, and to the opportunities it offers.[27] In other words, when discussing the ability condition of extended epistemic agency, the control space is both considerably enlarged, including various time scales of decision and cognitive influence of the social environment, and relativised to the existence or absence of scaffolding. An agent can thus be epistemically credited not only for reliably producing true beliefs, but also for having modified her system through enhancers or augmenters in order to reliably produce them.

Epistemic evaluation

Equally significant for epistemic credit, is how Condition 3 for epistemic agency, instantiated as the step of normative evaluation of an outcome, can be fulfilled in the case of extended cognition. In the case of basic epistemic actions, there is no metacognitive evaluation in the absence of a well-calibrated comparator, which is in part an external affair. For example, it is constitutive of the ability to form correct judgments of achievements that the prior feedback provided by others to the subject was unbiased.[28] A miscalibrated instrument is no instrument at all. An evaluative ability depends no less, for its success, on reliable scaffolding and a favourable task environment than does the first-order performance that is being appraised (although the scaffolding entities often differ and the correctness conditions always do: Sally can be right in judging that the name she retrieved is incorrect). Is there anything comparable, in the case of extended cognition? Is an agent able to discriminate the correctness of an output, when the latter is mediated by an enhancer or an augmenter?

This is a difficult question. An obvious difference from the more basic cases of epistemic

---

[27] For a discussion of the ethical implications of such goals, see Proust (2011).
[28] See Proust (2008), Loussouarn et al. (2011).

action discussed above, however, is that using an external enhancer does not seem to be a source of noetic feelings. When Sally tries to remember a proper name, she experiences a degree of confidence in her ability to remember it. Once she has retrieved a name, she experiences a degree of confidence in the correctness of her retrieval. Presumably, she has these feelings because she has had recurrent occasions of trying to remember names and facts, and storing cues predictive of epistemic success.[29] When using external models to enhance her thinking, however, no particular experience except that of moving a tool deliberately, in a goal-driven manner, seems, at least prima facie, to be associated with her activity.[30] How, then, can normative sensitivity be expressed in such a case? Three kinds of answers are possible. The first consists in denying that procedural metacognition cannot be applied to outcomes gained through extended cognition. The second claims that, granting that procedural metacognition is not always available or reliable in these cases, the agent's background knowledge about outcome and about tool reliability (or trust in the case of a human source) provide additional ways of evaluating the epistemic outcome. The third recognises that, in extended cognition, the agent has no epistemic control over the external mediators, and hence, can be credited at most with her instrumental decision to use a particular tool, rather than with the knowledge content so gained. Let us examine each of these three routes.

5 - Sensitivity to epistemic norms in extended cognition

Why could not procedural metacognition also apply to extended cognition? Here is how an argument might go for preserving a role of procedural metacognition. Using an *a-* or a *b-* mediator generates feedback, and hence predictive cues about future performance. The brain being a Bayesian system, it takes tools as equivalent to body parts, and evaluates cognitive outputs in a similar way, whether internally or externally generated. Take Sally's notebook (Sally does not suffer a severe memory disorder as Otto does). She can feel that the content of her notebook has been fiddled with: some addresses are missing, others seem wrong to her. When using his new pocket calculator, John may also feel, on the basis of intuitive arithmetic, that the outcome he gets cannot be correct. Both Sally and John are monitoring their extended processes as they do in unaided cognition, comparing expected and observed values. The same applies to the use of optical instruments: the output can be compared with some

---

[29] Cf. Fleming et al. (2012), Koriat & Levy-Sadot (1999).
[30] Metcalfe & Green (2007).

expected values, leading one to think, for example, that a blurred image reflects mishandling of the microscope rather than a strange cell cross-section. The role of feelings does not stop there. The selection of a mediator is itself integrated with metacognition: the anticipated cognitive effort associated with using a mediator, and the cognitive benefit that is expected from using it, need to be (either subpersonally or consciously) weighted against each other.

Procedural metacognition, however, cannot apply to all cases of extended cognition, particularly when agents are not familiar enough with the technology to appraise its epistemological interest and to reliably form expectations about its outcome. In these cases, the instrument having provided some output might easily have been mishandled. User errors may remain unnoticed. Wrong results may as a result be endorsed. In situations of this kind, the fact that the mediator produces true beliefs, if it does, would be a matter of luck. Agents cannot receive any epistemic credit for it, nor the coupled system agent-cum-mediator.

When agents, in contrast, do not have a sufficient command of the mediators for true beliefs to be reliably produced, they may at least correctly appraise their mediated outcomes as poor or systematically biased. They may be correct, furthermore, in attributing the latter to their own lack of competence, rather than to successive cases of "bad luck". Here, as in poor unaided cognition, their negative noetic feelings may encourage them to turn to self-modifying or self-augmenting techniques, when available. Can agents so modified or augmented now have reliable noetic feelings, i.e., is their epistemic-agentive experience sensitive to the normative status of their beliefs? Evidence suggests that epistemic norm sensitivity may not always survive system-directed engineering. While the adult benefiters from these techniques appreciate the heightened informativeness and correctness of their augmented perceptual states, they may also experience difficulty in "identifying with" their new cognitive system. After successful surgery for a congenital cataract, for example, some patients prefer to return to auditory exploration rather than live in a visual world, which, in comparison with their prior auditory world, seems to them disappointingly strange, cold and threatening, i.e. highly dysfluent. Blind adults with an established practice of auditory exploration may find it similarly difficult and unpleasant to use a tactile-visual substitution system (TVSS) to navigate (in contrast to babies, who have no trouble using it, and develop appropriate noetic feelings on their basis).[31]

To sum up: noetic feelings generated by mediators of the c-d kinds are not always reliable indicators of sensitivity to epistemic norms. Procedural metacognition, therefore, is

---

[31] Bach-y-Rita (1997). For a review of sensory substitution see Bach-Y-Rita & Kercel (2003). On noetic feelings in people equipped with TVSS, see Dokic (in print).

not always able to guide and motivate the acquisition of extended knowledge. If procedural metacognition was the only source of normative guidance, epistemic agents, in cases c and d, would hardly be creditable for acquiring true beliefs: they would mostly acquire them passively, for lack of a capacity for epistemic endorsement. There is, however, an alternative route to epistemic evaluation, through analytic metacognition.

Analytic, concept-based metacognition, is usually taken to be a corrective for the cases when procedural metacognition (i.e., metacognition based on noetic feelings) is either lacking or a source of illusions, in particular when feelings of fluency (felt ease of processing) are falsely taken to predict truth (for example subjects may rely on the familiarity of an assertion to judge it as true; they may take a retrieved memory to be correct merely because it was easily retrieved).[32] Experimental evidence shows, however, that agents turn to analytic evaluation only when four conditions are met, which, significantly, can easily be seen as specifying our three conditions of epistemic agency in a stronger reflective (or corrective) sense. They must (i) be aware of a factor that biases their noetic experience, and (ii) believe that this factor is sufficient to discredit an appraisal based on this experience. They must, furthermore, (iii) be ready to invest effort in reaching a correct judgment and (iv) have sufficient time and attentional resources for the correction process.[33] Note that Conditions (i) and (ii) belong to the evaluative/normative component of epistemic agency; Condition (iii) belongs to the motivation component, and Condition (iv) to the ability condition.
In other terms, people need to take the analytic turn when opting for a corrective epistemic action. This corrective action consists in allocating more effort in order to revise not only a prior acceptance, but also the cognitive parameters responsible for it. A corrective action is a form of unaided self-modification, where feelings are replaced by reasons in driving the epistemic decision.

To sum up: This "analytic turn" occurs when the noetic feelings associated with ordinary epistemic actions are suspected by the agent to be non-reliable for a given type of task, or for a given context. It is still more likely to occur when noetic feelings are either lacking or discordant, as in some cases of augmented cognition.[34] For extended cognition to generate

---

[32] See Koriat & Levy-Sadot (1999), Nussinson & Koriat (2008).

[33] Nussinson & Koriat (2008).

[34] Note that our three conditions for analytic metacognition constitute the most stringent way of "perspectivally endorsing the reliability of one's sources", in Sosa (2009)'s terms –a requirement of reflective knowledge. However, as seen above, noetic feelings result in a similar endorsement of the reliability of one's sources. Such an endorsement, in contrast with a commonly held view, does not require from the agent that she form meta-beliefs about her epistemic states, or about the sources of epistemic reliability for an outcome. The affective

extended knowledge based on analytic appraisal, then, our conditions on corrective action must be fulfilled. According to (i) and (ii), the agent must know *enough* about her mediators, and about her own competence in using them (as compared with the competence required) to evaluate the correctness of observed outcomes. Needless to say, "knowing enough" is also a matter of critical examination (based on a norm of informativeness). If the agent fails this test by her own lights, working to complete her knowledge is the right thing for her to do. In sum: Evaluation can only be successful, on these matters, if the agent truly believes – rather than merely feels – that her epistemic sources and mediators are reliable, and is aware of the conditions of correctness (accuracy, exhaustiveness, coherence, consensus, etc., according to the case) applying to the outcome of her current epistemic actions. [35]

What could the relevant processes be? Genuine information about witnesses is a prerequisite for a rational appraisal of trust to be formed. Specialised processes seem to develop early on for "epistemic vigilance" to be exercised with respect to others' testimony. The same mechanisms also apply to mediators' epistemic trustworthiness. The structure of an extended epistemic task, whether first-order or corrective, is the same in the cases where a mediator is another human being or a tool. In every epistemically extended action, as we saw in section 4, instrumental actions (like requesting information from someone, or consulting a map) are embedded in epistemic actions, in order to serve epistemic ends. An important step in both cases, which is constitutive of epistemic agency, consists in evaluating the epistemic value of the output, before endorsing it, and subsequently deciding to act on the basis of its information. Hence, mechanisms for epistemic vigilance track, in the first place, the source's properties that predict validity in outcomes: for witnesses, epistemic competence in specific fields, general knowledgeability, and benevolence.[36] For non-organic mediators, evaluation by competent experts. Processes for epistemic vigilance also track, in the second place, the contents that are communicated, mechanically computed or retrieved. A new piece of information gained can be assessed, as seen above, through noetic feelings, such as fluency and informativeness (which together constitute relevance). It can also be analytically assessed with respect to the coherence of the information with the beliefs the agent may have that are

---

endorsements that they provide, however, lack the kind of public justificatory access that characterizes the higher forms of reflective knowledge.

[35] Evaluation can go further, and inquire about the meta-beliefs themselves. Descartes' strife for *scientia* over and above *cognitio* seems to be critically focused on second-order knowledge: the claim that safety is only secured by the existence of God seems to be a third-order kind of epistemic evaluation of what counts as knowledge justification.

[36] Sperber et al. (2010).

inferentially related to it. The web of beliefs resulting from the addition of this new information should be increased, resulting in a higher confidence in the validity of this information.[37]

Let us take stock. We have considered three ways of addressing the question of the attribution/distribution of epistemic credit to an agent in extended cases of cognitive processing. We saw that epistemic feelings may sometimes drive an agent's acceptances, but also, often, reveal themselves to be unreliable. Analytic metacognitive processes, including the heuristics for epistemic vigilance, were found to be applicable in all cases. Thus, we are now in a position to reject the view that, in extended cognition, an agent has no epistemic control over the external mediators she may select and apply to enhance or augment her epistemic power, either to a task under way, or to her own cognitive system. In other terms, an agent can be epistemically credited – or criticized -, for deciding to use a particular mediator, on the basis of its epistemic reliability.

A further question is whether being credited with having made a good epistemic decision about which instrument to use should automatically be associated with fully crediting the agent with the epistemic worthiness of the outcome, when it is correct. On this latter question, three elements need to be held in mind: the embeddedness of cognitive mediators within an epistemic action, itself embedded in a world-directed action, the cultural scaffolding that constitutes in part some extended abilities, and the scaffolding constituting in part the epistemic planning involved in extended cognition. The co-occurrence of these three elements justify a careful case-by-case judgment. If, for example, an examination is intended to test a student's unaided arithmetic abilities, use of a pocket calculator justifies suspending any epistemic credit to the user for producing correct results. If a student needs to quickly solve a complex engineering problem, using a pocket calculator will be correctly put to his epistemic credit when finding a correct solution. This difference has to do with the embedded structure of extended cognition: if an instrumental sequence is used to perform an epistemic action, epistemic credit should be allocated on the basis of how the instrumental sequence relates to the whole action. Similarly, the role of cultural, linguistic and institutional scaffolding in norm sensitivity, both in unaided and in mediated cognition, have to be duly appreciated in attributing epistemic credit. The considerations above lead to a conclusion similar to Duncan Pritchard's defence of a weak construal of epistemic credit: [38] Cognition-friendly environments may allow an agent to gain knowledge even with a limited personal

---

[37] See Sperber et al (2010), section 6. See also Sosa (2009).

[38] In Pritchard (2010).

contribution of her own cognitive abilities. A minimal ability from the agent, however, consists in evaluating the epistemic value of her acceptances, whether or not generated through extended processing.

Conclusion

Struggling with multiple goals may hopefully, on certain occasions, be beneficial to each of them. In the present contribution, an attempt has been made to convince epistemologists that the view according to which animal knowledge is the most basic epistemic achievement that a cogniser can reach, should be reinterpreted and shifted in its scope. The automatic forms of registering, such as perceiving or remembering in a purely reactive or associative way, were claimed not to generate genuine knowledge, for lack of any sensitivity to an epistemic norm. In contrast, animal knowledge, as understood here, is constituted by an ability to monitor and control perception and memory on the basis of affective experience of a noetic kind. Such monitoring and control abilities are part of what it is to carry out an epistemic act, whereby an organism attempts to achieve an epistemic goal (like trying to remember whether *P*). Reflective knowledge, in contrast, is constituted in part by an ability to reliably monitor and control perception, memory and reasoning on the basis of background beliefs about task or self. The third and major goal of this contribution is to examine the notion of epistemic credit in the context of extended cognition: the position defended is that pure cognitive integration is not sufficient for allocating epistemic credit to an agent. Exploring the structure of epistemic agency in the extended cognition case from the viewpoints respectively of animal and reflective knowledge, however, offers insight into the conditions under which an agent's true beliefs count as knowledge.

As we have seen, a "revisionist" interpretation of dynamic coupling spreads epistemic credit to the whole environment including entities directly engaged in epistemic scaffolding (such as schools, teachers, academic cursus, etc.), physical mediators (existing systems for reproducing texts, computers, smartphones etc.), economic systems favouring, or not, knowledge, individualistic or interactive cultures, religious practices, industrial firms, and, why not? marketing agencies. This interpretation, ultimately, dissolves individual agency into a medley of causal and constitutive influences. In folk theories of action, however, it is taken to be a genuine individual act to attend a meeting, even though thousands of people participated in building the bus and the road used on the way to the meeting. A computer also required the competences of thousands of people for conceiving it and setting up its hardware

and user-friendly software. Should these thousands of people share the epistemic credit with Sally for using MatLab to present valid and innovative evidence? Our answer attempts to reconcile the role of external contributors to the definition and performance of a given cognitive task, with the specific contribution of the agent who performs it through her own "embedding" action. In this light, epistemic credit to an individual agent is more naturally seen as a comparative matter, rather than as a matter of absolute judgment. What is relevant when one credits Sally for making a scientific discovery is not, or not only, whether knowledge should be attributed to herself alone or to all the scaffolding entities that participated in the epistemic action. What is at stake, rather, is – granting her stable cognitive abilities and dispositions - how genuinely new (and valid) a particular experimental result is, as compared with other results whose respective authors had a *similar* access to epistemic mediators.

This is not to deny that there might be occasions when credit is justifiably based on cross-contextual comparisons. For example, Srinivasa Ramanujan, a self-trained mathematician from India, of socially modest origin, contributed major results to mathematical analysis, number theory, and many other domains. Someone who has achieved extraordinary epistemic achievements independently of any formal mathematical community or scientific institution, and in spite of very hard life conditions, surely deserves very high epistemic credit, as compared even to the best European mathematicians of his time, who had benefited from a much richer scientific scaffolding and motivating interaction in their own environment. Reciprocally, particular educational systems should also be epistemically credited for enabling students to form true beliefs and achieve higher abilities to act cognitively as compared with other systems. The institutional organisation of learning is part of the learning process, rather than its cause. Belonging to a highly-achieving system, however, does not need to deprive an individual student from being credited to form true beliefs, for it is through her own abilities, motivation, and norm sensitivity that she can form them.

References

Aikhenvald A. Y. (2006) *Evidentiality*. Oxford: Oxford University Press

Alston, W. P. (2005). *Beyond "Justification": Dimensions of Epistemic Evaluation*, Ithaca, N.Y.: Cornell University Press.

Bach-Y-Rita, P. (1997). Substitution sensorielle et qualia, in J. Proust (ed.) *Perception et Intermodalité*, Paris: Presses Universitaires de France.

Bach-y-Rita, P., & Kercel, S. W. (2003). Sensory substitution and the human–machine interface. *Trends in cognitive sciences*, *7*(12), 541-546.

Clark, A. (2007). "Curing Cognitive Hiccups: A Defense of the Extended Mind." *Journal of Philosophy* 104: 163-92.

Clark, A. (2010). "Memento's revenge: The extended mind, extended." In R. Menary (ed.), *Extended mind,* 43-66. Cambridge, MA: MIT.

Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, *58*(1), 7-19.

Couchman, J. J., Beran, M. J., Coutinho, M. V., Boomer, J., & Smith, J. D. (2012). Evidence for animal metaminds. In M. Beran, J. Brandl, J. Perner & J. Proust, *Foundations of Metacognition*, 21-35. Oxford: Oxford University Press.

Danziger, E. 2006. The Thought that Counts: Understanding Variation in Cultural Theories of Interaction. In S. P. Levinson & N. Enfield (eds.),*The Roots of Human Sociality: Culture, Cognition and Human interaction*, 259-278. NY: Berg Press.

Dennett, D. C. (1991) *Consciousness Explained* Boston: Little, Brown & Company.

Dokic, J. (forthcoming). The role of noetic feelings in sensory substitution, *Proceedings of the British Academy*.

Fleming, S. M., Dolan, R. J., & Frith, C. D. (2012). Metacognition: computation, biology and function. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *367*(1594), 1280-1286.

Fuller, S. (2012). Social epistemology: A quarter-century itinerary. *Social Epistemology* 26 (3-4): 267-83.

Goldman, A. (2010). Why social epistemology is real epistemology. In A. Haddock, A. Millar and D. Pritchard, (eds.), *Social Epistemology,* 1-28. Oxford: Oxford University Press.

Greco, J. (2003) Knowledge as Credit for True Belief. in M. DePaul and L. Zagzebski, (eds.), *Intellectual Virtue: Perspectives from Ethics and Epistemology,* Oxford: Oxford University Press.

Greco, J. (2010). *Achieving knowledge: A virtue-theoretic account of epistemic normativity.* Cambridge, UK: Cambridge University Press.

Hookway, C. (2003). Affective states and epistemic immediacy. *Metaphilosophy*, vol.34: 78-96. Reprinted in (2003). Michael Brady and Duncan Pritchard (eds.), *Moral and Epistemic Virtues*, Oxford, Blackwell: 75-92.

Ismael, J. (2006). Saving the baby: Dennett on autobiography, agency, and the self. *Philosophical Psychology*, *19*(3), 345-360.

Kirsh, D. and Maglio, P. (1994). On distinguishing epistemic from pragmatic action. *Cognitive Science*, 18(4): 513–49.

Koriat, A., & Levy-Sadot, R. (1999). Processes underlying metacognitive judgments: Information-based and experience-based monitoring of one's own knowledge.

Kurzweil, R. (2005). *The Singularity is near: When humans transcend biology*, New York, Penguin, 2005,

Lackey, J. (2009). Knowledge and credit. *Philosophical Studies*, *142*(1), 27-42.

Loussouarn, A., Gabriel, D., & Proust, J. (2011). Exploring the informational sources of metaperception: The case of Change Blindness Blindness. *Consciousness and cognition*, *20*(4), 1489-1501.

Maglio, P. P., & Kirsh, D. (1996). Epistemic action increases with skill. In *Proceedings of the eighteenth annual conference of the cognitive science society* (Vol. 16, pp. 391-396).

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological review*, *98*(2), 224.

Menary R. (ed.) (2010). *The extended mind*. Cambridge, Mass.: the MIT Press.

Menary, R. (2006). Attacking the bounds of cognition. *Philosophical Psychology*, *19*(3), 329-344.

Menary, R. (2010). Cognitive integration and the extended mind. In *The extended mind* , R. Menary (ed.), 227- 44. Cambridge, MA: MIT Press.

Menary, R. (2012). Cognitive practices and cognitive character. *Philosophical Explorations*, *15*(2), 147-164.

Metcalfe, J., & Greene, M. J. (2007). Metacognition of agency. *Journal of Experimental Psychology: General*, *136*(2), 184.

Nussinson, R., & Koriat, A. (2008). Correcting experience-based judgments: the perseverance of subjective experience in the face of the correction of judgment. *Metacognition and Learning*, *3*(2), 159-174.

Palermos, Orestis. (2011). "Belief-forming processes, extended." *Review of Philosophy and Psychology* 2 (4): 741-65.

Palermos, O. & Pritchard, D. (2013) Epistemology. Extended Knowledge and Social Epistemology, in Social Epistemology Review and Reply Collective, 2 (8): 105-120.

Pritchard D. (2005a) *Epistemic Luck*. Oxford: Oxford University Press.

Pritchard, D. (2005b). Virtue epistemology and the acquisition of knowledge. *Philosophical Explorations,* 8(3), 229–243.

Pritchard, D. (2010). Cognitive ability and the extended cognition thesis. *Synthese*, *175*(1), 133-151.

Proust, J. (2008). Epistemic agency and metacognition: an externalist view*, Proceedings of the Aristotelian Society*, 2008, CVIII, 3, 241-268.

Proust, J. (2009). The Representational Basis of Brute Metacognition: A Proposal, in Lurz, (Ed.), *Philosophy of Animal Minds: New Essays on Animal Thought and Consciousness*, Cambridge: Cambridge University Press, 2009, 165-183.

Proust, J. (2011) Cognitive Enhancement, Human Evolution and Bioethics, *Journal International de Bioéthique*. 22 (3-4):153-173

Proust, J. (2012). The norms of acceptance. In B. Roeber and E. Villanueva (eds.), Action theory, *Philosophical Issues*, Vol. 22, 2012, 316-333.

Proust, J. (2013). *The Philosophy of Metacognition. Mental action and self-knowledge.* Oxford: Oxford University Press.

Proust, J. (submitted). Metacognition and the evolution of communication.

Riggs, W. (2009). Two problems of easy credit. *Synthese*, *169*(1), 201-216.

Sosa, E. (2007*). A Virtue Epistemology. Apt Belief and Reflective Knowledge* vol. I. Oxford: Oxford University Press.

Sosa, E. (2009*). Reflective Knowledge. Apt Belief and Reflective Knowledge* vol. II. Oxford: Oxford University Press.

Sperber, D., Clément, F., Heintz, C., Mascaro, O., Mercier, H., Origgi, G., & Wilson, D. (2010). Epistemic vigilance. *Mind & Language*, *25*(4), 359-393.

Vaesen, K. (2011). Knowledge without credit, exhibit 4: extended cognition.S*ynthese*, 181:515–529.

Warwick, K. (2004). *I, Cyborg*. Chicago: Universy of Illinois Press.