Learning our way to intelligence: Reflections on Dennett and appropriateness

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Unlike many topics introduced in Daniel Dennett's *Content and Consciousness*, the nature of intelligence has not become a central issue in the philosophy of mind.[1] To appreciate this fact, we should notice that the question about what makes a state, process or behavior intelligent is importantly distinct from another closely related question about what makes a state, process or behavior psychological or mental.[2] The distinction between these two categories can be illustrated by way of noticing how philosophers and cognitive scientists use the labels "cognitive" differently. For example, for cognitive scientists, "cognitive" usually means something like "mental." Accordingly, perception, memory, learning, etc. are all necessarily cognitive phenomena. Philosophers, on the other hand, use "cognitive" to mean something like "intelligent" such that it makes sense to ask whether psychological phenomena like visual perception are cognitive or cognitively penetrable, as Fodor (1983), Pylyshyn (2000), Prinz (2006), and Siegel (2010) do. In short, some but not all mental phenomena are intelligent. Therefore, the question of what makes a phenomenon mental is different from the question of what makes that phenomenon intelligent. In this essay, I will pursue the question of what makes a state, process or behavior intelligent.[3] To do this, I will return to Dennett's initial proposal that learning and intelligence are intimately related phenomena.

1. The goal

In chapter three of *Content and Consciousness,* Dennett writes that the "capacity to learn from experience in such a way that…behavior improves in prudence is what I shall call the intelligent storage of information."[4] This statement amounts to a claim that learning functions as the criterion of intelligence, or, at least,

[1] To be fair, many philosophers such as Dretske (1988, 1990), Bermudez (2003) and Hurley (2006) have explored importantly related issues. Yet, the majority of the work in this area of philosophy has been devoted to exploring the nature of representation, intentionality, propositional content, rationality, and information processing. A targeted conception of intelligence has not been offered as part of the philosophical literature.

[2] Accounts of information processing or symbol manipulation such as Newell & Simon (1976) and Stitch (1983) are examples of the latter.

[3] The notion of intelligence that I am pursuing is a scientific notion. As such, my methodology will not be conceptual analysis. In this kind of endeavor, if various counterintuitive consequences result from my account, these will not immediately count as a *reductio* of the position. After all, science is often counterintuitive. Still, I hope to illustrate that what we think of as intelligence is already, to a large extent, in line with the claims that I am making here. As such, I would like the notions of learning and intelligence that I put forward to correspond to ordinary intuitions as much as possible. However, I do not insist that if ordinary intuitions conflict with the account I am offering, then the account is wrong. On my approach, it may turn out that we have *empirical* or *methodological* reasons that trump our ordinary intuitions. Intuitions ought to be considered, but they ought not to be the final arbiters.

[4] Dennett (1969, p. 49-50).

the criterion for the intelligent storage of information. It is this connection between learning and intelligence that I defend in this essay.

I begin by forwarding a definition of learning that combines a flexibility requirement with a success requirement. I then go on to argue that four features often cited as characteristic of intelligence: flexibility, transferability, manipulability, and appropriateness, are related to intelligence only insofar as they as they satisfy one of the two requirements of learning. Moreover, I argue that positing learning as the criterion of intelligence explains why there seems to be a natural connection between the above-listed features and intelligence.

In the final section of the paper, I identify and categorize four different learning kinds. These categories correspond to distinctions that Dennett has proposed between Darwinian, Skinnerian, Popperian, and Gregorian creatures.[5] Taken together, these considerations provide reason to accept that learning is the criterion of intelligence and that intelligence is a natural, biological, evolved phenomenon.

1.1 Learning: a working definition

I define learning as a process where, as a result of experience or reasoning, the behavior, mental processing, or representations of subjects change in some way that contributes to the satisfaction of their goal(s).

We should notice that the above definition has two requirements: a flexibility condition, which requires a change in behavior, representation or processing, and a success condition, which requires the change to contribute to the satisfaction of the agent's goal(s). These two conditions are each necessary and jointly sufficient for learning.

The above definition of learning is meant to be as broad and inclusive as possible, whilst remaining informative. Accordingly, my definition is both more demanding and more inclusive than the definition of learning commonly offered in psychology, where learning is defined as "a relatively permanent change in behavior due to experience."[6] First off, in contrast to the psychological definition, I remain neutral about whether learning occurs on the neuronal, cognitive, or behavioral level. This means that my definition can be accepted by psychologists, neuroscientists, and computer scientists alike. Secondly, by requiring learning to contribute to a goal, the definition I offer introduces a normative component to learning. This normative component allows us to distinguish learning from other kinds of relatively permanent changes that result from experience like PTSD or myopia.

Additionally, my definition has the virtue of leaving open a whole range of substantive questions, which ought not to be decided by fiat. For example, in order not to exclude anti-represenationalists, I stay neutral about how psychological

[5] Dennett (1996a).

[6] The Dictionary of Psychology, 3rd ed. "learning."

states are realized.[7] For similar reasons, I leave the term "goal" unqualified. I take it that a goal may be realized in action or in thought; and it may be aimed at success or truth.

Also, I use the word "change" instead of "develop" or "improve" in order to avoid limiting learning to states and behaviors that produce an increase in the probability of goal satisfaction. I assume that some learning allows for lateral changes, perhaps increasing the ease of goal attainment or decreasing the energy expended in achieving a goal, without thereby making it more likely that the goal will be attained.[8] Lateral modifications that do not improve the chances of success, but do contribute to its ease or facility count as learning. Changes that make goal satisfaction less likely or more difficult are not learning. Just like one cannot learn that the earth is flat, because it is not, the development of a panic disorder is not a learned behavior, though, of course, it is often acquired through experience. It is precisely for this reason that learning remains a normative notion.

Lastly, I use the plural "subjects" rather than the singular "subject" in order to leave open the possibility of group or species learning.[9] It seems to me that determining the proper ontological limits for being a subject of learning should remain an open philosophical and empirical issue. As such, my definition of learning makes room for different possible interpretations of what it means to be a subject, or agent, of learning.[10]

2. The Features

It is my contention that the above definition of learning has the virtue of allowing us to see how features commonly associated with intelligence establish their relation to intelligence by satisfying one of the two requirements of the learning definition. That is, flexibility, transferability, and manipulability satisfy the flexibility condition while appropriateness satisfies the success condition. Moreover, satisfying either the flexibility or success condition alone is insufficient for guaranteeing intelligence. As such, in reviewing the features commonly associated with intelligence and examining their connection to intelligent behavior, processing and representation, we see that it is the contributions that these features make to learning that underpins their participation in and connection to intelligence.

2.1 Flexibility

In this section, I argue that though flexibility is relevant for ascriptions of intelligence, it is only relevant insofar as it underpins the changes that learning

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[7] See Varela, Thompson & Rosch (1991) and Noë (2004).

[8] See Millikan (2000) chapter 4, for similar observations about ways of improving.

[9] See, for example, Gilbert (1989, 2004) on the plural subject, group minds, and group mental states and, e.g., Rupert's (2005) response.

[10] Some may have noticed that on the above definition, God turns out not to qualify as intelligent. After all, God knows everything and so he cannot learn anything new. God cannot change, since he's already perfect. Some may see this as a *reductio* of my position but I think the most appropriate response to this "problem" is to appeal to the familiar fact that one (wo)man's *modus ponens* is another's *modus tollens*. If it turns out that on the above definition God is not intelligent, then so much the worse for God.

demands. That is, flexibility is connected to intelligence because flexibility satisfies the flexibility condition of learning, and learning is the criterion of intelligence. Moreover, my claim is that flexible states and behaviors alone, disconnected from the goals of a subject, do not ensure intelligence. However, once we put flexibility together with the satisfaction of a subject's goals, what we end up with is learning.

Flexibility often creeps into discussions of intelligence, cognition, and psychological explanation. In fact, it isn't uncommon for intelligent behavior to be contrasted with fixed, inflexible behaviors. As José Bermudez writes in *Thinking Without Words*, "a distinguishing mark of the cognitive is that it is variant, and not stimulus-response."[11] He goes on to contrast fixed, rigid behaviors with cognitively integrated "behavior that is flexible and plastic and tends to be the result of complex interactions between internal states, learning and adaptations contributing and determining present responses."[12]

Bermudez is not alone in citing flexibility as a defining feature of intelligence. Hurley (2006), when discussing animal cognition presents a compelling picture of animals as inhabiting islands of rationality. These islands exist only to the extent that there are degrees of freedom or flexibility on them. And when Clark & Karmiloff-Smith (1993) defend the necessity of representational change in the development of human cognition, they connect this requirement to the need for flexible and manipulable states at higher, more explicit, levels of representation. In short, connections between intelligence and flexibility arise regularly for different theorists with various objectives.

However, when we consider flexibility and its connection to intelligence, we should ask what it is about flexibility that makes it a feature of intelligent behaviors, representations and processes. If we take some time to consider it, it becomes clear that it is not flexibility itself that we value, but rather, that for which flexibility makes room.

This point is easy to demonstrate since flexibility alone does not even come close to guaranteeing intelligence. After all, we have absolutely no reason to think that a mere lack of rigid determination makes a behavior intelligent. In fact, many flexible behaviors, in this sense, prove to be profoundly stupid. Think of random behavior, the most flexible behavior one could find. Is there any reason to think that a random act will necessarily qualify as genuinely intelligent? Imagine driving to the grocery store and stopping in the middle of the road to dance the Mambo; of going into coffee shop and reciting The Emancipation Proclamation; of sending a package to a friend and including an image of a power drill, a description of a mountain range at sunset, and a spoon. The fact is that behaviors that are not called forth by the context, though flexible, are hardly paragons of intelligence. In fact, quite the opposite seems to be true: a behavior that is not connected to its context in some strong, systematic way is almost sure to be disqualified from the realm of intelligence.

At this point, we may be reminded of the paradox of free will. Where it would seem that determinism undermines freedom, as Hume convincingly argued,

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[11] Bermudez (2003, p. 8).

[12] Bermudez (2003, p. 9).

being uncaused or not determined in no way reestablishes it.[13] The same seems to go for intelligence—fixed or inflexible behavior seems to undermine intelligence, but random or disconnected-from-the-context behavior doesn't spawn intelligence either. We seek a certain kind of connection between environment and action for intelligent behavior. We need flexibility, but not unbridled flexibility. In short, intelligence requires appropriately constrained flexibility.

Notably, the requirement that intelligence is both flexible and appropriately constrained is equivalent to the claim that intelligence requires learning. In fact, appropriately constrained flexibility amounts to satisfying the two requirements set out in the above definition of learning: the flexibility condition and the success condition. And we can see why this is correct because, upon reflection, it becomes obvious that the value of flexibility is not just in giving us any old options, but in extending to us the possibility of selecting the best option given our goals and opportunities. That is, we don't just care about having options for the sake of having options; we care about how those options are related to achieving our goals. After all, if a creature could select between various alternatives, but selected in a way that was thoroughly disconnected from its ends and circumstances, we would deem it no more intelligent than if the creature had responded with one designated, rote, or fixed behavior. It isn't just pursuing different strategies that we care about; it is about having the freedom to pursue the best strategy. And this amounts to having the capacity to learn.

In short, we want intelligent creatures to adjust their strategies based on what will be in their best interest. It is the flexibility to change its course, to try and retry, to learn from experience, or improve based on its present position where intelligence arises. As such, it seems that the reason that we value flexibility as a property of intelligence is because learning requires a degree of flexibility in order to allow for the appropriate modification of states, processes, representations, and behaviors. And this means that it isn't flexibility by itself that we value, but rather, flexibility's role in making possible the changes that are requisite for learning. And since learning is the criterion of intelligence, we can see why it is that flexibility is often cited as a symptom or feature of intelligent processing and behavior. So, it turns out the flexibility is not itself the mark of intelligence but, rather, a necessary feature of learning, which is integrally tied to intelligence.

2.2 Transferability

Another feature that is frequently invoked as characteristic of intelligence is transferability or context generality.[14] Transferability can be though of as a particular kind of flexibility: a kind of flexibility that highlights our commitment to intelligent behaviors or states playing a general role in our cognitive economy. Transferability highlights that intelligent processes ought not be context bound or domain specific. Like flexibility, transferability will satisfy the flexibility condition of

[13] Hume (1748, VIII), and Dennett (1996b);(2003).

[14] See, for example, Hurley (2006) on the combination and recombination of means and ends, and Evans (1982).

learning and, like flexibility, transferability alone will be insufficient to guarantee intelligence.

To get a better grip on what transferability adds to our concept of intelligence, we can contrast transferability with flexibility. Whereas flexibility yields responses that can vary in a particular setting, transferable behaviors are those that can be applied and re-applied in various settings and circumstances. In short, we can think of flexibility as creating a space of options in a given context, whereas we can think of transferability as allowing those options or strategies to be applied in multiple contexts, modalities, and environments. Of course, we should note that transferability requires a degree of flexibility, since a fixed state or behavior could not break free from its role in one context in order to be transferred into others.

To see how transferability is related to intelligence, we can begin by looking a classic discussion of conceptual content. As Gareth Evans has famously argued, in order for an element of thought to qualify as a concept, it must be capable of playing multiple roles in various propositions. He writes,

> It is a feature of the thought-content *that John is happy* that to grasp it requires distinguishable skills. In particular, it requires possession of the concept happiness—knowledge of what it is for a person to be happy; and that is something not tied to this or that particular person's happiness. There simply could not be a person who could entertain the thought that John is happy and the thought Harry is friendly, but who could not entertain—who was conceptually debarred from entertaining—the thought that John is friendly or Harry is happy.[15]

One cannot have the concept of BLUE without being able to think of various blue things: a blue couch, a blue chair, and a blue sky. And one cannot have the concept SKY, if one isn't able to think of the sky as, e.g., blue, cloudless, infinite, etc. Being a concept requires the capacity to recombine. Another way of saying this is that paradigmatically intelligent states are not tied to one role or context but can be transferred or applied in multiple roles and contexts.

This kind of multiple role-playing seems naturally tied to intelligence since a state or behavior that is singular or narrow in the scope of its application doesn't intuitively strike us as very intelligent. For example, if I can add jellybeans but not matchsticks or sheep, then one would be right to doubt if I am really adding. Since adding is an operation that should not be limited to one sort of object or setting, whatever allows me to calculate the sum of jellybeans seems distinctly dissimilar from the cognitive processes involved in basic arithmetic.

Crucially, the emphasis on transferability points to the fact that we want intelligent states and behaviors to be widely available to cognition.[16] We insist that

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[15] Evans (1982, p.102-103).

[16] Of course, the exact degree of generality, wideness, or number of circumstances of application cannot be specified precisely.

knowledge and skills are accessible to an agent in a large number of circumstances. But all of this simply seems to be a way of saying that transferability underwrites the capacity to appropriately apply what one knows or does in one situation to novel situations. And such wide applicability, context generality, or transferability, when combined with the need to contribute to the satisfaction of an agent's goals, is a straightforward appeal to learning: for requiring that we apply something that we know here, to change or improve the likelihood that we will attain some goal there.

After all, we should notice that, like flexibility, we value transferability for the sake of success or truth and not for itself. In the absence of enhancing or changing behaviors in one context by transferring knowledge and skills from another, that is, in the absence of learning or improvement, transferability seems quite useless. It would not do me any good to transfer what I have learned in yoga to map reading, unless it was going to contribute to the satisfaction of my map reading goals. Without a connection to my goals and the world, transferability would be as intelligent as random flexibility: which is to say, not very intelligent at all.

To end, it seems that transferability matters for intelligence because appropriately transferred behaviors and representations allow one to more easily reach one's goals. As such, we must admit that the ability to play multiple roles in multiple contexts isn't by itself a sign of intelligence, but only intelligent insofar as it is connected to the adaptability and modification of goal-directed behavior. In short, transferable behaviors satisfy the flexibility condition of our definition of learning, but in the absence of being appropriately tied to purposive behaviors, transferability falls short of ensuring intelligence. Importantly, because transferability does satisfy the first requirement of the learning definition, we can see why this feature is often taken to be characteristic of intelligence.

2.3 Manipulability:

A third important characteristic that arises in philosophical discussions of intelligence is manipulability. We should notice that, like transferability, manipulability requires flexibility, since one cannot manipulate what one cannot change. And like transferability and flexibility, manipulability will be a particular way of satisfying the flexibility requirement of learning. All three features will also fail to yield intelligent behaviors in the absence of a condition tying them to the particular goals and context of the agent. As such, all three conditions must be combined with a success condition, and thus, to satisfy the definition of learning, if they are to guarantee intelligence.

Manipulability refers to the requirement that an agent herself, rather than the environment or some third party, is responsible for intelligent behavior and processing. "Manipulability highlights the fact that when we speak of intelligence we want behavior that is not only flexibly related to the world, but flexible as a result of its being under the control of an agent."[17] In this way, manipulabilty ensures that intelligent processes are top-down, hierarchical processes that an agent can plan, organize, reorganize, guide, and control.

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[17] Fridland (2013, p.212).

Psychologists Richard Byrne and Anne Russon frame intelligence in terms of both flexibility and manipulability. They write,

> [W]e would be reluctant to describe as intelligent any sequence of behavior whose mental organization is a single unit or action connected to a goal representation, a long sequence of linear associative connections or a rigid hierarchical structure. Thus whether a behavioral structure is modifiable by the individual becomes crucial in diagnosing it as "intelligent" (1998, p. 671).

And Prinz (2004) goes as far as to define cognition in terms of manipulability. He states, "[c]ognitive states and processes are those that exploit representations that are under the control of an organism rather than under the control of the environment."[18] For Prinz, organismic control, which in mammals involves the prefrontal cortex, is at the heart of intelligent processing.

One important implication that follows from the requirement that intelligent processes be manipulable is that intelligence becomes a personal-level phenomenon. This is because manipulability requires global, integrated, centralized, hierarchical processes that are not available to subpersonal systems. That is, to be manipulated, a state must be targeted by higher-order states or mechanisms. The requirement that intelligent states are personal-level accords nicely with our intuitions about intelligence since, at the very least, the requirement that behaviors, processes, or representations be manipulable puts intelligence in the same realm as, for example, rationality and knowledge.

At this point, however, we should ask whether being under the control of an agent is sufficient for intelligence. But again, as with flexibility and transferability, the answer must be "no." For similar reasons as those presented above, we see that simply being under the control of the agent, in the absence of a deep and systematic connection to the goals and environment of an organism, will not yield intelligence. That is, if manipulability is not going to contribute to the satisfaction of a creature's goals by selecting or choosing the appropriate strategies in diverse and dynamic circumstances, that is, if manipulability isn't going to foster learning, then it is not obvious why manipulability is relevant for discussions of intelligence.

After all, what good is top-down control, if it runs counter to or even just neutral with one's own interests? If I made various true assertions that were deeply disconnected from my setting and circumstances, would my control over these assertions be enough to make them intelligent? Would my statements be any more intelligent than a digital computer's central processor? The fact is that like flexibility and transferability, manipulable behaviors should not be *determined* by the environment, but they must be lawfully and meaningfully connected to it. Without this further condition, it is difficult to see why being under the control of the agent matters for being intelligent. Surely, if we see that the behaviors, representations or processes of a subject are consistently disconnected from the objectives and

[18] Prinz (2004, p. 45).

environment of the organism or system then their being manipulated by top-down processes is hardly sufficient for making them intelligent.

It seems that manipulability's role in intelligence is to ensure that learning, or the changes and improvements that allow a creature to satisfy its goals, are not simply the result of passive, externally determined responses. In this way, manipulability endows learning with an active, deliberate component. But it is learning that must have this active feature. That is, control alone without a connection to goals is not sufficient for intelligence.

2.4 Appropriateness

What the above discussion makes clear is that in order to produce intelligent behaviors or processes, what needs to be added to flexibility, transferability, and manipulability is the appropriate grounding in an organism's needs and environment. As such, it may seem that it is appropriateness and not learning that constitutes the difference between an intelligent and unintelligent behavior. But as with the above features, appropriateness alone, that is, satisfaction of the success condition, without the capacity for change and improvement, that is, without the satisfaction of the flexibility condition, is insufficient to guarantee intelligence. An inflexible, nontransferable, or nonmanipulable behavior, though appropriate, is not sufficient for grounding attributions of intelligence. But this is simply to say that an appropriate behavior lacking the flexibility that when combined with it amounts to learning, is not intelligent.

In chapter three of *Content and Consciousness,* Dennett appeals to the notion of appropriateness in order to elucidate his claims about intelligence. He states that "[t]he criterion for intelligent storage is then the appropriateness of the resultant behavior to the system's needs given the stimulus conditions of the initial input and the environment in which the behavior occurs."[19] Dennett is right, of course, that appropriateness is central to intelligence, but it is important to clarify that it is only a flexible appropriateness that yields intelligence, proper. [20]

In line with Dennett's position, I suggest we understand "appropriateness" as a general term for getting something right, given one's goals and circumstances. Importantly, getting something right or doing the right thing can only be evaluated relative to a particular context. Saying, "Boston is the capital of Massachusetts," though true, isn't the right thing to say when the conversation is about cattle. And picking up a pen may be the right thing to do if one wants to write a check, but it is not the right thing to do if one is up to bat. It seems that no matter how clever or sophisticated a thought, action, or process is, without a connection to other states, behaviors or processes,[21] it simply cannot qualify as intelligent.[22]

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[19] Dennett (1969, p. 50).

[20] From the text, it is difficult to discern if Dennett takes his statement about appropriateness to qualify his previous assertion about learning, if he takes these two to be equivalent concepts, or if he takes appropriateness to be the more fundamental quality of intelligence.

[21] See Davidson (1975) for similar considerations about the relationship between language and thought.

As Dennett points out, "since appropriateness is not an intrinsic physical or formal characteristic of any thing or event, no examination of the relations between intrinsic characteristics of input and output will give us a clue about intelligence."[23] So, no behavior or representation, no matter how internally coherent or consistent could qualify as intelligent, if that behavior does not bear the proper connections to other states and behaviors. As such, we should understand appropriateness as guaranteeing the following: that a behavior, representation or process is instantiated at the right time, place, and way given the goals of the creature and the affordances of its environment. And no behavior or state that doesn't have this feature qualifies as appropriate.

But is being appropriate sufficient for intelligence? I will argue that the answer to this question is "no." This is because, if a behavior cannot change appropriately in changing environmental conditions, that is, if a behavior is not capable of appropriate modification, then that behavior is not intelligent. I will argue for this claim in two moves: First, I will make clear that the notion of intelligence tacitly assumes appropriateness in contrary counterfactual circumstances, i.e., intelligence requires responding differently, if the situation were different. Second, the flux of the natural world guarantees that situations will be different. As such, in the natural world, intelligence requires the flexibility to change one's behavior appropriately. Put differently, intelligence requires the capacity to learn.

In order for a behavior, representation, or process to qualify as intelligent, it is not enough that it is instantiated at the right time, place and way, given the organism's needs and context. Though acting appropriately is an important feature of intelligence, I argue that there is an additional, tacit assumption involved in ascriptions of intelligence. This assumption can be formulated by appeal to Dretske's counterfactual condition for knowledge.[24] We can say that intelligent behavior requires that:

(CC) If *b* is <u>not</u> appropriate in context *c*, then *S* will <u>not</u> instantiate *b* in *c*.

The counterfactual condition rules out states that are only appropriate as a result of chance, luck, or accident from qualifying as genuinely intelligent.[25] Essentially, this condition affirms that intelligence requires a strong, systematic, and flexible connection between a behavior and its environment. This kind of connection can be established only if we incorporate a counterfactual condition because, sometimes, luck makes a behavior the right, appropriate, or successful behavior, even when it is not intelligent.

I'll elucidate this point with an example:

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[22] As Dennett has written, "The capacity to use and store information intelligently, then, does not emerge automatically at any degree of size or complexity of the information storage and processing mechanisms, but is an additional and separable capacity" (1969, p. 51).
[23] Dennett (1969, pg. 50).
[24] See Dretske (1969).
[25] One may argue that a state isn't appropriate if it doesn't meet CC. In this case, being appropriate would be equivalent to being flexibly appropriate. As such, the distinction between learning and appropriateness would vanish.

> A common piece of advice that college students pass along to their friends who stayed out partying instead of studying for their exams is to choose "c" for every answer on a multiple-choice test. The idea is that, at least some of the time, "c" will be the right, i.e., the appropriate, answer. But though this strategy may betray some intelligence (not a great deal, since studying would clearly be a more intelligent alternative) when the student chooses "c" as a response to a test question, she is not responding intelligently.[26] Not because "c" isn't the right answer (the point of the advice is to maximize the number of times that the student will choose the right answer), but because the behavior cannot satisfy the counterfactual condition. That is, even if the right answer was *not* "c", the student would choose "c" anyway.

Intuitively, this helps us to see why ascriptions of intelligence require CC. We see that intelligence requires not just doing the right thing at the right time in the right place, given one's goals and needs, but also, not doing that thing if it is not the right time, place, way, etc. The reason why choosing "c" for every answer makes choosing "c," even when it is the right answer, not intelligent is because this behavior doesn't meet CC.[27] The behavior appears intelligent because it is appropriate, i.e., it is right, but on analysis, we conclude that it is not intelligent because it doesn't bear the proper systematic and flexible connections to the world. This is precisely the difference between the strategy of choosing "all cs" and the strategy of studying, learning the subject matter, and only choosing "c" when it is the right answer. The latter is intelligent while the former is not.

Once we have established that intelligence is not simply determined by appropriately responding to a situation, we can think about the kinds of demands that the natural world places on creatures. That is, we can think about what kinds of contexts a real creature will have to encounter and respond to appropriately. With only a moment's consideration, we should see that ecological contexts shift and change regularly. It is not simply that animals encounter bivalent scenarios: i.e., worm (w) or no worm (-w), but situations like (1/2w) where only part of the worm is visible, or (ww) where the worm is in water and not on land, or (mw) where the worm is in another bird's mouth. Each of these scenarios requires more than a simple, "on/off" mechanism in order for an animal to respond appropriately. Appropriateness in the natural world, as it turns out, requires a nuanced, flexible set of responses.[28]

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[26] This is why Dretske (1981) says that a broken clock is *not* right even once a day!

[27] We can also think of Charlie Chaplin's *Modern Times* in this context. In particular, we can recall the scene when Chaplin goes from tightening the bolts on the conveyer belt, to using his wrenches to tighten anything they will fit, including the buttons on a lady's dress.

[28] A paradigm example of lacking this sort of flexibility is the wasp, *Sphex ichneumoneus:* "When the time comes for egg laying, the wasp *Sphex* builds a burrow for the purpose and seeks out a cricket which she stings in such a way as to paralyze but not kill it. She drags the cricket into the burrow, lays

As such, in order to respond appropriately to changing environmental conditions, that is, in order to respond appropriately in the natural world, a creature must be able to adjust its strategy based on its circumstances. And this is precisely what learning amounts to: it requires modifying or adjusting one's behaviors and representations in a way that will contribute to the satisfaction of one's goals. We see that without this kind of flexibility, success or appropriateness at a time does not get us very far in our quest for intelligence.

So, if a behavior only qualifies as appropriate in one context but is not sensitive or responsive to various relevant, graded, environmental changes, I think we'd be hard pressed to call that behavior intelligent. At the very least, that behavior would lack all of the features that we've cited above as characteristic of intelligence. But, as we saw above, those features without appropriateness don't get us very far either. However, if we take these features together, what we see is that they amount to learning. That is, they amount to the satisfaction of the flexibility condition and the appropriateness condition, which taken together constitute learning. So, if we take learning as foundational, we can see why appropriateness matters for intelligence, since no behavior, process, or representation could be an instance of learning if it were not appropriate but we can also see why flexibility, transferability and manipulability matter, too.

In light of the above, we see that the capacity to learn incorporates appropriateness with the three features of intelligence discussed above. Further, this criterion accounts for why these features seem to be characteristic of intelligence by highlighting their connection or contribution to learning. This means that the learning criterion both unifies and explains the features that we take to be characteristic of intelligence. Methodologically, it would seem that a substantive, unified, explanatorily powerful criterion of intelligence is exactly the one that we want.

3. The learning condition: past and future

Before ending, I'd like to be clear about how learning functions as the criterion of intelligence. My claim is that *either* past or future learning qualifies a behavior, process, or representation as intelligent. Therefore, if a state or behavior is the result of past learning or if that state or behavior serves as the basis for future learning, then the state or behavior shall qualify as intelligent. Satisfying either

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her eggs alongside, closes the burrow, then flies away, never to return. In due course, the eggs hatch and the wasp grubs feed off the paralyzed cricket, which has not decayed, having been kept in the wasp equivalent of deep freeze. To the human mind, such an elaborately organized and seemingly purposeful routine conveys a convincing flavor of logic and thoughtfulness--until more details are examined. For example, the Wasp's routine is to bring the paralyzed cricket to the burrow, leave it on the threshold, go inside to see that all is well, emerge, and then drag the cricket in. If the cricket is moved a few inches away while the wasp is inside making her preliminary inspection, the wasp, on emerging from the burrow, will bring the cricket back to the threshold, but not inside, and will then repeat the preparatory procedure of entering the burrow to see that everything is all right. If again the cricket is removed a few inches while the wasp is inside, once again she will move the cricket up to the threshold and re-enter the burrow for a final check. The wasp never thinks of pulling the cricket straight in. On one occasion this procedure was repeated forty times, always with the same result" (Woodridge 1963, p. 82). See also, Dennett (1996b).

disjunct is sufficient for meeting the learning criterion. This means that learning as a criterion for intelligence is bidirectional or bi-temporal. This may seem like an odd qualification, but there are good reasons to think that it is required for an adequate account of intelligence.

First, we should note that past and future learning usually go hand in hand. That is, a behavior that is potentially modifiable by learning in the future is ordinarily a behavior that has been acquired through learning in the past. This fact seems to underlie Dennett's point that "more intelligent animals require longer periods of infancy, but gain in ability to cope with novel stimuli because of the proportion of 'soft-programming'—programming not initially wired in and hence more easily overruled by novel stimuli."[29] Essentially, we see that the capacity to deal with novel situations, that is, the capacity for learning, is often importantly related to a state's development through past learning. Past and future modifiability are both rooted in the potential for flexible, variable, and appropriate responses. It turns out that the opposite is also true: behaviors that are *not* acquired through experience or learning are often behaviors that do not have the potential to change as the result of experience and learning. Tropistic or reflexive behaviors are obvious examples of this kind of rigidity.[30]

Though the conjunction of past and future learning is often the norm, there are certain exceptions, for which it is important that we account. It is because of these exceptions that the learning condition should be formulated as a disjunction, rather than a commitment to either one of the disjuncts, or to their conjunction.

To start, there is the rather depressing reality that people peak, plateau, and die. For example, my gymnastics skills peaked during my sophomore year of high school—they've only gotten worse since then. And my math skills plateaued in college—in years, they have neither improved nor changed. And the inevitable is inevitable—nothing will change or improve after that.

These realities are important for us to consider since they highlight that future learning cannot be the sole criterion upon which we base ascriptions of intelligence. After all, we should not want a criterion that necessarily classifies "peak" or "near death" behaviors as unintelligent. But that is exactly what would happen if *future* learning (not just future *or* past learning) were necessary for intelligence.

In order to identify the cognitive nature of such events, we should have the opportunity to look backward to past learning. In this way, we can determine how sensitive and responsive these processes have been to experience, success, and failure. That is, we can assess whether the organism bears a non-arbitrary, systematic, meaningful connection to the world by specifying how its behaviors have been formed.

Just as future learning runs into hurdles as the sole criterion of intelligence, past learning faces challenges, too. For example, Prinz (2004) has argued against learning as the criterion for intelligence based on the presence of innate cognitive mechanisms. He states, "[i]t seems coherent to postulate innate cognitive abilities

[29] Dennett (1969, p. 66).
[30] See Bermudez (2003), and Dretske (1988) for more on these kinds of behaviors.

(cognitive scientists do that all the time), and innate abilities are, by definition, unlearned."[31]

In order to accommodate for intelligent mechanisms, abilities, or knowledge that are not the result of ontogenetic learning, I suggest we focus on whether such knowledge or abilities are subject to learning in the future. That is, we can ask if these processes have the disposition to change, improve, and develop over time and experience. In this way, using a counterfactual, we can evaluate them for their intelligence based on what kind of changes or improvements they make possible. Using this strategy, we avoid having to say that unlearned states are necessarily unintelligent,[32] and we get to hold onto the learning criterion, too.

The disjunctive learning condition also helps us to see that the reason that learning is tied to intelligence is not because we are particularly concerned with causal histories, but because causal histories tell us something important about the nature or constitution of the behaviors, representations, and processes that have them. The reason potential or future learning counts as a criterion of intelligence is because the disposition to learn tells us not only about the way that a state, process, or behavior is related to the world, but about the underlying qualities of that state that make it possible for it to be related to the world in that way. In short, having a bidirectional learning condition highlights both the extrinsic character of intelligence and the fact that having the right character is often connected to internal capacities, abilities, mechanisms, and systems.

4. An objection and an opportunity

The burning question at this point of the paper should be, of course: what kinds of changes qualify as learning? Does sensitization count as learning? How about habituation? All adaptions? Any useful modification at all? There are, after all, an enormous number of changes in behavior, processing and representation that contribute in some way to the satisfaction of a creature's goals. And many of these changes do not seem to be paradigmatically intelligent. This fact is the second reason that Prinz (2004) thinks that learning makes a poor criterion of intelligence. He states,

> …some insects are capable of learning and memory. Fruit flies, for example, can be conditioned to avoid electric shocks. We might even attribute learning and memory to individual neurons.[33]

To get clear on this issue, it may be helpful to return to an exchange between Dennett (1991) and Dretske (1990) where it is precisely the scope of learning about which they disagree. Dretkse insists that real learning is ontogenetic learning, that is, learning within a lifetime.[34] According to Dretske, only states that are the result of

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[31] Prinz (2004, p. 44)

[32] Or, as will become clear below, only intelligent due to participating in a lower level of learning.

[33] Prinz (2004, p. 44).

[34] "Natural selection gives us something quite different: reflex, instinct tropisms, fixed-action-patterns, other forms of involuntary behavior—behavior that is (typically) not explained in terms of the actor's beliefs and desires" Dretske (1990, pgs. 14-15). See also Dretske (1988, pgs. 104-107).

intra-generational learning really qualify as meaningful or intelligent. Dretske writes,

> In order to get meaning itself (and not just the structures that have meaning) to play an important role in the explanation of an individual's behavior (as beliefs and desires do) one has to look at the meaning that was instrumental in shaping the behavior that is being explained. This occurs only during individual learning.[35]

In contrast, Dennett asserts that that phylogentic learning is no less learning than learning within a lifetime; to cut it in any other way, he argues, is quite arbitrary. Dennett writes,

> The curious question, of how much traffic with the world is enough, somehow, to ensure that genuine learning has been established, is simply an enlargement of the curious question that has bedeviled some evolutionary theorists…But if nothing but an arbitrary answer (e.g., 42 generations of selection) could "settle" the question for natural selection, only arbitrary answers (e.g., 42 flies must buzz) could settle the question for a learning history, for the processes have the same structure. They must begin with a fortuitous or coincidental coupling, thereupon favored—and they have the same power to design structures in indirect response to meaning.[36]

It would seem that we are at an impasse. What appeared to be our best shot at a unified, explanatorily potent criterion of intelligence now seems too broad to adequately differentiate intelligent from unintelligent behaviors, representations and processes. It seems that either we have to allow the changes that result from natural selection, classical conditioning, habituation, sensitization, and everything in between, to qualify as learning, or we have to deny that learning alone can function as the criterion of intelligence.

In reality, things are not so bad. As opposed to giving up the learning criterion, I suggest that we take learning's ubiquity as an opportunity to connect higher-order, human-level intelligence with the rest of the natural world. Specifically, I suggest that we begin by differentiating various kinds of learning into clear and substantive categories. In doing so, we can offer non-arbitrary boundaries for different learning types and, thus, different levels of intelligence. Additionally, this approach will ground learning and intelligence in an evolutionary history.

All learning will turn out to be appropriate and flexible (to some degree), and at higher taxonomic levels, we'll begin to see transferability and manipulability emerge. We will not have to decide which learning level is "really" learning but by introducing substantive distinctions, we can produce clear boundaries between learning kinds. In this way, those theorists who want a more stringent criterion of

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[35] Dretske (1990, p. 14).
[36] Dennett (1991, p. 125).

learning can appeal to the learning level of their preference as the criterion of intelligence. Using this strategy, we can appease those theorists who want only higher-levels of learning to count as intelligent, without needing to abandon learning as our primary criterion of intelligence.

In order to categorize learning into different kinds, I suggest that we follow Dennett's (1996) classification of creatures. That is, I suggest we categorize learning according to whether it is of the Darwinian, Skinnerian, Popperian or Gregorian variety. Crucially, distinguishing between these kinds of learning will allow us to differentiate between, phyologentic, ontogentic, representational, and self-conscious varieties of learning, making it possible to understand their respective connections and contributions to the evolution and development of intelligent systems.

The category of **Darwinian learning** should include the systematic changes that take place via natural selection. This will be our lowest level of learning. Here we connect appropriateness or the success condition with only a small degree of flexibility. The flexibility of Darwinian learning is achieved via selectional processes over multiple generations and is measured in evolutionary time. A simple example of Darwinian learning is the camouflaging capacities of lizards, which have evolved to decrease the likelihood of predation.

Next, we have **Skinnerian learning**. Skinnerian learning is best understood as resulting from classical or operant conditioning. This kind of learning is trial and error and it comes down to a creature's capacity to "modify (or redesign) their behavior in appropriate directions as a result of a long, steady process of training or shaping by the environment."[37] As Dennett notes, "there is no doubt that most animals are capable of" this kind of learning. An example of Skinnerian learning would be developing a preference for red cups after having been given sugary drinks in red cups in the past. At the Skinnerian learning level, we have appropriateness and a bit of flexibility, but not all that much.

At the third level, we have **Popperian learning.** Popperian learning is learning that goes on inside the animal without necessarily first having gone on in the world. In contrast to Skinnerian learning, Popperian learning does not need to be acquired through a long process of actual reinforcement. Instead, such learning can result from weighing various options in one's mind, that is, it can result from doing trial and error in one's head. This is why this kind of learning is called Popperian—because it "permits our hypothesis to die in our stead."[38] Dennett thinks that "mammals, birds, reptiles, amphibians, fish and even invertrebrates exhibit the capacity to use general information they obtain from their environment to presort their behavioral options before striking out."[39] We can think of the Popperian level of learning as exhibiting appropriateness, a medium to high degree of flexibility, some degree of transferability and, arguably, some degree manipulability as well. Ruth Millikan (2006) gives the example of a squirrel

[37] Dennett (1996a, p. 87).
[38] Dennett, ibid., p.88
[39] Dennett, ibid., p. 93

checking out a bird feeder from different angles, trying to figure out the best way up, as an example of Popperian learning.

The last and highest learning level is **Gregorian learning**. At this level we have creatures like us who can use language to reason, problem-solve, and learn.[40] This is the kind of learning that most of us do in school. It is at this level that we can naturally talk of explicit knowledge, agency, meta-representation and self-consciousness. At this level, we have appropriateness, and a high degree of flexibility, transferability, and manipulability. I should add that at this level we get creativity, too.

By categorizing learning kinds in the above fashion, we gain the capacity to distinguish between higher and lower forms of learning and, thus, non-arbitrarily decide where intelligence of the sort we care about comes into play. By using this approach, we need not give up learning as the criterion of intelligence since we can, if we wish to, identify only specific levels of learning as constituting our criterion of intelligence. However, we have the added benefit of naturalizing intelligence by connecting it to more basic forms of learning.

In this way, we won't have to decide who's right about learning: Dennett can have all the categories of learning, Dretske can take the Skinnerian variety on up, and Prinz can be at home with Popperian and Gregorian learning. If one prefers a higher level of learning as the "real" criterion of intelligence, then that is okay by me. It seems to me that these preferences don't add much to our understanding of the world as much as they betray what we want and like about it. But to get this far, I think, is to get to a good place. We have shown that intelligence is not simply in the eye of the beholder. We have laid out a clear, substantive criterion for intelligence, and also tied it to our evolutionary past. Not bad for a day's work.

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[40] Dennett, ibid., p. 99

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