On Philosophy

If philosophy is to be considered a human behavior, the first word to define is 'behavior'. The goal of my effort is to answer the following questions: What is the meaning of free will? In what sense do humans control their decisions? What is an ethically correct decision?

Let's briefly discuss a robot's behavior. We assume that this robot is executing instructions provided by a human. It follows, therefore, that this robots's decision depends on the decisions of the human supplying its instructions. So, how might this robot logically err *independently* of its human programmer? Normally, if the Arithmetic Logic Unit within its CPU were incorrectly wired, for instance, the robot would not perform arithmetic correctly; and therefore a logical error would result. But what exactly is the relation between a logical error and an incorrect decision? And as a further matter, how do *humans* know when they have made errors or incorrect decisions? We make math errors for example, but how do we know this? What do we perceive as the error? The way we form these perceptions is absolutely fundamental to the way our brain works, and it is by forming such perceptions that we learn, we understand, and we communicate through language.

On a side note, it may be true that a fundamental language barrier impairs our ability to communicate abstract ideas. Now, either we *know* this is true, or we merely *imagine* it's true. But how can we know what we don't know? Is there an absolute limit regarding what we can figure out? We now arrive at the front porch of the study of epistemology - the branch of philosophy concerned with the nature and scope of knowledge. The central aim of this study is to relate the notions of belief, truth, and justification, in order to establish what can acceptably be regarded as justified true belief - knowledge.

Let's consider the following question: what does it mean that a belief is justified? Suppose I step in front of a light source and observe a shadow being cast behind me - should I believe in the existence of my shadow? Aristotle related the concept of existence to causality; let's examine this association. According to this view, the existence of my shadow is manifest in its effects. So suppose I used my body to block sunlight from reaching the ground, thereby causing a shadow to appear. Clearly, what we are observing as my shadow would be the effect of my body's positioning, rather than vice versa. What may perhaps be inferred, then, is that it's more accurate to speak of an effect dependent on the position of my body, versus an effect dependent on the appearance of my shadow; though I perceive my shadow, its appearance alone should not be considered as existence. If Niels Bohr were present, he'd say: "How wonderful that we've met with a paradox; now, we have hope of making some progress". Considering that paradoxes make good riddles, see if you can answer these important questions: What is it which *can* be perceived to exist, yet must *not* be observed? Alternatively, What is it which *cannot* be perceived, yet whose existence *must* be observed? I have no clue whatsoever.

Anyways, supposing that knowledge is justified belief, the next thing to consider is the question: what is knowledge used for? Perhaps knowledge is used for responding. What connection would knowledge have with intelligence? In many AI textbooks, intelligent agents are considered to take actions which maximize their chances of success. Intelligence would therefore be related to knowledge of an "appropriately successful" response. We should like to know then, what determines the appropriateness or successfulness of a response? Logically, success depends on the relation of past and future events. Considering that knowledge of cause and effect is the key to understanding this relation, perhaps intelligence may be understood as knowledge of causality.

Causality is the relation between an event (the cause) and a second event (the effect),

where the second event is understood as a consequence of the first. So imagine we're observing some behavior or phenomenon and trying to explain it's occurrence by pointing to causes. The scientific strategy is to falsify hypotheses which are being tested under controlled environmental conditions. Now if we're trying to establish the causes of some phenomenon via the scientific method, we should do well to notice that we're implicitly controlling the phenomenon's occurrence (i.e. because we're trying to cause it on purpose). Intelligence, knowledge, and causality can therefore be seen as related through the concept of control, where control is defined as the power to influence or direct the course of future events.

Behold a thermostat. A thermostat is used to maintain the temperature of a room by stabilizing it at a reference value or set point. We may therefore presume that the purpose of its behavior is to control the temperature; but how would we differentiate between the *purpose* and the *cause* of its behavior? The definition of a 'cause' is:
(1) a person or thing that gives rise to an action, phenomenon, or condition;
(2) a principle, aim, or movement that one is prepared to defend or advocate.

In contrast, a 'purpose' is defined as:
(1) the reason for which something is done or created or for which something exists.
(2) one's intention or objective.

Now, it seems to me that the difference between a cause and a purpose is not quite clear - in fact, the two definitions are arguably identical. Upon critical examination of the definition of a 'purpose', one might further argue that the first entry is a bit vague. Perhaps an example will help us understand the ambiguity. Suppose you order someone to do something: you say, "fall to the floor". He responds, "give me a reason". Now assuming you aren't going to simply respond, "because I said so", how would you explain the reason *why*? A 'reason' is defined as:
(1) a cause, grounds, basis, rationale;
(2) a purpose**,** motive, motivation, point, aim, objective, intention, goal;
(3) an explanation, justification, argument, defense, vindication, excuse, pretext.

Clearly, the choice of reason might involve a cause, a purpose, or an explanation of both. So what is the reason an apple falls from a tree? To give a mathematical explanation of its behavior, we would invoke the laws of physics: we say, the gravitational potential energy of the apple is minimized as it falls, thus providing an understandable reason for the apple to fall.

But instead of passively waiting for an apple to gravitate, suppose you *commanded* an apple to fall. If the apple, for some reason or another, obeyed your command and fell, would the sight of the falling apple immediately make you happy? or would you wonder: why did the apple not question my order? If, instead, the apple steadfastly refused to obey your instruction without provision of a reason, perhaps you'd pugnaciously retort, "How *dare* you question my order, apple?! Off with your skin!!" Supposing that coercion was not an option, however, you would need to reason and argue with the apple until it believed a certain truth value. So what reason would you provide it? Mathematically, we know the apple seeks equilibrium. Perhaps you could try to explain to the apple that equilibrium is not on the branch. But, then again, maybe the apple would insist on hanging because it perceives a different equilibrium position.

In reality, of course, an apple doesn't perceive anything - it doesn't hear arguments, nor does it respond to commands - it just responds to forces. But let's suppose we're talking about a *special* apple, which, in addition to feeling the forces upon it, also harbored its own intention. Assuming this apple was doing something intentionally, what would be 'causing' its behavior? Perhaps its behavior would stem from some desire to achieve an intention.

Let's take a moment to ponder, then, how intentions might originate. To address this

question, let's return consideration to the thermostat. We know the purpose of the thermostat's behavior is to control the temperature. Why? Because the thermostat maintains the temperature at a reference value. Why? Because inside the thermostat is a mechanism which exists at equilibrium only when the temperature is at a reference value, such that if the temperature were *not* at this reference value, then the mechanism would generate a response which brings the temperature back to this value. As a result, the purpose of the thermostat's behavior is to control the temperature. *But what causes the thermostat to have this purpose?*

Imagine a thermostat in a room, with the room temperature matching its reference value. When the temperature falls, an electronic circuit generates the thermostat's response. How might the behavior of charged particles moving through an electronic circuit be correlated to the purpose of the thermostat's behavior? To aid us in this inquiry, let's imagine an epic dialogue between two different types of controllers: one is a thermostat and the other is an autocrat.

Epic Dialogue

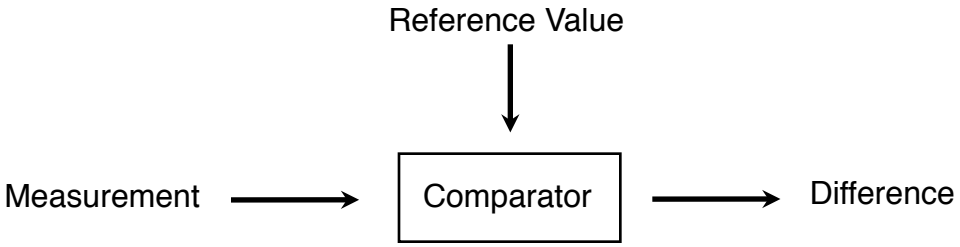
King: Squire, are you aware of the purpose of your behavior?

Thermostat: Indeed Sire, the purpose of my behavior is to control the temperature of the air.

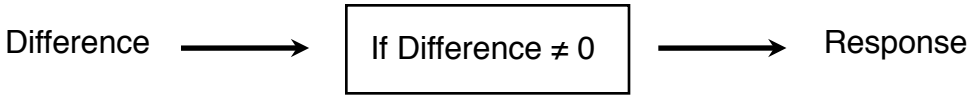
King: Very good. And, how do you go about doing so?

Thermostat: Well, the first thing I always do is measure the temperature value...

...and after I measure the temperature value, I compare this measured value to my reference value...

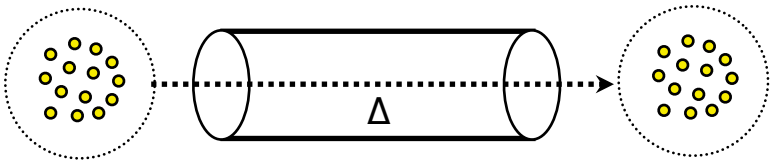


...and if the temperature is not what it's supposed to be, I respond.



King: So, could you explain to me then, what *causes* your behavior?

Thermostat: Well, I know that my actions are being generated by signals composed of electrical currents, which are being generated by the displacement of electronic particles through a wire.



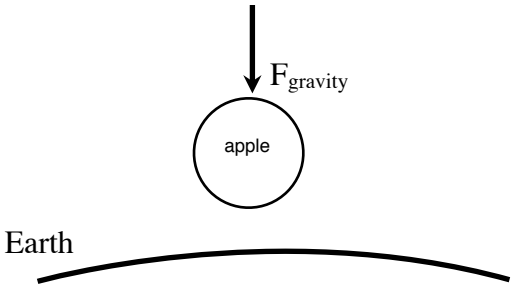
I suppose the causes of my behavior, then, should be related to the causes of these particular electron-displacement currents.

King: And if these electronic currents caused your actions, then would you also suppose that the temperature is controlled by the behavior of these electrons?

Thermostat: Well, I don't really see how the electrons' behavior could actually control the temperature, because these electrons are not really aware of the temperature value - at least not in the same sense that *I* am aware. I mean, if one can say that an electron is "aware" of anything, I suppose it is only aware of the forces that act on it, at the place where it is located at any instant.

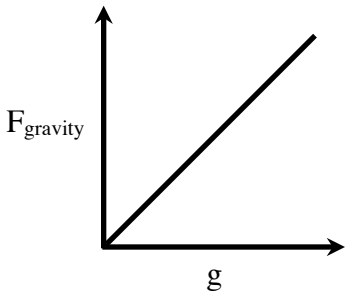
King: That's very interesting, Squire, because in many respects, the behavior of an electron is very similar to the behavior of an apple falling from a tree. You see, a falling apple is

also “aware” only of the forces in its immediate vicinity. For instance, it feels the force of the Earth’s gravity.

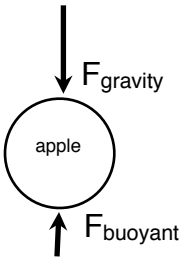


And if gravity were the only force acting on the apple, then the force which the apple experiences will be a function of a single variable, *g*, which refers to the acceleration that the Earth imparts to the apple.

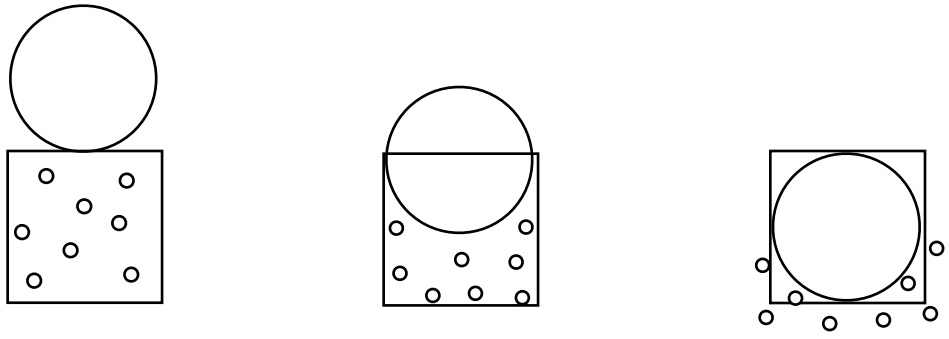
$$F_{gravity} = f(g)$$



Generally, however, in addition to the gravitational force, a falling apple will also feel a force in the *opposite* direction of gravity, called the buoyant force.



This force, which is a result of the air pressure along the apple’s path, is related to the motion of the apple falling through the air. Now, in case the air is initially motionless, the falling apple will cause the air in its path to move with a speed related to the speed of the falling apple itself - the faster the apple is falling, the greater the speed with which the air is made to move out of the space being occupied by the apple.



So consider, if the motion of the apple through the air causes the motion of the air itself, and the motion of the air affects the pressure along the apple's path - which, in turn, influences the motion of the apple via the buoyant force - then the motion of the apple is automatically effecting a change to itself via the buoyant force. See, whenever there's a difference between gravity and buoyancy, this results in a net force on the apple.

$$F_{net} = F_{gravity} - F_{buoyant}$$

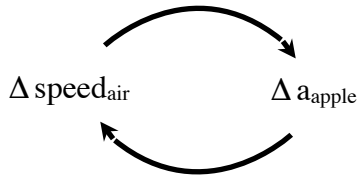
This causes the apple to accelerate with a magnitude inversely proportional to its mass.

$$a_{apple} = F_{net} / m_{apple}$$

This acceleration defines an immediate change in the apple's velocity, but also translates into an effect on the speed of the air moving immediately along the apple's path.

$$a_{apple} = \Delta v_{apple} \rightarrow \Delta speed_{air}$$

This change of air speed causes the pressure being felt on the surface of the apple to change, which generates a different value of the buoyant force, and a different acceleration.



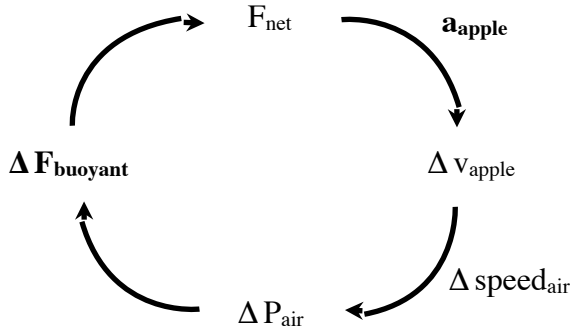
Accordingly, with the effect of the buoyant force causing a change in the motion of the apple, the effect of which is causing a change in the buoyant force itself, a complete description of this force requires us to incorporate a *circular* model of causality known as closed-loop feedback. Again, this need arises because the motion of the apple through the air generates a changing effect on its own motion. Are you following me so far, Squire?

Thermostat: Indubitably, Sire, I shall relate to you what you have described: the apple's motion causes the displacement of the air, generating the buoyant force; the feedback emerges because this force changes the apple's rate of motion, which causes a different amount of air displacement, generating a different amount of buoyant force, and therefore a different change to the apple's rate of motion; and the process thus repeats because a change in the buoyant force causes a change in the acceleration of the apple, and a change in the acceleration of the apple causes a change in the buoyant force.

King: Majestic Squire, you are a splendiferous hear-sayer, indeed!

Thermostat: Bless you, my Liege, you have generously provided me with invaluable insight concerning the behavior of falling apples.

King: Kindly think naught of it, good Squire. Now let us resume our analysis. Thus far, we have established that a falling apple experiences a continuously changing buoyant force, and is consequently subject to a continuously changing acceleration. So, we have defined two changing variables - acceleration and buoyancy - which are mathematically related through closed-loop feedback.



Logically, a change in either of these values will establish a self-propagating condition that persists until the buoyant force assumes the value of the gravitational force. Thus, as long as the force of gravity is greater than the buoyant force, the apple will continue to experience a changing acceleration and buoyancy.

$$F_{net} \neq 0 \text{ -> } \Delta F_{buoyant} \neq 0 \text{ -> } \Delta F_{net} \neq 0 \text{ -> } \Delta a_{apple} \neq 0$$

As soon as these two forces acting on the apple equilibrate, however, they will do so constantly - and the apple will no longer accelerate.

$$F_{net} = 0 \text{ -> } a_{apple} = 0 \text{ -> } \Delta F_{buoyant} = 0 \text{ -> } \Delta F_{net} = 0$$

Now, since the acceleration of the apple equilibrates to zero, it follows that the changing buoyant force minimizes the changing acceleration of the apple. That is, the changing acceleration of the apple establishes a damping or *negative* feedback effect on itself via the changing buoyant force. But when we trace the chain of causalities in reverse, starting from a change in the apple's acceleration, we may derive the following relations:

the changing acceleration depends on the changing buoyant force

$$\Delta a_{apple} = f(\Delta F_{buoyant})$$

the changing buoyant force depends on the changing air pressure

$$\Delta F_{buoyant} = f(\Delta P_{air})$$

the changing air pressure depends on the changing speed of the air

$$\Delta P_{air} = f(\Delta speed_{air})$$

the changing speed of the air depends on the changing velocity of the apple

$$\Delta speed_{air} = f(\Delta v_{apple})$$

the changing velocity of the apple depends on its acceleration

$$\Delta v_{apple} = f(a_{apple})$$

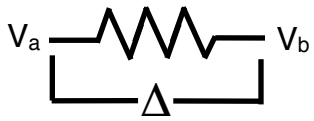
We may thus see that, whereas the apple's changing velocity is a function of its acceleration, and the apple's *changing* acceleration is a function of the changing buoyant force, *there is no explicit function of the apple's changing acceleration*.

Thermostat: Sire, what an esoteric mention. What significance does this entail?

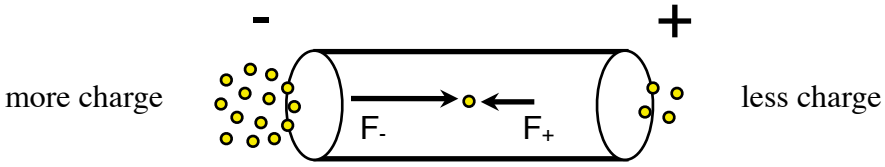
King: It signifies, Squire, that the value of the apple's changing acceleration does not immediately depend on the value of the changing buoyant force in the same manner as the value of the changing buoyant force immediately depends on the value of the apple's changing acceleration. In a sense, therefore, the changing acceleration can be understood as a side-effect of the changing buoyant force. Now tell me, Squire, perhaps you fancy a discussion of axiomatic set theory and the foundations of mathematics?

Thermostat: Not really.

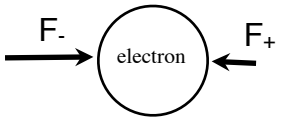
King: Very well then, we shall return our attention to the issue of the temperature.
Thermostat: I shall have no qualms.
King: Now, you say you are to control the temperature value, correct?
Thermostat: Yes.
King: So, if the temperature were to drop below your reference value, you would need to generate heat in order to raise the temperature to your reference value, correct?
Thermostat: Indeed.
King: It is known that heat may be generated by an electronic resistor connected across a voltage difference.



This voltage difference results from a difference of charge density across the two ends of a wire generating an imbalance of forces on the electron and causing it to move down the wire.



Now, the end result of the electron's behavior would simply be to balance this difference of charge - similar to the manner in which the apple balances the buoyant force against gravity.



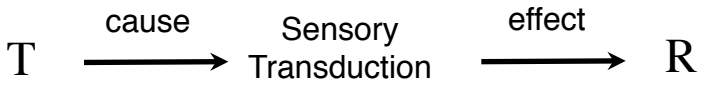
But a complete treatment would involve a discussion of what is known as the Lorentz force, which is the effect of the accelerating electron's own electromagnetic field on its motion. However, these forces do not concern us right now. The main point we are concerned with here is to understand the distinction between the *cause* of the electron's behavior and the *purpose* of your behavior.

Thermostat: It seems you wish to distinguish, then, between behaviors which result from 'causes' and those which result from 'purposes'.
King: That is correct, Squire.
Thermostat: If I may, I would like to advance my humble opinion.
King: Please do so.
Thermostat: It seems to me, for reasons that are not yet completely understood, that perhaps the *only* thing which may properly be understood as a 'purpose' is something which would cause a particular perception, rather than something which would cause a particular response. In lieu of this consideration, however, I notice that it would be intuitively difficult for an observer to establish the purpose of a behavior, if only because the intended perception must be observed from the point of view of the behavior itself.
King: That is interesting, Squire. Would you elaborate on your reasoning?

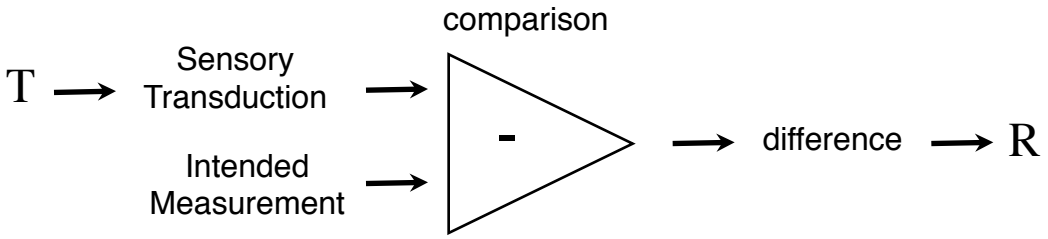
Thermostat: Of course. So, imagine if a cold breeze were to cause a drop in the temperature and my response were to then occur. To an observer, I notice, it would appear that a temperature change was causing my response.

King: Yes, it would look like this environmental variable was somehow directly related to your response.

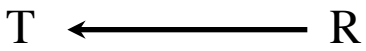
Thermostat: Indeed, but this would merely be an illusion; the environment would only *appear* to be causing my response. In reality, my response to the temperature would not be mechanistically caused by a measurement of its value.



Rather, my response would have occurred only because the environmental temperature did not match my intended measurement.

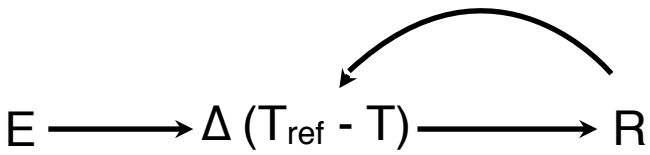


As such, my actions would be properly understood only if they were viewed as being caused by the changing state of a *difference* between my perception and my reference value. Now, the reason for this is not complicated. It's quite simply because my responses have an effect on the temperature value.



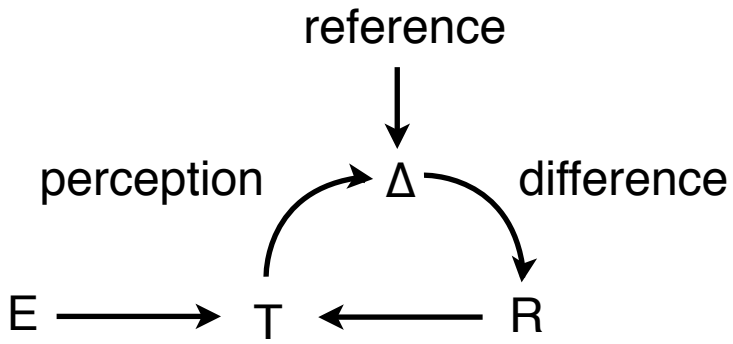
And so, as a result of the influence of my own actions upon my perceptual state, we are forced to dismiss the impression that my actions are being entirely caused by an environmental process.

King: Hmm. So let me hear you straight: the cause of your response is the *difference* between the temperature and your reference value, which is being influenced simultaneously by the environment and by your response.



And since your response alters this difference, the cause of this response at any given moment is the result of a circular law of cause and effect. To state it forwardly, with the observable consequences of your actions directly affecting the perceptual variable being

compared to your reference, the perceptual effects of your actions are feeding back onto their perceptual causes.



And as a result, the temperature value which you perceive at any given moment is fundamentally a controlled perceptual input.

Thermostat: My Lord, you are precisely correct! My behavior is fundamentally a controlled perception, the purposive result of which is to immediately minimize a perceptual difference with respect to a hidden - yet intrinsically defined - reference value.

King: This is true, Squire. In fact, we may very well be logically forced to define the purpose of *all* behavior as the control of perception. But before anything else, allow me to point out to you the significance of this model of behavior. The operating mechanism of your response is in fact identical to the quantum mechanical wave function collapse.

Thermostat: My God, Sire, that sounds like a bodacious claim! What exactly are you saying?

King: Well, you see, there's this strange concept in quantum mechanics known as "the observer effect," which refers to changes which the act of observation will make on a phenomenon being observed. Evidence from experiment has led many a scientist to the realization that what we perceive as reality in the present necessarily depends on our earlier decision of what to measure. Therefore, it's absolutely wrong to assume the observable features of a system exist prior to our measurement. So, consider now that you've decided to measure a particular temperature at a certain time in the past by defining your reference value. This decision controls the difference causing your response. What you will perceive as the temperature at a future time will have thus depended on what you decided to measure at an earlier time. In other words, by strategically defining your behavior as the control of perception, it is in fact possible to meaningfully interpret your current perceptual state as the result of actions dependent on your earlier choice of reference value - which is your decision of what to measure.

End of dialogue

What is the meaning of free will? The definition of behavior as the control of perception suggests that free will is the decision to control a perception. Logically, an awareness of this decision must govern our actions in order for these actions to have been freely willed. This naturally leads us to the definition of consciousness as our experienced awareness of the perceptions we have decided to control. Defining free will and the purpose of behavior correctly is very important for understanding the concept of making ethical decisions.

So let's talk a little bit about ethics. There are two ethical theories in particular which use fundamentally conflicting methods to arrive at the judgement of right or wrong behavior. One of them, utilitarianism, analyzes the consequences of actions to determine the correct behavior. Utilitarianism is intimately associated with the principle of maximizing happiness, and so the method of quantifying happiness needs to be correctly established. Taking the purpose of behavior into account, we define the maximization of happiness as the control of all perceptions. In other words, happiness is maximized precisely when the difference between each and every person's perception and reference value is simultaneously minimized. This leads us to the critical definition of unhappiness. Unhappiness is defined as conflict, the situation where the pursuit of one person's happiness directly causes another person's unhappiness. Conflict means that the same perception is being controlled at different reference values, such that one controlled perception automatically interferes with another.

We might be inclined to consider pain as a form of unhappiness. We ought to distinguish, however, between pain and conflict. In general, if a person is in pain from a natural illness, we do not consider this to be a conflict between human behaviors. Unless, of course, a human has intentionally administered the illness (i.e. poison). When a person is murdered, the assailant and victim are controlling the same perception; but the purpose of one's behavior is to protect a life, while the purpose of another's is to destroy that same life. Murder is thus understood as an interference pattern between controlled perceptions. I wonder, therefore, under what circumstance does euthanasia constitute murder or conflict? It stands to reason that our utilitarian duty is to identify controlled perceptions and terminate conflict.

Let's move on to the other ethical theory, the deontological moral philosophy of Immanuel Kant. Most philosophers consider this theory to be superior to any alternate mode of moral reasoning. According to this viewpoint, humans ought to decide right and wrong based upon aspects of their actions which exist *independently* of their consequences. All their concentration, in other words, is to be focused upon determining whether or not the *principle* used to justify an action is universalizable. This leads us directly to perhaps the single most important issue in modern moral philosophy: are some actions wrong not because of their good or bad effects, but rather for a *reason* pertaining to the inherent wrongness of either the actions or the rules from which the action is performed?

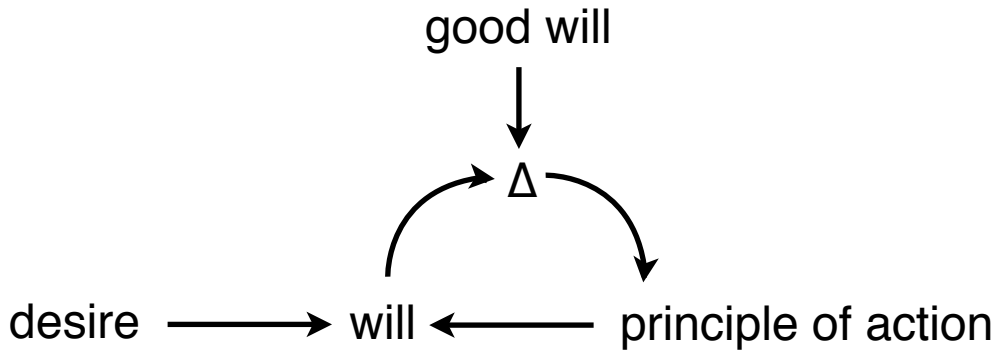
Now, with perceptual control in mind, let's suppose that the behavior of every person has a purpose. In addition, let's suppose that this purpose does *not* relate to the observable consequences of their actions. This would contradict the existence of closed-loop causality through perceptual-feedback, which is the fundamental concept of behavior as the control of perception. It would therefore appear that deontology is at odds with the essential concept of purposive behavior. And, in fact, Kant *explicitly* stated that actions should not be considered correct merely because they fulfilled some subjective purpose or desire. Rather, he believed actions are commanded as a means to an end which he referred to as 'universally willed'. Accordingly, Kant saw something very important in seeking to develop a rational framework of rules which he believed should guide everyone, independent of their subjective interests and

personal goals. In its proper application, deontology focuses on the *logic* of a moral judgment. For instance, here is an prime example of deontological moral reasoning:

> Suppose we allowed lying, so that instead of telling people they ought not to lie, we tell them that lying is fine. So we all decide to follow the moral judgment that lying is right. Now, when you tell me something, I consider that you might be lying, so I cannot ever trust what you say. Because of that conclusion, I realize that you cannot even lie to me! Thus, the rule that allows lying makes lying impossible.

This is the logic that supports the moral judgment that lying is never right. It vaguely resembles an attempt to realize a theory asserting its own unprovability. Let's now consider the following scenario: a band of killers wants to murder an innocent man who has taken refuge in your house; the killers come to your door and ask you point blank if he's hiding in your house. Though murder is the result and a lie would save a life, according to Kant, you *must* tell the truth. That is, you *cannot*, for any reason, reject the logical argument proving that lying is wrong.

Now, Kant interestingly maintained that an action derives its moral worth not from its practical purpose, but rather from the recognition of the act resulting purely from an influence on the will. Accordingly, the principle which governs an action must demonstrate an influence on the will by virtue of the will itself to govern the principle of the action. In other words, the effect of influencing the will must influence the cause of selecting the principle of action - and though independent of *any* other effect, the effect of selecting the principle of action must cause the sense of influencing the will. Therefore, since the effect of a perceived difference upon the influence of the will influences its own cause, Kant is controlling a perceptual representation of the concept of influencing the will. Thus, deontology only appears to be inconsistent with the definition of behavior as the control of perception. In reality, deontological reasoning exhibits closed-loop causality through perceptual-feedback.



According to Kant, the will is normally influenced by desire to pursue some material purpose. The difference between a 'good' will and a will 'disturbed by desire' influences the selection of a principle of action, whereby the good will is realized through the influence of this principle on the will itself. It stands to reason, therefore, that a deontological moral decision is logically identical to a controlled perception of the will. Any human decision at all is in fact an opportunity to realize that behavior is the control perception.

So having discussed free will, let's now deliberate on consciousness. Consciousness may be associated with the awareness of our perceptions at any given moment, and also with the concept of self-awareness. For instance, consider the thought of 'seeing a cat': we think of a perception of the cat's color, its shape, its texture, etc., and also of the conscious awareness of this experience. Now, given the fact that we actually *have* a conscious experience of our perceptions, we should ask the following question: What knowledge do our senses give us about the objects of our conscious awareness? Can we know, for instance, whether our perceptions are identical to those of another? In other words, what is the relation of our perceptions to our knowledge of reality? We must have a method of establishing the correspondence between reality and the truth about what appears from an observer's intrinsic perspective.

This distinction between 'appearance' and 'reality' is one of the most troubling in philosophy. So the question we are now considering is the following: How could we relate the appearance of an object to the existence of a reality existing independently of this appearance? Consider, if we see a hungry cat in one part of the room and then see it later in another part, we suppose that the hungry cat had moved. But if the cat's movement is merely a perception in our mind, then the cat cannot be hungry - because its hunger cannot be perceived by us. So if we regard the behavior of the perception which represents the cat to us as an expression of hunger, rather than as mere movements of patches of color, then we are led to an aspect of the cat's movement which would persist independently of our perception of it. The cat's movements, in other words, would be a means of controlling its own experience of hunger. And this experience of the cat would be controlled independently of our experience of the cat's movement. As a result, if we associate the cat with this controlled experience, then we shall have described an independently existing aspect of reality.

Now consider, when we look at a certain color, we are consciously aware of the immediate experience of seeing the color. And if we have specifically decided to perceive this color, we may also decide to have a *different* experience at the same time or at a different time. Let's remember that we've arrived at the definition of consciousness as being our experienced awareness of the perceptions we have decided to control. That is, our entire reality is described as a controlled experience. So now we must ask: Is there some natural limit to what we can know about an entirely perceived reality? Perhaps a correspondence between perceptual appearance and physical reality exists, such that an object which physically exists further from us than another should also appear further to our senses. But if the most we should know about reality is only what is required in order to secure a correspondence in our senses, then there could exist no knowledge independent of our perceptual experience.

Immanuel Kant tried to show that we *do* have such knowledge independent of experience - i.e. *a priori* knowledge. Before Kant, it was believed that all such a priori judgment was only contained in propositions where the subject automatically implied the predicate - such as, for instance, 'A hungry cat is a cat'. Kant insisted that knowledge of the fundamental propositions of ethics must be known a priori. He also attempted to show that a priori knowledge applied to all the propositions of arithmetic logic and geometry. He explained, if we look at '5 + 7 = 12', the concept of '12' must be known independently of the concepts of '5', '7', and '+'. That is, no analysis of the subject will automatically reveal the predicate. It seemed, to Kant, that we should need to know some truth about particular things in advance of our experience of them in order for logic and arithmetic to apply to these things. Evidently, Kant put an important question at the beginning of his philosophy: How is pure mathematics possible? Defining behavior as the control of perception, how do we describe the behavior known as pure mathematics?