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Hume's Ideas Today

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Hume's Enquiry

"Now each man judges well the things he knows, and of these he is a good judge."- Aristotle, from Nicomachean Ethics

It is a cold Friday night, in late November. You are at a pool hall down the street from your apartment with several of your friends. Returning from the restroom, wiping your hands on the back of your jeans to get rid of the last dampness left behind by the air dryer you round the corner and see the striped eleven ball slide neatly into a corner pocket. Your friend Jack is bent over the table with his pool cue extended and the cue ball is rolling away from the direction the eleven ball traveled about half way across the table between Jack and the pocket the ball traveled into. Your other friend, Stan, walks over from the bar with another pitcher of a cheap, domestic brew and asks you what just happened, as he sees Jack grinning ear to ear. You tell Stan that Jack just hit the eleven ball into the corner pocket. Stan asks you how you know this, did you see it happen? You reply, looking a little oddly at your friend for such an interrogating question, no you didn't see Jack hit the ball, but you saw the ball go into the pocket, and it looked like Jack was in the position to have hit the ball. Stan says nothing but gives a little nod.

Jack having made the first shot now lines up to take his second. As you sip your beverage Stan taps you on the shoulder again and asks you what is about to happen. At this point anyone would look at Stan and ask him if he was running a fever. You ask Stan what he means. He tells you that he wants to know what is going to happen when Jack strikes the cue ball with his cue. At this point you turn on Stan and ask him if he's gone completely off his rocker, and exactly how much he has had to drink. He seems a little saddened and so you back off and ask

him what the matter is. He replies that he just wants to know what is going to happen when the pool cue contacts the cue ball. You sigh, taking a long pause to drink some more of your beer, and then tell Stan in a matter-of-fact manner that when the pool cue strikes the cue ball it will cause the cue ball to move. If Jack's luck keeps up, it will cause it to move towards the ball Jack is aiming at, and from that point, provided Jack hasn't had as much to drink as it seems Stan has, the cue ball will contact the ball Jack is aiming at, causing it to travel towards the pocket Jack is aiming at. Stan seems strangely excited and intrigued, and without a moment's hesitation asks you, "how do you know that?" Remembering why you usually don't drink with philosophy majors you turn to Stan and ask what exactly he means, "that's just what happens!" you say, "It's the laws of physics!" Stan then asks how you know these laws of physics. You tell him grudgingly that he had a physics class just like you in high school, and try as his type might, he must remember Newton's principles. "Besides," you say, "any rational, reasonable human being that's watched a game of pool, or has lived long enough to drink that beer knows this stuff."

Stan says he is still a little confused. He asks how you know that the laws of physics are going to apply in this instance. Exasperated you tell him, "Because that's how the laws of physics operate, they are mathematical certainties." Stan retorts that he isn't asking you for what your textbooks say, but how YOU know this. "Because, Stan, every time I've hit a cue ball with a pool cue, the same thing has happened! I know that it will happen!" Stan doesn't seem to think that this is a satisfactory answer. Amidst the noise of rumbling pool balls and laughter he asks you how you know that just because this has happened every time in your past experience that it the same thing will continue to happen in the future. "Because Stan, that's always how it has been, that's always how it will be," you say, finishing your beer and excusing yourself to go to the restroom, mostly just to escape you annoying friend.

In this scenario, skeptical Stan is channeling not only a bit of Socrates in his method of questioning, but the ideas of David Hume, a Scottish philosopher of the 18th century whose work lands him among the most influential modern philosophers. Hume was a slightly round man who pursued several different careers during his life, initially dropping out of college, trying his hand at studying law, a position in a merchant's office, a secretary in the military, and a tutor. Throughout this entire time he continually pursued philosophical studies and published several different works. These included *A Treatise of Human Nature*, *An Enquiry Concerning Human Understanding,* the *Enquiry Concerning the Principles of Morals, Dialogues Concerning Natural Religion*, and interestingly, *History of England* a thorough look at England's history from the times in which the Roman Empire laid claim to the British Isles, to the Glorious Revolution. This was Hume's best-selling book, but it is not the topic of this paper, nor did it contribute to the school of Modern English philosophy as did the *Treatise* or the *Enquiry.* No, Hume's biggest claim to modern fame lies outside of his reputation as a historian and is due to his revolutionary ideas in Empiricist Philosophy. These ideas challenged the notions of rationalism that had long been held since the times of Plato and Aristotle and were espoused still at great length by modernists such as Descartes. They are also slightly shocking when fully realized, and it is speculated that it was the nature of these ideas which led Hume to pursue careers which were active and engaging; he sought ways to occupy his mind.[1]

Perhaps some of Hume's most intriguing ideas are those unearthed in his *Enquiry Concerning Human Understanding*, a work which presents in a condensed and articulate manner Hume's epistemology, his ideas on free will, and a criticism of religious belief in miracles. Breaking down the human reasoning process, Hume explores how we, as human beings, come to

[1] See Bailey and O'Brien, Ch. 1, pgs. 1-5

possess knowledge, how our minds relate ideas, how we reason or connect ideas, and how we view probability and necessary connection. The resulting philosophical theory is revolutionary and troubling for many reasons. One, it disrupts the classical idea of man as a rational creature; two it places limits on what was often seen as the boundless intellectual capability of man; and three it introduced Hume's famous problem of induction.

Hume's ideas have today found an interesting ally in the emerging discoveries in the realms of psychology, evolutionary theory, neuroscience, and the philosophy of the mind. Modern studies have shown that our minds do not operate upon rules of formal logic, lending further support to claims like Hume's. We are not creatures who utilize our supreme gift for logic to analyze the smallest parts of our lives, to make critical decisions, or to carefully weigh the consequences of our actions. We do not calculate the total utility to be gained from our decisions before acting. Instead it is beginning to become clear that the human mind is often guilty of committing serious crimes against rationality, utilizing quick decision making mechanisms that can and do get it in trouble when attempting to reason out or make sense of certain scenarios. Instead of utilizing a slow and carefully reasoned approach to many problems, the mind takes shortcuts. These shortcuts can get us in trouble sometimes and this is due in no small part to the fact that we are both unaware that we have made such shortcuts, and that we also will defend such mistakes as being completely rational. Such contemporary findings fall into harmony with much of what Hume writes in the *Enquiry*. They also shake to the core beliefs which have long been held by experts in many fields, including political science and economics. If man fails constantly to meet the standards set by classic notions of rationality, operating instead upon things such as Hume's Custom and Habit, is there any way in which he can still be deemed rational?

Answering this question is tricky but not hopeless. The same fields which cast doubt upon our position as the chosen, rational children of some higher power (or the evolutionary chain) also give reason not to lose faith in our intellectual abilities. Research on this topic has revealed that in certain scenarios our quick and dirty heuristics (mental strategies which utilize rule sets other than logical reasoning) actually become extraordinarily fast and frugal, in some cases outperforming carefully designed mathematical optimization formulas at certain tasks. This interesting detail is likely a result of the intimate relationship between the ancestral environment of human kind, and the human brain's adaptions to this environment. While perhaps at times the mind falls short of what our higher conscious processes would identify as being rational, it is possible that the brain is actually operating on its own agenda, which when examined in the context of the environment, is ecologically rational.

In this paper I will explore the results of research into the fields of evolutionary and cognitive psychology, behavioral and neuro-economics, and philosophy of the mind. Framing these against a backdrop of Hume's *Enquiry* and the ideas expressed within it, I will attempt to solve some of the issues that we are left with: If we as human's do not operate in accordance with the classical sense of what it means to be a rational creature, are we doomed to the intellectual darkness that that entails? Are the positive aspects of our quick thinking minds great enough in number that we may in some way salvage our self-assurance by redefining what it means to be reasonable in terms of our environment? How shall we use this knowledge to benefit us, if it can, and what exactly do both positive and negative findings on both sides entail? And is Hume right; are our ideas of necessary connection and causation really something only developed by human custom and habit, unreachable by reasoned argument? This investigation will consist of several parts, the first being to show the extent to which the human mind falls

short of classic standards of rationality, as I suspect several of you reading this paper adhere to some rather dusty classic notions of humans' capabilities— I hope to release you from such comfortable shackles. Note, however, that not all hope for trusting in our abilities is lost. Before declaring ourselves irrational for a failure to meet standards that we ourselves set forth, we should instead consider whether it is possible that our very definition of rationality is due for an update. Finally after looking at both sides of this coin and their implications our analytical gaze will turn towards tackling Hume's ideas of having good reason for believing things we believe, and the formidable challenge presented by his famous Problem of Inductive Reasoning. It may prove impossible to disprove or refute Hume's position, but there is also the possibility that there may be a way to work around the issue using an evolutionary argument which blurs the lines between naturalism, rationalism, and empiricism. I believe that examining the evidence which will be presented in favor of holding the human mind as an ecologically rational operator, and using what we know of evolutionary theory, an argument can be made for our belief in causal relationships between past witnessed events. Because our belief in causality has not yet doomed our species, we have grounds to believe that this belief may reflect the true nature of the universe.

Quick and Dirty Thinking

This first step in our discussion should focus on dispelling some of the notions of the human mind that have been assumed and endorsed for quite a while. Primarily, it has been a commonly held view that humans are rational creatures. In this context the word "rational" means fitting the standards of classic rationality. This viewpoint has been heavily endorsed over the centuries by schools of philosophy and economics, a trend reflected in the fact that these of individuals of classic rationality are often labeled today as "econs," or *Homo economicus*.

Econs are smart and intelligent. Classical economists believe humans carefully weigh accepted risks and possible gains to be made, seeking to maximize positive outcomes of their actions. They act in their own best interests. When problem solving and utilizing critical thinking skills they work in a step by step process, using deductive or cogent inductive reasoning. Real humans, shockingly, do not do this. Real humans act as Hume points out, drawing conclusions and forming beliefs from means other than carefully reasoned arguments.

If we can turn back for a moment to our original story of you and skeptical Stan in the pool hall, let us examine Stan's question about the outcome of one ball striking the next. Considering a situation like this, all of us will come to expect that the first ball will, if it hits the second ball, cause it to move. This predicted outcome comes to us quickly, and as reflection seems to show, without a carefully reasoned process of thought. Arguing that at each moment we engage in complex calculations with regards to balls trajectory, velocity and motion is ridiculous. It is easy to come up with explanations for your certainty to Stan *post facto*, after he makes you consider this belief, but there is very little conscious thinking in its creation. How then is it that you come to this belief? The answer is it isn't really "you" doing it; that is to say, it isn't your conscious self.

Think for a moment about all of the things human beings do every day without relying on their powers of reasoning and problem solving: jumping out of the way of a car as you walk across a cross walk, knowing if your mother is calling to you lovingly or angrily, recognizing a friend's emotions as they appear on his face, hopping across a puddle, or even walking– something incredibly hard for toddlers to accomplish (hence their designation) but effortless to us as we balance our entire body weight on just two points through the fine adjustments of muscles. When a quarterback throws a football, he is presumably not using mathematics,

physics, or geometry to accomplish his task; he is eyeballing a distance and throwing a ball. In this scenario, while his choice to throw the ball to a certain receiver is quite conscious, again there are many things at play which he does not work through in his head. The time necessary to calculate yardage, wind speed, trajectory, etc. is time no quarterback has, and even if given the time to do this, many individuals will not perform any better; sometimes they will do worse when they, "think about it too much."

These non-conscious brain processes not only affect the human body, but also our minds and conscious thought processes. For the purposes of discussion in this paper, I will adopt a technique for differentiating these two systems in the mind, non-conscious and conscious, as Daniel Kahneman does in his work *Thinking Fast and Slow*.[2] For the most part, our automatic processes will go by the title of system one, and our conscious thoughts and cognitive processes will go by the moniker system two.

System one can be best described by adjectives like fast, and automatic. For the purposes of this discussion all those processes which the brain performs without our knowledge of them can be titled as system 1. These tasks range from things such as heartbeat control, balance, environmental awareness, "completing the phrase bread and …" and processes which feed into and influence our conscious life.[3] If you have ever knocked a bowl off your kitchen counter only to catch it before you realized what you were doing, you have evidence of your system one in action. Flinching is also a good example of system one: it is a moment in which the body reacts quickly and automatically to a perceived threat, often before a conscious understanding of the threat can be obtained. System one can further be broken down into two further categories, those

[2] See Kahneman *Thinking Fast and Slow* Ch. 1 pg. 20
[3] Ibid. Ch. 1 pg. 21

which are incredibly basic, such as heartbeat and breathing regulation, and other very basic body processes, and more complex, automatic mental processes. In this paper we will primarily be dealing with this second part of system one's abilities.

System one acts remarkably quickly, but has some significant drawbacks, which will be discussed at greater length in a moment. For the time being, however, system one's major flaw can be summed up in that it lacks the ability to reason, its entire series of processes being automatic or reactionary, transforming input to output without stopping to consider whether its output is correct.

System two on the other hand is a part of the human mind we are all very familiar with. System two designates all those thought process of which we are conscious. Planning out one's day, creating a playlist for a friend, interpreting a piece of poetry, making tough decisions and learning a dance for the first time involve the mind's system two. System two is conscious thought and awareness, and therefore also the seat of the idea most of us refer to when we think of the "self". It specializes in tasks which require a large amount of focus and reasoning.

System two is far more thorough and slow moving than system one, but has its own set of limitations and cognitive energy. The first is that it is awfully lazy.[4] System two is much like a smart child who gets held back in elementary school because he sees little point in doing work that he is very capable of doing. If not nudged into action by system one or some interest of its own, system two is happy to do very little. This is likely because system two's second weakness is reflective of the fact that it is very much the seat of conscious attention in the mind. System two has only so much focus which it can expend; a "limited capacity of attention."[5] When

[4] Khaneman Ch. 3, pg. 44
[5] Ibid. Ch.1, pg. 23

someone says she can't multitask, she really means than her system two is incapable of doing so, and to a certain extent, almost everyone is bad at this once the number of tasks gets too high.

Though it is convenient to describe both systems as being separate entities the two really interact in a very fluid way, system one activating and feeding information into system two, and system two being able to sift through this input and determine how to use it. This combination of the systems, however, leads to the problem at hand: system two's lazy nature and inability to focus intensely on more than one task compounds the weaknesses of system one. The two are like workers on an assembly line, system one eagerly embracing its job but having little knowledge of what a good final product looks like, while system two down the line knows exactly how a good product should look, but would rather spend his time daydreaming than examining the objects riding past him. Together they create a functioning mind for an individual which has the potentiality to be quite irrational, and often is.

A good way to demonstrate this idea is through example, consider the following:

Adolf Hitler was born in 1892.

Adolf Hitler was born in 1887.

The true answer may come as a surprise, but neither of these statements is correct.[6] Kahneman uses these two (false) statements, as a means of demonstrating the ways in which external factors (those things separate from the actual content of the question but still involved in reading and

[6] Ibid. Ch. 5, pg. 63

answering it) can demonstrate human decision making, specifically with regard with questions printed in ink. Most people, those who do not have an answer immediately available to them, will pick the first **bolded** statement as being true. It is easier to read, and stands in contrast with everything else on the page. The given explanation of this is that the bolding of the word plays on system 1, which draws our attention to significant differences in our environment. This, coupled with system 2's lazy nature causes the majority of individuals faced with a lack of readily available knowledge of the actual answer to pick the bolded answer, rather than choosing to occupy their mental efforts with searching their memory for an answer they may not know at all. Another heuristic contributes to one's willingness to select the bolded answer, or actually, either of the answers.

Faced with the choice of Hitler's birthday above, many people initially severely limit the scope of their knowledge basis search because they assume that one of the statements they are presented with must be the correct one. This commonly made assumption is a function of system one, and is in no way limited to simple problems about historical dictators' birthdays. In almost every situation humans are presented with, their system one is incredibly effective at making sense of the information present, but fails to leave room for additional information. Kahneman smartly labels this particular heuristic "WYSIATI, which stands for what you see is all there is."[7] Because of this characteristic of the human mind, a proposed pair of answers such as the one above becomes a false dichotomy. The ability to entertain possibilities outside of what is immediately presented to an individual is a function of system two. Such a task is quite mentally exerting however, as it opens up a whole new set of possible actions and answers. Presented with two possible years in which Hitler could be born, system two's task becomes

[7] Ibid. Ch. 7, pg. 86

deciding between the answers offered, not because it can't consider other alternatives, but because quite often it doesn't become activated enough to consider alternatives. Assuming that the individual is somewhat determined to answer the question, and is not thrown off by the bolded text, he will engage in a process of assessing the two answers for viability. Do any of the dates ring a bell? What does he remember from his world history classes? The process will likely incorporate an organized search of his memory as well as an evaluation of any associations the dates bring to mind. He will evaluate any gut feelings that may pop up as a result of system one processes, such as the bolded text. All this puts a load on his system two, but it is light compared to the task of finding an answer if WYSIATI is not in place.

Should the possibility that the two answers are not the only possible choices be indulged, a whole new world of problems opens up: is either of these the correct year? Are they close? In looking for the correct year should one go up or down? If WYSIATI is not in effect, rather than deciding between two given choices, a whole new group of possible questions emerge which must be asked, leaving the individual with a much more challenging task, and no clear place to begin. For the lazy system two, failing to question WYSIATI is a positive in terms of saving energy and effort, but is not reliable for getting the correct answer.

The balance between the two systems is difficult to concretely describe, and there are many situations in which the nature of the relationship differs. System two is quite capable at times of monitoring the input it gets from system one and realizing if it is making a system one mistake. System two can't necessarily stop system one's actions, but it does possess the capacity to know the truth value of certain assumptions system one makes. Interestingly however this realization of a system one error hardly stops system one from continuing to endorse its own, so to speak, viewpoint.

Some system one mechanisms are much more resolute than others. For a good example of this, look no further than optical illusions. Optical illusions present the viewer with a series of inputs into the visual cortex which creates for an individual a visual experience that differs from the objective reality of what they are actually viewing. Visual processing is a job done entirely by system one. Humans don't have to consciously make an effort to process the light coming into their pupils and striking the backs of their eyes into an image, nor do they have to make themselves perceive depth and motion. The same is true of the other senses as well. System two does a large amount of its daily operating based upon information of this sort. These very basic automatic processes, when subject to error, are the hardest sort of cognitive error to overcome, even with system two's awareness of the situation. A wonderful example of this can be found in figure one below.

http://www.indiana.edu/~ensiweb/lessons/tables2.jpg

Figure 1

The viewer of this illusion (often named the "two tables illusion,") is presented with (as the name suggests,) images of two tables. The stunning thing about the tables is that their surfaces are the exact same size and shape, a fact which is easily verifiable with a ruler, but not with the eyes. The table on the left appears to be far narrower and longer, while the one on the right appears stout and squarer. Despite being able to confirm that both tables are the exact same shape, however, it is impossible for the viewer to experience them that way. While system two has hard evidence about the illusion, it cannot stop or correct the processes system one carries out which create the illusion. This undermines our ability to evaluate the tables correctly, and while system two is capable of becoming aware of the illusion and reminding itself of the phenomenon, there is still a part of the viewer which refuses to endorse this idea.

In his book, *The Tell Tale Brain*, Dr. Ramachandran speculates that optical illusions are a product of our evolutionary history, a history hardwired into our brain. The two tables illusion is a product of the orientation and shading of the tables. The human brain uses cues, such as shading in order to make sense of its visual perception. These cues cause the brain to see the tables as being different, rather than the same, and will also cause depth perception changes in illusions such as the figure 2. Here the rows of circles are perceived as either bumps or depressions depending upon whether they are shaded from above or below. If the viewer were to hang upside down and look at the image, the illusion would be reversed. The claim is that the brain is evolved to process visual input with the assumption that there is normally one major source of light, the sun, and that this source of light is above the head. Rather than waiting to identify the position of the light source in question, the "visual system," (system one), "takes a shortcut; it makes the simplifying assumption that the sun is stuck to your head."[8] In both of the illusions presented above system two can be quite aware of the fact that measured with a ruler both table tops are the same size, and that there is nothing about the circles in figure 2 that is actually three dimensional, but system two is unable to stop the mind from perceiving the pictures the way system one processes them.

http://i214.photobucket.com/albums/cc309/toylion/inorout.gif

Figure 2

Optical illusions are not the only example of system one errors that system two cannot protect against, even with knowledge of the error. Phantom limbs are tactile-sense errors which cause in individuals the phenomenon of feeling a limb where none is present.[9] Many of these individuals experience pain in these phantom limbs, and no amount of system two analysis of the fact their limb is gone quiets the ailment. Only techniques which appeal to system one on a basic

[8] See *The Tell Tale Brain* by V.S. Ramachandran Ch. 2, pg. 54.
[9] Ibid. Ch. 1, pg. 25

level appear to have any therapeutic results. One known treatment, which works especially well for patients who feel they have a cramped phantom hand, is to place their remaining hand into a mirror box, thus presenting the vision with the illusion that they have two, fully movable, working hands. In many cases this relieves the experienced pain, and causes the phantom hand to feel stretched and relaxed.[10] Only by giving system one visual input which creates another false, but more pleasant error, can the painful tactile mistake be overcome. The knowledge and ability to do this are part of system two, but directly appealing to a person's system two through reason and logic will not cause the illusion to fade.

Other system one errors are, to a certain extent, able to be corrected by system two. These errors are often of a different nature from the basic, sense-oriented system one errors which produce sensory illusions, but instead relate to more basic mental functions system one carries out, such as association. When reading the words, "peanut butter and…" the associative part of system one brings the word "jelly" to mind without conscious effort, but the action of completing the sentence with this word, on paper or verbally, is a system two decision.[11] The associative machine produces errors in many judgments as well. Consider the following paragraph.

> "Linda is thirty-one years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations."[12]

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[10] Ibid. pg. 33

[11] The extent to which this is true was raised to me in a discussion. What I mean to say is that when confronted with the phrase, "peanut butter and ____," jelly of course comes to mind. However, there is a difference between having a word in mind and communicating it. If for instance, one was in a situation where answering aloud, "jelly," would not be appropriate, you would not open your mouth and speak. You couldn't stop your mind from associating the word jelly, however.

[12] Kahneman Ch. 15, pg. 156.

Now out of the following options, choose which description is more probable to be true for Linda: "Linda is a bank teller; Linda is a bank teller and is active in the feminist movement."[13] Shockingly, in a study done by Kahneman, 85% to 90% of participants, who were, for what it is worth, undergraduate students, picked the second choice.[14] The problem with this is that ranking it more likely that Linda is a bank teller who is also a feminist is a logical error. The number of bank tellers who are feminists can only be less than (or in a very progressive world equal to) the total number of bank tellers. The reason this error occurs is that following the reading of the description of Linda the subject knows several of her traits, traits which fit into certain stereotypes. Upon seeing the word "feminist" in the choices, the associative, stereotyping machine in system one matches the word feminist to the qualities which are known about Linda, and the error is complete. Why does this happen? System one seems to be much more adept at association than thinking in terms of probability. System two, due to its laziness, doesn't attempt to engage in an in-depth analysis of the probability of the two choices, and so the word "feminist" lures nearly all participants in the study into a logical trap. To what extent can system two rectify this problem? When informed of the logical fallacy the problem encourages, individuals are able to understand their mistake, and when informed of why, they can correctly identify when rereading the problem, or reading problems like it, the association which occurs as a result of the association their mind makes given Linda's traits. This doesn't stop the individual's mind from making the association. Even after understanding the logic underlying the bank teller/ bank teller and a feminist problem, the word feminist will be very appealing, as it fits with the social description the subject is primed with. As Stephen Gould puts it, though he knows the conjunction of bank teller and Feminist is the least possible, "a little homunculus in

[13] Ibid. pg. 158.
[14] Ibid.

[his] head continues to jump up and down, shouting at [him] - "but she can't just be a bank teller; read the description."[15]

What differentiates this scenario from those of the illusions beforehand is that system two's knowledge of the logical fallacy allows the individual to make the correct decision and not be deceived by system one. In the case of the illusions, no matter how much knowledge of the sensory illusion system two has the individual's perception will not differ.[16] Ultimately however it can be argued that in both cases, the logical fallacy and the optical or tactile illusion, system two is capable of learning that an error has occurred. This reflects again the dualistic nature of the human mind, but also complicates our attempt to answer our question: is it proper to judge human actions by standards of classical rationality. System one doesn't operate in line with such standards, and system two doesn't always have the information or motivation at hand to be able to, though it may have the capacity.

There are also situations in which human beings' decisions, while not in error, still conflict with classic models of rationality. In an experiment carried out by Dan Ariely, students at a university were given the option in their lunch hall of purchasing, with their meal plan, either a Hershey Kiss or a rich chocolate truffle. Both were offered at a very low price, one cent for the Kiss and 15 cents for the truffle. The majority of students in this scenario chose the truffle. At 15 cents apiece the expensive truffle was a good deal. Here the students seem to fit

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[15] Stich, Samuels and Tremoulet, *Rethinking Rationality*, 3, quoted from Gould, *Bully for Brontosaurus*

[16] There is a question in philosophy of mind that wonders whether those who are experienced in a field, i.e. the trained art historian, or the classical conductor, who "hear more" or "see more" in orchestral pieces and classical paintings. This question is not applicable in the case of optical illusions however. In the case of analyzing a painting, a trained studied art historian observes brush strokes and blotting techniques, and can identify how it is that a painter has in a two dimensional image created an illusion of depth, yet they will still on the most basic level experience this illusion of depth. A better comparison is that someone who knows a great deal about optical illusions is like someone who knows a good deal about yellow light. Despite knowing about its wavelengths, and that it reacts with humans red and green rods, the viewer cannot alter how they see yellow light. Likewise despite knowing how an optical illusion works, the viewer cannot alter the illusions effect.

the classic model of econs rather well; those who liked chocolate enough to wish to buy one took into account the relative prices of the chocolate, saw the value of the expensive truffle for just 15 cents, and chose accordingly. However, when the price of each chocolate was lowered one cent, making the Kiss free, the cheaper chocolate was suddenly more favored.[17] Though the students were willing to spend fourteen cents before the price drop, suddenly spending no cents seemed a better decision, though spending less money earlier did not. In another study in which participants were asked whether they would rather have a $10 giftcard for free, or a $20 giftcard for $7, individuals more often chose the former, even though the later offered a better monetary gain.[18]

Results such as these indicate the interesting idea that humans aren't always seeking to maximize the total utility of a given situation. The trend seems to be that while more could be gained from loss of something, in this case currency, the option to gain without any loss appeals more to subjects. This does not seem to hold up to classical theories of economics. An "econ" would always choose the $20 gift card for $7. Why then do humans shy away from such a utility maximizing choice? We will answer this question in a later section. For now, we will look at how exactly this non-conscious system is thought to work in order to better understand its hindrance on the existence of *homo economicus*

Hume and System One

In all the scenarios described, the human mind has proven to be far less than the rational paragon classical philosophers and economists have made it out to be. This is due to the fact that

[17] Ariely, Ch.3, pg. 52.
[18] Ibid. pg. 58.

the human mind is not one, complete, rational entity, but a combination of systems which operate separately as well as cooperatively to carry out the many processes required of them. System one operates independent of a logical standard, and so when presented with a situation requiring logical thinking, can lead an individual to make faulty choices. It equivocates, associates, cuts corners and jumps to conclusions in the interest of getting to answers quickly.

Hume recognized this non-logical system at play in human thought. Suppose, he argues, that a fully reasonable individual (a person with a well-functioning system two) were brought into the world and were to witness several events in succession. He would have no way to reason a connection between them, and therefore, "their conjunction may be arbitrary [or] causal."[19] However, if this man is exposed to the same events in the same order repeatedly over the course of his experience, he will "draw this inference," that the two are related causally.[20] Furthermore, even if he is made to realize that he has not arrived at this belief in connection by logical means "he would nevertheless continue the same course of thinking."[21] Hume acknowledges that man is indeed capable of reasonable argumentation and deduction, but asserts that those things are not the cause of his ideas of necessity and connection; instead repeated exposure to similar events in a similar series forms within him these ideas through Custom or Habit— he does not use logic to arrive at these conclusions. Even if these powers are used to argue against the intellectual habits he has formed, his mind holds fast to these beliefs, his system one still associating the two ideas together in an order.

Hume is, of course, arguing against a rationalist explanation for knowledge of causal relationships; he points out that the position that such ideas could be deduced from inner

[19] Hume V. 35.
[20] Ibid.
[21] Ibid.

axiomatic principles of logic can't be true. If an individual with full reasoning capabilities, but no experience in the world, popped into existence in our fictional pool hall, he would have no deductive method for concluding what would occur when a cue ball struck an eight ball, or when that ball traveled towards the rim of the table. During his first witnessing of these events, he may decide that the different events playing out in front of him are occurring at random. With repeated exposure to the moving of one ball when it strikes another however, he can connect the two, and will do so. The connection is not a feature of system two, because he is not engaging in a process of reasoning, but one of association.

A plausible explanation as to why system one functions in this associative way can be found in some modern models of neuroscience. To begin with, system one's characteristics may be a result of the neurological structure that embodies it and the way this structure functions. . The structure of the brain is believed to be a very advanced example of a connectionist network. Connectionist networks or neural networks are, "made up of a large number of *units* organized into *layers*. In a typical connectionist network there are three layers— an *input* layer, a *hidden* layer, and an *output* layer."[22] The layers are connected, each to the next layer in the chain. Figure 3 shows a simplistic example. Input is received by the first layer of nodes. Each connection between nodes in the model has certain a certain "weight." This weight and the nature of the input then determines the extent to which the units in the middle layer activate, based upon their activation function— the threshold at which they receive enough input to activate— the process then repeats between the middle and output layers. To give an example let us say the rightmost input layer unit receives a stimulus of 8. The connection between it and the rightmost hidden layer unit is 0.5. This means that the hidden unit receives a stimulus of 4.

[22] Ravenscroft, Ch. 7, pg. 97

The right most hidden layer unit has an activation function of 3.5, and so with a stimulus of 4 it activates. From here the connection weight between this unit and the center most output unit is 2, and so the stimulus between the two becomes 8 again. Based upon the activation function of this final unit it will activate or remain dormant. When this process occurs across all the different units together, many different input and output patterns are possible.

The purpose of the connectionist network is to model how biological neural networks might be constructed. As a neural network system one is very complex, having the same characteristics that the ideal connectionist network does— it handles multiple tasks at once, it is quick and automatic, it can keep functioning in the face of structural decay and damage, and it tolerates poor quality input.[23] System one does not cease functioning due to mild concussions, handles man's different tasks at once, alerts an individual to sudden movement in their immediate area even if little information about what the movement is available, and correctly completes tasks such as chicken sexing— something individuals can do correctly, but cannot articulate how they correctly complete the task. It also explains why it does not prove effective to reason with system one, as its functioning depends upon more simple connection weights and unit activations. The final similarity the two share is that connectionist networks are capable of "learning." Connectionist networks can be tweaked by having their connection weights and activation functions adjusted until they output the correct answers to entered inputs. System one, a biological neural network, has its own method for weighting connections between neurons.

http://www.mind.ilstu.edu/curriculum/connectionism_intro/imgs/PDP_3LFFN_1.GIF

[23] Ibid. pg. 103

The principle regarding the formation of synaptic connections between neurons is known as Hebb's rule. Often stated simply, "Neurons that fire together, wire together," the actual rule states that synapses will be potentiated or culled depending upon in which order the neurons on either end of the synapses activate.[24] When an individual sees motion in the first billiard ball set moving, it activates a particular series of neurons. When the ball strikes a resting billiard ball, and the second ball begins to move, to simplify things, neurons associated with that ball and with motion activate. The more often the first series of neurons activating is followed by the second series, the two will build strong synaptic connections, leading the activation of one to precede and usually lead to the activation of the next series. If, however, the second series activates before the first series, which would be akin to the events happening out of order, the synapse weakens. The more an individual sees the first event occur, followed by the second event, the stronger the synapse grows, the firing of the first now causing the second to activate; the first moving ball is now associated with the second moving ball. The inverse side of the rule makes sense as well. If a person was to witness an effect occur before its supposed cause, it would likely lead the individual to question the causal nature of the relationship.

This method by which synapses strengthen and weaken tunes system ones network, reinforcing certain connections by experience and weakening others. With regards to the example of chicken sexing, students are trained by masters who simply give them positive or negative feedback as they gradually improve at the skill, because neither master nor student can articulate what they are looking for. System one cannot be reasoned with because its evolved structure and the process by which it functions are dependent solely upon experience, and is carried out in an automatic manner. In the classic sense of the word, there is no way to call such

[24] Rubin, Lee, and Sompolinsky, pg. 364

a system rational, and, for humans containing this sort of system, it seems difficult to maintain the position that such creatures are classically rational.

It has been shown that the classical sense of human rationality, in which "econ" humans utilize reason and good common sense to make decisions in the interests of themselves and others, may not be the most apt description for normal human behavior. Until this point, the blame for this shortcoming seems to rest squarely on the shoulders of humans' system one type mental processes. Should man then be thought of as a creature who is capable of being classically rational, but who is held back by some of his more primitive features? If system two is responsible for reasoning, and making most of the decisions which classical economists and rational philosophers would predict, it seems to be the only one of the two systems which is capable of meeting the expectations of these thinkers. Perhaps then, utilizing the careful planning and reasoning of which system two is capable, man could find a way to catch, inhibit or tame his non-rational tendencies. Obviously, as is well known, people are capable of engaging in purely logical thought. If we were not able to understand mathematics, step by step reasoning, and the rules of symbolic logic, human kind would never have been able to build the pyramids, the golden gate bridge, or IBM's Watson. Should we then perhaps discuss rationality purely in terms of the human system two, taking the fact that we contain its abilities as enough to continue to think of ourselves as classical rational, targeting this claim only upon our higher faculties? Can we use our capabilities for reason and planning to deal with system one in a way which channels its abilities towards an end in line with the standards of classically rational decision making?

One of the first considerations that should be looked at is whether or not it is appropriate to separate system one and system two when discussing man's rational nature. Several problems immediately come to mind when making this distinction. System two may indeed be capable of reasoning, but this is exactly the same as saying that man is capable of reasoning. Certainly, if taught the rules of formal logic, system two can solve its own proofs and make valid deductions, but its inherent drawbacks mentioned previously (laziness for one, depleting concentration, etc.) still land it short of performing as an "econ." Adding to this, it may conceptually be possible to separate the two systems, but the reality of the situation has already proven to be much more complicated. System two is influenced by system one when making decisions, and in most cases it is unaware that such influence has occurred.

System two is in no way all seeing. It is however the only part of the mind which is responsible for conscious experience. Because of this, the workings and influence of system one go mostly unknown to the individual within whom it operates. In a study by psychologists Nisbett and Wilson, subjects who had their opinions or views on something changed by associative programming were unable to identify that their opinions had been altered. The subject's system two was unable to identify that a change had taken place. In a particular experiment, subjects who were originally asked to give their opinion on a topic, public busing, were then made to listen to an attractive individual arguing opposite to the subjects opinions. Afterwards the subject's opinion had, not surprisingly, changed to be closer to the attractive individual's opinion. The interesting part, however, was that the subjects then incorrectly remembered the initial opinion as being closer to their changed opinion.[25] System twos vulnerability to the unregistered influence of system one puts a severe damper on efforts to label

[25] See *Telling More than we can Know*, Nisbett and Wilson.

it as reliable and rational. Its lack of ability to introspectively analyze its own decisions places doubt not only on system two's rational faculties, but also proves that any attempt to deal theoretically with system two alone is bound to run into trouble. It is not only influenced by its non-rational counterpart, but it is also often unaware when it has been, and so the individual is also unaware of his system one's doing.

For another example of this, look to the anchoring effect. Anchoring occurs whenever an individual is first introduced to a statement, fact, or number which primes them in a certain way to react to later questions or scenarios. For instance participants in one study were given two questions: "Is the height of the tallest redwood more or less than 1,200 feet?" and the second question, "What is your best guess about the height of the tallest redwood?" In one of the participating groups, the first question contained the measurement 180 feet. The two subject groups in this study produced the average answers of 844 and 282 feet; their answers swayed by the first questions number.[26] The key point to our discussion here, however, is that individuals are often unaware that they have been influenced by the anchoring situation. When told about the anchoring effect, many people deny its existence. In another study dealing with real-estate agents, agents were shown an on the market house. The agents were split into two groups, one which saw one asking price, and the other which saw a far higher asking price. The agents insisted asking price was not one of the things which influenced their estimated reasonable buying prices, but Kahneman calculated an anchoring effect of 41%. When informed of the influence, the professionals still denied that it occurred.[27] In this case system two was not only

[26] Kahneman, Ch. 11, pg. 123
[27] Ibid. pg. 124

unaware of the effects of the anchor, but when informed of them, denied the possibility of the influence.[28]

At this point it should be apparent that attempts to salvage human rationality by inhibiting or fighting against system one are bound to run into problems. System one is simply too essential to the human existence and interwoven with system two. Seeking to focus simply on our processes which are capable of logic will inevitably fail because we have no way of telling exactly when our logical capabilities are being affected by our non-rational side. Is there a different line of reasoning, placing emphasis on system two, which will achieve our goal? The answer may perhaps lie in the idea of not only discovering system one's influences on our daily decisions and lifestyles, but also harnessing its heuristics to improve ourselves.

System one has a tendency to go with the status quo. This default heuristic, combined with system two's lazy personality, lead to individuals very often going with whatever options are initially given to them. For example, during a study done on the pension plans of college professors during the 80s, it was discovered that the "median number of changes in asset allocation [during] the lifetime of a professor was… zero."[29] The default options they were assigned were by and large the ones which they stuck with. In many cases, this default heuristic stops about 30% of employees eligible to join 401ks (and other such plans) from simply taking the additional step necessary to sign up for a savings plan.[30] Recognizing this, and other heuristics and biases to which we are subject, Thaler and Sunstein recommend the novel

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[28] Interestingly, another set up subjects tested, business-school students, who had only a slightly higher anchoring effect percentage did admit that the asking price probably influenced them in some way. With the professional experience the real-estate agents also seem to have some professional hubris. This should be troubling— they are the individuals who do this professionally, but they reject an effect which could very well greatly affect their field of work.

[29] Sunstein and Thaler, Ch. 1, pg. 34

[30] Ibid. Ch. 6, pg. 107

approach of harnessing these flaws which separate the humans from the "econs." Speaking about the "default" heuristic, they suggest that perhaps the correct course of action is, instead of attempting to combat the lazy bias, use it to the individuals benefit. Making enrolment in 401k plans the default for newly hired employees dramatically reduces the percentage of employees not enrolled.

Sunstein and Thaler's advocacy of a nudging theory of changing choice architecture, or the context in which people make decisions, brings to the table a novel approach of addressing human irrationality. Knowing that we may never be able to address or catch all the situations in which humans are influenced by their system ones, it seems reasonable that a better alternative may be exploiting the ones we do know of in order to "nudge" our non-rational processes to make a classically rational choice.

Will then a conscious attempt by system two to manipulate our system one towards rational choices redeem us in the eyes of classical rationality? The answer to this is unfortunately no. On the one hand there are simply too many situations in which system one plays a vital role. Practically speaking, there is no way that we would be able to engineer choice structures for all these scenarios in order to direct system one to rationality at every point that it might err. On the other hand, even if we managed through such means to recruit system one to the rational side, system two is still imperfect. This is because though system two is still plagued with several issues, most notably its laziness and limited energy reserves. The classical rationality found in an Econ would necessitate him being ever alert, calculating the factors and variables in his environment, constantly invoking his system two to solve tasks, no matter how large or small, so as to catch all errors made by system one and accomplish the task at hand in as timely a manner as possible. This is not how humans function. In reality even our conscious

processes engage in faulty reasoning and continue to endorse it, or fail to fully engage, and so this second strategy of hoping to focus solely on system two in order to declare our conscious processes are at least rational is also doomed to failure.

An objection that may be raised to this argument is that while with regard to many circumstances they fail to act completely rationally, humans are never-the-less deserving of the title rational animals because they are capable of reason. While we may hold mistaken beliefs and encounter problems reasoning about things in the world, Hume's "matters of fact," we are able to solve in deductive manners mathematical and logical problems, which are of a much different, certain nature ("relations between ideas"). To this I would argue that I find no quarrel with these statements, indeed I am fully ready to admit that human beings are capable of classic rationality in certain circumstances, but I do not believe that rationality with regards to only some subject areas and circumstances is enough to preserve the classic position of economists and rationalists. If one's nephew is at times well behaved, but at other times quite a troublesome child, that gives one little ground to label him as the perfect example of good behavior. Likewise, just because we are capable of at times acting in accordance with classical rationalist theory doesn't mean we deserve the title of being rational in this traditional sense. After all remember, that after years of tutoring and practice we may be able to calculate the angles of an isosceles right triangle, but upon being asked to choose between two expensive vacations, we may pick the less valuable one as the result of its brochure offering something "free". While it is possible to point to scenarios in which man displays the sort of rationality Descartes and company would be proud of, there seems to be a fundamental disconnect between the type of rationality espoused by philosophers and economists in this tradition and the possibilities of the real world. Scientists do not continue to accept the theory of gravity because masses in the

universe are capable of being drawn to each other, but because they are, and so philosophers should have a higher standard for bestowing the title of classical rationality on humans than when they sometimes operate in such a manner.

We should then reexamine under what standard of rationality human thought and action should be discussed. Just because it does not conform to formal logical principles does not mean that system one is useless. In fact, the same characteristics of system one that make it non-rational (and thus humans that act upon these irrational) also make it, as Hume points out,

> "so essential to the subsistence of all human creatures, that it is not probable, that [its functions] could be trusted to the fallacious deductions of reason, which is slow in its operations; appears not, in any degree, during the first years of infancy; and at best is, in every age and period of human life, extremely liable to error and mistake."[31]

Reason or system two has many drawbacks which would make it unsuitable to carry out many of the tasks that system one, or Hume's Custom and Habit do. Indeed the non-rational nature of system one proves more beneficial than pessimists wish to believe

Your Brain is Fast and Frugal

Perhaps an entirely different approach is necessary then when evaluating the rational abilities and aspirations of humanity. Instead of looking at the disparities between the lofty goals of rational models of human thought and the reality of human behavior— attempting to make excuses or outright lamenting the intellectual darkness we might seemed doomed to— perhaps the correct approach to these questions is instead to redefine the idea of rationality. Such a

[31] Hume V 45.

redefining takes into account not just the lofty theoretical ideas of humans, but focuses on the context of the world in which humanity finds itself.

Up until this point this paper has discredited system one, not as what it is— an automatic, reactionary system— but in the context of how it fails to meet the standards of theories of classical human rationality. This is not doing system one the justice it deserves however, because the truth of the matter is that system one is very good at its job; it just so happens that that job is not to be rational in the "econ" sense of the word. System two, as pointed out earlier, to a certain extent, often falls short of this standard as well. Why? The answer lies within the origins of the human species.

By all accounts of modern science and philosophy, all life, and by extension that of human beings, are the result of the process of evolution. While evolution is often spoken of as designing, or having some intent in mind, and though I may write in this way at some point (forgive me if I do) it must be very clearly understood that evolution has no purpose, and no end goal in sight. Indeed, "evolution is going nowhere— and rather slowly at that."[32] From the dawn of time, since the first microorganisms that began the great outbreak that is cellular life, every species which has emerged is a result of the evolutionary process, or natural selection. Summed up quickly the theory states:

> "A population evolves when there is selective retention of blind variation within the population… Mutations continually crop up among members of a particular species, independent of the environment, resulting in different phenotypic traits… When a particular kind of a phenotypic trait is better suited to the present environment than similar traits possessed by other members of the population, then the individual possessing that trait has greater fitness, or a higher chance of success at survival and reproduction."[33]

[32] See Ruse *Taking Darwin Seriously* Ch.5, pg. 203
[33] Thomson *Evolutionary Epistemology and Scientific Realism*, 2.1 pg. 169

It is through this process that the human brain, and every other DNA and RNA based life-form science is now aware of, is thought to have been formed. Traits which were beneficial to individuals processing them are seen as more likely to be found in large parts of a population eventually, so long as they lead to a greater chance of reproduction. While this is usually how evolution is thought of, many caution against a very optimistic view of the process. Thomson reminds us that this process is not as clean cut as many would like it to be. In the following discussion let it be remembered that just because, "we possess a certain capacity and have survived only entails that any deleterious effects it has in the present environment do not lead to its being selected against."[34]

As the human brain is something which exists in and must interact with the world and its environment, it should be expected that it too is the result of the evolutionary process. The capacities which the brain is capable of at the very least have not been fatally detrimental to the historical human environment. However, this means that there is no reason to believe the human mind would have evolved into a perfectly adapted machine for logic and mathematical calculation. It seems unfair to judge it by these standards; there is no reason to assume the brain would possess such capacities today, unless it was the case that failing to evolve them would have been fatally detrimental to the species Looking at human capabilities of problem solving and mental capacity in the context of the real world in which they exist allows us to examine the positive aspects of our "irrational" nature. It turns out, that many of our non-rational characteristics may prove to be prudentially and ecologically logical, and that it may be necessary to reconsider how we judge the "rationality" of human beings.

[34] Ibid. 2.2, pg. 172

It has already been noted that there are certain ways in which the human system of reasoning seems to fall flat. Linda the bankteller provides a good example of these sorts of questions. In *Rethinking Rationality*, Stich, Samuels and Tremoulet make a good distinction between these sorts of errors, and other performance errors of which humans are capable. Errors made by some factor other than a humans internal logical systems, or "psycho-logic," such as errors due to wandering attention, anger, or fatigue are deemed *performance errors*. Likely, if the individual was in a more normative mental state, he or she would not make the same mistake again. On the other hand *competence errors*— the sort of error present in the Linda problem— are correctly reasoned in accordance with the individuals internal logical schema. Finding performance tasks, such as Linda, in which most humans do very poorly, enables experts to detect, "normative shortcoming[s] that we all share."[35] In the case of the Linda problem, instead of actually addressing the issue at hand, and hence avoiding the fallacy, the mind uses a heuristic to address a different, but similar question, "which one of these things does Linda's description fit the stereotype of?" According to Stich however, this is not the problem that rationality pessimist would like to make it out to be. Instead, it is simply a case of the human brain attempting to cope with a task it hasn't adapted to deal with, answering a question involving conjunction and percentages, by answering a question it has, "what sort of person do I associate with these traits?" Evolutionary psychology sheds light on this theory with the idea of Darwinian Modules.

In describing to the reader what exactly a Darwinian Module is thought to be by Evolutionary Psychologists certain difficulties exist, particularly how vague the theory about them actually is. The theory can be summarized however, in the following way: The human

[35] Stich, *Rethinking Rationality*, Section 3.

brain contains certain module systems. While these systems vary in nature greatly, they all are thought to have four primary features:

1. Darwinian Modules are domain specific. They deal with a certain set of mechanisms, data, or procedures.
2. The modules are computational. "Darwinian modules utilize domain specific systems of knowledge when… when doing computations or solving problems.
3. Darwinian modules are innate and determined by genetic factors.
4. All humans are assumed to have these modules (so long as they possess relatively normative mental structures).[36]

What all this boils down to is the theory that the mind possesses certain internal modules which are specialized to certain tasks. For example, it is hypothesized that many cognitive abilities humans possess are the result of these modules, one being a module that serves our facial recognition needs.[37] The module is activated when observing another's face, analyzing the contortions, expressions, and other facts (sweating) in order to make certain determinations about identity, intent, and emotions. Darwinian Modules, as the name implies, are the result of the evolutionary process, the capacities they grant humans proving beneficial (or at least not detrimental) to survival and reproduction.

According to evolutionary psychologists, our minds are in fact very adept at solving problems in a way which would have benefited our ancestors in the historic human environment, or "the environment of evolutionary adaptation."[38] The theory goes that those instances in which humans encounter competence errors are situations which were not present within the

[36] Ibid. Section 4.1.3
[37] Ibid. 4.2
[38] Ibid. 4.4

evolutionary environment. In situations which the brain would have encountered, a module, or many modules exist that are adapted to the task, and performance is quite high.

Many experts still heavily debate the existence of Darwinian modules, and how exactly such an idea would fit into the conceptual framework involving system one and system two is difficult to say. Simply saying that system one and Darwinian Modules are the same thing does not seem to work, because in the examples that follow it is evident that system two related tasks, such as a logic game, seem easier for individuals in scenarios which, psychologists hypothesize, the mind has evolved to deal with effectively. Maybe then both system one and system two are somehow made up of these models. Cosmides and Tooby argue that the idea that the mind is mostly Darwinian Modules, the *Massive Modularity* theory, is necessitated by the nature of the evolutionary process and how modules work. They argue that since modules by definition are domain specific, and "different adaptive problems often require different solutions," it should be assumed that the mind will have modules for many different problems.[39] This is because a module which evolved to be a general problem solver would have to sacrifice speed, reliability, and efficiency as, "generality can be achieved only by sacrificing effectiveness," whereas with many different modules, "Speed, reliability, and efficiency, can be engineered into specialized mechanisms because there is no need to engineer a compromise between different task demands."[40] This argument says that evolution would necessarily favor massive numbers of very specialized modules as in the course of nature, "a single [general] solution would be inferior to two specialized solutions."[41]

[39] See Cosmides and Tooby, pg. 89
[40] Ibid.
[41] Ibid.

There are several problems with this argument however. If the brain were mostly composed of modules that were evolved to be domain specific within the environment of human's ancestors, some explaining seems in order for how I can seem to operate a car so well without needing to pay much attention to it. Obviously for things which have only been encountered by human beings in the last one hundred years of our evolutionary history, such as typing (a very complex skill which must combine motor function, language, and spatial mapping), there would not have been time for humans to evolve modules with domains specific to these very specialized tasks, and yet many humans are excellent typists. This throws doubt on the claim that our brain is massively made of these very specifically designed and domain oriented modules. The second claim that the *Massive Modularity* argument rests on is the claim that one general solution is inferior to two specialized solutions. This claim makes the mistake of assuming that in the evolutionary scheme of things, that certain traits can be observed in isolation, without the context of an organism's entire phenotypic and genetic makeup. As Thomson points out, when talking about evolution, one must keep in mind that it,

> "it is a sufficing and not an optimizing process… a heritable trait… need not be the best imaginable, or even the best available (an individual that possessed many satisfactory traits may have a better overall chance of survival than its relative that possessed a few optimal traits).[42]

Assuming that many, specialized systems would develop, because this would doubtlessly be better adaptively is to misunderstand the evolutionary process.

So what then can we be certain of if the idea of system one and system two brain processes and Darwinian Modules don't neatly mesh? First and foremost, it should be remembered that while system one and system two present a convenient way of talking about

[42] Thomson 2.1 170

brain processes there is no division in the brain that is this simple. Secondly, although we can't be sure exactly how the individual parts of the brain relate or function together, or how in this case the different theories may blend, we can know that the brain is a product of the evolutionary process. This means that those capacities the brain has are evolved capacities.[43] Our abilities to engage in system two style reasoning, and those heuristics in which our automatic processes engage— the capacities we have to associate, to be influenced by anchoring effects— are the result of the evolutionary process. Perhaps then it is for this reason that within certain scenarios, or when presented with data in ways more like the environment of early humans and primates, individuals are better able to engage in correct problem solving.

Very good examples of situations in which these evolved capacities allow the mind to solve problems very effectively are those which involve frequency reasoning. Many studies have shown that humans are quite bad at reasoning problems centered on probabilities.[44] This should be surprising in terms of evolutionary psychology, as the world is and always has been an uncertain place, where chance abounds.[45] Intriguingly, however, when individuals are given the same problems which originally contained a question in terms of probabilities, but now with the same data represented by frequencies (instead of 5% doing x, the question states out of every 1000… 50 do x), performance increases dramatically.[46] The theory goes that while human ancestors dealt with chance, as it occurred over time, they were accustomed to deal not in probabilities, but with frequency of certain events. If nine times out of ten fighting large mountain cats was a bad idea, instead of representing that statistic with a probability, 90%, early humans would likely instead simply remember that only one of the last ten attempts on the part

[43] Gigerenzer and Sturm
[44] See Stich Sections 2.2-2.4
[45] Ibid. 5.1
[46] Ibid.

of their tribe to attack a mountain cat ended well, and make a decisions based upon the memorable frequency of bad cat encounters. Before learning to deal with the concept of mathematical probabilities, the human mind had long dealt in the frequency with which it witnessed events.[47] Because of this the mind is much better at engaging in the question that follows how it tends to deal with the given data. Asking the brain to deal in percentages is like asking a native English speaker to take a test in French: both are capable of doing the requested task, but would prefer to do so in their own language.

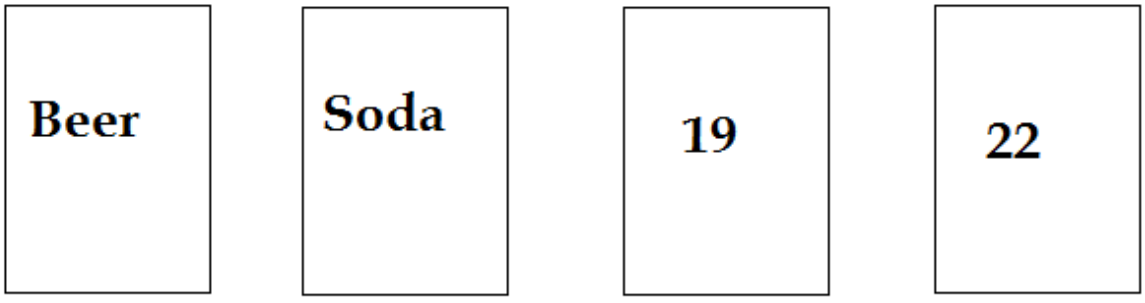
Perhaps even more extraordinary is that a change in the scenario itself can often affect the reasoning abilities of an individual. In this instance, the very basic relations and rules of a game were kept, but the scenario of the question asked was changed.

In 1966 Peter Wason devised an experimental selection task which has now come to be known as the Wason Selection Task.[48] The task is simple: The subject of the experiment is presented with four cards, two of one sort of characteristic, say with shapes on one side, and the other two with another characteristic, say colors. A question is then asked: "Which cards would you have to flip over to determine the truth value of the statement 'All cards with circles have yellow on the other side." Assume in the diagram below that the square and circle shapes are printed on a white side of a rectangular card with a color on its opposite side.

[47] Ibid.
[48] Ibid. 2.1

The true purpose of the task is to determine the test taker's susceptibility to fallacies while attempting to figure out an if –then logical problem (modus ponens). The large majority of subjects answer this task incorrectly, turning over too many, too few, or the wrong cards.[49] The correct answer is that the circle card and the red card would need to be flipped over in order to evaluate the statement's truth value, since if the circle did not have yellow on the other side, or the red had a circle on its opposite side, the statement would be false. What is on the other side of the yellow card does not matter, because the statement says nothing about yellow cards necessarily having circles on the opposite face, and the square is completely irrelevant.

The fact that is of most interest to the evolutionary psychologist here, however, is that there is an easy way to improve the performance of individuals on testing the truth values of if-then statements. It appears that by changing the situational context, but leaving the general nature of the if-then statement in the problem the same, performance can be dramatically boosted. The often used task which demonstrates this rearranges the more basic Wason Selection Task into a scenario in which the subject is placed in the role of a bouncer in a hypothetical bar. The four options, or cards, now have a drink on one side, and an age on the other. The subject is then asked to make sure the law is being followed, that if a person is drinking alcohol, they are over the age of twenty one. The scenario is still one which tests an if-then statement, one in which two of the cards must be checked (Beer, and 19) and the other two are irrelevant (Soda, and 22), but on this task individuals answer correctly much more



consistently. "About 75% of college student subjects get the right answer on this version, while only 25% get the right answer on the other version."[50] Why is this? The proposed answer, from psychologists such as Cosmides and Tooby, is that in this second circumstance our brains are dealing with a problem they have adapted to deal with. In this problem structure, the content of the problem is changed form a basic set of variables to a social scenario to one in which you are tasked with discovering someone who is cheating a set of social rules. The human brain, it is hypothesized, is adapted to dealing with these sorts of social exchanges. With regards to scenarios like the one presented in the problem, humans are thought to specifically have "cognitive mechanisms that enable them to detect cheaters."[51]

What exactly is meant by a cheater-detection-mechanism? Certainly no one is claiming that the brain has built in radar which picks up those with dishonest intent. Instead the claim is that in animals capable of stable social arrangements, (like bats, or humans) which can engage in altruistic "non-zero-sum" actions, such actions are likely undertaken in the hopes of "reciprocal altruism" from that individual later.[52] For example, bats in colonies are known to share food with unfortunate members of the group who are going hungry. Experts believe that altruistic actions like this, wherein the well fed bat loses a little and the starving bat gains a lot, arise in evolution thanks to the benefits individuals and species receive from a social safety net. Groups of individuals with a propensity to engage in these sorts of actions would likely, on the whole, do better than groups which were not charitable, and so the genes for such a capacity would spread slowly throughout the group. However, in these scenarios the altruism is only beneficial so long as it is indeed *reciprocal*. Being naïve would put an organism quite at the mercy of those which

[50] Ibid. 5.2
[51] Ibid.
[52] Ibid.

attempted to cheat the system. Because of this, in large groups which are capable of altruistic behavior, it stands to reason that for such capabilities to continue in the species the organisms would also have evolved the capacity to either intuitively predict cheaters, or at least remember situations in which they had been cheated and plan accordingly in the future. Granted this depends upon the population having cheaters as well, but it is unfortunately easy to prove that there are humans in the past who have attempted to cheat, just look at the Enron scandal. Because humans are both capable of reciprocal altruism, as well as cheating, we likely have adapted so as to process information in a way that protects us against cheating.

This hypothesis has been tested in studies by Gigerenzer and Hug who discovered that given the same problem, and even the almost the same content, inclusion of a cheating cue led participants to perform much better. In this scenario participants were split into two groups and each asked almost exactly the same version of a Wason Selection Task. In one problem the subjects are given the scenario that a group of Alps hikers are staying overnight in a cabin. The rule is that hikers staying in the cabin overnight must bring firewood to the cabin. There are also members of the Swiss Alpine Club, who may carry wood, but who will not be staying overnight. The subjects were asked which of the four cards to check (carried wood, carried no wood, stayed overnight, will not stay overnight) in order to make sure the wood rule was followed. The second group as asked almost the same question, but instead of including Club members, who may carry wood but wouldn't stay overnight, it stated that it was rumored that some hikers would try to break the rules, by not bringing wood but staying overnight. The cards and correct answer in this scenario were exactly the same. So what happened? In the non-cheating version of the question, 53% of participants flipped over the right cards. In the cheating version 89%

did.[53] The percentage in the non-cheating question is still higher than the norm for a more abstract Wason Selection Task, but the cheating version's results are far higher still. This information conveys the idea that the mind deals better with real world, social situations, and even better still with logical problems if it has been clued into the potential of cheating in the environment.

Stepping back a moment to examine the several ideas just discussed, it will be helpful to direct the conversation back to the question of rationality. The human being cannot be considered rational in the classic sense. Evolutionary psychologists claim that to expect the mind to work in such a way is unreasonable, because those environments in which humans' ancestors evolved were not ones which dealt in pure logic and mathematics. The work of Gigerenzer, Hug, Cosmides, Toomey, and Wason has suggested that the mind seems better adapted to dealing with tasks which match the way it has evolved to perform. Frequencies are computed better than percentages; logic in a social environment is much more easily deduced than in experiments with abstract values and letters. The mind is not separate from the world but a product of it. Understanding this, it seems misguided to hold it to standards of classic rationality; as such classic theories represent idealized and simplified versions of the world. If the mind contains modules that allow for the proper processing of information as long as it is in the proper context, and which allow for the survival of the individual in its environment, there is a good case that could be made that humans are indeed quite rational creatures.

The first way of addressing this is to look at the tradeoffs which the mind makes in functioning as it does. Working fast at times and slow at others, it strikes a balance that helps it in different situations, which proves to be, while not classically rational, very beneficial to

[53] Ibid.

survival. For instance, if a human needed to assess trajectories, examine the true level of risk present, make a pro's and con's sheet, and assess the direction of the wind before determining whether and in which direction to run from a lion, the species would not have lasted long in its ancestral homeland. In this way it can be noted the mind's tendencies work in a *prudentially* rational way. While perhaps the best path of escape might not always be chosen, taking the time to think about the "best" path would almost never be the "best" approach. If running away automatically, before one even knows what one is running from, proves successful a majority of the time— even though it may occasionally be a worse move— the mind, reacting to an uncertain world, is certainly doing the best it can do within the restrictions the real world imposes. In the case of Linda the bank teller, the brain uses a heuristic to match the described woman with a known stereotype, the feminist, and moves on, not wasting too much time on the problem.

System two's characteristics are also a result of adapting and surviving in the environment. One of system two's primary faults is that it is rather lazy. This too may actually be a very well adapted biological trait. Heavily engaging system two actually takes a surprisingly great toll on the body. When in a higher state of activity, system two depletes the body of its glucose at an accelerated pace.[54] During intense periods of thinking the nervous system consumes far more energy than usual; Kahneman likens this phenomenon to a sprinter using glucose stored in muscles. [55] While classic economists might think that a constantly engaged system two would be ideal for a man seeking to increase his chances in the world, this is not true. The laziness of system two is actually quite useful, because to rouse it from its usual, minimum operating level consumes precious resources that could be needed at a later time. Here

[54] Kahneman,, Ch. 3, pg. 43
[55] Ibid.

again, the idea of the human mind being prudentially rational surfaces. If system two can conserve energy by being lazy— engaging fully only when it is necessary— and system one can react in ways that can get beneficial results at least a majority of the time, and quickly, then in an uncertain world these systems do have a logic to them after all.

The constantly changing environment which human beings evolved in also presents an interesting question. When doubting the rational ability of humans, people often point to their inability to follow plans or rules which have been created as rational solutions to a problem. For instance, if Robert decides he is going to invest in stocks, he would be wise to consult with someone experienced in the matter. His friend, an experienced trader, would likely tell him that what he should do is consult and follow one of the major optimization strategies in use in the marketplace. These strategies are based on mathematical, statistical data, and seek to maximize returns for investors at various levels of chosen risk. Most would likely agree that Robert, if he were an econ, would agree to such a strategy.

The problem with the idea of optimization strategies is that while these strategies, developed by experts, seek to incorporate data about the world in order to, say, predict the best ways in which to invest, they utilize rationality and act with certainty about an uncertain world. The strategies suggested to Robert in this case may indeed be the best if the world were a place which contained event regularity, but the external environment is not, as Hume would quickly remind Robert, a place which is under any obligations to adhere to regularity.

Harry Markowitz's *mean-variance portfolio* is a system of dividing wealth amongst assets which is supposed to maximize return for a given level of risk. In 1990 it won Markowitz the Nobel Prize in economics. While an excellent strategy for investing, it turns out the *mean-*

variance portfolio is bested by a strategy which doesn't require a Ph.D. in Economics to understand or invent: the 1/N method, where N is the number of alternative investments. About 50% of people utilize this strategy when allocating wealth, and studies have shown that it actually earns better returns than complex computation models. In fact, Markowitz himself used the 1/N strategy for his own portfolio[56] Gigerenzer identifies three factors of the environment which account for this, and which should be considered when choosing between strategies like the *mean-variance portfolio* and 1/N: "(1) Degree of uncertainty, (2) number N of alternatives, and (3) size of the learning sample."[57] In this instance, with regards to the investing example, the learning sample means the size of the past data which is available for the computation to draw on. In less uncertain environments, and with a large sample size, say hundreds of years of stock data, strategies like the *mean-variance portfolio* can outperform 1/N. The real world though, and the real stock market, are not places in which an ideal scenario like this is possible. The argument that with enough data computational strategies will catch up and pass the 1/N rule, say in five hundred years, doesn't deserve much confidence, because there is no way to ensure that all of the data on past stock market fluctuations will still be relevant in the future; the economic market, procedures, and policies which regulate it are ever changing. This is because the real world is highly uncertain, in fact Hume would say entirely uncertain. The 1/N heuristic attempts to solve this problem by not relying at all on past circumstance. The world is not as predictable as the *mean-variance portfolio* would like it to be, and so strategies which function better in an environment that is ever changing and susceptible to surprises grant better returns. In this case prudential rationality doesn't just dictate that the evolved strategies should be used, because it

[56] Gigerenzer and Sturm, 1. pg. 246
[57] Ibid.

gets the answer faster and is therefore more useful, but the heuristic humans are inclined to use actually works better than the calculations the typical "econ" would seek to employ.

Within the environment of the real world then, it would seem that it is both prudentially and sometimes even entirely more rational to adopt those strategies which the rationalist perspective would frown upon. Another ideal example of this is probability matching experiments, wherein a subject is presented with a specific game. The game, say two decks of cards before the subject, is stacked. One of the decks of card contains more face-cards than the other; say 2/3 of the left deck is face-cards, and only 1/3 of the right deck. The subject wins every time he picks a face-card, and loses on any other card. The classical economist or rationalist philosopher (and most lay-people) would assume that as the game continued, the subject would realize one of the decks paid off better and pick only from that deck. This isn't what happens however! Instead, subjects seem to randomize their guessing patterns. In experiments done with coins weighted to come up head 75% of the time, subjects have been shown to actually guess heads approximately 75% of the time, and pick tails the remaining 25%, even though a guess of heads every time would maximize their wins.[58]

According to Lo, this behavior makes sense from an evolutionary standpoint when the species as a whole is considered. Animals that are given two options, such as to nest in a valley or on a plateau must choose from only one of the locations. When the nesting season is sunny, as it is 75% of the time, animals in the valley will produce many offspring, while those on the plateau produce none. However, if the season is raining, as it is 25% of the time, the young in the valley will drown, and the plateau will become wet enough to allow the animals nesting there

[58] See Lo, *SBE 2020: A Complete Theory of Human Behavior*

to produce young.[59] In this case, if the entire species was to maximize its chances of producing young as the classical rationalist would, every individual would nest in the valley, resulting in a tragedy of the commons scenario during a rainy season; the whole species would be wiped out! The human tendency to lean towards a more productive option, while still randomizing at times, provides a failsafe for when good options go bad. Not all such adaptions are focus on the species as a whole; however, many make sense for individuals as well.

The earlier visited example of subjects' preference of a free Hershey kiss to a 14 cent quality truffle deserves a revisit. In the ancestral settings in which humans evolved, loss aversive strategies like this could have proven to be beneficial. If presented with the choice of x or the better option of y, classical rationality would say pick y, even if you may have to exert some sort of effort (z) to obtain it, the overall outcome being greater utility than x. In the context of evolutionary theory however, risk aversion of this sort makes sense. Effort z while resulting in more beneficial outcome y, still requires something on the part of the individual, effort which in an uncertain world could prove risky. Adaptively then, x may seem to be the better deal. Taking risks for increased payoffs in an uncertain world, whether the risk is an effort of some sort, like searching further outside a cave, or giving up three easily caught rabbits in an attempt to hunt a deer, could be detrimental. Choice x comes at no risk, it's free. Due to its adaptive nature, the brain isn't concerned with the fact that x is on the whole less of a payoff than y; it is attracted to the fact that it is risk free. Again, in our modern world, framed by theories of classical economics and rationality, choosing x makes little sense (especially when the difference between x and y is 14 cents). Viewed as an evolutionary adaptation however, the brains love of free things is ecologically rational, as gaining something for nothing might have been overall a better

[59] See Brennan and Lo, *The Origin of Behavior*

deal for early human ancestors. Thus, what seems initially to intellectuals studying human behavior to be another irrational trait is actually something which may have helped our species be as successful as it has been thus far.

The truth then is that while human beings do fall short in terms of classical rationality in one sense, they are vassals of a very legitimate form of rational action. It is incorrect and naïve to analyze human behavior and problem solving in terms of standards based around ideas of system two and western-classical thought. Pointing out that in certain scenarios, in closed systems and in modern settings humans do not adhere to a standard of rationality of their own manufacturing is pointless. Instead human beings should be examined within the context of the environment they evolved in, evolving through generations characteristics which proved to help them survive in this uncertain world. True the human mind may fail at logical tasks modeled on a world of our own pure thought and abstract in nature, but this is due to the fact that the need to deal with such issues in the past was never as important as the mind's need to interact with the world as it really is. This ecological rationality, or naturalized rationality, takes the form many times of heuristics and biases, system one processes rather than fully reasoned out arguments. In a way, the brain is "street-smart" rather than "book-smart;" it traits allowing it to survive the dangers of its evolutionary past.

David Hume hit upon this feature of the human mind with his description of Custom and Habit. For Hume, the idea of causation is inescapable, and linked to these systems of human nature. Given what has been discussed, this should come as no surprise. Humans fall short of classical rationality when they infer cause and effect relationships, and instead rely upon the

more subtle workings of the non-conscious brain. Perhaps though, viewing human beings as ecologically rational creatures will lend support to a new argument here as well, one which incorporates system 1 type processes and our evolutionary background in order to provide Hume with a reasoned argument for the existence of causality.

Dealing with the Skepticism

Custom and Habit, or system 1 processes do not make use of classical deductive reasoning to draw inferences such as cause and effect relationships. Instead the mind connects the two things and infers this connection from repeated conjunction, and utilizing inductive reasoning, makes predictions about the future using these inferences. Induction, however, is a problematic process for Hume as well. Hume states that he, "[has] said that all arguments concerning existence are founded on cause and effect."[60] Future predictions of cause and effect are however, he notes, based upon trust in past experience, and our making it "the standard of our future judgment…"[61] However, making this inference, that those things which were true in the past will continue to be true in the future, means one is assuming that the future experiences will share a regularity that past experiences have. The only justification for this assumption is that past experience ere the inductive prediction has conformed to the regularity of events from further in the past.[62] This idea is hard to word, so an example will help greatly. When a person is playing a game of pool, she is assuming that her cue ball contacting the eight ball will cause the second ball to move. If you asked her why she believes this, based upon experience, she would answer that every time in the past when one ball has struck another, the second one has moved. If you asked her why she believed that this next strike, this next future event, would

[60] Hume, IV. 30.
[61] Ibid.
[62] Ibid.

continue to occur in line with the regularity established by past events, all she could answer would be that in the past her predictions about the future based on the past have held true. If asked how she could be sure that this time such regularity would continue again all she could cite was the trend in the past for the future to unfold like the past. At this point our pool player is engaging in circular reasoning.

Hume's point about our errors in beliefs about cause and effect with regards to matters of fact really is claiming that such beliefs are faulty in two aspects. First, where there is conjunction, humans see connection. Looking back at events witnessed together, we infer cause and effect, or associations, between the two, without a solid basis of logic for doing so. Secondly, with regards to future events, we believe that these connections will continue to be true, due to an underlying belief that the future necessarily remains similar to the past. Though we are powerless to stop these beliefs (and even if we could it would be quite startling to willfully choose not to believe them) we can entertain the idea that we do not have logically solid reasons for accepting them, says Hume.

These ideas set down in Hume's works, can be seen as a precursor to much of the research and discovery discussed in the first half of the paper, and the connections between the work of psychologists such as Kahneman and the Scottish philosopher are evident. Such recent findings pay tribute to Hume's ideas, lending support to his view of the man using means other than reason to come to conclusions about causality. However, the idea of an ecologically rational man changes up the game for Hume. In this next section, I wish to explore how the ideas of Stich, Gigerenzer, and others, relate to Hume's problems regarding our beliefs in matters of fact. I will address both of what I take to be Hume's points on causation in turn: 1) that humans have no logical reason for believing in the relations they infer between matters of fact,

but we do so anyway; and 2) that our belief in a future and future events which are consistent with past occurrences is based only upon circular reasoning. The first of these deals with past events and our ideas about them, the second deals with future predictions. I will attempt to find a way in which ideas of natural rationality and evolutionary theory can give us a logical reason for accepting beliefs about certain truths about the universe up until the present, thus answering Hume's first claim about Custom and Habit. The second point, Hume's Problem of Induction, I suspect will prove more stalwart in its ideological bastion, and so I may still have to grant it to Hume. I ask that those who support Hume's position follow the philosopher, who states he will keep his mind, "still open to instruction," and I shall promise to do the same.[63]

Custom and Habit, those aspects of system 1 which Hume believes show the irrational nature of man's beliefs, are in fact the most essential aspects of the human mind according to the argument that follows. Ideas of cause and effect, association, anchoring, dispositions to strategies such as 1/N, and many of the brain's other capacities for action are capacities which have emerged from the evolutionary process. Here I do not mean to endorse a rationalist position (though empiricism and rationalism begin to blur when discussed in terms of evolution) position.[64] I am not saying that Humans are born already having neural connections, and start with an innate knowledge of the workings of the world. They DO however have within their genetic makeup the capacity for their brain to form such connections. Some have argued that these capacities which the human mind is capable of because of its genetic makeup, which have

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[63] Ibid.

[64] I say here that evolution blurs rationalist and empiricist positions because classically, rationalism was the approach which began with some innate human rational ability, and reasoned towards the outside world from that. Empiricism believes, in layman's terms, that we are a blank slate, and that we learn from the world, rather than developing innate sources of reason and knowledge. Evolutionary theory blurs the two in that it states that the environment determines which traits of a species survive, and which don't, but many of the selected for characteristics are genetic, and therefore, these traits are inherent to the creature, but their being a part of its genetic code is a result of their ability to not be fatally harmful to the creature in its natural environment.

been selected via evolution, can be taken as a sort of evolutionarily approved set of abilities and inherent knowledge. They believe that those traits that animals possess have withstood the evolutionary gauntlet and in order to do so, must reflect approximate truths about the world. Again this word "inherent" is troubling, but it should not be understood as implying knowledge of something *a priori*, but rather because the capacity exists, it must be in response to some feature of the world. For example, many animals, humans included, possess the system-one capacity to understand depth and judge distances. Proponents of this position would take this as evidence that our universe is spatially three dimensional; believing the capacity for experiencing the world this way means that must be the way the world is.

Thomson, who does not agree with these arguments which seek to found some epistemology on evolutionary theory, is especially troubled by their claim that,

> "Reason… is what has promoted our survival, enabling us to employ tools and language, to band together for protection in a hostile environment. That reason has so promoted survival is explained by its somehow being "in tune with" or mirroring the world..."[65]

Thomson vehemently disagrees with this approach for reasons that will soon be addressed. His summary of the argument is simplified and not a direct description of any one particular philosopher's theory, but it is a useful starting point. Should we take the capabilities of our mind, both reasonable and automatic, to be representative of approximate truths about our environment?

[65] Thomson, 2.2, 172.

Ruse, one philosopher who would answer yes to this question, supports a variation of this idea with the use of "epigenetic rules."[66] This term Ruse borrows from Wilson, who defines such rules as

> "any regularity during epigenesis that channels the development of an anatomical physiological, cognitive, or behavioral trait in a particular direction… In cognitive development, the epigenetic rules are expressed in any one of the many processes of perception and cognition to influence the form of learning…"[67]

Ruse wants to say that our genetic makeup leads our cognitive abilities in certain directions, directions which lead to our understanding the world in a way that reflects reality. That our DNA contains instructions to develop our brain and body in certain ways with certain capacities, and that such genes have survived over the centuries, means for Ruse they must give us some understanding of the way things really are.

For an example of how such rules influence us, Ruse points to the fact that all Humans, even newly born children, break down colors into four primary categories: blue, green, yellow, and red[68] . Though using different languages, we all cognitively understand colors as being based in these four main groups. Ruse uses this fact in order to demonstrate the results of his proposed epigenetic rules; such a species wide pattern indicates that genetics must play a part in determining how we classify colors.[69] The epigenetic rules at work here could be multiple things, the anatomical makeup of the human eye, the wiring of the visual cortex, etc. The outcome is that we, as a species, are led by these different structures and limitations to understand colors as belonging to these four major categories.

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[66] Ruse, *Taking Darwin Seriously*, Ch. 4, pg. 143.
[67] Lumsden and Wilson, *Genes Mind and Culture*, pg. 370
[68] Ruse, Ch. 4, pg. 143
[69] Ibid. pg. 144

To use another example, one which is at the center of our discussion, our inference of causality from conjunction can be understood as being the result of epigenetic rules. Like classifying colors, all humans share this cognitive similarity. This is because here too epigenetic rules are at work, channeling our understanding of the world in this particular direction. The construction of our neural networks, the ways in which synaptic connections strengthen and weaken, and all of our other cognitive processes lead us to understand the world as a place of causal connections. These capacities and structures which channel our conceptions are the result of our genetic blueprint.

Ruse himself takes this Darwinian position and proposes to link it to Hume's ideas of Custom and Habit. In this way he is, "giving… an evolutionary interpretation to the propensities, thus converting them into epigenetic rules."[70] Hume practically invites Darwinians to harmonize their theories with his, realizing the similarity between that instinct, "which teaches a man to avoid the fire," and that which, "teaches the bird, with such exactness, the art of incubation…"[71] He sees within animals many of the same faculties of reason he identifies in humans, and so does not draw a line between the rational man, and animals, as many philosophers have done. In his work *A Treatise of Human Nature* the philosopher even identifies the function of animal reason as being, "their own preservation and the propagation of their species."[72] This smacks of Darwinism, and proves inviting for those like Ruse who seek to make a connection.

In this explanation, human beings form connections from conjunction because they have evolved to do so. Our many system one processes are the result of the ways in which our

[70] Ibid. Ch. 5, 184.
[71] Hume, Section IX, 85.
[72] Hume, *A Treatise of Human Nature*, pg. 177

genetics predispose us to be wired. "Epigenetic rules" with regard to our Humean propensities then are those ways in which our biological system has evolved in order to facilitate the mental formation of these connections which are not founded in classical reasoning, but possibly a result of such biological processes such as Hebb's rule. Our genetics give us both the capacity to infer and the inability to stop ourselves from inferring causation from conjunction.

Ruse and others advance the position that evolutionary theory allows philosophers to posit that these evolutionary rules allow us to grasp approximate truths. Individuals whose genetic dispositions led them to embrace utterly false ideas as truth would be selected against. Ruse even goes so far as to claim that our knowledge of logical and mathematic truths is a result of these rules. He claims that in countless situations which would have happened to early proto-humans, those with mathematical and logical abilities, "would have been at greater selective advantage over [others]."[73] Using an allegory of humans watching tigers enter and leave a cave, Ruse believes that humans who were able to correctly add and subtract tiger numbers would have an evolutionary advantage over those which could not.[74] Ruse's argument, when broken down into its most simple terms, is that evolution results in systems which will allow us to know truths about the universe, since not being able to grasp these truths would likely make organisms ripe for extinction.

While in the previous section various grounds were given for taking the human mind to be something which possesses ecological rationality, and for holding it to a more naturalized standard of rationality than the classical one of old, this natural epistemology which Ruse endorses is a strong claim. I think he has hit upon an important idea, but his theory may take too

[73] Ruse, Ch. 5, pg. 162.
[74] Ibid.

strong a stance on what truths our unconscious capacities carry us to. Thomson hits upon many of the problems which plague such a position. His most important point is to remind us what exactly evolutionary theory guarantees us, and that is that the fact that, "we possess a certain capacity and have survived only entails that any deleterious effects it has in the present environment do not lead to its being selected against."[75] Just because we possess certain capacities, including mental ones, only means that they haven't been so terribly adapted to the environment that they have killed us. As this statement implies, evolutionary theory can't even guarantee us that the capacities we have aren't harmful to us. "If a gene causes one phenotypic trait which is highly beneficial and another which is slightly deleterious, the beneficial trait will be selected for but the other trait will also be selected."[76] For every positive trait which has helped our species survive over the centuries, there could be many negative traits that we also have inherited. The only thing we know for certain is that the traits we have aren't so bad that they caused our species to die out at some point prior to now. While it does seem likely that as a species humanity has evolved many useful adaptations to its (at least its ancestral) environment, Thomson is quick to remind us that there is no way evolutionary theory can justify a theory like Ruse's.

These are problematic points for those such as Ruse, who seek to find some sort of evolutionary basis for confidence in the truth of our own beliefs, a naturalized Darwinian epistemology. This is further complicated by the lack of relation between truth, and those things which prove beneficial to us. Ruse and many other philosophers arguing for evolutionary epistemology do so as grounds for belief in scientific realism, attempting to use ideas of evolutionary theory to posit that our capacities are directed by natural selection towards our

[75] Ibid. 172
[76] Ibid. 2.1, 171

believing truths, and that science is progressing towards some truth. Thomson again pokes a hole in this argument by pointing out that there is a disconnect between theoretical capacities, and practical abilities.[77]

Thomson argues that there is a difference between a trait or capacity having a practical value for survivability, and that trait or capacity accurately reflecting an objective truth about the universe. To understand his point, let's look at a simple example. Some believe that the human ability for religious experience is based within the structure of the brain.[78] Evolution may have adapted our bodies to have a predisposition to attribute and conceive of the supernatural. This may have arisen from a benefit it brought to our early ancestors. This does not give us any grounds, however, to assume that our religious beliefs are true. There is a fundamental difference between the "theoretical ability," as Thomson labels it, or the capacity to have a theory, and the "practical ability" or the practical use that comes out of that theory.[79] To use my own example, there is a difference between the practical abilities a group has— sticking together and building a civilization— and the theoretical ability or capacity they hold which promotes that— having the same religious beliefs. The truth or falsity of the theoretical belief then is irrelevant. Ultimately, "There is no warrant for moving from 'cognitive strategy x does not result in a fatal decrease in fitness' to 'cognitive strategy x delivers approximately true theories."[80]

Which thinker is right then? Thomson seems to have very solidly rebutted Ruse's ideas that epigenetic rules for Humean propensities cause us to endorse an accurate representation of the way the universe works. Or has he? Thomson is quite right with regards to many of the

[77] Ibid. 2.2, 173.
[78] Ramachandran, *Phantoms in the Brain*, Ch. 9, 188
[79] Ibid.
[80] Ibid. 174

things he notes in his article, and I want to be clear here that I am not endorsing scientific realism founded in evolutionary epistemology. Instead, I want to focus very specifically on the first of Hume's problems I've identified— that there is no process of reasoning which can lead from conjunction of experienced events to a causal relation between them.

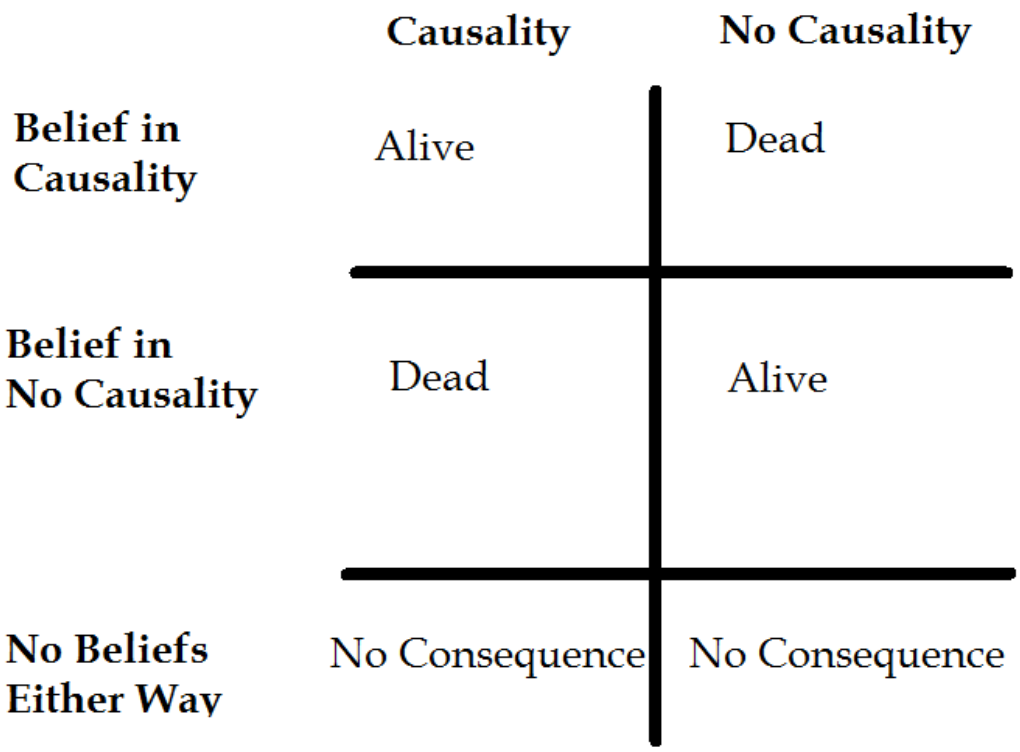
Causality has always been something very much at the center of philosophical and scientific debate. Science continually searches for the causes and effects of things, from the big bang to nuclear fission, and philosophy, as we have said, debates the existence of causality, and more often just how far it ranges when debates over determinism and free will come to the table. This is because the existence of causality (or lack thereof) in a universe is one of the fundamental features of that universe. Two universes, one with causality, one very much like Hume's speculative universe in which, "all the scenes of nature [are] continually shift[ing[in such a manner that no two events [bear] any resemblance to each other," would be completely different from each other in almost every way imaginable (and because of the limitations of our own mind, ways unimaginable as well).[81] It follows likewise that the existence or lack thereof of causality would heavily influence whatever life was to exist in these universes.

Life, evolving in any universe, would have three possibilities with regards to belief in causality. In one case, life could follow the path that it has with humans, evolving to the point we are now, where we come to believe in and operate on the assumption of causality. The capacities and predisposition to do so are a result of our own evolutionary heritage. The opposite of this is that life could hold the belief that there was no causality in the world, such that it believed and operated on the principal that all events of nature were random. The third and final possibility is that life might hold no conception of causality, having no belief either in its

[81] Hume, *Enquiry*, VIII 64.

existence or lack of existence. The options are either then belief in causality, a belief in no causality, or no belief at all with regards to these matters.

These options (see the chart on the next page) seem to exhaust the all possibilities for the status of causality in the universe, and the capacity and abilities of life to hold a certain belief about this characteristic of its environment. Where we now must focus our attention is on how the different possibilities play out when introduced to each other. While Thomson believes that our adaptions and beliefs do not necessarily have to equal truths in order to be successful, with something as basic to the foundations of how a universe would operate as causality, it is hard to imagine that a false belief could lead to success. It seems likely that if a belief about causality— or its opposite, randomness— were to be held, only that belief which operated in harmony with the nature of the environment of the life form holding it would not be so deleteriously harmful as to kill off the species in question. This idea is slightly complicated so let me rephrase this. If a being were to live in a universe which contained causality, and the being believed that there is no causality, this belief against causality would be so detrimental to that beings survival it would die. Likewise, in Hume's theoretical universe where all of nature was random and new, a being which held a belief in the existence of causality would also be put in such unfortunate circumstances it too would die out. Of the three possible statuses of belief with regards to causality life can hold, in both universes one is necessarily fatal: the one which is a belief opposite to the true nature of the universe. The beliefs that are in line with how the universe operates are likely not detrimental, and even if they are, not as detrimental as the false beliefs. The third option, the life form not having a belief at all, something more likely of less than intelligent life, would not affect it in either a positive or a negative way, but we will come back to this idea to answer a possible rebuttal or question that this argument may raise.



The main focus here is to answer the issue raised by Hume's skepticism— is there anything other than custom and habit which can lead us by reason from conjunction to connection? Is there reason which can bridge this gap? The answer now seems to be yes. The very fact that we hold the belief that our universe is causal, that genetically we are predispositioned to hold such a belief, and are still very much alive, would seem to provide some warrant the truth of the belief; our inferred causal connections reflect a cause and effect relationship that exists in objective reality. If it didn't we never could have evolved to contain mechanisms which allow us to hold these beliefs and operate upon them. Causality and necessary connection are too basic in their relation to the workings of the universe for life to be able to survive holding a belief which was contrary to the truth of its own environment.

Naturally this argument will be controversial, and so I will now seek to address what I take will be some of the biggest questions and criticisms with regards to it. The first is that I

have little justification for my claim that to believe the opposite of a universe causal nature is to invite certain doom upon oneself. I will admit that this claim seems very broad, and it is difficult to think of a way in which it can be empirically tested. It seems justified, however, by common sense. How in the world, in a universe which contained causality, but and individual believed that all events were random, could that complex life form function? One would never make the connection between eating and feeling nourished, between fire and pain. Likewise in a random universe, where one believed in causality, the pattern of expectations and behaviors originating from the belief would be very detrimental to the being. If behaviors and beliefs emerged based on connections which were made between events which had absolutely nothing to do with each other, or which were ever changing, the behaviors and beliefs would be extremely ill-suited to the environment. If our universe up to this point had not contained causality and connection, say between eating and being nourished, but we had continued to do so, having the faulty belief that eating necessarily led to better survival rates for ourselves, we likely would have been wasting our time and placing ourselves in a good deal of danger.[82] This lack of standard necessary connection, in which any random event is possible, is hard to conceive of true, but it seems quite reasonable to claim that if one were to attempt to operate in this universe with a theory that necessary, stable causal relations existed, one wouldn't survive long.

The second objection I foresee is that it can be argued that while humans have the capacity to infer causation from conjunction of events, this doesn't necessarily mean that we have to. The human mind may also possess the capacity to hold no belief in causation; we just may not have an example of such a human. To this I answer how would this claim be supported?

[82] I must admit in my examples here, I still seem to be speaking from a paradigm which believes in causality. It is very difficult indeed to conceive of a world without causality, and so even my attempts to discuss or theorize about such a world are of course very hard to do.

The problem here is that every normally functioning human being, in the natural world, seems to come to hold beliefs in causality. It would seem impossible to discover whether or not a human could grow up without having Custom or Habit lead him or her to ideas of causality, as exposure to the environment and conjoined events within it lead to the formation of causal relations and ideas of necessary connection in the human mind. In order to explore any capacity for the human mind to believe in a random universe one would have to discover how halt the more normative capacity for causal belief from being developed. Perhaps raising a child to adulthood within a controlled environment of some sort would be the key. If this environment acted, in what the subject would at least observe as being a completely random manner perhaps a belief in randomness would emerge. However, this carefully controlled environment is NOT representative of the actual world and the way things are. That such efforts would have to be made to steer and individual towards a belief in a random universe seems to cause this argument to only reinforce the idea that our universe contains causality, and that conjoined events we have witnessed in the past are necessarily connected. Furthermore, if upon being released from the random-belief-instilling room the subject promptly died attempting to navigate the outside world it would seem additional proof to my position.

Finally I anticipate the raising of a question similar to a point made by Thomson in his article. Drawing on a quote from Hilary Putnam he argues that if rationality and survival value were equivalent, the cockroach would be far more deserving of having its capacities labeled rational and truth-producing than humankind would.[83] I must admit, the challenge to my argument provided by the workings of less intelligent life forms is the most complicated to answer. It requires figuring out whether or not it is appropriate to treat them on the same level as

[83] Thomson, 2.2, 173.

a being that can articulate their belief in causality, or whether to say that their basic processes can in no way be interpreted as endorsing any belief. Doing so is extremely difficult, and depends on many things, such as how one qualifies beliefs, and what philosophy of the mind one endorses. In doing my best to answer this question I will actually be giving two answers. The first is based on a premise that those who are quick to agree with Putnam would; that cockroaches do not have beliefs as we do. The second, which I tend to agree with more, argues from a functionalist prospective— that the proto-beliefs of the cockroach and reflexive behaviors it operates on are functionally equivalent to our system one processes, though not as complex. In this way, I answer both those that agree with Putnam and take his argument to be a *reductio ad absurdum*, because a cockroach shouldn't be thought to have beliefs, and those who believe that denying cockroach beliefs is not as easily justifiable.

1.) How does one account for life which survives quite well, but has no concept of causality? It is for this reason I have included not holding a belief one way or the other about rationality in the possible directions life can take. Truly, there are organisms which do seem to survive quite well, but which do not hold the capacity of beliefs, at least as we think of them. Some organisms, such as extremophiles— single celled organisms that can survive at extremely hot and cold temperatures, and some at any point in between— have so defensively adapted that they can survive nearly any environment. Beliefs do not factor into their survival strategy. Though a cockroach is much more complex than a single celled organism, most would agree it is also a being which does not operate on beliefs. All these organisms do indeed seem to have some sort of reactionary processing ability, and this may operate upon cause and effect premises, but as they do not have a higher capacity for conscious belief, they wouldn't be able to hold certain things for true, create theories built of past experience, and question the epistemic

foundation of their world. As they aren't endorsing a belief which is directly contradictory to the fundamental way in which their universe operates, and operating on this belief, they are not placing themselves in certain danger, as they have no theoretical ability, just practical ability.

2.) The example of the cockroach does not do damage to my argument in the way that Putnam might wish. This is because the cockroach, and other less intelligent life forms, while perhaps lacking the ability to reflect upon their actions as resulting from beliefs about the world, never-the-less operates within their environment in ways which assume causality. They too have epigenetic rules which cause them to develop and behave in certain ways, and these behaviors are what is important. If a cockroach mates with another cockroach, it may not have the higher ability to understand exactly why it is mating, or what causes lead to what effects in the process, but the fact that it engages in mating, and has epigenetic rules that lead it to, functionally attributes to it a belief in causality. It is operating on an instinct which functionally believes that fertilizing eggs means more cockroaches.

A single celled organism that eats by reflex, absorbing smaller organisms that come into contact with its outer membrane is operating in the same way functionally that the human system one does. It is responding to an outer stimulus with an automatic process, a process that it possesses the capacity to carry out due to its genetics. It is functionally inferring that eating will lead to the effect of nourishment, and thus its survival. This puts it on the same level as our non-conscious, "non-belief holding" system one. In the billiard ball example, system one's anticipation of the second ball moving, and its operating upon this assumption is, to a functionalist, a belief. The cockroach, the single celled organism, and humans all share in common these automatic behaviors and traits, which to the functionalist count as beliefs in causality. This means that all these beings should be classified as believing in causality, and

thus, as they are not extinct, their belief implies that they live in the universe on the left column of our chart, the one which contains causality. Other than this point, it matters little for my argument whether or not a cockroach's greater ability to survive implies that it is more rational than a human. Nothing I have said means that I believe humans to be the MOST ecologically rational creatures on the planet; that title may very well belong to the noble cockroach.

Either way, whether the cockroach and amoeba are not capable of beliefs in general, or whether they functionally are endorsing a belief in causality, fitting them into the argument at hand does not cause significant structural damage. The most vital parts of the theory are that humans believe in causality, are not extinct as a result of this belief, and so therefor must live within a universe containing causal connections. The only other option is that the universe does not, and within that universe, a belief in causality would be fatal, and therefore would not be evolved.

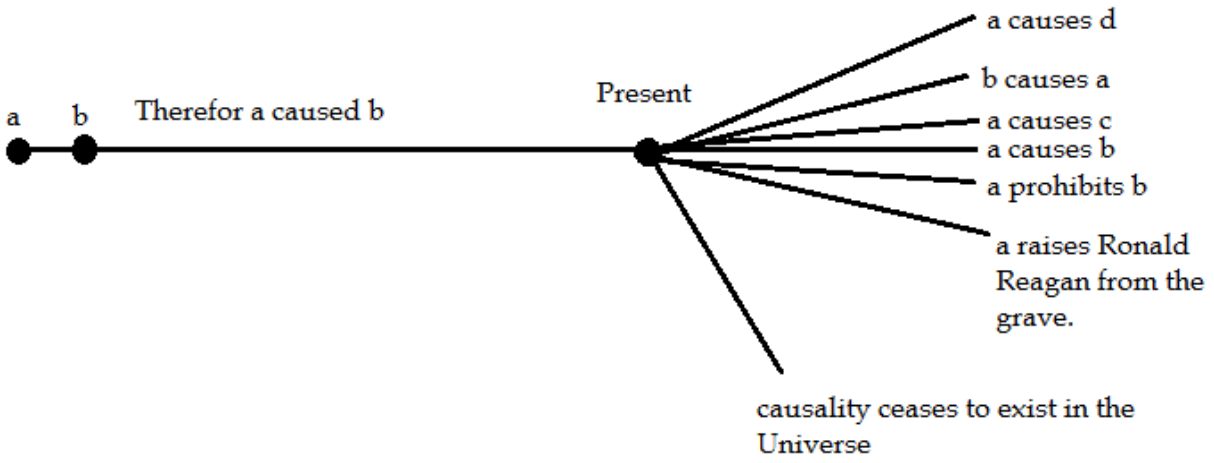
A final point I wish to make clear here, if it was not earlier, is that I am not claiming that every time we infer that event A caused event B we are correct in that belief. I am claiming that our inferences of causality mirror a fundamental truth about the universe, that it contains causal connection. I am not asserting that our inferences are infallible. Just because we think event A caused event B, does not mean A really did. Event D could have caused event B, and we are simply mistaken. Our predisposition to infer causality and continued existence simply means that up until this point, the universe has contained causal connections; we can and do from time to time make mistakes when we infer falsely that two events have a causal relation. However, the more we witness B follow A, and the more we are attempt to be sure through investigation that B was not the effect of some other cause, it can be more and more safely assumed that a causal

relation did exist between A and B. To this end the natural sciences play an integral part in our worldview; their constant inquiry and experimentation will allow us to be sure that our inferences of causal connection are not in error.

I must admit however, while my argument presents a new avenue to take against Hume's skepticism, and attempts to give reason for the jump from conjoined events to causally connected events, it does not solve Hume's second problem. While it does give a reason to believe in causal connections other Custom and Habit, it cannot provide an answer to the problem of inductive reasoning. I have argued that indeed there is at least one reasonable argument by which we can examine our past experienced events, and be certain that they did not simply occur with conjunction, but indeed maintained a cause and effect relationship. Thus we can know causality is not something simply born of the human mind, but something which does exist, because without its existence our propensity to believe it would have gotten us killed eons ago, the only other option being that the universe would operate in a manner contradictory to our currently held belief. This at least gives an answer to one part of Hume's skepticism with regards to cause and effect.

The second part, Hume's problem of induction, proves much more problematic. The past is certain, it's already been experienced and observed, and we now have not just propensities to believe in the causes and effects which have been witnessed in it, but a reason to. Hume's point about the uncertainty of the future, however, is stubbornly steadfast. The fact that it seems to remain unanswerable, or rather, irrefutable, is I admit, of great annoyance; the very fundamental flaw in the logic behind inductive reasoning stands firm against my argument presented in favor of causality.

Our proven point cannot say anything about the future, for while it gives us reason to believe that in the past our universe has contained causality, the very nature of the problem Hume points out is that there is no way to infer based upon this that in the future such rules will continue to hold true. There is simply no way to prove what the future will bring. The second the move is made from confirming past ideas of necessary connection as being true to using this to make claims about the future, fallacious circular reasoning has been used. Time is often described linearly, and so to make my point clear, I will use this description now. Human experience occupies a traveling point through



time— the present— with a clearly defined past behind it. The past has been observed, and therefor has a certainty to it. The argument I have made strives to provide good reason to believe that with regard to past witnessed causal events, Hume's Custom and Habit deliver truth. The second propensity our epigenetic rules; our system one; our Darwinian modules, whatever one wants to call it, instills in us is to expect that in the future the same causal relationships will exist. This process is very similar to the one which infers connection from conjunction, but because it attempts to predict the future, it does not deliver truth in the same way.

Where exactly do we then stand, having admitted defeat on the problem of induction? True, the clouds of doubt about future events have not been waved away, but it is important to realize the humble task that has been accomplished. Hume believed that human custom and habit, processes automatic and out of the control of our reason, instill in us belief in causality, and he was right. He also believed that no process of reasoning could take us from A to B in the same way that these propensities did. These automatic processes however, instilled in man by the evolutionary process as he adapted to his environment, are ecologically rational, and their very existence allows for an argument to be made which gives reason to our linking of A and B.

Conclusion

Returning to the idea of playing pool, we now have a much more informed perspective about the factors at play as one observes the game, and the implications of these factors. As we watch one ball head towards another, we anticipate that if the two collide, the second will move relative to the force the first one struck it with. This is a notion of connection that humans come to not by classically rational argument, but because of their uncontrollable mental processes. The idea of the two being connect Hume stated, cannot be arrived at by any processes of formal reasoning.

The fact then that we still arrive at such ideas, and continue to believe in and operate upon them (especially in the case of making inductive predictions about the future) shows that Human beings are not the classically rational creatures we once made ourselves out to be. *Homo economicus* is simply a fantasy of rationalists and economists and has been held up as the paragon humanity should strive to be for too long. This is because human thought and action are not just controlled by the part of the brain responsible for higher level reasoning, the system two,

but also by a whole set of barely understood components which make up system one, the non-conscious processes of the human mind. This system is responsible for our belief in cause and effect connections, but also leads us astray from a standard of classical rationality in many other ways. It jumps to conclusions, endorses stereotypes, deals poorly with percentages, and largely all without the knowledge of the conscious thought of the individual.

To be harsh on system one for these reasons however is a mistake, because it adapted for a certain job in a certain environment. Humans evolved in the world and are a product of natural selection. Our minds are adapted to it, and not to carry on a standard of perfect logic. This is likely why when presented with information in a format that would exist in our ancestors environment— frequencies rather than percentages, beers in bars rather than colors on cards— we are better problem solvers. The human mind is both prudentially rational, meaning that it attempts practically to get the best results in the least amount of time in order to have a better chance of survival, and also ecologically rational, in that it can operate better in the actual world than do theoretical optimization strategies.

This way in which our brains do work, which Hume rightly pointed out is not classically logical, and how they came to be, allow for a reasoned argument to be made which allows us to endorse the truth of ideas of necessary connection with regards to past experiences. The fact that we believe in causality, and cause and effect relationships, and because for such a fundamental characteristic of the universe believing the opposite of how it truly was would certainly be fatal, we can infer that our ideas about such very basic universal principals do mirror truth. This, it should be kept in mind however, does not give us a reasonable argument to prove that in the future such connections will maintain the same relationship, or continue to exist at all.

What then should we do, if future events cannot be reasoned to logically? The answer, I believe, at least until someone comes along who can solve that problem, is to remember that we are ecologically rational creatures, and should continue to operate in the way we have been doing for such a large amount of time, even if it still leads us to logical fallacies. We should have faith in the abilities and capacities which have brought us this far. Why? To put it simply, it may be the only thing we are capable of doing.

On my honor, I have not given, nor received, nor witnessed any unauthorized assistance on this work.

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Appendix

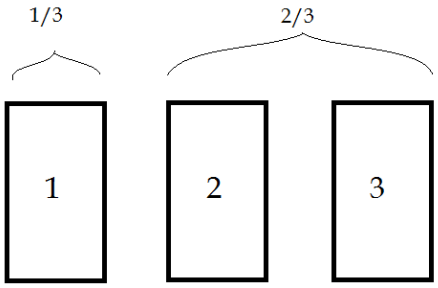
The Monty Hall Problem

During my work on this paper, Dr. Tom Cook of the Rollins Philosophy department and I spent some time musing over the phenomenon of the Monty Hall Problem, and how it relates to the issues discusses within my paper. The discussion was just so interesting that I could not help but to write about the more interesting ideas it contained here.

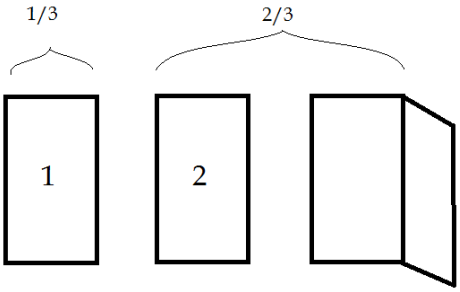
The Monty Hall problem is a guessing game, or probability puzzle, named after the game show host Monty Hall. In the problem, modeled after the game show *Lets Make a Deal*, participants must choose between one of three doors. The prize they want to find is located behind one of these doors; the often used example is a car. Behind the other doors is nothing. When a contestant picks the first door, Monty (or the tester), who knows where the car actually is, will open up one of the doors where the car is not, revealing a nothing. The participant is then asked if they would like to keep the door they

initially picked, or switch to the other remaining door. When the final selection is made the remaining two doors are opened and the outcome seen.

The Monty Hall problem is interesting for readers of this paper because its underlying probabilities are incredibly hard for the human mind to grasp. Once the first nothing door is opened, most people believe that switching makes little difference, as the chances of picking the correct door are now 50/50— one choice is right, the other is wrong. Truly though, this is not the case. Switching actually provides a roughly 66% chance of choosing correctly, whereas staying with one's original answer affords a success rate of roughly 33%. People, including many mathematicians for quite some time argued about the truth of this problem, and when you first explain it to a friend, it is quite likely they will refuse to believe the idea of switching equally a better chance of success. First I shall explain why switching is indeed beneficial.



When you first pick a door, you are picking one out of the three doors. Obviously this means to begin with you have a 1/3 chance of selecting the right door. This also means mathematically you have a 2/3 chance of being wrong. Those are unfavorable odds.



When the host of the game opens one of the doors (here assume you picked door one), and reveals nothing, the odds of the game do not reset to 50/50. Instead, one half of the 2/3rds probability

block has been eliminated, meaning the remaining door, number two, now has a two thirds chance of having the car behind it. There was initially a better chance the car was behind one of the two un-picked doors, and so this is still now true, the contestant just knows that one of these two doors has nothing. Switching changes the contestant's odds from a 1/3 chance of success to a 2/3 chance!

This may or may not seem simple to the reader, but most people have a great deal of difficulty grasping what is going on. Columns, articles, and even television programs have discussed the Monty Hall problem; it is that big of a source of controversy. I believe that my paper sheds light on this problem in a couple interesting ways. The first is why the problems structure is hard to grasp for most individuals. One of the facets of the human mind mentioned in the paper is that it deals poorly with percentages, but well with frequencies. With only three doors to analyze, most people think in percentages, 1/3, then 50/50. The human mind doesn't handle doing percentages well. One of the ways to make the mathematical structure of the game more apparent is to expand the three doors into 10, or even 100 doors. At this point, if all the doors except the initially picked door and one other door were opened, it becomes much clearer for most individuals which door. I believe that this enlargement of the game stops the brain from attempting to deal with the doors as percentages, and instead forces it to deal with the doors being opened as a frequency problem. When every door has been opened except number 9 and the original door picked, suddenly the fact that 9 is where the car resides becomes much clearer.

Musing on the problem I have also come to the further conclusion that activating the brains systems which deal with social scenarios may have some positive outcome as

well. If someone is still having trouble deciding between the door they originally picked, and the one left unopened by the game host, reminding the person that the game show host knows where the car is, and so will intentionally not open that door, could also help them to suddenly come to comprehend the problem. The brain does better when cheating is suspected in a scenario, and so too seems to do better (at least based upon my own internal reflections) at understanding the game when reminded of the game host's knowledge and intent.

I believe an experiment to see how all these two factors helped subjects solve answer the Monty Hall Problem would be fascinating, and as I have only mused here on the possible effects such factors would have on participants' abilities, and reasons for these effects, I encourage someone to follow up this question. Perhaps it could even serve as the start of a great thesis topic!