2017

Consciousness In Comatose Clowns: No Funny Business

Mary Gregg Gregg
University of Mississippi

CONSCIOUSNESS IN COMATOSE CLOWNS: NO FUNNY BUSINESS

A Thesis
presented in partial fulfillment of requirements
for the degree of Master of Arts
in the Department of Philosophy and Religion
The University of Mississippi

by

Mary Gregg

May 2017

ABSTRACT

Consider the tragic case of four circus clowns whose pie-to-the-face gag effectively knocks each one into a cream-pie coma. In each of the four cases, motor capacities (voluntary speech, limb movement, etc.) are not available to the patient's conscious control. Although none of our apparently comatose clowns have voluntary motor capacities, each has a unique set of internal and external activity going on. In other words, each of our clowns (Bozo, Chuckles, Wiggles, and Krusty, respectively), now sits in a Vegetative State. Now, there's a problem. Sometimes comatose patients are conscious, so there's a big philosophical and empirical issue going on here: how can we tell which patients are conscious and which ones aren't? Different neuroscientists and philosophers use the concept 'consciousness' in a variety of ways *and* have proposed different tests based on what they take 'consciousness' to stand for. To solve this problem, we'll need to figure out the best conception of 'consciousness' and the test it corresponds to. To figure out if there's a way to free conscious patients from their confounding bodies, I will: (1) examine four promising proposals in the scientific and philosophical literature about the conditions under which patients have vegetative consciousness and how to test for it; and (2) consider whether the proposed tests are efficient or accurate measures of detecting the kind of consciousness they are trying to test for. Based on how (1) and (2) turn out, I'm going to argue that one of the four theories—the Integrated Information Theory of Consciousness (or IITC)—gives both the best account of consciousness *and* the most reliable test for it, and therefore offers the most promise for detecting consciousness in VS patients.

TABLE OF CONTENTS

LIST OF TABLES

FIGURE PAGE

CONSCIOUSNESS IN COMATOSE CLOWNS: NO FUNNY BUSINESS

1. INTRODUCTION

Consider the tragic case of four circus clowns whose pie-to-the-face gag effectively knocks each one into a cream-pie coma. In each of the four cases, motor capacities (voluntary speech, limb movement, etc.) are no longer available to the patient's conscious control. In other words, each of our clowns (Bozo, Chuckles, Wiggles, and Krusty, respectively), now sits in a Vegetative State (VS for short). On the other hand, although none of our apparently comatose clowns have voluntary motor capacities, each has a unique set of internal and external activity going on. Now, we have a problem. Sometimes comatose patients are conscious, so there's a big philosophical and empirical issue that demands attention: how can we tell which patients are conscious and which ones aren't? Different neuroscientists and philosophers use the concept 'consciousness' in a variety of ways *and* have proposed different tests based on what they take 'consciousness' to stand for. To solve this problem, we'll need to figure out the best conception of 'consciousness' and the test it corresponds to. So, why exactly should we care about all this consciousness stuff? For a few reasons: First, we don't want to give false hope (to loved ones and researchers alike). Second, we don't want to waste limited resources (money, hospital space, staff time, etc.). Third, while we *do* want to avoid the first issue, we don't want to do it by unplugging the conscious patients—we want to un-trap them. To figure out if there's a way to free conscious patients from their confounding bodies, I will:

(1) examine four promising proposals in the scientific and philosophical literature about the conditions under which patients have vegetative consciousness ; (2) consider how to test for consciousness as described in each case; and (3) consider whether the proposed tests are proper or accurate measures for detecting each type of consciousness.

Based on how (1)-(3) turn out, I will argue that one of the four theories—the Integrated Information Theory of Consciousness (or IITC)—gives both the best account of consciousness *and* the most reliable test for it, and therefore offers the most promise for detecting consciousness in VS patients.

2. SEND IN THE CLOWNS

Back at the hospital, the primary care physician Dr. John Dolittle has tried out some tests on our clowns in an attempt to figure out which ones are conscious. In spite of Dolittle's best efforts, the test results look both peculiar and inconclusive. Puzzled, he shares his report with the head of the coma ward, Dr. Abby Normal, in the hopes of getting a second opinion on the matter. Here's what Dolittle reports to Dr. Normal:

2.1 The Reports

Name: Clown, Bozo T.

Symptoms: fMRI scan showed activity in the spatial and motor cortexes of Bozo's brain which fired after a verbal statement was uttered.

Test and Results: Patient was asked to imagine standing still in a tennis court and swinging his arm to hit the ball. This command was followed by activity in the brain regions involved in motor imagery (in the pre-frontal cortex). Patient was next told to imagine walking from room to room in his home and visualizing what he would see there. Immediately afterward, the parahippocampal gyrus (associated with navigation and spatial imagery) was activated.

Name: Clown, Chuckles T.

Symptoms: The fMRI scan showed activity in Chuckles' parietal lobe. The parietal lobe is

related to temperature-tactile stimuli, activated when a patient 'feels' cold, hot, etc.. The parietal lobe is activated after the glass cube in the patient's hand when you tell Chuckles that the (lukewarm) glass cube in his hand is an ice cube.

Test and Results: A glass cube and verbal stimulus ('the instructor will put an ice-cube in your hand') was administered to him. Parietal lobe of Chuckles the clown is triggered after both the glass cube and verbal stimulus ('the instructor will put an ice-cube in your hand') are administered to him.

Name: Clown, Wiggles T.

Symptoms: Wiggles did not show activation in the spatial or motor cortices even after testing. Instead, Wiggles possessed motion-processing and color-processing capacities which activated at different times in different sensory-specific cortices.

Test and Results: A red patch was held in front of Wiggles' eyes. At this time, regions V4 and V4a of the brain (affiliated with color processing) were activated. Next, a red ball was moved back and forth in front of the patient's eyes. Immediately afterwards, the V5 region of the brain (involved in motion processing) was activated roughly 100ms before V4-V4a (color processing).

Name: Clown, Krusty T.

Symptoms: Krusty's neural systems display high levels of activity and interaction between highly-specialized regions of the thalamocortical system. The thalamocortical system has a couple things going on. First, it has highly-specialized structures built up to fulfill very particular

kinds of functions. Second, it has ways of connecting (or integrating) all these highly-specialized systems. So, we have both highly-specialized (custom-made) functional systems *and* high levels of connection between these specialized systems going on (Tononi 293-294).

Test: A plastic-encased electromagnetic wire coil was released onto Krusty's scalp, generating an electric current in the patient's gray matter right under the skull. The current then activated brain cells, fiber passageways, and synaptically-linked neurons. The EEG and MRI scans displayed lots of activity in Krusty's thalamocortical system—*many* regions lit up on the MRI, including sites with task-specific regions (color and motion detection, etc.) and others affiliated with a whole slew of other tasks and capacities of various kinds. The EEG scan (a measuring stick for the amplitude of the electrical activity in the brain) showed high amplitudes of electrical activity (ringing at roughly 30 to 35 times a second).

After looking over the patient charts, Dr. Normal doesn't know what to conclude. So, she decides to take a look at some of the basic literature in consciousness studies. What she discovers is that people are defining consciousness in all sorts of ways. The following are the definitions Dr. Normal came across:

2.2 Concepts of Consciousness

Object-consciousness versus fact-consciousness

The doctor finds that some philosophers (like Fred Dretske) draw a distinction between object consciousness and fact-consciousness. In object-consciousness (or knowledge of things), the perceiver is just aware of the object of experience. (In certain cases, this object can be the experience itself.) In other words, the perceiver does not take the object of experience to be some

way or to have some set of attributes—the stimuli is 'felt' but no perspective is taken. On the other hand, fact-consciousness, (or knowledge of truths) is being aware that something is the case—in other words, the perceiver perceives the object as being some way.[1] The object is had from a certain perspective—the perceiver's take is a part of the experience (Dretske 263-4).

Brute-consciousness versus reflective-consciousness:

As Dr. Normal read on, she finds that some philosophers make distinctions between kinds of reflective and fact-consciousness: brute-consciousness and reflective-consciousness (Gallagher and Zahavi 119-21). In brute-consciousness, the perceiver is aware of the experience but forms no concepts about the experience. Think of the earthworm's pain when it's lopped in half by the fiendish fisherman—even though the earthworm may not be capable of forming concepts about the pain, it is certainly pained by the decapitation—it can feel the pain even if it can't say anything about the pain it's undergoing. Unlike the earthworm's pain, reflective-consciousness pain demands that the experiencer have some first-person, reflective concept in mind while they undergo the experience—so, if the fiendish fisherman gets whacked in the face by the angered earthworm, the fisherman will both have an awareness of the slimy slap *and* be aware *that* he's aware of the counterattack. Some philosophers think you can make judgments without reflective consciousness. By this assumption, reflective-consciousness is a *kind* of fact-consciousness and object consciousness is something a brute thing like the earthworm could have. It follows that fact-consciousness requires some kind of judgment, maybe even reflective-awareness.

Self-awareness versus first-person awareness

[1]This point about consciousness as consciousness *of* can be traced back to Brentano's descriptive psychology project in the early 19th century.

Our doctor gets to self-awareness and first-person awareness. According to her reading of Chalmers, something can be self-aware so long as it's something like a system capable of scanning itself for viruses (Chalmers 221-4). On the other hand, first-person awareness is an awareness of *who* one is and *where* one is. In other words, the subject self attributes the experience, which requires internal introspection.

In an attempt to see where and how these two concepts connect and where they come apart, the doctor thinks up another example. Think of alien limb syndrome. The patient, first-personally aware of the limb's movements, experiences the limb and its actions but does not associate those actions/consider those to belong to him/her—there's no self-awareness—they're just along for the ride. This, to our doctor, suggests that first-person experience does not guarantee self-awareness. *Particularly in VS cases*, thinks Dr. Normal, *this problem will become even trickier to resolve*.

Access-consciousness versus phenomenal-consciousness

Having found no clear answer, our doctor continues to sift until she comes across an article by Ned Block. She takes Block to say that access-consciousness occurs when information is made available to the executive control (or 'scanning') centers of a system (Block 272-3). Essentially, something is access-conscious if there's the right kind of broadcasting between frontal areas of the brain and other, task-specific regions (Crick and Koch 570). When phenomenal-consciousness is present, the patient can sometimes *just* have a 'felt' dimension to his states—no complex thoughts are even present, in some cases.

When phenomenal-consciousness is present, the patient can sometimes *just* have a 'felt' dimension to his states—no complex thoughts are even present, in some cases. Dr. Normal

discovers that the relationship between access-consciousness and phenomenal-consciousness is controversial. For some, phenomenal-consciousness can be identified with brain structure and function. For others, phenomenal-consciousness is something that goes on in addition to (but systematically correlated with) structure and function. These issues are pretty confusing to Dr. Normal, so she sets this pair aside. After all, she *is* dealing with human patients in the actual world.

****

Now Dr. Normal is even more confused than she was before consulting the literature. She accosts her reading materials:

"Alright, you've got some nifty-sounding ideas, but how do we *know* that *any* of these concepts are accompanied by conscious experience?! And *which* of our clowns is *really* conscious?!"

3. THEORIST THROWDOWN

Having heard Dr. Normal's screams of frustration from down the hall, consciousness experts Dr. Adrian Owen, Semir Zeki, Giulio Tononi, and Christof Koch cram into Dr. Normal's doorway, each theorist yelling over the others in an effort to get his own idea heard. As the jabbering reaches a dull roar, Dr. Normal replies.

"*Quiet*, all of you!" Booms Dr. Normal. "Now, I'd be happy to hear all of your suggestions *one at a time*. You there—Dr. Owen—start us off."

3. 1. Owen

3.1.1 What consciousness is

Dr. Owen explains that he (now) thinks of consciousness as a sort of brute object-awareness *plus* self-awareness *and* reflective first-person awareness of who and where you are (Martin, Vanhaudenhuyse, Coleman, Boly, Pickard, Tshibanda, Owen, and Laurys 1936-8). So, consciousness, according to Owen, entails a complex kind of awareness where the patient possesses both object-consciousness (knowledge by direct acquaintance that something is going on) and fact-consciousness (knowledge about the experience). Put another way, consciousness, by Owen's definition, is knowing who you are, where you are, and what is going on around you. He doesn't really address what his take on phenomenal and access-consciousness is.[2]

[2] Although Owen doesn't mention it, it's clear that some form of access-consciousness is going on here.

3.1.2 How to find it

How do you catch the conscious person? According to Dr. Owen, you need to find out if the patient's spatial and motor cortices can be activated. If so, try to use those areas to get the patient to communicate. If this awareness response is present, reproduce this response in a way that will allow the patient to communicate yes/no answers by letting them manipulate their own brain activity in the spatial and motor cortexes, a method that would not require the use of motor-response training. This method is called the *volitional test*. We already have a couple clowns who have this kind of activity going on in their brain regions (Bozo and Krusty)—all we have to do now is train the patients to use these areas to talk to us. Here are the specifics of Owen's *volitional test:*

In order to get a yes/no response pattern, brain areas involved in motor and spatial awareness must be activated according to the yes/no answer each area's activation indicates as a form of command following. The activation of areas involved in motor imagery was used to indicate 'yes' answers. In order for the patient to answer 'yes', he/she must be told to imagine standing still in a tennis court and swinging his/her arm to hit the ball. In order to activate the areas in charge of spatial imagery to indicate a 'no' answer, the patient must be told to imagine walking down a familiar street or walking from room to room in his/her home and visualizing what he/she would 'see' (1930-3).[3]

3.1.3 What this means and why it works

If the VS patient does use this yes/no system, then we know they're capable of willfully

[3] This test is something like the Turing test (Turing 433-60), with the exception of the qualities behind the output. While Turing suggested that we get mechanistic imitation of conscious activity from the machines, Owen' Turing-like test assumes the binary 'yes'/'no' answer indicates not just behavioral imitation but conscious communication.

controlling their own brain activity, suggesting that VS patient is conscious (and capable of conscious communication) even in the absence of other motor functions. Based on what regions of the brain we'd need to activate, it's obvious, concludes Owen, that three of our four clowns — Bozo, Chuckles, and Krusty-- are likely conscious, but to know for certain, we'd have to make sure that this activity could be repeated on command. Sadly, Wiggles' conscious state is indeterminate at best.

Owen goes on to explain the test's assets in greater detail. Based on this test, not only do the VS patients have the capacity to think a given thought (tennis or home)—they can use this thought to say something else over and above the raw experience to say something *about* that experience (Owen 132-4). So, the VS patient is not just capable of having certain thoughts, but inducing and deploying them intentionally in order to communicate. Even when behavioral tests of awareness fail, we can test for internal awareness by allowing the patient to use their spatial/motor imagery capacities to communicate.

"That's all well and good, but you've missed the most important part," Dr Noh chimes in.

3.1.4 Some methodological setbacks

According to Dr. Noh's criticism, areas of the brain associated with awareness *can* be activated right after verbal commands were presented to the patient. However, these areas can *also* be triggered in the *absence* of a command as a result of apparently involuntary reflex. By focusing on the brain chunk being activated instead of what is *activating* that brain chunk, it's unclear whether the activated brain area is the result of the intentional action of the patient's conscious effort or just the product of an automatic, bodily reflex. (Even Owen admits that there are still errors in taking certain kinds of firing as intentional awareness when it could be just sporadic,

reflexive firing (Owen, 2006).)

Noh is willing to grant that the causal relation in Owen's *volitional test* is *necessary*, but he doesn't think it's a *sufficient* determinant of conscious experience. If power of misrepresentation is present, the patient's thoughts will have *aboutness*, so the thoughts will be directed at the object of the patient's experience. Owen's test is aimed at testing for intentionality (since he's trying to test for the patient's ability to mentally represent the object of his experience as being some way), but his test fails to meet the criteria you'd need to *prove* that this kind of intentional awareness is present. So, while strongly *suggestive* of intentional production of motor or spatial imagery, we need a better way to substantiate Owen's test.

"Oh yeah?" Owen sputters, "Let's see *you* come up with a better solution!"

"Hold your horses, we'll get there!" Exclaims Noh. "First, let me just explain what kind of consciousness *I'm* looking for—you know, the *right* kind of consciousness."

3.2 Noh

3.2.1 What consciousness is

Essentially, the patient's consciousness is made up of 1) the awareness of the stimuli; and 2) the attribution of traits to this object of awareness (Noh 4-8). Noh believes that the patient's' ability to mentally represent stimuli as having certain properties reveals the inten***s***ionality below the intentionality of the representation. Inten***s***ionality captures the way that a representation designates its objects. Different representations can label the same object in different ways. So, one representation can't always be substituted for the other in all circumstances (in thought or talk). Noh then makes an example of Chuckles. According to Noh, Chuckles not only

experiences the ice cube, but has certain particular kinds of (intens*i*onal) feelings (that the ice-cube is cold) which belong to the (inten*t*ional) beliefs about this experience (where the patient believes the ice-cube is in his own hand). If the patient's experience possesses these two attributes, then the patient is able to get into his multi-faceted mental representation (8-9).

3.2.2 How to find it

Noh explains that to overcome the issues which the *volitional test* encounters, he's concocted the *misrepresentation test*, which focuses on an area whose reflexive triggers cannot (as the motor cortex's activations is) be mistaken for state-conscious representational states: the parietal lobe. Here's what you'll need to do:

To test for this misrepresentation we can use fMRI or EEG to detect temperature-tactile activation by detecting activity in the parietal lobe. Put a lukewarm glass cube in our clown patient's hand. Then, tell the patient that the cube in his hand is an ice-cube. If the fMRI scan shows that the parietal lobe is activating, we know that the patient 'feels' cold (even though the cube in his hand is actually lukewarm). If the patient's parietal lobe activated after the cube and verbal message were given, then the patient is not giving an automatic bodily response (since the automatic bodily response should reflect a reaction to the lukewarm cube), where no activation of the parietal lobe would occur. Instead, if the parietal lobe is activated, then the patient is listening to the verbal message and telling its body to respond accordingly (as *if* the cube were a *cold* ice-cube).

That's all for the methods part, but, according to Noh, it's got big implications.

3.2.3 What this means and how it works

If the clown's parietal lobe is stimulated, this tells us that he is *mis*representing the physical

input-stimulus (by representing the warmer glass cube *as being* a *cold* ice-cube), then we know that the patient understood the verbal instruction.[4] Since the verbal instruction differs from the physical stimulus and the body responds according to the verbal instruction rather than the physical stimulus, we can infer that the patient misrepresents the stimulus because they understand the verbal command and cause the body to follow suit, indicating consciousness. "Fine, but why is this any better than my volitional test?" Owen implores.

Noh responds with an exploration of the broader implications of the *misrepresentation test*. By testing for misrepresentation, we've detected what John Searle calls an aspectual shape[5] (or *how* something is experienced) occurring in the patient. When the patient *mis*represents, he has some belief about the stimulus he is aware of and that belief contains a certain set of traits, both of which allow our patient to construct some aspectual shape, intentionally-directed at the stimulus. Based on this criteria, Noh says Chuckles and (maybe) Krusty are conscious. So long as our clowns have the right kind of representation, they're conscious. According to Noh, *the misrepresentation test* gets around the issues of misattributing consciousness to unconscious, reflexive states. When the patient *mis*represents, he has some belief about the stimulus he's aware of, and that belief contains a certain set of traits, both of which allow our patient to construct some aspectual shape intentionally-directed at the stimulus. Because no motor-sensory areas are involved in the misrepresentation test, testing for activity in the parietal lobe prevents

---

[4] Noh, Hyungrae. "Ascribing Consciousness to Vegetative State Patients: A New Methodology." (n.d.): 1-14. Print.

[5] Close to Gottlob Frege's *mode of presentation* concept, where the nature of the reference itself does not change but the way we take it to be does change. For example, a musical note can have different labels (or 'senses')--A flat and G sharp. Here, we perceive one note in two different ways, but the note (or 'reference') itself doesn't change.

us from getting an automated-semantic response (Noh 11).

Owen is flabbergasted, “Zeki, Noh is crazy, right? Help me out here, pal.”

Zeki pipes in. “ Sorry, Owen, I’m siding with Dr. Noh on this one—you’re asking *way* too much of our poor patients! Let’s lay off the requirements a little”

“See?!” smirks Dr. Noh, “Dr. Zeki is exactly right, which means my theory works better than yours.”

Dr. Zeki throws Noh a puzzled look: “You’re half right, Dr. Noh, but *your* theory isn’t out of the woods just yet either.”

Dr. Normal nods furiously. “Agreed, Zeki! But before you start your spiel, let me just get my worry in edgewise, here.”

3.2.4.2 Some methodological setbacks

Dr. Normal explains that, even if typical cases of VS patients manage to misrepresent, there are cases of hallucination blindsight cases where this same kind of misrepresentation occurs unconsciously. In Paul Azzopardi and Howard Hock’s study, visual hallucination in blindsight cases were explored to see whether these illusions could be processed without the conscious participation of the patient. According to the results, the patient reports that they aren’t aware of the visual stimulus going on in their impaired lobe. The problem is, in spite of this, the motion’s direction was processed ‘correctly’ in the visual field, so the ‘motion’ within the illusion was detected by the impaired lobe, in spite of the patient’s lack of awareness (Azzopardi and Hock 877-8). Discrimination (through a kind of mis-representation) occurs, but without the input of the patient’s conscious awareness (878). Here, the ‘right’ answer is given, but not as the result of

something brought to the attention of the patient's conscious awareness. So, just because the cases of misrepresentation happen to be conscious doesn't mean that it's the mis-representation that makes them conscious, since this activity can be performed even in the absence of consciousness.

"Your turn. Zeki."

The big worry Zeki has with the theories of both Noh and Owen has to do with sticking the 'consciousness' label on post-conscious activity. Zeki points out that sensory-specific detection processes (like color and motion) happen at different times. He argues that there is evidence that consciousness can happen even at the level of space-and-time-separated color and motion processing and that the unity of experiences is a post-conscious phenomenon. In cases where patients are presented with motion and color stimuli, motion is processed before color by roughly 100ms although the patient mistakenly assumes that the two (motion detection and color detection) occur in the same instance (Moutoussis and Zeki 1409-11). In fact, he argues, there is evidence of mis-binding.

According to the Moutoussis-Zeki study, patients mis-bind motion detection to color-detection. Here, the patient scoots the motion-processing later so that it and the color-process allegedly occur simultaneously (even though motion processing occurs approximately 100ms before color-processing) (1409-10). In a series of trials, patients were presented with a series of images (of changing color and direction) and were told to determine which change happened first and whether the change was simultaneous. The patients claimed that the motion and color changes happened simultaneously. However, the test results show that the patient's brain regions responsible for motion activated before the region responsible for color detection. Since the brain

only binds these experiences once each site has processed its respective data and brought the data to a perceptual level, it seems that this unification (of visual and motion processing) occurs only after the perceptual experience has occurred in the respective sites. So, unified experiences are really just post-conscious phenomena (Zeki 584-5).

Both Owen and Noh toss Zeki a skeptical glare. "And just what would you propose we do *instead*, Dr. Zeki?" the theorists demand.

"First, you both need to adjust your take on consciousness," Zeki replies. "I'll describe my version of consciousness then get into the plan of action we ought to take—to save all the conscious clowns *you* guys keep trying to kill off!"

3.3 Zeki

3.3.1 What consciousness is

Zeki asserts that we need to draw a distinction between micro-consciousness and macro-consciousness. According to Zeki, micro-consciousness is 1) distributed across space in sensory-specific regions, and 2) distributed across time based on when these regions are activated. For instance, since color processing occurs in region V4 and motion processing occurs in the geographically-distinct V5 region and each process is its own micro-consciousness, micro-consciousnesses are distributed across space. Since motion processing (in V5) occurs roughly 100ms prior to color processing (in V4), micro-consciousnesses are distributed across time. If a system has mechanisms which manage to detect things like motion, color, and shape, we have conscious experience. Put another way, consciousness just is the right kind of (here visual) detection. So, if the visual detection sites in the brain are firing, then we have micro-consciousness (and if multiple sites are firing at once, we have multiple micro-consciousnesses

occurring all at once). More broadly, if the brain has any functioning perceptual detection capacities, we have a kind of micro-consciousness going on--visual or other (Zeki 582-4).

Zeki thinks of macro-consciousness as a post-conscious binding of various micr-consciousnesses (583). In other words, macro-consciousness occurs when the brain takes processed information from two or more sensory-specific areas and represents them as co-occurring at the same time. It's post-conscious because by the time the brain gets to the information, it's already been processed by the sensory-specific sites. Here, the brain links up the pre-processed (and therefore perceived) information from each site. Sometimes it does so correctly (through binding) and at other times falsely (through mis-binding) where perceptions which occur at different times are taken to happen all at once, so that the unified phenomena (of color and motion, for example) seems to occur together (582-4).

While not all VS patients have the ability to visually detect objects, many do seem to have functioning sensory-detection mechanisms. For Zeki, micro-consciousness is always a form of brute object-consciousness. In contrast, macro-consciousness is a form of fact-consciousness, though it doesn't need to be accurate or reflective. Because this binding appears to occur after the experience itself, it seems that we do not possess one unified, conscious experience, but multiple consciousnesses which are judged to be unified only after the conscious experience has been undergone. This unification only occurs after the conscious detection sites have processed their information.

3.3.2 How to find it

Present imagery of a moving red ball to the patient's eyes. If the relevant regions in the patient's sensory-cortices are activated, the patient has micro-consciousness. If the regions associated with

post-conscious binding are activated, then the patient also has macro-consciousness.

3.3.3 What this means and how it works

A patient who passes this test only needs to have motion-processing and color-processing capacities activating at different times in different sensory-specific cortices. So long as our clowns possess some kind of perceptual-detection capacities, we've got conscious clowns. So long as our clowns possess some kind of perceptual-detection capacities, we have conscious clowns. For Zeki then, all of our clowns are likely conscious. While all of our clowns most likely have micro-consciousness, there might be some that have macro-consciousness as well.

We may even be able to make a plausible guess that Bozo and Chuckles possess a kind of macro-consciousness in addition to their micro-consciousnesses. Because both the motor and spatial regions are activated, the brain may be binding these processes together to create a unified experience. Although Krusty does show interconnected activity in the thalamocortical system, this activity and its location tells us little about the state of our patient's consciousness. The interconnectedness is irrelevant to Zeki's conception of consciousness and the higher-order thalamocortical system is not itself a region responsible for sense-detection. So, while we *might* be capable of inferring that these unconscious connections resulted from a previously-conscious perceptual state, the connections themselves tell us nothing about what triggered this or what is being unified.

"Just hold on a minute," Dr. Normal protests. "Consciousness *must* be more than detection!"

3.3.4 Some methodological setbacks

Dr. Normal expresses her confusion, explaining why it's not clear that the disparate components

of visual processing are themselves different loci of *conscious perception*. Likewise, the idea that macro-consciousnesses' unification of these space-and-time-separated sensory processes occurs *after* the phenomenal experience is questionable. Although *detection* happens in each separable visual process, this detection can occur even when the subject isn't consciously aware of the detection, suggesting that detection is not equivalent to perceptual experience. If these distinct visual processes can occur and function without the input of the subject's awareness, it seems implausible that these disconnected, functioning processes are, on their own, kinds of perceptual experience.

It seems then that macro-conscious connection is the place where conscious awareness begins, since this is where active integration appears to occur. Many systems (like the brain) have a multitude of processing mechanisms which function on their own as independent processing sites, but few have the ability to unite the data from each of these processing sites into one, integrated, phenomenal experience. While there is a time difference between the occurrences of each visual *process*, there is not a time difference between conscious perceptual experience—it is in this unity that consciousness is formed. It could be that one perceptual mechanism is activated before the other, but the perception itself plausibly is able to unify the two processes into one experience. Much like H_20, where the compound cannot exist without the necessary relation of each disparate part to the other, the occurrence of conscious perception seems to rely not on the disparate functions of each individual process, but on the connections forged *between* each of these visual processes.

Zeki wonders aloud. "Alright, what the heck do you suggest we do *instead*, Dr. Normal?!"

"Ahem," Tononi and Koch jump in. "We might have a workable alternative."

4. IITC

4.1 What Consciousness Is

Tononi and Koch present IITC, which maintains that any non-zero amount of information implies consciousness. According to IITC, there will be phenomenal-consciousness when there's a non-zero amount of integrated information. Since the information is being integrated, there will *also* be some degree of access-consciousness—if the information is being integrated together with their system's executive centers, then it will also have access-consciousness. While Koch and Tononi don't address the other forms of consciousness, it's reasonable to suppose that some patterns of activation in the system will result in brute object awareness while other patterns of activation will result in fact or reflective consciousness. According to Giulio Tononi and Cristof Koch, consciousness is characterized by three qualities: it's unified, it's informative, and it's integrated (Tononi 287-9).

1) It's unified: You cannot divide your conscious experience into parts while in the experience. You may divide the experience through analysis after the fact, but this does not mean that the experience while being experienced was divided. Similar situations can be found elsewhere. A living organism functions as one, unified animal. This is not to say that after the fact it cannot be dissected into its separate functional parts, but only that, while living, it is necessarily unified and ceases to exist as a living thing once it has been carved and diced in one manner or another.

2) It's informative: the conscious experience you have at a given moment of time (t) rules out

countless other possible experiences you could be having in that exact moment. The experience is specific to this (here and now) particular kind of experience.This system only exists in this particular order in this particular moment for this particular kind of conscious perception and which disappears once that forged and highly-specialized connection goes away again. This shows us that it's not just detection but a kind of highly complex, integrated system.

3) It's integrated: the bigger the amount of integrated information, the more conscious a system is. Integrated information is the stuff you get only when the (here neural) mechanisms within a system share information with one another and the amount of information obtained from this relation is greater than the amount of information which each individual component (neuron/neural system) possesses on its own (Koch and Tononi 46).

On Tononi and Koch's account, consciousness occurs not in the disparate activation of dis-unified neurons and neural systems but in the particular kind of sharing of information between these neural mechanisms and systems. The contents of this experience may vary in complexity and volume, but at the very least, the contents, whatever they may be, will be unified, integrated, and informative (46-7). If the system functions as one, unified system of indivisible experience composed of integrated information, the entity is conscious. In other words, the more the mechanisms within a system create information which exceeds the amount of information each individual mechanism possesses on its own, the greater the degree of consciousness the system possesses. Additionally, object-consciousness or fact-consciousness can be present in the system—whether it has one or the other will depend on the complexity and specialization of the system. The more complex the connections, the greater the amount of shared information, so the more likely you have conscious experience. But, a system still has simpler object-consciousness

so long as it has some kind of specialized, integrated connection within a system.

For IITC, then, even at the minimal stages of consciousness, phenomenal consciousness can occur. When it comes to access-consciousness, it's a little trickier. If we divide up access-consciousness into 2 kinds--(1) detection, and (2) taking what's been detected and broadcasting it to the executive control center of the system (Block 272-4)--then, according to IITC, a system that has access-consciousness (2) does have some kind of phenomenal experience. In other words, if something is access-conscious (1), it's not really conscious by IITC standards, since it's missing the crucial component of highly-specialized interconnectedness resulting in a kind of informative perception rather than detection. However,so long as the patient possesses the integrated, informative, and therefore unified neural system(s), then it has access-consciousness (2)--the patient *will* have some kind of phenomenal, conscious experience.

4.2 How to find it

Stick a plastic-encased electromagnetic wire coil on the patient's scalp. This will generate an electric current under the skull. Use MRI and EEG scans to record the brain activity that follows the stimulus. If the fMRI scan shows that the brain cells, fiber passageways, and synaptically-linked neurons are activated in different sensory and function-specific sites, we have interconnected brain activity (Koch 24). If the EEG scan shows a high degree of electrical activity (which approximates those of wakeful patients) then we have a high degree of interaction (and therefore information sharing) going on between these interconnected sites (25).

"Fine, but how exactly does this make your theory any better than ours?" Owen and Zeki demand.

"Let me try to translate," Dr. Normal suggests.

4.3 What this means and how it works

Dr. Normal begins. First, for IITC, lots of different regions must be activated for a system to be conscious, so this activity is probably not simply a reflex. The higher the level of activation, the less likely this brain activity is a reflexive response in the absence of consciousness. So, it gets around the first issue Owen's theory faces. Second, it avoids Owen's second weakness because you *can* have sufficient levels of integrated activation to achieve consciousness *even if* the centers responsible for self-recognition and self-locating aren't activated (or malfunction). Third, IITC gets around Noh's issue, since integrated activation can occur even if the patient doesn't manage to 'misrepresent' anything. And, fourth, based on IITC's response to Zeki, IITC avoids the weaknesses with Zeki's test (by not calling unconscious detection mechanisms conscious). Even if IITC isn't perfect, it can at least do more than the other theories can.

Dr. Normal goes on. This would mean that for IITC, Krusty is clearly conscious. Additionally, Wiggles is clearly unconscious. Bozo is *likely* conscious because he has to integrate a lot of information to pass the Owen test (since he must activate a bunch of things to construct the kind of awareness Owen demands). Remember that, for Owen's test, you need to have motor and spatial lobes all working together. There may not be as *much* integration going on, but they're still conscious (because he has a non-zero amount of integration going on in his system. If we perform IITC test on Bozo and find that there's some kind of observable, synaptic connection going on between the function-specific regions (those responsible for spatial, motor, and temperature-tactile awareness) and other brain regions interacting in this clown, we probably have some degree of consciousness going on. If we discover that these function-specific regions are connected to geographically-separated brain regions and have some level of complexity and

some active interaction going on within these connected regions, we can infer that the patients are at least minimally conscious. Likewise, Chuckles might be conscious, since the patient is forced to make similar connections in his mis-representation (where our patient has the experience of the lukewarm cube, the verbal cue about the cube, and the interpretation of the experience, one which differs from the body's actual contact with the cube).

As for Wiggles, Tononi and Koch *both* take seriously the possibility that small systems and subsystems that have a nonzero amount of integrated information might possess their *own* consciousness (like the visual system itself, the individual cells, etc.). So even if *Wiggles* isn't conscious, Wiggles' *subsystems* might be. However, the conscious cells aren't Abby Normal's patient—Wiggles is—so even if we have a bunch of conscious organisms living within Wiggles, *they* aren't Wiggles, so Wiggles isn't conscious. Consequently, IITC suggests pulling the plug on Wiggles.

Tononi and Koch grimly affirm Dr. Normal's interpretation. "We're afraid so."

"*No*, you're not getting away *that* easy," mutter the theorists.

Koch and Tononi cast a look of confusion at the group. "Well, just what have we left out?"

4.4 Methodological Setbacks

4.4.1 Zeki's rebuttal:

Zeki heads the assault. "Why assume that connectedness within neural systems is even necessary (let alone sufficient) for consciousness? Sure, maybe my test's criteria are too weak, but what makes your test any stronger? Even if we assume that integrated brain activity is some kind of active information integration, what *about* this integration tells us anything about its

conscious state? Why should we think that data-swapping *must* be a conscious activity in all cases of its occurrence? Look, it might be the case that a conscious person happens to have the additional quality of integration of information going on, but why make the integration a minimal requirement for the presence of conscious experience? I'm not denying that a subject with integration going on is conscious, I'm just saying that the integration isn't the factor that gives the subject its consciousness. Basically, it sure seems like integrated information is a product of consciousness, not itself a conscious activity" (Zeki 584).[6]

Zeki goes on to attack Koch's *Neurobiological Framework for Consciousness.* The Neural Correlates of Consciousness (or NCC) project suggests that certain regions (like V1) are ruled out as possible nodes of consciousness (Krich and Koch 569-70)-Zeki thinks this claim seems unfounded. According to Zeki, not only is V1 a viable *possibility*, it is *necessary* for *any* kind of conscious experience, and therefore *cannot* be ruled out (Zeki 582). Furthermore, why not think that this integration (or "binding") is itself a *post*-conscious phenomenon? What feature of integration tells us that its conscious rather that post (or even *un*) conscious? (Zeki 584). Here's the issue: even if we assume that this activity is some kind of active information integration, what about this integration tells us anything about its conscious state? Why should we think that data-swapping *must* be a conscious activity in *all* cases of its occurrence? (re-iterate binding issue). For the same reasons that Owen and Noh's tests were rejected, IITC should also be rejected.

[6] Think back to Tim Bayne's problem case of disconnected experience in cases of absence seizure with disunited experience and behavioral output. Since there are cases where the subject is conscious even in a disunited, experiential state, it seems that, not only is unity of information not necessary, but irrelevant to the presence of consciousness.

4.4.1.1 Tononi and Koch respond:

Before this connectivity occurs we've just got detection going on. Even within these connections we've got a pretty minimal kind of consciousness going on. IITC asserts that once the axioms (or essential properties of consciousness) are found, consciousness and the phenomenal experience of the patient have been discovered. The process of integration works to connect otherwise disparate bits of data by both differentiating the phenomenal experience from all other experiences and at the same time unifying and connecting all sensory data together within the phenomenal experience. The key to this integration is connectivity between mental elements which depend causally on the interaction and unity with other elements within a given mental system. As Tononi states,

> The IITC also addresses, at least in principle, the second problem of consciousness, which is not considered in other approaches. The IITC claims that, as the quantity of consciousness depends on the amount of information that can be integrated within a complex, the quality of consciousness (whether visual, auditory, colored, etc.) depends on the informational relationships among its elements (Tononi 2004). More precisely, it is specified by the matrix of effective information values among all of its subsets. According to the IITC, the "meaning" of each and every quale, such as "red" is provided exclusively by the informational relationships among the elements of the complex (Tononi 287-9).

So, the elements which unite to form your experience are indivisible—you cannot lobotomize the experience you undergo while you sit within the experience. Without this unity, each disparate part would act of its own accord as independent elements with no necessary causal connectivity and therefore possess no degree of consciousness. Put simply, every conscious experience you undergo is unavoidably unified and indivisible based on the causal dependence of the elements whose combination comprises your conscious phenomenal experience (as H2o's existence depends not on disparate elements but on the unifying causal relation between the elements of

Hydrogen and Oxygen).

4.4.2 Owen offers a counter-attack:

IITC talks about mechanisms and neural systems as being conscious, but this is a large leap to make given the shortcomings of the empirical data—it might be more plausible to assert that these mechanisms give rise to consciousness without themselves BEING conscious entities (since each separate mechanism's possession of consciousness might do away with the necessity of integrated information)

4.4.2.1 Tononi taps out and Koch tags in:

Koch reminds Owen that IITC does not claim that the neurons or neural networks are *themselves* conscious but does think that, with sufficient interconnectivity and complexity, the systems can *produce* conscious experience. The IITC is concerned with discovering qualia (elements that comprise consciousness) by explaining the contributions of Neural Correlates of Consciousness (or NCC) to conscious perception (especially visual)—to discover which NCC's *produce* each particular aspect of consciousness. Again, we're looking for the neural *correlates* of consciousness, *not* conscious neurons. According to Crick and Koch, finding the neural correlates means finding the *producers* of particular aspects of consciousness. The theoretical framework of the information integration theory of consciousness (IITC) provides a tentative solution to questions about the quality and quantity of consciousness produced by physical systems (consciousness is affiliated with the brain's capacity to integrate information)

While presence and amount of data and data-detection can be mimicked not just by (apparently aware but unconscious) animals but inanimate objects as well (such as high-storage

capacity computers), the connections made between these data points, when this connection is present, requires more complex mental states.

4.4.3 Noh throws in his two cents:

Is causal connectivity synonymous with information integration? These interactions seem to interact/are affiliated with one another but are not one and the same process. Correspondence between information integration and the experience of consciousness does not appear to guarantee that conscious experience just is (or is, even in part) information integration

4.4.3.1 Koch and Tononi respond:

Even if the connection itself were found to be caused by something/someone else, the mere possession of these connections allows the patient to make free association between each part to gain access to the capacities of recognition that separates conscious recognition from mere command-based, disconnected detection. (So, we don't just see that there is a plant in front of a computer, we recognize what it means/that it doesn't belong in relation to what usually sits in front of a computer/how we feel/that it is we, the person in possession of this recognition that is doing the thinking and feeling.)

As a puzzle's completion gives you the finished picture, so a neuron on its own, like one individual puzzle piece, does not embody the entire picture within its miniscule shape, but, together with the remainder of its neural coalition, comprises (in some circumstances) an NCC). In cases where they're not connected (c/c one kind has been lost), this does not mean that each can exist independent of the other, only that whatever was taken away was not essential for consciousness (or) Zeki's definition of consciousness is a bereft conception, one that does not account for the complexity of even basic consciousness (detection of motion is not one and the

same as recognition of motion/moving objects--one is automatic, unconscious, the other is a conscious, aware process.

5. CONCLUSION

After shooing the theorists out of her office, Dr. Normal begins to process the proposals. Owen's test gets it wrong sometimes, so we'd run the risk of lying to family and friends by calling automatic, bodily reflex the product of a (now gone) conscious agent. Noh's theory runs into the same issue, just in a different section of the brain. Zeki's test would certainly save us from having to pull the plug on any of our clowns, but it's not clear that disparate sensory-detection sites make for conscious experience. Even though IITC isn't perfect, it at least seems to overcome the limitations of the other theories by identifying not just the activation site, but the type, quality, presence, and cause of the trigger *and* how it relates to other neural systems which might serve as motivation for the trigger (where the absence of connections indicates absence of thoughtful motivation and action). So, Dr. Normal thinks that IITC does the best justice to the unity that consciousness seems to have. She decides to pull the plug on Wiggles.

Does this mean that *we* should pull the plug on Wiggles and cases just like him? Should we use resources to *try* to wake indeterminate cases like Bozo up? These are tricky questions which I leave the reader to find the answer for themselves. I haven't given definitive proof for why IITC is the best theory out there—I've only tried to show that, of the three theories, IITC seems to be the most effective test.

BIBLIOGRAPHY

Block, Ned. "How Many Concepts of Consciousness?" *Behavioral and Brain Sciences Brain Sci* 18.02 (1995): 272-87. Print.

Brentano, Franz. Descriptive Psychology, Trans. Benito Mueller. London: Taylor and Francis, 2012. Print.

Brogaard, Berit. "Are There Unconscious Perceptual Processes?" *Consciousness and Cognition* 20.2 (2011): 449-63. *ScienceDirect*. Web.

Chalmers, David J. "The Content and Epistemology of Phenomenal Belief." *Consciousness: New Philosophical Essays* (2003): 220-271. Print.

Crick, Francis, and Christof Koch. "A Neurobiological Framework for Consciousness." *The Blackwell Companion to Consciousness* (2007): 567-79. Print.

Dretske, Fred. "Conscious Experience." Mind 102.406 (1993): 263-83. Print.

Gallagher, Shaun, and Zahavi, Dan. *The Phenomenological Mind*, London: Routledge (2008): 1-257. Print.

Kihlstrom, John F., and Randall C. Cork. "Consciousness and Anesthesia" *The Blackwell Companion to Consciousness*. Ed. Max Velmans and Susan Schneider (2007): 629-40. Print.

Koch, Christof. "A Consciousness Meter." *Scientific American* 24.1 (2013): 24-25. Print.

Koch, Christoph and Giulio Tononi. "A Test for Consciousness." Scientific American (2011): 44-47. Print.

Martin, Monti M., Audrey Vanhaudenhuyse, Martin R. Coleman, Melanie Boly, John D.

Pickard, Luaba Tshibanda, Adrian M. Owen, and Steven Laurys. "Willful Modulation of Brain Activity in Disorders of Consciousness." *New England Journal of Medicine* 362.20 (2010): 1936-938. Print.

Noh, Hyungrae. "Ascribing Consciousness to Vegetative State Patients: A New Methodology." n.p. (2016): 1-14. Print.

Owen, Adrian M., and Martin R. Coleman. "Detecting Awareness in the Vegetative State." *Annals of the New York Academy of Sciences* 1129.1 (2008): 130-38. Print.

Searle, John R. "Intentionality." Mind: A Brief Introduction. Oxford UP (2004): 112-35. Print.

Tononi, G. "The Integrated Information Theory of Consciousness.” Encyclopedia of Consciousness (2009): 287-299. Print.

Zeki, Semir. "A Theory of Micro-Consciousness." The Blackwell Companion to Consciousness (2007): 580-88. Web.

Zeki, Semir. “The Disunity of Consciousness.” TRENDS in Cognitive Science (2003): 214-218. Print.

LIST OF APPENDICES

APPENDIX A: CONSCIOUSNESS CHART

Consciousness Chart					
Name	Bozo				
Brain Function	activity in the spatial and motor cortices occurs after verbal command is uttered				
Theorist	Owen	Noh	Zeki	Tononi and Koch	
Conscious or Unconscious?	conscious	likely (un)	conscious	(likely) conscious	
Name	Chuckles				
Brain Function	activity in Chuckles' parietal lobe after verbal cue and physical stimulus				
Theorist	Owen	Noh	Zeki	Tononi and Koch	
Conscious or Unconscious?	likely (un)	conscious	conscious	likely conscious	
Name	Wiggles				
Brain Function	motion and color-processing activated at different times in different sensory-specific cortices				
Theorist	Owen	Noh	Zeki	Tononi and Koch	
Conscious or Unconscious?		(likely) conscious		unconscious	
Name	Krusty				
Brain Function	high levels of activity/interaction between highly-specialized regions of thalamacortical system.				
Theorist	Owen	Noh	Zeki	Tononi and Koch	
Conscious or Unconscious?	conscious	unconscio	likely cons	conscious	

CURRICULUM VITAE

MARY GREGG
2216 Church Street, Oxford, MS 38655 | 561-420-7123 | magregg@go.olemiss.edu

EDUCATION

University of Mississippi, University, MS
M.A. in Philosophy (expected) 2017

Palm Beach Atlantic University, West Palm Beach, FL B.A. in Philosophy

TEACHING EXPERIENCE

University of Mississippi, University, MS

Graduate Writing Fellow—To Department of Philosophy **2016--2017**
Provide writing assistance to all students of philosophy through constructive feedback regarding paper structure, strength of argumentation, clarity, thoroughness of analysis, and proper formatting

Teaching Assistant—To Dr. Donovan Wishon, Robert Westmoreland, and Timothy Yenter in "Introduction to Philosophy" **Fall 2015-Summer 2017**
Met with students upon request for tutoring and writing assistance, lead group study sessions and reading sessions, graded all student work including final exams and essays

PUBLICATIONS

"Knowledge and Language"
Published in issue 11 of *Philosophy Now*

PRESENTATIONS

"Ascription of Consciousness: A Matter of Perspective"
Paper presented *at The Second International Conference on the Philosophy of Mind* in Braga, Portugal
Portugal