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A Proposed Hierarchy of Mental States

Cameron Bosinski
Upstate Medical University

Higher Order Theories of consciousness assert that the nature of consciousness is hierarchical. A mental state enters into awareness when it becomes the object of a higher order mental state. One limitation of this theory is that it does not adequately explain how the consciousness of humans is different from the consciousness of non-human animals. The solution proposed in this paper suggests that Higher Order Theory can be improved by constructing a discrete hierarchy of mental states. Organisms with qualitatively more consciousness have access to higher levels in the consciousness hierarchy than organisms with qualitatively less consciousness. In order to provide empirical support for the proposed hierarchy, a cluster analysis was performed. The implications of viewing the nervous system as a functional and structural hierarchy will be discussed.

Keywords: consciousness, Higher Order Thought, hierarchy, neuroscience

1. Introduction

While many theories have been proposed to explain consciousness, one promising theory is the Higher Order Theory of Consciousness (Rosenthal 1986). Although there are many versions of Higher Order Theory (Higher Order Thought, Higher Order Perception, Self-Representational Higher Order Theory), this article will refer to Higher Order Theory in the generic sense. Higher Order Theories follow from Lycan's Simple Argument (Lycan 2001). Lycan's Simple Argument begins with the premise that conscious beings are capable of having both conscious and unconscious mental states. The conscious mental states enter into the awareness of the conscious being, while the unconscious mental states do not. Although the unconscious mental states do not enter into awareness, they nevertheless can affect the behavior of the conscious being. Work by Freud (Freud 1922; Westen 1999; Mlodinow 2013), has shown that human behavior is not only influenced by conscious mental states, but also by unconscious mental states.

Higher Order Theory proposes a solution to this problem. The theory states that there are lower mental states and higher mental states. In order to be aware of a lower mental state, a higher mental state must be conscious of it. Once the higher mental state is directed at of the lower mental state, then the lower mental state enters into awareness. When this occurs, the lower mental state transitions from an unconscious mental state into a conscious mental state. For example, there may be several conversations occurring simultaneously in a busy restaurant. Although the sound waves from each conversation are entering our ears and are activating neurons in our brain, many of the conversations do not enter into our experience. Only by shifting attention to a new conversation can the previously unconscious mental states become a part of conscious experience.

Cameron Bosinski, BS, MS, medical student, Upstate Medical University, USA; main research field: Philosophy of Neuroscience.

For this reason, many have found Higher Order Theory to be appealing (Gennaro 1996). However, Higher Order Theory is not without its limitations. Higher Order Theory cannot explain why some organisms appear to be more conscious than other organisms (Jamieson & Bekoff 1992; Dretske 1995; Tye 1995; Seager 2004). Humans appear to be more consciousness than birds and birds appear to be more conscious than worms. This common sense notion is inferred by observing the varying degrees of complexity that the behavior of these organisms can have. Because the behavior of humans is more complex than that of birds, it can be inferred that humans require a brain that is more conscious than that of a bird. The same relationship follows for the complexity of bird behavior in relation to that of worm behavior. Unsatisfactory explanations to this objection have been given by Genaro and Van Gulick (Gennaro 1996; 2004; Van Gulick 2006). They state that the higher order mental states of non-human animals might be simpler than those found in humans. However, this merely sweeps the problem under the rug, rather than addressing how animal and human consciousness may differ.

Currently, Higher Order Theories only assert the existence of higher-ordered and lower-ordered mental states and as such, have been called double-tiered theories (Metzinger 1995). This article will propose a novel solution to the problem stated above by developing a multi-tiered hierarchy. In order to justify a multi-tiered hierarchy, empirical data was gathered. If consciousness exists in a functional hierarchy, then it is likely that the brain exists in a structural hierarchy. In order to determine whether or not the nervous system exists in a structural hierarchy, a cluster analysis on the total number of neurons found in the brain of each organism was performed. Once it could be demonstrated that the nervous system exists in a structural hierarchy, a detailed hierarchy of mental states could be developed.

2. Methods

2.1. Consciousness Hierarchy

This article proposes that consciousness can be divided into several parts, which exist in a specific hierarchy. Organisms with qualitatively more consciousness have more levels in the hierarchy than organisms with less consciousness. It should be noted that the mere addition of mental states within a single level of the hierarchy is not enough to change the kind of consciousness that an organism has. The addition of mental states to a single level is a difference in degree, while the addition of levels to the hierarchy is a difference in kind. For example, being able to visualize wider range of colors merely adds more mental states to a single level in the hierarchy. In order for an organism to be qualitatively more conscious, it must become aware of new types of information that it was not aware of before. The more levels in the hierarchy that an organism has, the greater proportion of reality it can be aware of and the more conscious that organism can be considered to be. An awareness of a greater proportion of reality necessitates access to new types of information and allows the organism to perform more complex behavior than it could without less consciousness.

The base of the hierarchy begins with the unconscious process of stimulus detection (Figure 1). Stimuli are physical entities in reality that can activate detectors specific for that stimulus. When the detectors detect the presence of the stimulus, the detectors change in order to indicate the presence of the stimulus. In humans, this process takes place inside of sensory receptors cells, such as photoreceptors, which detect light or olfactory sensory neurons, which detect odorants. Exactly what counts as a detection mechanism will be described in the discussion section.

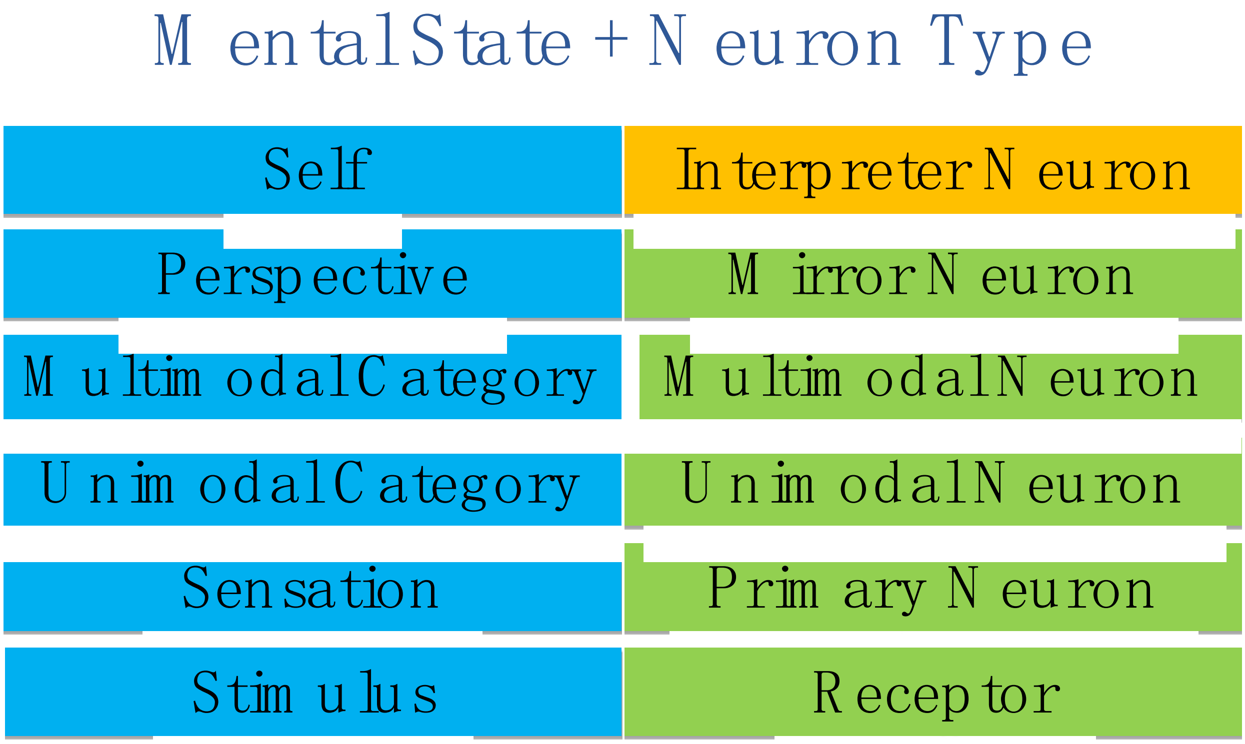


Figure 1. The information hierarchy of consciousness as proposed by this paper. Mental states are in the column on the left. Higher mental states are necessary to be aware of lower mental states. The types of neurons that each mental state corresponds to are found in the column to the right. Experimental evidence for the interpreter neuron has not yet been found.

In living beings, the detection of stimuli by multiple detectors is integrated to produce a sensation. In humans, primary sensory neurons in the primary sensory areas of the brain carry out this task. At this point, the sensation is not yet experienced by the organism, it is only a potential sensation. In order for this sensation to be experienced by the organism, a higher order mental state must attend to it. This relationship is in accordance with Higher Order Theories of Consciousness. The next part of the hierarchy is not supposed by Higher Order Theories, but is proposed by the theory presented in his paper.

The comparison of multiple sensations produces a unimodal sensory category. A unimodal category of sensations is composed of multiple sensations within a single sensory modality. Examples of unimodal sensory categories include colors, the taste of wine, the sight of a painting. Unimodal sensory categories correspond to unimodal sensory neurons, which are found in the association areas of the cerebral cortex. These areas of the brain are known to produce the experience of complex unimodal sensations when stimulated, such as seeing people (Selimbeyoglu & Parvizi 2010).

After unimodal sensory categories are produced, they can be integrated into multimodal sensory categories. Multimodal sensory categories are carried out by multimodal neurons, which integrate sensations from different sensory modalities. These neurons are important for linking words spoken with the facial movements of the speaker (Skipper, Nusbaum, & Small 2005). Without these neurons, information from one sensory modality would be unable to integrate with the information from another sensory modality.

Now that the sensory systems have been integrated, the sensory system as a whole must be integrated. The comparison of multiple multimodal sensory neurons produces a perspective. A perspective is the set of sensory inputs that an organism is experiencing in a given context at a given time. Although this has not been shown experimentally, it is expected that mirror neurons will integrate multimodal neurons in order to produce perspectives. Mirror neurons however are known to be activated when an monkey performs an action and when that same organism watches another perform the same action (Rizzolatti & Craighero 2004). The proposed explanation is that the mirror neuron is activated because that organism is experiencing the same perspective in two different situations. In one situation the monkey is eating a banana, while in the other situation, the monkey is watching an experimenter eat a banana.

The highest level of the consciousness hierarchy that humans have achieved is the self. The self results from the comparison of multiple perspectives into one coherent being that persists through time. There are currently no known neurons that can carry out this function. However, experiments on split-brain patients by Michael Gazzaniga have led to a curious finding. He discovered that the knowledge of the world that can be expressed through language is limited to the left cerebral hemisphere (Gazzaniga 1995). Once the corpus callosum is severed, new information arriving into the right hemisphere cannot be spoken. However, information entering into the left hemisphere is easily spoken upon receiving it. For this reason, he asserts that the “interpreter” is in the left hemisphere. The neuron that bears the function of the interpreter will be called the interpreter neuron. An interpreter neuron integrates multiple mirror neurons and gives humans awareness of a singular unified self.

2.2. Cluster Analysis

In order to provide some validation of the hierarchy proposed by this article, an analysis of the nervous system of multiple different organisms was performed. The central claim of this article is that consciousness can be divided into a hierarchy of discrete parts. Because the process of consciousness is dependent on the existence of many individual neurons, the amount of consciousness that an organism has should be proportional to the number of neurons that exist in its nervous system. In addition, because the proposed solution is hierarchical, the nervous systems of different organisms should not only contain progressively more neurons, but the progression must occur in multiple discrete clusters, rather than continuously. A cluster analysis was chosen for its ability to separate a large cluster of data into multiple smaller clusters. Clusters that form earlier in the cluster analysis are more closely related to each other than clusters that form later in the analysis. The inference that can be made is that organisms that are clustered together earlier in the analysis possess the same level of consciousness, while organisms that are clustered later in the analysis have differing levels of consciousness.

In order to perform the cluster analysis, a literature search on the total number of neurons present in the brain or entire body of different organisms was performed. A total of 41 different organisms were collected (Table 1). The numbers given refer to the total number of neurons present in the brain of each cephalized organism or the total number of neurons present in the entire body of each noncephalized organism.

Table 1

Number of Neurons in the Brain of Each Organism

Organism	Number of neurons
Human (Herculano-Houzel 2009)	85,000,000,000
Elephant (Herculano-Houzel 2009)	23,000,000,000
False Killer Whale (Herculano-Houzel 2009)	21,000,000,000
Chimp (Herculano-Houzel 2009)	6,700,000,000
Macaque monkey (Herculano-Houzel, Collins, Wong, & Kaas 2007)	6,376,000,000
Tufted Capuchin monkey (Herculano-Houzel et al. 2007)	3,690,000,000
Common Squirrel monkey (Herculano-Houzel et al. 2007)	3,246,000,000
Capybara (Herculano-Houzel, Mota, & Lent 2006)	1,600,000,000
Three-striped night monkey (Herculano-Houzel et al. 2007)	1,468,000,000
Cat (Ananthanarayanan, Esser, Simon, & Modha 2009)	936,000,000
Northern greater galago (Herculano-Houzel et al. 2007)	857,000,000
Black-rumped agouti (Herculano-Houzel, Mota, & Lent 2006)	760,000,000
Common Marmoset (Herculano-Houzel et al. 2007)	634,000,000
Octopus (Hochner, Shomrat, & Fiorito 2006)	500,000,000
Common treeshrew (Herculano-Houzel et al. 2007)	261,000,000
Guinea Pig (Herculano-Houzel, Mota, & Lent 2006)	240,000,000
Eastern mole (Sarko 2009)	204,000,000
Brown Rat (Herculano-Houzel 2005)	200,000,000
Star-nosed mole (Sarko 2009)	141,000,000
Hairy-tailed mole (Sarko 2009)	140,000,000
Golden Hamster (Herculano-Houzel, Mota, & Lent 2006)	90,000,000
House Mouse (Herculano-Houzel, Mota, & Lent 2006)	71,000,000
Short tailed shrew (Sarko 2009)	60,000,000
Smoky shrew (Sarko 2009)	40,000,000
Frog (Kemali & Braitenberg 1969)	16,000,000
Zebrafish (Hinsch & Zupanc 2007)	10,000,000
Cockroach (Strausfeld 2007)	1,000,000
Honey Bee (Menzel & Giurfa 2001)	1,000,000
Ant (Shulman 2013)	250,000
Fruit fly (Lagercrantz, Hanson, Ment, & Peebles 2010)	100,000
Lobster (Fraser 2010)	100,000
Aplysia Californica (Cash & Carew 1989)	20,000
Pond snail (Uncited 2005)	11,000
Leech (Macagno 1980)	10,000
Box Jellyfish (Garm, Poussart, Parkefelt, Ekström, & Nilsson, 2007)	10,000
Planaria (Agata 2008)	8,000
Hydra (Bode, Berking, David, Gierer, Schaller, & Trenkner 1973)	5600
C. elegans (White et al. 1986)	302
Ascaris Suum (Jarecki, Frey, Smith, & Stretton 2011)	298
Ascidian (Horie, Nakagawa, Sasakura, & Kusakabe 2009)	100
Starfish (Hinman 2013)	100

Before the cluster analysis was performed, the data gathered was compared to the result that would be expected from Benford's law (Benford 1938). Benford's law is an empirical finding that in nature, numbers that begin with the digit "1" occur more frequently than numbers that begin with the digit "9". The numbers that begin with digits closer to 1 are more frequent, while the numbers that begin with digits closer to 9 are less frequent. Figure 2 shows the expected result of Benford's law and the data gathered by a literature search.

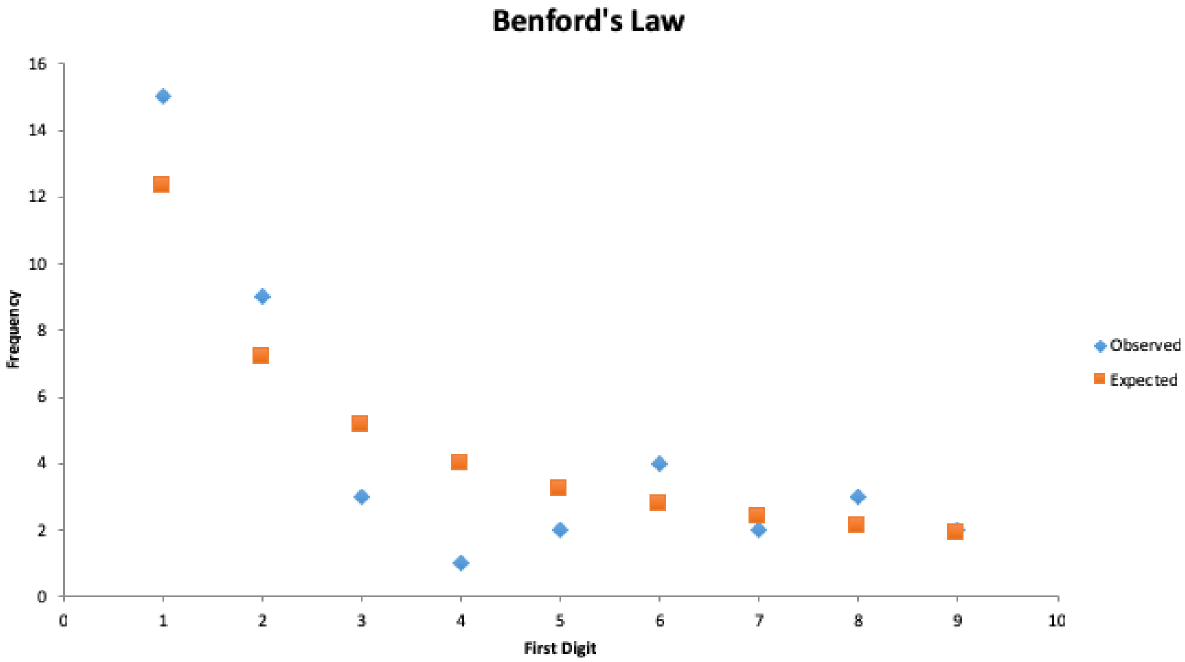
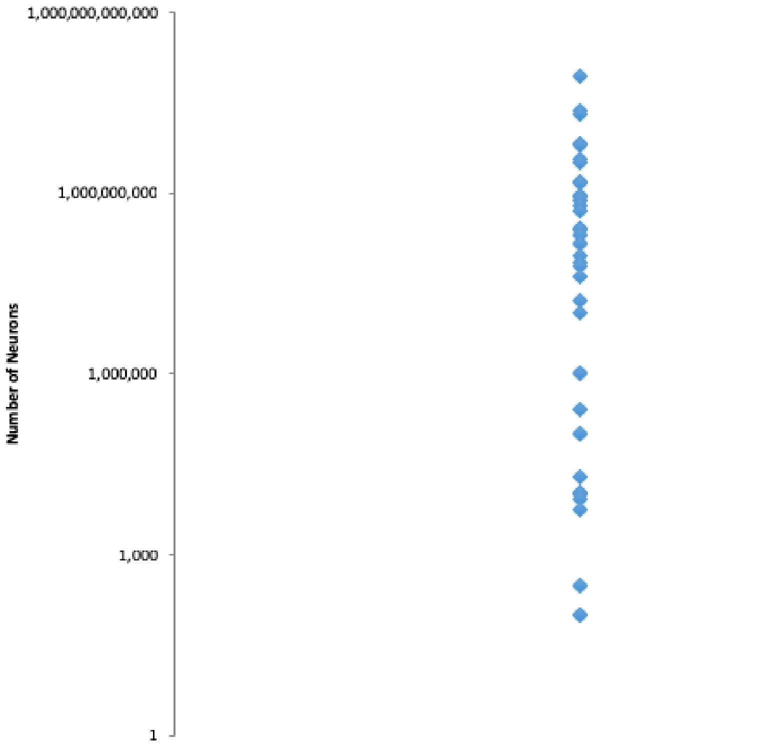


Figure 2. A graph of the frequency of each first digit in the data collected (observed). The data set is compared to the first digit frequencies expected from Benford's Law (expected). Chi Square Value = 69%.

Once the reliability of the data had been established, a cluster analysis was performed. This analysis was performed in forwards and backwards to increase the validity of the result. First the organisms were grouped into one large group (Figure 3). Then, the cluster analysis divided organisms into groups until every organism was split into a different group. The graph of 4, 7, and 10 clusters are shown in Figures 4, 6, 8. The organisms present in each cluster are listed on the left hand side. The organisms with the most neurons are listed at the top while the organisms with the fewest number of neurons are at the bottom. The average value of each cluster in each set was calculated and a trend line was drawn for each so that an R^2 value could be calculated (Figures 5, 7, 9). The cluster analysis was then performed in the reverse direction. In this calculation, every organism began in its own group. Then, the cluster analysis was performed in reverse until all organisms were again clustered into one large group. The result from 8 clusters is shown in Figure 10.



Organism	Number of Neurons
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Honey Bee (Menzel & Giurfa 2001)	1,000,000
Ant (Shulman 2013)	250,000
Fruit fly (Lagercrantz et al. 2010)	100,000
Lobster (Peter Fraser)	100,000
Aplysia Californica (Cash & Carew 1989)	20,000
Pond snail (Uncited)	11,000
Leech (Macagno 1980)	10,000
Box Jellyfish (Garm et al. 2007)	10,000
Planaria (Agata 2008)	8,000
Hydra (Bode et al. 1973)	5600
C. elegans (White et al. 1986)	302
Ascaris Suum (Jarecki et al. 2011)	298
Ascidian (Horie et al. 2009)	100
Starfish (Veronica Hinman)	100

Figure 3. A graph of all of the data collected, from the smallest (starfish) to the largest (human). Each dot represents either the total number of neurons in the entire nervous system of noncephalized organisms or the brain of cephalized organisms.

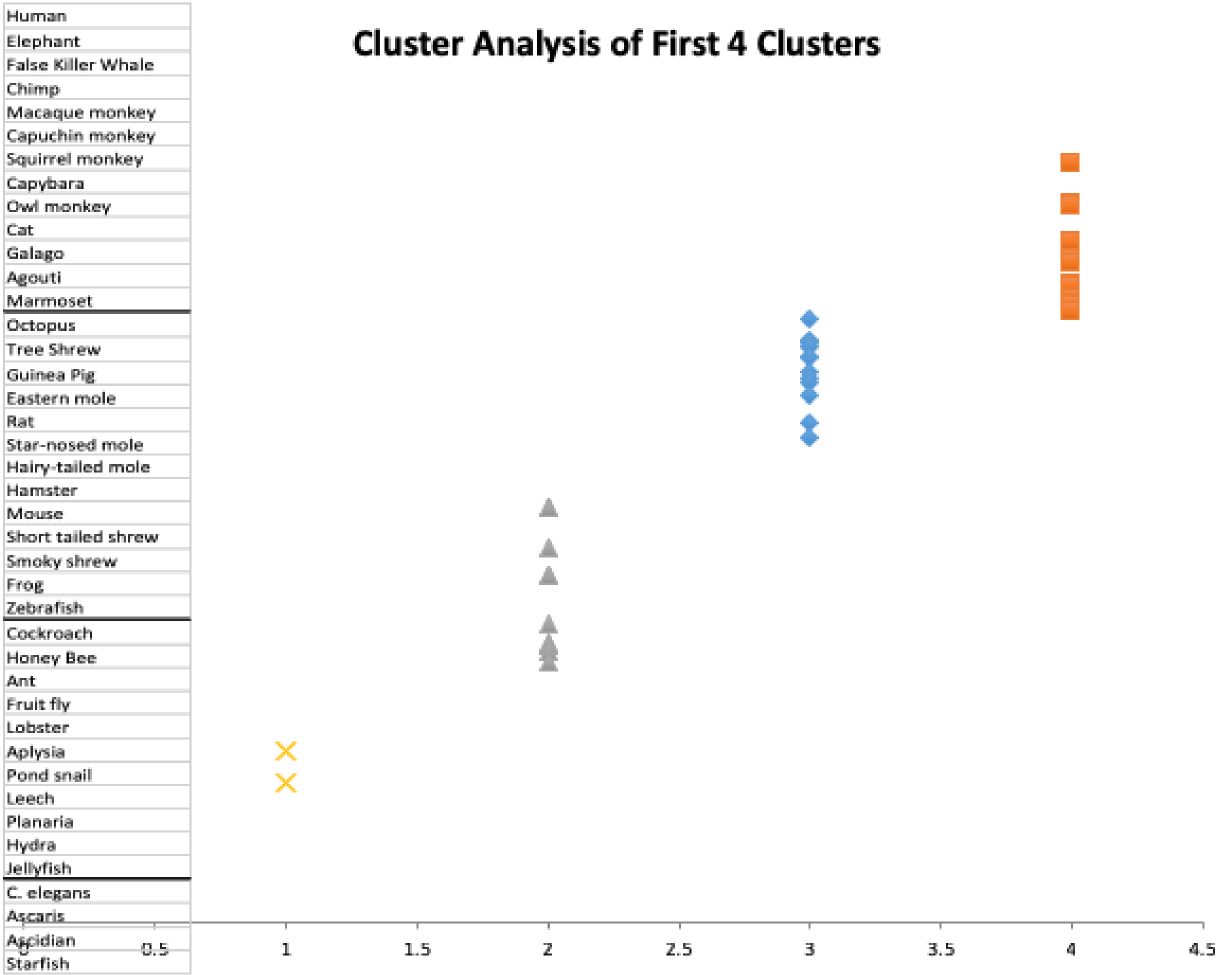

Figure 4. A graph of the first 4 clusters formed by the cluster analysis. The corresponding organisms in each group are listed on the left-hand side.

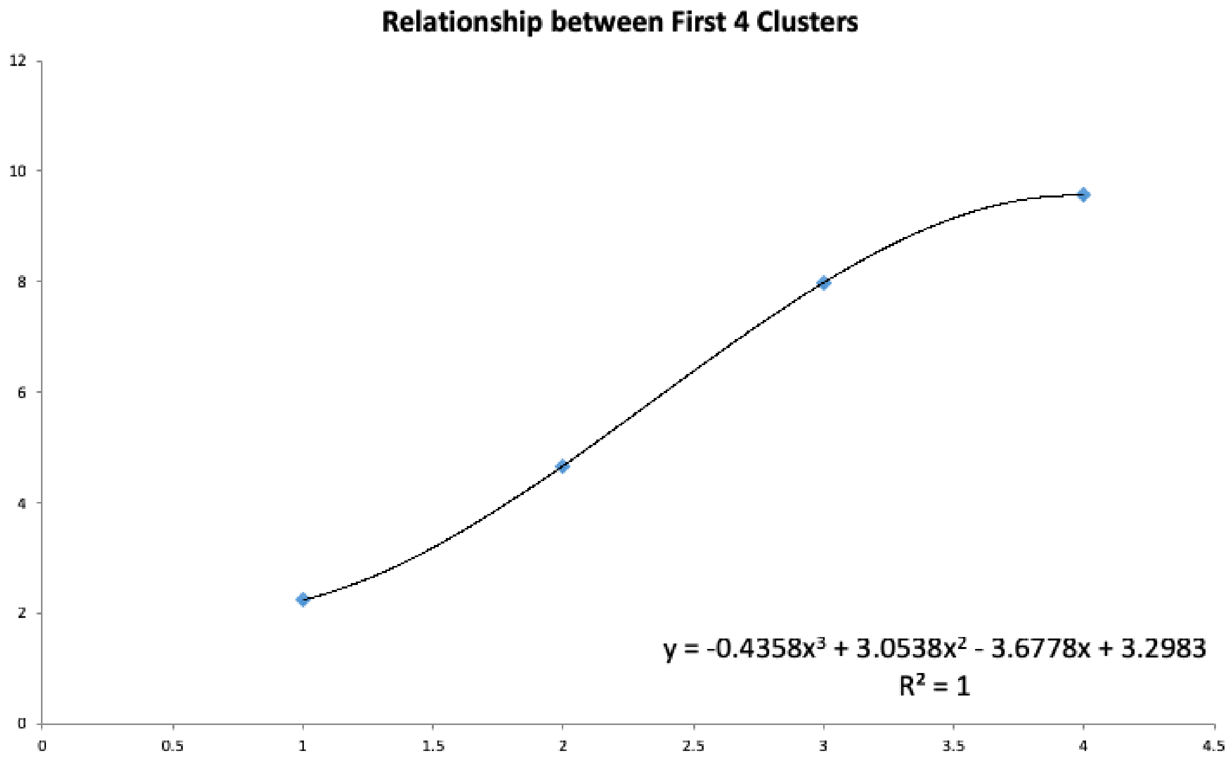

Figure 5. A graphical relationship between the first 4 clusters. A third order polynomial trend line was drawn with an R^2 value of 1.

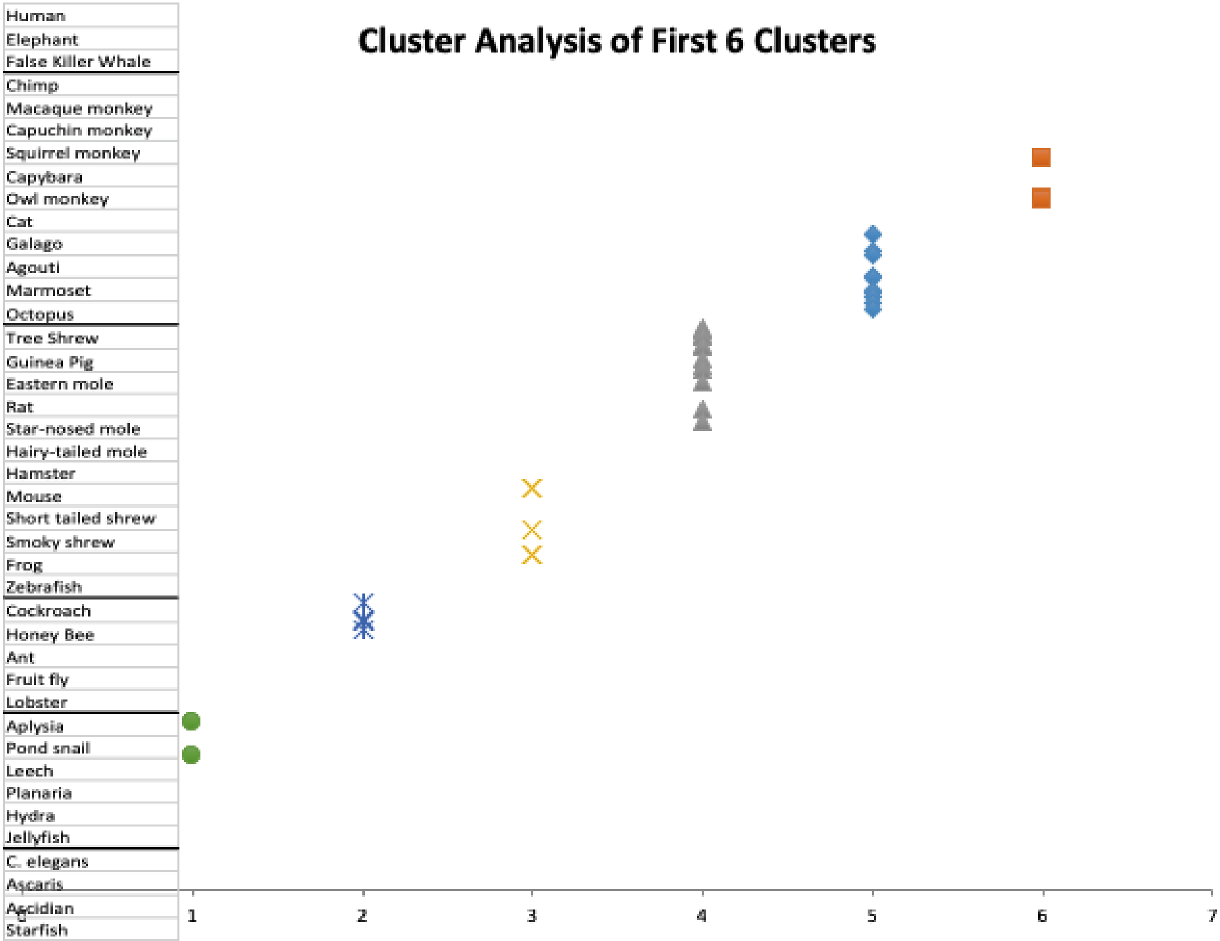

Figure 6. A graph of the first 6 clusters formed by the cluster analysis. The corresponding organisms in each group are listed on the left-hand side.

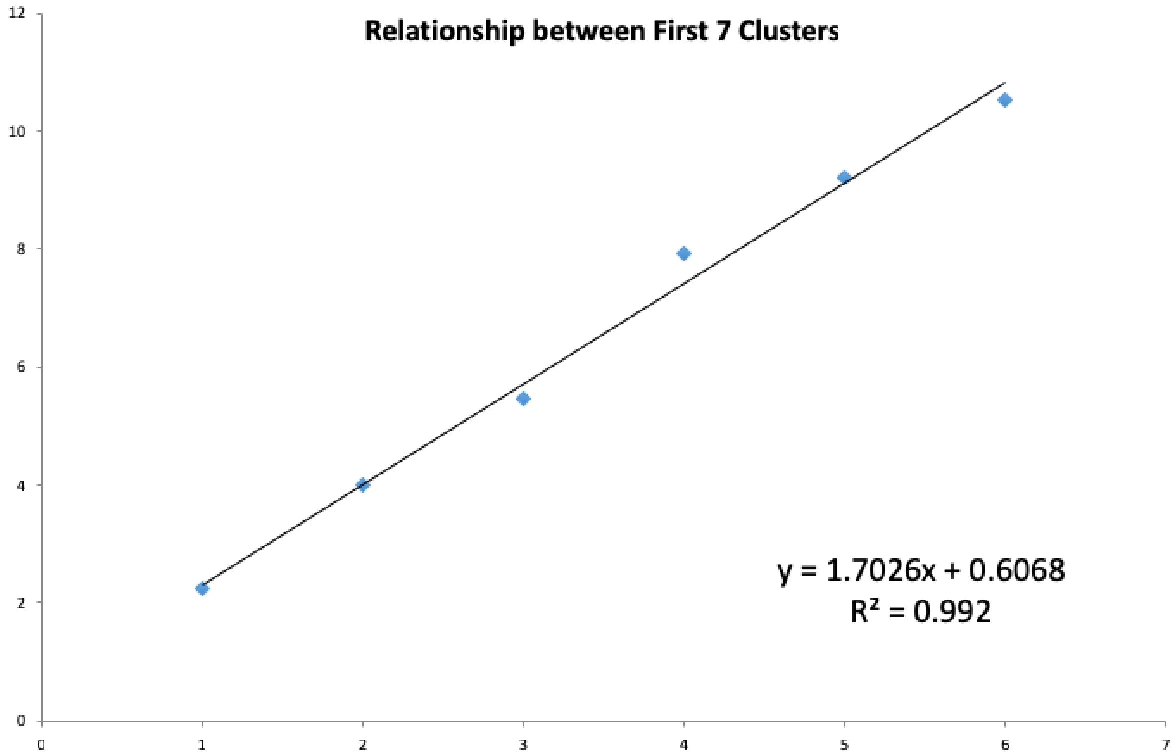

Figure 7. A graphical relationship between the first 6 clusters. A linear trend line was drawn with an R^2 value of .99.

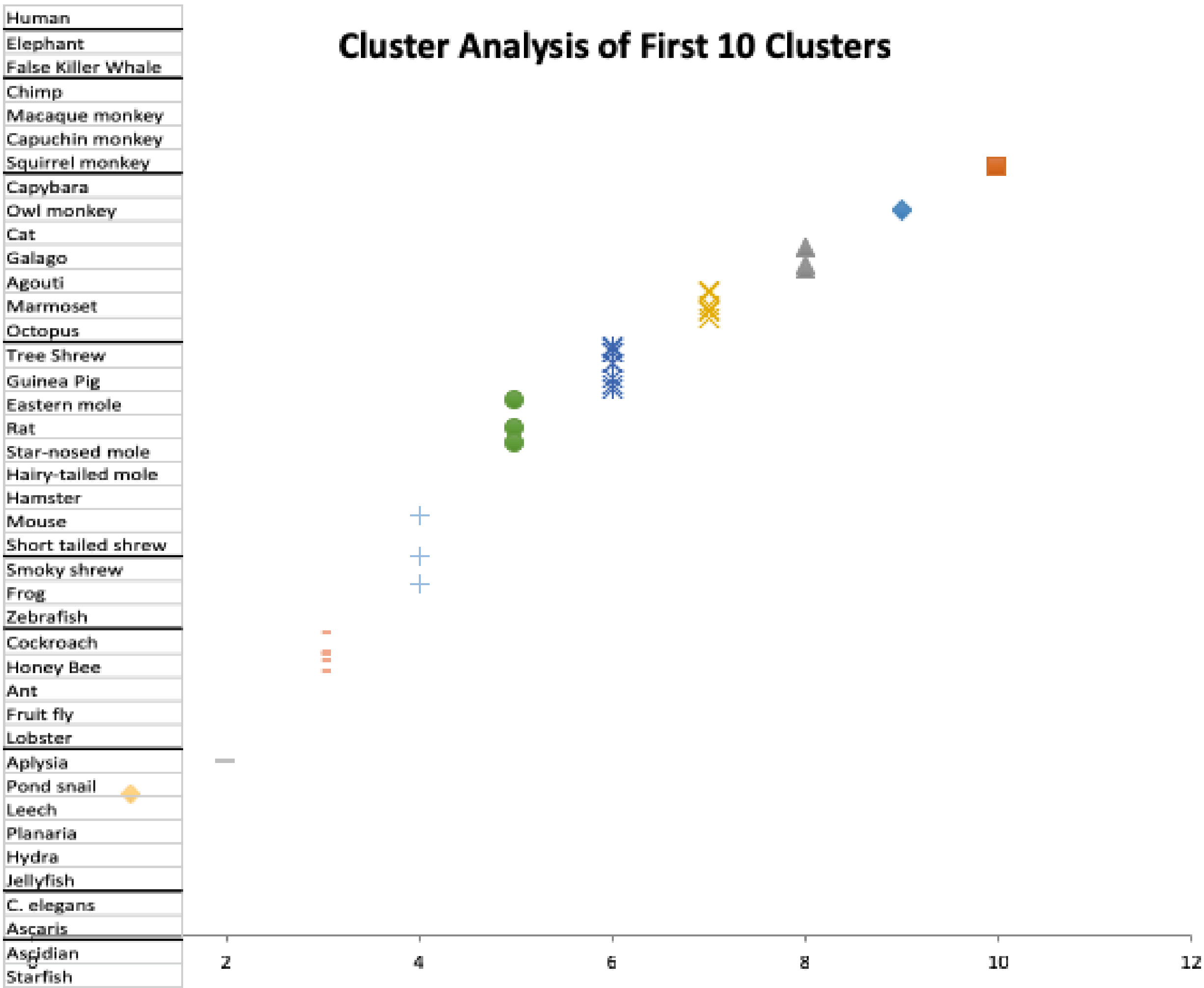

Figure 8. A graph of the first 10 clusters formed by the cluster analysis. The corresponding organisms in each group are listed on the left-hand side.

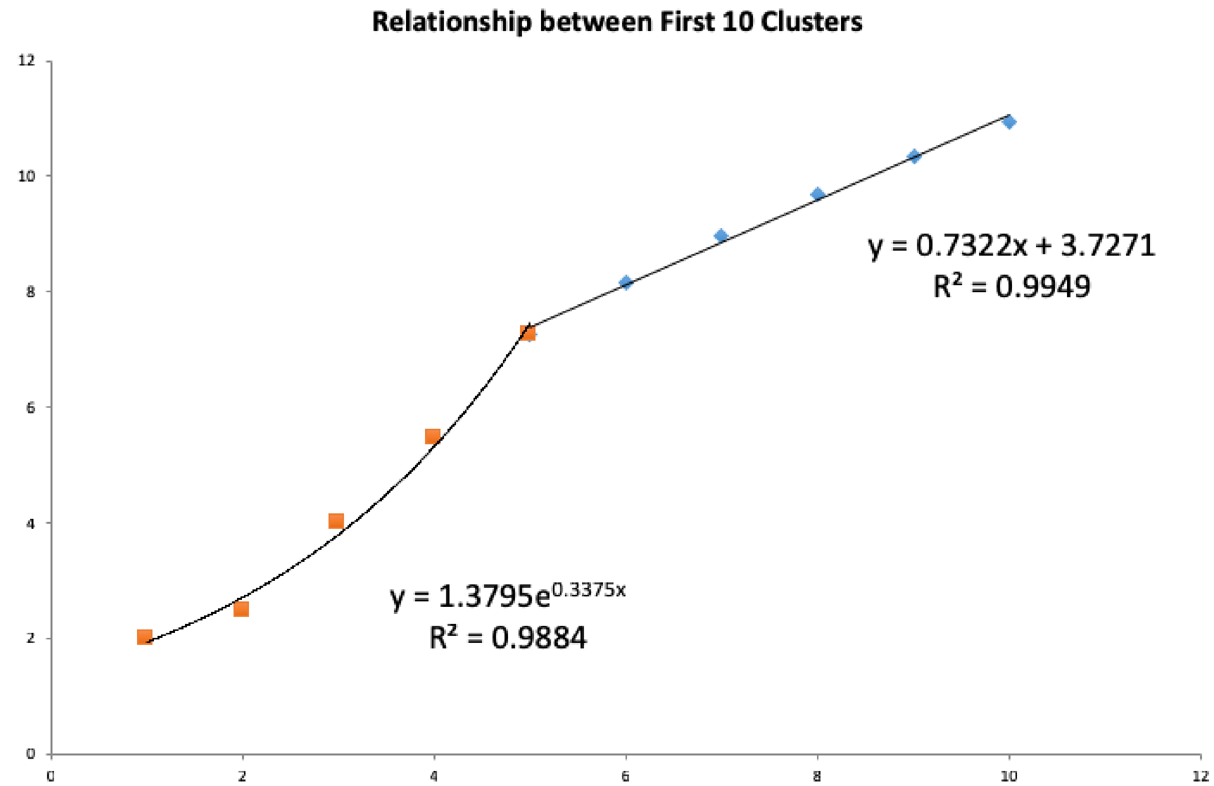

Figure 9. A graphical relationship between the first 10 clusters. Two different trend lines were drawn in order to best approximate the data. The first trend line is exponential and corresponds to invertebrate organisms. R^2 value is .988. The second trend line is linear and corresponds to vertebrate organisms. R^2 value is .995.

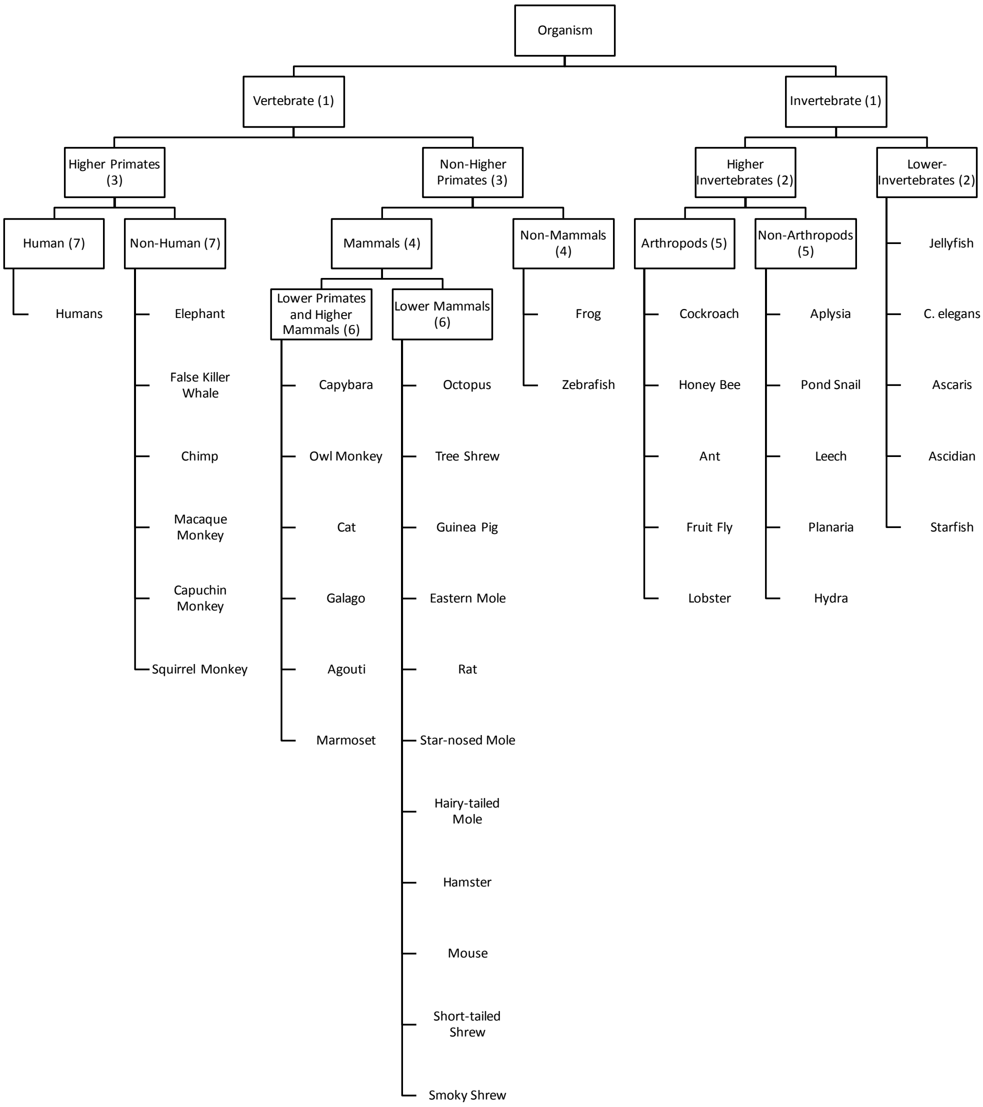

Figure 10. A visual representation of the cluster analysis performed in reverse. All organisms began in one large group and then were broken down into smaller groups. Numbers indicate the order in which groups were formed. Invertebrates split from vertebrates first. While humans split off from the higher primates last. This analysis was repeated until every organism was split into a separate group. The final result is not shown.

3. Discussion

3.1. Analysis of the Cluster Analysis

The comparison of the data gathered to Benford’s law is a crucial first step. This demonstrates that the dataset compiled is large enough to be considered reliable. Because the dataset likely reflects natural patterns, further analyses could be performed on it.

At present, there is no accepted taxonomy of conscious organisms. In order to categorize the results, groups were named based on the evolutionary similarities of the members in each group. Because this method does not accurately reflect the kind of consciousness that each organism has, there are several exceptions. This indicates that the attempt to assign evolutionarily-determined phylogenetic categories to groups of organisms with similar degrees of consciousness may be inadequate. An organism may have evolved to be equally as conscious as another, even if it emerged from a different evolutionary path.

The first result of the cluster analysis divided the organisms into two groups: vertebrates and invertebrates (not shown). This is true of all organisms, except for the octopus, which is an invertebrate, but is grouped as a vertebrate. One prominent difference between vertebrates and invertebrates is that vertebrates have myelinated axons while invertebrates do not. The myelination increases the speed of neural communication in the vertebrate nervous system. The third cluster made a division between invertebrates with a brain and those with a neural net. The only exception to this is the hydra, which has a neural net, but is grouped with other organisms that have a brain. The fourth cluster that forms is between primates and other types of vertebrates (Figure 4). There are four exceptions that occur in this group. The cat, capybara, false killer whale, and elephant are classified as primates, although evolutionarily they do not belong in this group. When viewed together the first four clusters fall along a sigmoid curve (Figure 5).

The fifth cluster that forms separates humans, false killer whales and elephants from the rest of the primate group. The sixth cluster separates the arthropods from the other invertebrates. The seventh cluster that forms separates the jellyfish from C. elegans, ascaris and the starfish. At this point, it is difficult to determine whether to the cluster analysis is forming meaningful groups or if the divisions are becoming too subtle to be useful (Figures 6 and 7). The cluster analysis was carried out until 10 groups had been formed and graphed on a scatter plot (Figure 8). Although graphing four groups produced a sigmoid curve, graphing the data from 10 groups shows that two different tends emerge (Figure 9). The invertebrates, which have unmyelinated axons increase their number of neurons exponentially, while the vertebrates, which have myelinated axons only increase their numbers linearly. This relationship might provide insight on how the speed of conduction relates to the computational power of the nervous system.

A second cluster analysis was carried out in the reverse direction from the first cluster analysis. In this analysis, each organism began in its own group and was merged with other groups until all organisms belonged to one large group. Cluster 8 was taken to be the best representation of the data and is shown in Figure 10. This cluster analysis yielded similar results to the cluster analysis in the forward direction. Vertebrates were separated from invertebrates. Invertebrates were divided into arthropods, invertebrates with a brain and the hydra and lastly invertebrates without a brain. Vertebrates were divided into non-mammals such as the frog and zebrafish, non-primate mammals and the octopus, lower primates and the capybara and the cat, higher primates and elephants, and finally humans. These clusters follow the phylogenetic classification of organisms, but do not do so completely. Octopus have been shown to have superior intelligence when compared to other invertebrates (Fiorito, Planta, & Scotto 1990). The octopus is an interesting anomaly within the invertebrates.

An explanation is required to justify the use of the predicted number of neurons in the elephant brain instead of the measured number (Herculano-Houzel 2009). The prediction used is based on the scaling up of a rodent brain so that it is the size of an elephant's brain. Although this prediction is smaller than the number of neurons measured in the elephant brain, 97.5% of the elephant's neurons are found in the cerebellum (Herculano-Houzel 2009). The human cerebellum only contains 80.2% of the neurons (Herculano-Houzel

2009), while the cerebellum of the mouse contains only 62.2% of the neurons (Herculano-Houzel, Catania, Manger, & Kaas 2015). The cerebellum is not as involved with consciousness as is the cerebrum. Rather the cerebellum is involved with the processing of unconscious stimuli that are important for motor coordination (Doya 2000). Because of the large size of the elephant, more neurons are required for motor coordination. A measurement of the number of neurons in the minke whale will be published soon (Herculano-Houzel via personal communication on 4/5/16). Because the minke whale lives in water, it may require fewer neurons that are dedicated to motor control. A separate analysis of only the cerebrums will need to be performed in order to separate the contributions of the motor neurons from those of the sensory neurons.

3.2. Analysis of the Proposed Hierarchy

3.2.1. Stimulus Detection

What counts as a stimulus detection? In order to answer this question, detection method must be defined. The step in the process that determines whether an event is a detection mechanism is the existence of a transduction mechanism in the causal chain. For example, physically pulling on a propeller to start an airplane engine directly causes the engine to start and therefore lacks the need for any detection method. While, using a key to start the engine depends on the existence of a transduction mechanism in the causal chain. Removing the ignition is like removing the receptors on the surface of a neuron, while removing the spark plugs is like removing the neurotransmitters. Those that support quantum conscious want to be able to assign “proto-consciousness” to individual electrons. However, if you wanted to remove the detection mechanism from an electron, what exactly would you remove? If there is no detection mechanism that can be removed, then how are they able to detect anything? The theory put forth in this paper does reject the notion that electrons are able to be in any way conscious. The way in which electrons interact with the reality should not be considered a detection.

What exactly counts as a transduction mechanism? From the examples given above, the mechanism must be an analog to digital conversion. The key must be turned past a threshold in order to cause the spark plug to generate a spark. In the same way, after neurons depolarize past a threshold, they release neurotransmitters. This converts an analog input signal with many possible values into a digital output with only one value. Either the neuron fires or it does not. Either the spark plug ignites or it does not. This conversion from analog to digital allows physical phenomena to be converted to information about physical phenomena. One could say that electrons absorb energy in quantized packets and that this is somewhat analog or somewhat digital. But this still does not fundamentally change the phenomena. Using the propeller example above, if four people pulled on the propeller rather than one, the phenomena would not fundamentally be changed. The people pulling the propeller are still directly causing the propeller to move without using an intervening detection or transduction mechanism. Therefore, awareness cannot be assigned to quantum phenomena.

Another possible objection is that some might say that wave function collapse is the basis of this transduction method and therefore allows for quantum awareness. Unfortunately, this view reverses the causal direction. Wave function collapses are caused by observation; they do not lead to observation (Von Neumann-Wigner interpretation (Neumann 1955)). It is a contradictory statement to assert that consciousness causes collapse and that the collapse causes consciousness. To give an incorrect analogy, rain causes the ground to get wet and that the ground getting wet causes rain. This analogy shows that the causal chain does not proceed in both directions.

3.2.2. Sensation Production

A consequence of Higher Order Theories is that it is impossible for a sensation to exist in isolation: in the absence of a being that is able to experience it. An example to illustrate this point would be to imagine a creature that is capable of only being able to see the color red because it has a very specific receptor for the color red and the color red alone. This ability is independent of any other qualities that are inherent to light waves. It is important to note that it is very unlikely for such a creature to exist in nature, which is full of genetic variation and idiosyncratic protein expression. The haphazard organization of nature usually results in the production of either a single sensory receptor that is capable of discriminating between a range of sensory information within a single modality or of multiple sensory receptor subtypes, each responding uniquely to the stimulus and thus providing the contrast necessary for awareness. But if such an organism did exist, it would not be aware of the color red. Only once a second receptor type has been added can the creature distinguish between different colors, resulting in a unimodal categorization of sensation and the simultaneous awareness of both colors.

Now we must ask, why has awareness not occurred in the first step of the hierarchy, but has appeared in the second? In order to explain this, reference must be made to Ludwig Wittgenstein's discussion of private languages (Wittgenstein 2010). Wittgenstein argues that there is no such thing as a private language. The existence of a language known only to a single individual is nonsensical. The reason being is that languages are necessarily shared between individuals. Neurons also cannot have a private language. Only once a comparison can be made can the presence of a stimulus enter into awareness. Even though at this stage of consciousness sensation is not present in awareness, it can nonetheless affect behavior. The production of a behavior in response to a stimulus cannot be used as a conclusive test for determining that an organism is aware of its environment. In this situation, the pain generated may only be a stimulus detection and therefore, does not actually enter into awareness. The need for comparison explains the hierarchical organization of nervous system that is correctly described by Higher Order Theories.

Experience is the ability of an organism to transform stimulus detection into sensation. The production of sensations is the result of integrating multiple stimulus detections. This stage of consciousness only allows for awareness of the present moment. Since it solely depends on, and is directly linked to which neurons are being activated in the present, it is not possible to be aware of sensations experienced in the past. The ability of a brain to produce sensation first requires that a stimulus be transduced into information that the brain can use: into biological methods of communication between neurons, such as action potentials and chemical signaling. In humans, photoreceptors detect the presence of photons and allow for the sensation and awareness of light. However, when a sensory neuron is activated in isolation from the rest of the nervous system, it does not produce an experience.

The reason that Higher Order Theories of consciousness correctly describe consciousness is that consciousness requires two steps. The first step is stimulus detection, while the second step is the detection of the information created as a result of the stimulus detection. Information does not exist in the external world, but is about the external world. In the same way, sensations are about the external world, rather than being found in it. Any detection mechanism that only has one step cannot be aware of the information that is produced as a result of the detection. This mechanism is correctly described by Higher Order Theories. Consciousness is information detection.

3.3.3. Categorization

Categorization is the ability of an organism to determine which sensations are of the same sensory modality. Although the sight of red produces a different sensation from the sight of blue, both of these have the commonality that they are both colors. Each color corresponds to a different wavelength of the electromagnetic spectrum, but nonetheless, all are fundamentally only a wavelength of light. Even when shown a completely new color, any person could identify the entity as being a new color and that it belongs in the category of colors.

In order for an organism to be aware of a specific level, at least one mental state must exist at the next higher level. The arrangement of sensations into categories is necessary in order for an organism to be aware of potential sensations. The categorization process occupies the level above sensation production. Categorization begins when a stimulus activates a distinct set of sensory receptors. This distinct pattern of sensory receptors then activates a specific set of primary sensory neurons. The specific pattern produced by the primary sensory area then activates a specific unimodal association area. This produces a unimodal category. If this unimodal association area represents the category of color, then this area will only be activated when photoreceptors are exposed to a stimulus that possesses the features that are common to all colors. All other patterns of neural activation that are produced by stimuli that do not have the characteristics of color will not activate the brain area specific to the category of color. This level of consciousness allows for awareness of only the past and present. In order to categorize what is currently being experienced, the brain must compare it to what has been experienced previously.

In addition, humans only possess photoreceptors for the red, green, and blue portions of light. Then how do we see the secondary colors, yellow, orange, and purple? In the categorization level, the nervous system is able to take combinations of sensations and convert them into distinct sensations that were not directly detected. For this reason, consciousness is not completely reducible to its fundamental sensations. Each level of the hierarchy adds information which is not found in the lower levels of the hierarchy. Prediction is similar to categorization, except that it is concerned with the future rather than the present.

3.3.4. The Self

The self is a prediction of what we would expect ourselves to do in a certain situation. This explains how someone could say, “I was not being myself” and begs the question, then who were they being? From everyone else’s point of view, they were the same person, except that their actions may have been out of character for that person. This raises the possibility that there was a difference, not in how they acted, but rather in how they thought they would act. These predictions run against that person’s notion of himself or herself and are attributed to an error in action rather than a fault in oneself. The self can adequately be characterized as a prediction of one’s actions in a given situation. Actions in line with this prediction are considered to be purposeful and willful, while those that go against it are deemed to be errors from the unconscious or influences external to one’s consciousness, such as peer pressure or groupthink.

3.3.5. Superhuman Consciousness

This level of consciousness is not currently accessible to humans. It requires knowledge derived from the experience of multiple selves. This level will be called the Epiself. This level is analogous to the example in which the color red was imperceptible to an organism that only has a single receptor for the color red. In the same way, it is impossible to even speculate on what type of information this level can hold. Not only is it composed of information that humans do not know, it is composed of information that humans cannot know.

3.3.6. Information

This article also demonstrates that a clear distinction needs to be made between awareness and mere detection. Awareness is the detection of information. Without conscious beings, information would not exist. Because information is about entities in reality, conscious beings are needed to assign that information to entities in the world. The consciousness hierarchy shows that not all information is made equal. The complexity of the information contained in the level of unimodal categorization cannot be completely reduced to the information present at the level of sensation. New information is created when multiple sensations are compared to each other. The color yellow does not result from the activation of a yellow photoreceptor. Rather, it is the result of simultaneously activating both red and green photoreceptors. Lastly, the amount of complexity that a set of information holds is dependent on more than the amount of information present. Complexity is also dependent on the content of that information. The comparison of multiple sensations produces a unimodal sensory category and the comparison of multiple perspectives produces a self. Merely knowing the amount of information present will not lead to the correct calculation of complexity. The content of the information must also be taken into account.

4. Conclusion

One problem with Higher Order Theories of consciousness is that they do not adequately explain how the consciousness of non-human animals is different from that of humans. This article proposes that mental states can be organized into a discrete hierarchy. From lowest to highest, the levels in the hierarchy are sensation, unimodal categorization, multimodal categorization, emotion, perspective and the self. Although these levels are the only levels known to exist, it is reasonable to expect that an increase in computational power could produce the predicted Epiself.

The machinery necessary to produce each level of consciousness will be discussed in another paper. The next paper will also address the concerns of epiphenomenalists by showing that in order to have certain cognitive abilities, a conscious being must be aware of certain types of information. In addition, there is distinct set of machinery that is necessary before an organism can be aware of each type of information. The function of consciousness is to produce information that will allow an organism to modify its behavior so that it can adapt to a changing environment. The characterization of consciousness in this article and the next may help lead to the development of artificial forms of consciousness.

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