# The Physics of Zombies II: Madore's Rules of Zombie Vision and Visual Target Confirmation

David Madore [1], Robert Madore [2]
1. The Necropology Institute, Email: david@necropology.com
2. The Necropology Institute, http://necropology.com

*JOAN: The Journal of American Necropology*, 2011, I (I): 20-35
This file version: July 15, 2011

## I. Abstract

Madore's Rule of Zombie Vision states that zombies do not abide by a dress code when picking their targets. Zombie vision is broader in its available spectrum than human vision and is more effective at night than normal, human vision. Atomic and molecular changes in the makeup of the pigment rhodopsin, present in both humans and zombies, have been identified as the means by which zombies have a broader spectrum of vision than humans. Zombies target human shaped objects if said object also has human infrared heat signature. Zombies can detect life visually.

**Keywords**: Necropology, Zombies, Vision, Madore, Rhodopsin, Biophysics, Infrared

**Content:**



## Preface

We encourage readers to read our first paper "The Physics of Zombies: Madore's Rules of Zombie Cohesion…." before reading this one. While it is not *essential* to understanding and enjoying this paper, it will be helpful as we will use terms and concepts that are drawn from our previous research. The paper is available here: www.scribd.com/doc/57439058/

## 1. Introduction

We believe we have solved the riddle of how a zombie can tell the difference between a live human and a fellow zombie by visual signals alone. First, we must understand what it is that we mean by "zombie vision", we are all familiar with the following phenomena:

A) A zombie stands in the middle of an empty road at high noon. A human steps out of a doorway and into the road a hundred feet away. The zombie turns in the direction of the movement and spots the human. The zombie gives chase and begins giving off "prey alert signals" as he chases down the human.[1]

B) A zombie mills about with twenty other zombies, no prey alert signals are being sent or received by the group. A lone human walks around the corner and smack dab into the middle of the group. All zombies turn and identify the human as prey and begin to attack.

C) A human waits to leave his hiding place in the middle of a crowd of zombies, the closest zombie being fifty feet away, when he leaves his hiding place all of the zombies that have line of sight to him and are looking his way. They do not shout "hello, friend", rather, they immediately give chase so they can bite his face off.

How do zombies do that? How can a zombie differentiate between a human and a zombie with just a glance? How can a zombie pick a human out of a crowd of zombies? Is there anything that can be done to mask or disguise yourself so that a zombie cannot tell that you are not a zombie?

Those are the questions that we mean to examine in this paper.

It is important to note that we are not concerned with the other four (or more?) senses that a zombie may have, or utilize, in its hunt for prey. While it may be true that zombies use a combination of senses in detecting prey, this paper focuses on the transmission of signals that must be occurring when a zombie has only his (or her) vision alone in determining the authenticity of prey.[2]

Indeed, this paper recognizes the following axioms about zombie vision:

A) If necessary, a zombie can tell the difference between a fellow zombie and a human using vision alone.
B) There must be something in the visual signal that a zombie can utilize to discern that even though an object is shaped and/or moves like a zombie, it is actually a live human.

---

[1] Told you so! Read the first paper first! Prey Alert Signals are covered in depth here: http://www.scribd.com/doc/57439058/

[2] Again, concepts such as "authenticity of prey" coming from "true signals" are discussed in depth in our other paper. Briefly, however, we mean the ability of a zombie to distinguish true prey from false signals it may believe emanate from prey that actually belong to non-human sources.

We mean to examine just what it is in "B" that allows the zombie to unerringly target a human when they are spotted. We will now examine "morphology" and whether or not it provides sufficient information for a zombie to decide "friend or foe" when looking at a human.

## 2. Target Morphology

Morphology, defined, is **the form or shape of living organisms** (and, in our paper, it includes undead organisms.)

Basically, morphology means "how animals, tree leaves, people, dogs, cats, birds, fish, amoeba, etc. look like to others."

When a human being targets another creature he often relies on morphology.

For example, when a hunter enters the woods, he might be looking for a 10 point Buck deer. The hunter can tell the difference, by sight, between a deer and a raccoon, a deer and a tree, a deer and a helicopter. He can also further refine his morphological parameters and tell a doe (a female deer) from an older, 10 point buck (larger, male deer.)

When looking for the large, male deer, the hunter is looking for body size, the number of projections on his antler set ("points") and other pleasing and desirable characteristics (pleasing to the hunter.)

On his walk through the woods, the hunter may see many deer that day, and choose not to take one until he finds "the right one." The "right one" will be defined by the morphology of the deer – it is based on what the deer looks like to the hunter.

It is therefore natural to assume that zombies would likewise follow their human kin[3] in utilizing morphology in determining the suitability of prey. It is assumed that a zombie can look at a human and instantly tell its "zombie/non-zombie" status based on how closely it resembles a fellow zombie.

We now must ask a serious question: In plain terms, does a zombie make its decision about attacking a human because the human "looks human and not like a zombie?"

Our belief is that a zombie *cannot and does not rely on normal-vision morphology alone in determining that what it is looking at is prey*.

Imagine if you will, a well-kept Wall Street Executive. He is young, in great physical condition and is immaculate in his grooming and clothing. He buys high-end clothes, has his hair done at the finest shop and there is never a speck out of place. One day, as he

[3] We are well aware that some readers are offended at the notion of "zombie kin" and that they are in anyway related to the living. That is foolish. They come from us and in a very true sense, they ARE us.

steps out of his limo and into his high-rise apartment building, he is bitten on the pinkie by what he believes to be a "crazed child". It is just a scratch, barely bleeding, so, instead of going to the doctor he retreats to his medicine cabinet, takes a sedative and falls asleep on his feather bed while still wearing his expensive suit.

During the night he succumbs to the scourge and turns into the undead. When he rises as the undead in his apartment, his hair is still combed, his clothes are still neat and the only discernible change is that he has a terrible pallor to his skin and eyes. The only "wound" he has is a small one on his pinkie.

Does *HE* look like a zombie? **NO**, but he *is* one. So, now…

Imagine if you will, a crazed homeless man. He has not washed in several years. He is caked with dirt, grime and his clothes are in tatters. He has scars on his face from living on the street and getting into fights, being mugged and doing some mugging himself. He has several diseases and receives no health care, his sores are running and he has a terrible pallor to his skin. His teeth are rotten, craggy or missing and they only serve to highlight his head which is topped with hair caked in dirt where it is not falling out. He has never been bitten and he only has normal, human diseases. [4]

Does *HE* look like a zombie? **YES**, but he *is not* one. So, now…

If the Wall Street Executive stepped out of his apartment and made it to the streets after turning, he would NOT be attacked by his fellow zombies. They would look at him and determine his life force as non-existent and leave him alone. He would absolutely pass as a zombie, despite being well dressed, manicured, hair in place and having a small barely discernible wound on his finger.

If the crazed homeless man stepped around the corner of the executive's apartment building and walked into a zombie crowd, they would immediately tear him apart as he is a human. He would NOT pass as a zombie despite looking like a zombie, with his wounds, missing teeth, and torn clothing.

If one were to change "crazed homeless man" to a burn victim in hospital bed, or a prize fighter after a hard fought fifteen round championship fight, or a stabbing victim with half his face torn off in a knife fight, and presented them all to a zombie, the outcome would be the same: a zombie can tell the difference between a living human being and a zombie by looking simply looking at them.

A zombie will attack a *living* burn victim. A zombie will attack a bloody, scarred up and beaten, but *living* prize fighter. A zombie will attack a cut up *living* human with half his face hanging off. Wounds and scars and horrible visages do not make you a zombie to other zombies!

[4] Obviously we are not making a statement about the homeless population in general! In fact, some homeless people are very nice, wonderful and creative. In fact, the Buddha was homeless for most of his life. On with the show!

Zombies do NOT have a dress code. Not even a "reverse dress code" where if you look disheveled enough that a zombie will pass you by as unappetizing. One cannot fool a zombie by dressing like them, having scars like them, having wounds like them, etc.

The prize fighter, the homeless man, the burn victim only superficially resemble zombies or victims of zombie attack (and hence soon to be zombies) *to other humans*! **Humans do not look like zombies to other zombies; they look like humans to the zombies**.

While a human relies on morphology to tell what things are visually, a zombie must be seeing something beyond what humans see when they look at each other. There must be something else involved in zombie vision when they look at a crowd of humans, all with human shapes and characteristics and yet unerringly picks a living human out of the assembly.[5]

Why? How?

### 3. Target Heat Signature

What else is there that could be transmitted visually from a human to a zombie's eyes that provide the difference? What is a major difference between a live human and an undead zombie?

We believe the answer lies in the temperature and heat signature of the human that the zombie is observing. The dead and undead are generally speaking, not the same temperature as a live human. A live human's temperature is approximately 98.6° F (37° C) whereas a zombie's temperature approximates the ambient temperature of its local environment.

We believe that zombies have a mechanism whereby they can receive, process and act upon the difference in heat signatures between living humans and zombies. We do not arrive at that notion lightly! We have already discussed *and dismissed* the notion that it is simply an observation on the part of the zombie that "well, he looks like and must be a zombie because he is a banged up human." There is something deeper.

At this point it might be instructive to return to the originating observation of this paper, namely, that zombies *must* have some mechanism for simply seeing a human from a distance and accurately discerning its life status. A zombie can simply see a person and tell their life state. There must be some aspect of the human that is being transmitted (or

[5] *Mea Culpa* time! We suggested in our first paper (http://www.scribd.com/doc/57439058/) that zombies might be fooled by mechanically powered mannequins in a store window. We also suggested that more work needed to be done on zombie vision. At the time we did not realize that the latter would so affect the former! Obviously a zombie will not be fooled by a mannequin OR a person dressed as a zombie. This does not change any of the axioms of the first paper, it simply refines them. That is the great thing about science; when the truth comes out you need to set the record straight. At least WE found the error before the error found us. The field of knowledge constantly expands! Read on, explorer, read on!

available for a zombie to decipher) from the human to the zombie's ocular faculties that only zombies can see, interpret and act upon.

In plain and simple terms, zombies MUST see something we humans do not normally see.

The difference in heat signatures between zombies and humans is obvious. Humans generate and radiate heat all over their bodies. This radiation is observable in the infrared spectrum and we believe it is the essential part of target confirmation a zombie utilizes in making prey attack decisions.

Is there anything out there that backs the notion that zombies can see infrared signals? Do zombies have the capability to see infrared signals with their zombie eyes?

**4. Rhodopsin**

This paper contains a fact that will come as a surprise to many:

*Humans can see in in the Infrared spectrum – we have IR "heat vision!"* [6]

That is right folks, humans have IR vision! We can see in the IR spectrum, however, we can only do so for a few *femtoseconds* [7] and only after we have had our eyes closed for approximately thirty minutes. Humans produce a chemical pigment called "rhodopsin" that allows our eyes to have monochromatic (black and white) heat vision in low light/no light conditions.

**How it works in humans…**

When we see objects we are actually seeing either the light reflected off an object from a light source or radiating from the object itself. *In the first instance*, simply imagine the light source being the sun. We do not see objects directly; rather, we see the light source coming down and then reflecting off the object and on to our eyes – reflected light. *In the second instance*, simply imagine the filament in a light bulb or an incandescent light bulb – the light we see is coming directly from the object – radiating light.

When the light reaches our eyes it is either absorbed, or reflected, by the pigments in our eyes. Different pigments respond to different wavelengths of light. The pigments, when

[6] "Heat Vision" is a bit of a misnomer. All light is capable of producing heat. Humans, however, mostly experience heat from light, or light as heat, from infrared waves. We feel heat due to the IR waves causing molecular excitation and movement in our bodies and our nerves respond. Thus, we are using "heat vision" interchangeably with IR vision. We chose to do this so as to avoid the dreaded term "night vision" – IR vision is not night vision alone, as there is ample IR during daylight hours. The confusion comes from the fact that many "night vision" devices utilize IR as the light source – all squares are rectangles, but not all rectangles are squares.

[7] A femtosecond is an extremely small unit of time. A femtosecond is $1^{-15}$ or .0000000000000001 of a second or one quadrillionth of a second. So, that's not long at all! Yet it is still longer than any of us want to be face to face with a zombie.

struck by the specific wavelength of light that they respond are "photo-excited" and send a signal to the brain that said wavelength is present. The brain interprets this signal and creates an image in the brain from a composite of pigment signals from the eyes.

Healthy humans have many types of pigments called "ospins" in their eyes (e.g., photopsin I, photopsin II, photopsin III, melanopsin). These are the basic molecules and pigments associated with normal vision. Various layers of our eyes and the rods and cones of the eyes are filled with these pigments. As mentioned, depending on their chemical make-up, they absorb, reflect or are affected by, various wavelengths of light. They are the chemicals that are light-sensitive and provide the chemical triggers that set off neuronal chain reactions that result in "vision."

This paper is mainly concerned with the rhodopsin variant of opsin. Rhodopsin is made up of a protein (ospin) and a chemically bonded non-protein (retinal). The retinal is chemically bonded on the atomic level, through a process called "covalence" – it is a tight bond, wherein electrons are shared and paired between the ospin and the retinal atoms, forming a new molecule – Rhodopsin.

Rhodopsin is unusual in its makeup and characteristics. Unlike other opsins, Rhodopsin, in humans, is photo-bleached immediately by direct light. Meaning, it is rendered useless by direct light and it takes up to thirty minutes for the body to regenerate the molecules back to useful levels. This can only take place if the eyes are closed and there is no light leaking in to the eyeball. It simply does not last long enough for it for it to be useful to us in our normal vision processes.

However, during its brief life it provides an amazing ability to humans. We can see infrared waves of light from both reflection and radiation sources! As the rhodopsin is in the rods of the eyes, we can actually make out distinct shapes, patterns with the clarity of normal vision despite the light source being from what we normally consider invisible to us. The problem, for humans, is that it simply does not last – we do not receive constant updates about the light being emitted in the IR spectrum as our rhodopsin is photo-bleached almost instantly and with a long recharge time. Were that not the case, we would be able to see fairly clearly in IR and the normal light spectrum.

We, humans, *do* indeed have "heat vision" wherein we see objects clearly and distinctly by the heat either radiating from them or being reflected by them. Unfortunately our "heat vision" ends within a femtosecond upon opening our eyes.

We have already discussed the fact that zombies must have extra-senses beyond the basic human vision, how then does rhodopsin work in a zombie to give them that "extra edge?"

**How it works in zombies…**

We believe that rhodopsin, in zombies, is present in a higher level and/or different state than it is in living humans.

Given the phenomena's importance and its introduction into the world of Necropology, we are going to be extremely technical on the details in this sub-section:

First, let us begin with an analysis of the stages rhodopsin goes through in a human before it becomes unusable for heat vision (you may safely skip "The Science" sections below and move to each "The Summary" section if you do not enjoy physics and molecular chemistry):

**The Science:** The rhodopsin is present as a red/blue pigment that undergoes photoisomerization in approximately 200 *femtoseconds*. After photoisomerization, a second chemical appears, namely, bathorhodopsin. Bathorhodopsin represents a distortion of the trans-covalent bonds. Regeneration takes place in approximately thirty minutes and requires relative darkness. As the pigments are red/blue they are reflective of that color spectrum and red light decreases the impact of photoisomerization providing longer term signaling from the opsin. Essentially, the rhodopsin is unaffected by the red wavelengths, including the infrared spectrums.

That's it, back to the straight talk….

**The Summary:** If you have rhodopsin in the rods in your eyes, you can see objects in the IR spectrum. The pigment, like the other pigments in the eyes, is an essential part of what gives us vision.

### 4.1 Heat-Vision-Blind Zombie Paradox?

The astute reader at this point already knows where we are going with all of this: we are saying that zombies have rhodopsin in the rods of their eyes and thus they can see in IR/heat vision!

However, the astute reader is also likely asking a tough question:

IF rhodopsin is photo-bleached in *femtoseconds* and the average person is walking around with eyeballs full of bleached (and useless) rhodopsin, wouldn't they also be in that state when turned into zombies? That is, shouldn't zombies be as heat-vision-blind as the average human? Yes?

Nope.

Rather, we believe rhodopsin production, utilization and stabilization in zombies follows this progression:

1) Production increase prior to transformation from human to zombie
2) Rod inversion
3) Neo-Rhodopsin is locked in to a non-bleachable, "undead" state.

First, let us examine notion one: *production increase prior to transformation from human to zombie.*

**Why it matters?** In order for Zombies to have the heat vision that they have, they must have more rhodopsin in their systems than humans normally have.

**The Science:** We believe that there is an increase in the production of rhodopsin during the viral/bacterial transformation. We have strong standing in this argument; the source of the production is the only controversy. Bacteria actually produce forms of rhodopsin for their own use! They are called "bacteriorhodopsin" and they work the same as regular rhodopsin in photo-trophy (at least as far as the bacteria are concerned)! The rhodopsin present in zombies is a result of bacterial chloride pumps that produce bacteriorhodopsin that have a G-protein receptor that allows bonding with human proteins. The only question that remains is whether or not the bacteriorhodopsin is actually a "vira-rhodopsin" from the primary viral infection, or from a bacterial "free loader" conditioned to feed on the virally undead. [8]

**The Summary:** We believe that there is an increase in the production of rhodopsin during the viral/bacterial transformation when humans are bit. Either the virus itself carries the capacity to create rhodopsin or it comes from bacteria that utilize a virally infected person's body as a playground. Six of one, half dozen of another – the suckers have rhodopsin to spare!

Now, let us examine the second notion: *Rod Inversion*

**Why it matters?** Zombies display very fine-tuned heat vision, this is normally associated with a rod inversion in mammals. Rod inversion in zombie eyes would account for their superb visual IR acuity and for the observed phenomena of eye/eye color change seen by witnesses during a transformation.

**The Science:** Mammals and zombies that have superior heat vision also have inverted rods in their eyes. [9] Or, more precisely, the "inversion" is actually a swap of the heterochromatin to the center of the nuclei for the euchromatin (and other transcription factors) that get pushed to the edges of the nuclei. This inversion actually happens after birth in normal mammals and is thus, fully probable as a result of the "birth" of a zombie due to viral transformation. This makes sense. Coupled with the possibility of chloride pumps (bacteriorhodopsin makers) AND/OR increased neo-rhodopsin production from the host, there is a likely supplanting of normal rod configuration via nuclear bond corruption. There also seems to be a thickening of the outer nuclear layer in zombies, this makes total sense as that allows for "focusing" – it allows for the photons coming

[8] It does matter. One implies that the virus itself creates things, that zombies are still "alive." The other implies that the bacteria can live where nothing else does. Zombies never cease to amaze us.

[9] A zombie's eyes are not perfect for IR vision. Humans lack the *tapetum lucidum* layer on their eyes. This is an extra layer of protein that distorts (improves) the focal length and allows for better photon gathering. It is also why animals' eyes glow in the dark when light is shined on them – perhaps the reports of zombies with glowing eyes IS from some type of tapetum lucidum growth? However, "growth" and the undead do not normally go hand in hand, thus, we leave that notion to other Necropologists (for now.)

into the eye to pass through individual nuclei, as opposed to being scattered and incomplete visual profile being "visualized" in the zombie brain. The zombie virus is a dirty, dirty beast – it not only transforms normal flesh to necrotic flesh, it transposes nucleic properties! This means "de-zombification" is going to have to be done on even the smallest components of transformed humans. The virus seems to be all encompassing.

**The Summary:** The internal, very small structures in the eye that process what we see are altered in zombies. The rods in the eyes stay where they are, and how they are placed, however their nuclear makeup is inverted. The inversion of the makeup of the rods allows for better heat vision than humans have, plus, they likely have more nuclei to pass light through – thus seeing better. The same way a 20 megapixel color camera is better than a 5 megapixel black and white camera.

Now let us examine the final notion: *Rhodopsin, in zombies, is locked in to a non-bleachable, undying state.*

**Why it matters?** This is why zombies are not like humans whose rhodopsin bleaches and becomes unusable.

**The Science:** We believe neo-rhodopsin never reaches the bathorhodopsin stage; it remains unbleached even after photoisomerization. Obviously! We believe that the rhodopsin is preserved in the same way that the other zombie systems are maintained: in a state of anti-apoptosis, that is, where apoptosis, also known as "PCD" (programmed cell death), is suspended. During normal apoptosis, cells die and the fragments are engulfed and carried away by phagocytic cells (i.e., cell eaters that eat cells). We know that phagocytic cells are simply not working in zombies. They do not carry away dead cells, or their contents, therefore there is an abundance of cell fragment rhodopsin still sitting in the eyes. Arrested necrosis accounts for rhodopsin's presence (after build up) however, it does not account for its longevity in an un-bleachable state. For that, we turn to cofactors (coenzymes)! We believe the zombie transformation also carries with it a protein moiety, something akin to adenosine triphosphate (ATP) that alters the photophosphorylation of the pigment loaded cells. We believe that the pigment ("neo"-rhodopsin in zombies) is a cyclic photophosphorylation-type pigment, with the remarkable property of being both the recipient and causal factor in its own stabilization! That is, we believe the ATP both causes and is caused by its own photophosphorylation cycle! We believe it is "self-powering" in the sense that the light the eye receives is used to initiate a proton-motive force that itself catalyzes the ATP into action. [10] It is the ATP synthase that starts reinforcing the protein moiety itself and thus causes stabilization of the associated pigment. [11] The pigment, therefore, is just along for the ride.

[10] Well, not really "catalyze" since that's a real word in science with real meaning different than how we are using it for dramatic affect in that sentence. It sounds better than what we really mean which is "goad" – it goads the ATP Synthase into action. Yes, that's it, it GOADS it into action.

[11] We believe that the ATP synthase photophosphorylation is thermodynamically favorable on a macromolecular level. Try saying *that* ten times fast! We can't!

This is also what is likely occurring across the entire zombie cell spectrum, more research remains.

**The Summary:** The chemical that zombies use to see IR ("heat") is as long lasting and as durable as the rest of the systems that support their undead "life." It sticks around just like they do.

**Full Section Summary:** In essence, zombies have more rhodopsin (i.e. "neo-rhodopsin") in their eyes than humans do. It matters not whether a human was alive and full of bleached rhodopsin when they are turned; the virus increases levels, inverts nuclei and lasts a long time. No paradox.

Now, we must move on to how zombies take the heat signature information coming in to their eyes and combine that with the normal vision they ALSO possess to form a complete target confirmation loop.

**5. Target Confirmation: Normal Vision plus Rhodopsin Enhanced Vision (A+B=C)**

We believe that we have solved the riddle of how a zombie can spot a human in a crowd of zombies. We believe that a zombie uses a combination of morphology and IR to create a composite signal that both details the target's visible spectrum and IR spectrum morphology.

Wait, what? *Morphology* is important again?
YES! Morphology is critically important now.

We believe that zombies utilize TWO sets of morphological visual images when determining whether a target is legitimate prey or simply shaped like legitimate prey. Zombies do not see in just the normal visible spectrum we see in, they can also see in the IR spectrum *and* they can combine those two inputs when judging prey.

Humans see in a rather narrow wavelength range of approximately 390 nanometers (nm) to 750nm, with most sharp focus vision coming in the 500-550nm range. Zombies, meanwhile see in the 390nm-1000nm range! [12] The 700-1000nm range is considered "near to mid infrared" range – the same range as most "thermal imaging" cameras.

They not only see what we see, they see what we do *not* normally see.

Thus, when looking at a crowd of zombies with a human in the middle, they can draw upon the expanded vision to see the extra "essence" the human has a heat signature that deviates from the other members of the crowd. They see "cold" zombies and a warm human, or, if the zombies just walked out of a burning building, they see "cold" humans and warm zombies.

[12] Possibly higher! The rhodopsin/bacteriorhodopsin might be capable of 1000nm-1400nm absorption. Additional testing remains to be done.

At night, we are at a disadvantage when the zombies are on the prowl. They have better vision than we do during the day and much better vision than we do at night. During the day, they are essentially on even ground with us as our vision approximates most of their range, at night; however, the IR spectrum gives them a much broader range. They have both normal vision and IR vision, at night, one would suppose, that they would rely on their IR capabilities. They will see us coming long before we can see them.

So, great, zombies have "heat vision" and can see in IR as well as the normal visible spectrum? **Yes.**

So, that's fantastic! We can use that against them, right? We can throw a flare, start a bonfire, light a car on fire and they'll chase that, right? **Nope, won't work.**

**Morphology, morphology, morphology!**

We believe the formula for zombie target confirmation is utterly simple:

$PM = B\mu$

Where PM is the Panoramic Morphology, and
$B\mu$ is the background (or complete) IR seen by a zombie.

Panoramic Morphology is another term for "the whole vista, what a zombie sees when looking at the world."

Target detection is therefore also quite simple, as follows:

$\Delta PM = (B\mu + T\mu) / (B\mu - T\mu)$

Where $\Delta$PM is change in Panoramic Morphology,
$B\mu$ is background infrared, and
$T\mu$ is target infrared

Zombies are looking for $\Delta$PM, changes in the IR, when viewing the world. This could be said to be the "zombie scan" method. They look out at the world, notice changes in IR and it is a lock. This process is continual and ongoing, it happens whenever a zombie is using its eyes. That is step one, if the zombie is just simply looking around. Step two is even easier:

A+B=C

Where, A is Human Morphology,
B is Proper Human Heat Signature, and
C is Target Confirmation, thus:

In ΔPM a zombie sees a human shaped "thing" come into view, it checks its temperature (visually), compares it against the background it has been viewing, determines a change in the panorama it is seeing and gives chase. In (A+B=C) the human is already in view, thus not changing the "scene" and the zombie checks the target morphology and then checks its temperature and attacks! This takes place as fast as normal vision and target authentication does in humans. [13]

So, that means no bonfire distractions? They won't chase a road flare?

Nope.

Zombies clearly know what "things look like" – they can process morphology. They know what a human looks like! In fact, as they chase us around all the time, it is safe to say that they know *exactly* what a human looks like. They would no more attack a bonfire than a human would. They would no more attack or chase a road flare than a human hunter would go after a pinecone believing it to be a deer. They can still see *us* even when there are other heat sources around.

Do zombies *ever* get confused by target temperatures? Yes. That's the good news.

The bad news is that it is usually confusion between the recently turned and normal, uninfected humans. If you have ever seen a zombie tearing into another zombie or a "soon to be zombie" you know what this means.

**Scenario**: A human is in the center of a zombie "pig pile" wherein a dozen zombies have leapt upon a fleeing human. The human has succumbed to a hundred bites and is on the ground in the throes of transformation. The zombies continue to attack! They kneel down, rip out organs and feed.

The human dies and transforms, he begins to thrash around in full zombie fashion…. YET…. the zombies continue to feed! Why? Why are they attacking what is now a fellow zombie?

They do so because the body has not yet cooled. They believe they are attacking a thrashing, living human. Come back in a few hours, after the body has cooled, and one will see that the zombies are disinclined to attack it. The human/zombie has the right morphology, plus the right temperature thus A+B=C for the gathered zombies. Again, after the body cools, no zombie will go near it. [14]

---

[13] Perhaps it is even faster! Zombies have more information in that they have IR signatures, which are reliable, whereas a human also might possibly have to wait for other "signs" that a target is really a target, such as movement, and other signals emanating from the target that might be controlled by a target. Essentially, an IR signature is superior due to the fact that it is actively emitted by the target full time (while it's alive) and received passively by the zombie. A human might have to wait for a rabbit to move in order to see it.

[14] Some zombies MIGHT attack on morphology alone. They might have low rhodopsin, due to sever injury, a bad virus hold, or just plain bad genes. If this were the case the zombie should visit a *zopthamologist* immediately!

## 6. Conclusions

As stated in the start of the paper, this paper recognizes the following axioms about zombie vision:

A) If necessary, a zombie can tell the difference between a fellow zombie and a human using vision alone.
B) There must be something in the signal that a zombie can utilize that tells it that even though an object is shaped and/or moves like a zombie, it is actually a live human and vice versa.

We can now amend those to:

A) If necessary, a zombie can tell the difference between a fellow zombie and a human using *zombie vision* alone.
B) Zombie vision includes normal human vision plus IR vision capabilities.

That is the long and short of it, folks. If A+B then C! Zombies have life detectors in their eyes. Blame rhodopsin.

## I. "Disguise" Addendum

We are aware of attempts to "disguise" one self as a zombie in an attempt to pass among the zombie undead unharmed. We must advise you that if you DO attempt such a stunt you had better have a cooling/heating apparatus that brings your temperature in line with the ambient zombie temperatures. A warm human hiding among zombies is soon a very cool, and very undead, human.

**Acknowledgments**

The Madore brothers would like to thank, in no particular order, all the people who have given us feedback and inspiration and for the cooks/chefs at Buddy's BBQ in TN. Thanks to all who have visited our site, twitter and the message board forums we're haunting. We super, duper appreciate it. Oh, and to Bill Nelson of wezombies.com for asking us "What's next fellows?" Without that question you wouldn't be reading this! This paper and all verbiage did not exist until he asked us a few weeks ago – so, yes, we are THAT lazy (and industrious when questioned.)

**Soundtrack for this paper:**

Iggy & The Stooges: "Search and Destroy", on repeat a hundred times. If you don't know that song, learn it. If you do, live it (at least while hunting zombies)! Thanks, Iggy!