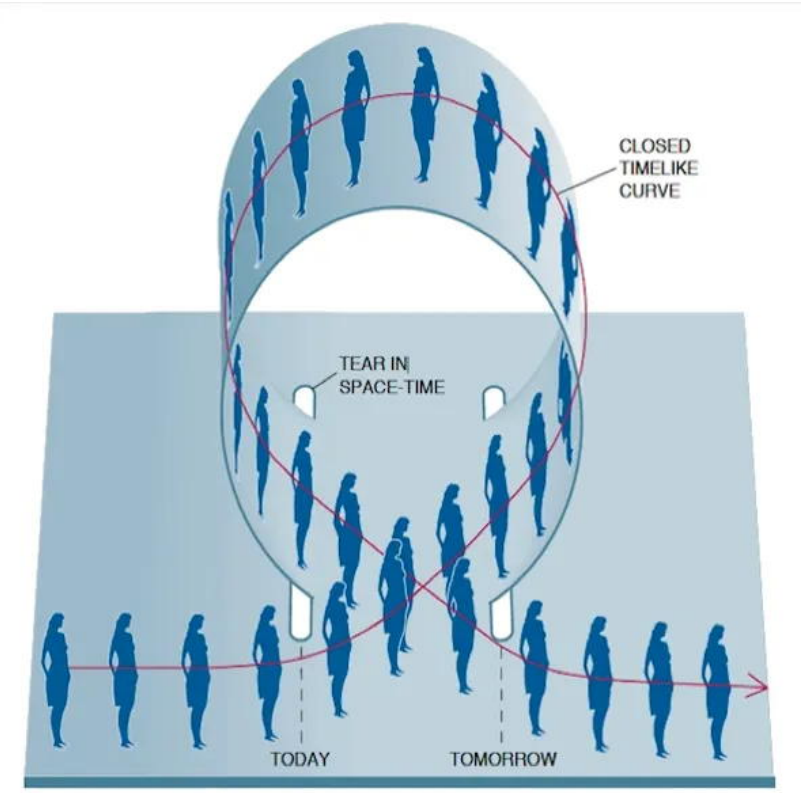


To Be Confused I – Physics

Considering closed loops in space-time.

"*Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things.*"
— Isaac Newton, physicist and theologian

Confusion

Allan Ropper says, in his book *Reaching Down the Rabbit Hole* (2014): "An understanding of confusion has yet to be operationalized... It is not, technically, a disease, but a syndrome, a collection of problems."

Confusion exists on an interesting spectrum. We have a rough idea of what it means to have no confusion and what it means to be entirely confused. But on closer inspection, a complete absence of

confusion has much in common with being completely confused. The difference in the two extremes is somewhat subjective. It's what you decide to be.

A completely certain person is not sane or else they're not living in the real world, and we can say the same about a completely confused person. In either case, the person involved may claim themselves to be at either extreme; what determines whether they are or are not confused depends more on our judgment, not theirs.

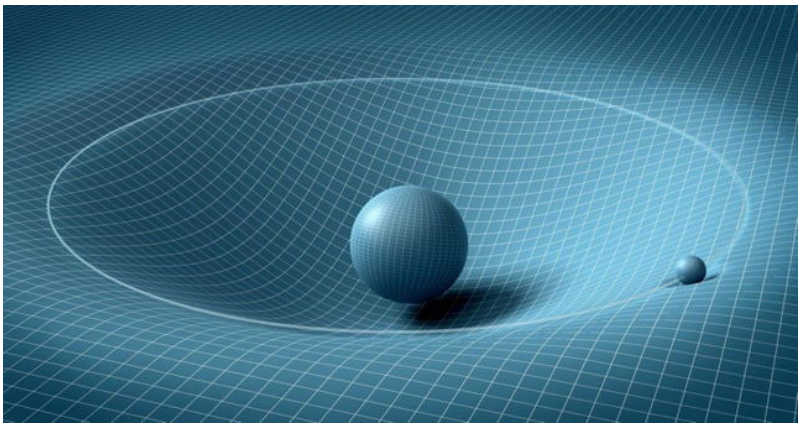
> "*Be confused. Confusion is where inspiration comes from*."
> — **Robyn Mundell,** author

In this series, I'd like to contrast different kinds of confusion in order to clarify that we all are confused all the time. Insanity can bring confusion, but there is nothing insane about being confused.

I'd like to contrast the confusion we experience in our well-balanced minds with the confusion that exists when we feel unbalanced. I'd like to make the point that we never really know where we are on the spectrum. Not only does confusion fail to be operationally defined, but the best we can do is define it relatively. It's relative to what's needed at the movement, and it's relative to what other people expect.

I want to begin with a confusing concept in physics. At least I hope it will confuse you. In this way, I would like you to experience the intellectual confusion of a sane and well-balanced person, namely yourself. I would like to make the point that our minds have a particular way of isolating confusion so that we can cope with it.

In the next installment I want to consider the emotional confusion of a sane and well-balanced person, again yourself. I want to explore how we deal with what we don't know. How we resolve our confusion and how we make excuses for it.



Gravity

To fully appreciate Albert Einstein's General Theory of Relativity, you must really see the mathematics. That's because most ideas develop from the specific to the general, you begin by understanding core

things and then you generalize them. The thing about General Relativity is that there is no specific core idea that explains it. That's why it's a "general" theory.

> Here's a beginners video on space-time curvature and its representation in the general theory.
> **Demystifying The Metric Tensor in General Relativity**
> https://www.youtube.com/watch?v=Hf-BxbtCg_A

There are some core formulas, but they end up referring to each other, depending on each other, and upsetting each other: space-time everywhere depends both on the mass of objects everywhere and the energy of everything in between. To get any "general idea" of what General Relativity says you have to completely specify everything in the universe now and forever. It's a great theory if you want to generate confusion.

In 1949 Einstein's estimable and tragic friend Kurt Gödel—tragic because after Einstein died and for lack of friends Kurt starved himself to death—found an exact solution to Albert's equations for the whole universe at all times in the past and future. Remember, these are equations for the universe itself, not for anything particular in the universe. These are equations for space-time itself, the firmament of existence.

That Gödel found any solution at all was notable in itself, but what the solution said of the firmament was untenable at the time, and is still fairly untenable today. However, there's little doubt that everything he found would be true if the conditions he assumed prevailed. The fact that these conditions are not the conditions of our universe offers small consolation. That's because regardless of Gödel's assumptions, the properties true of the firmament in his model universe remain true in our real one.

Dust

"All are from the dust, and to dust all return."
— **Ecclesiastes** 3:20

Gödel took dust as his starting point but he added one thing: the dust was uniformly rotating. Gödel's universe was uniformly filled with rotating dust. In this case, Gödel found, the space-time curvature of the entire universe could be described exactly and, with the right density of dust rotating at the right velocity, his universe had several odd properties. Of these, the property I want to describe is that of the closed loops.

You've heard that space-time is curved, and you've probably heard of the trajectories of light rays bend as they pass near stars. That is spatial curvature. There is time curvature as well, but time doesn't curve, it stretches or compresses so it's called time dilation. As light rays pass stars time is first compressed and light's frequency increased, and then stretched and the frequency decreases as the light moves away.

If you moved in or against the direction of the rotation in Gödel's model of the universe, the spatial curvature would bring you back to where you started. This is roughly the 3-dimensional analog to moving fully around the equator on a globe. That is, you never feel any force, you always feel that you're moving in a straight line, but you eventually return to where you started.

We can swallow this. The globe provides a familiar example. And while this circularity limits the extent of the universe, just as the globe limits the extent of the earth, it doesn't mess with our future. There may be a limited amount of space on the earth, but there isn't a limited amount of time.

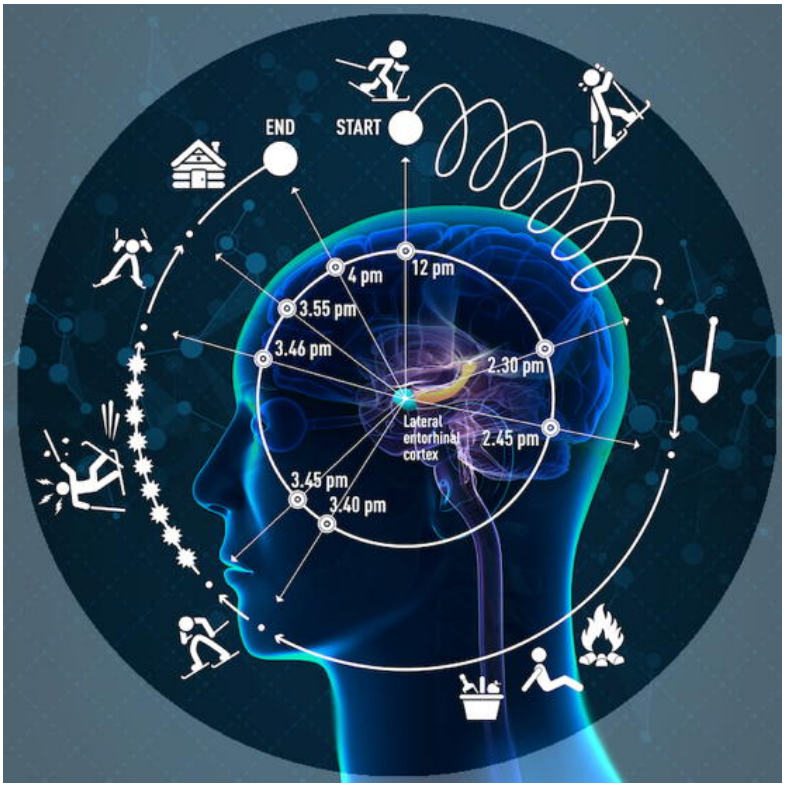
The funny thing about Gödel's special model is that it has a limited amount of time too. Starting at any point in this dusty model, as time goes forward, it eventually comes back to where it started. We have no analog for that, and that is the puzzler.

To get a grip on this, we have to be careful what we assume is happening. These are statements about the nature of space and time, not the behavior of things in space or time. From the point of view of any local region of dust, life is normal, life is good. Everything seems normal and there's no human way to reach the edge of the universe or the beginning of time.

Also, this is not our universe. In our universe, so far as we know, space may be finite or not. We don't know. That is to say, space might wrap around on itself but time does not.

I find that a small consolation because it's clear there is the same dynamic in both cases. The rotating dust universe highlights what appears to be the truth, which is that time is just a measure of change and not some kind of eternally changing beingness.

Time may not wrap around on itself in our universe, but it is still, according to Einstein's theory, which has never been shown wrong, a thing that "does not pass." Time does not pass and nothing "happens" in it. Time is just another degree within which we describe the configuration of things.



Time

Look at time more carefully in Gödel's universe. What does it mean for time to wrap around? Consider a simple model, different from Gödel's, that has only one dimension of space and one dimension of

time. This is called the 1+1 dimensional model. It’s not a 2-dimensional model that you would picture on a flat plane because you can’t rotate from space to time just by turning a corner.

In the 1+1 model, you can only travel left or right and you can only trace time forward or backward. You may start at any point in space or time, but there are only two aspects of your motion and you can’t turn. We can picture what it means to “be closed” by putting this 1+1 model on the surface of a sphere.

At any point on the surface of this sphere, things are relatively normal. We can always choose our direction and time would seem, for those of us living there, to always move forward. Were we to move left or right far enough, we would come back to where we started, but we’d never know we’d completed a circle unless we left something behind to remind us.

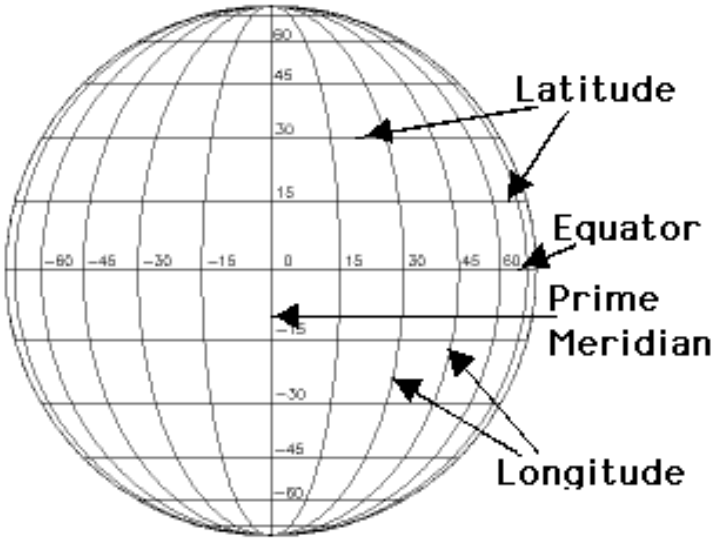
The same would be true of the time circle. Time would always seem to move forward and we’d never know we’d come back to the start unless there was something there to make that starting time special.

Being

What we call time is not time, it’s being. It’s being that moves forward as the clock ticks, not time. Time is just the fabric across which we move. As time passes, our being changes, not time.

This is true of all things. At least that’s how we see it. Rocks “be” and stars “be” and all the cars, pets, and people “be.” And they all “be” at the same rate because they’re all made of stuff that changes at the same rate. That is the case as long as time is not distorted.

In fact, space-time is distorted, but to an infinitesimally small extent, on average. To see a discrepancy in the “being” of things, they and us have to travel through extensive regions of warped space-time. We see this happen constantly on subatomic timescales, but it evens out on average. We suspect this happens in the neighborhood of supermassive objects, but they’re too far away to affect us. What might happen if changes didn't cancel out on average? What would this do to our sense of being?



Space Looping

When things come back around, they encounter things as they were and still are. This completion of the circuit is either one of consonance or dissonance.

Dissonance means the starting and finishing situations don't "fit" and there is some kind of reckoning. If you raced a car around a loop to the starting line and encountered your car idling on the starting line, then you'd crash into it. This would be dissonant.

But if you completed the loop and found your car racing away from you at speed equal to your own, then you would follow this car without conflict. This would be consonant.

Laws of physics are consonant. If they fail at this, then they're not laws. There is an exception, and then there's a new law.

The exception connects things that otherwise don't match. The exception in the car crash scenario is the dynamics of collision which would reconcile all the pieces of the moving car and the stationary car with which it collided. In that case, the portion of track ahead of the starting line would be littered with debris and we would not see a continuously repeating cycle.

For things to repeat, as we might expect in a closed loop that offers no other point of view, all points must be consonant. This means that the end of the cycle must "fit" the beginning of the cycle in order to allow the cycle to repeat as it did before. There must be no rear-end collisions because there is no more "space" in which a new evolution can go.

We can visualize this in the 1+1 dimensional world. Simply imagine racing around the equator to return to your starting point. If there is nothing at the starting point upon your return, then you simply continue around and around. If there is something at the starting line, then it had better be moving forward at the same speed as you, or it must be off to the side so that you can get around it.

But in a world of one spatial dimension there is no “off to the side” to provide the room to get around. Consequently, in one spatial dimension all cars must go around at coordinated speeds if the looping is to be perpetual. This doesn’t mean that speeds can’t change, it only means their changes must be coordinated to allow continuity. All kinds of patterns are allowed as long as no car slams into another.

Time Looping

In our 1+1 dimensional universe, going around the equator is much the same as going around the poles. Latitude and longitude lines look different only because that’s the way we draw them, but if we limit ourselves to great circles, which are circles around the circumference, then any circle is the same as any other. Except in this case, one is a spatial loop around the universe and the other is a temporal loop through time.

The simplest case is to do nothing. We just sit in our car on the starting line at time zero and wait for time to come forward enough to return to zero. What happens then? We’re still sitting on the starting line. Do we feel any change in being? Not if we don’t remember anything. If we do remember something, then it’s because we’ve left something behind, namely the memory of what was and the measure of time passing.

A memory is not nothing, and time only “passes” if you record it. To record it you need a device to measure it, and this device is much like the car that travels through space because it counts the “road” it passes. Call this your clock. You don’t actually need some mechanical device if your memory is good enough. You are the clock, your being measures time.

When your unmoving time traveling car returns to time zero, you must meet yourself in consonance or dissonance. But a finite-time universe offers no alternative future in which dissonance can occur. The physical laws, whatever these “true” laws are, require consonance upon reaching time zero in the time looping universe.

> Here’s an episode of the Sci-Fi series “Atropa” in which there is a time loop but, naturally, it’s not a time loop because if it was a time loop then no one would know it. So it’s the “going back in time to change things” theme, which does not work, makes no sense, and is not supported by any physics. Yet this is what people keep imagining when they think of time travel:
> Sci-Fi Series “ATROPA” Episode 6: **Dust**
> https://www.youtube.com/watch?v=dpr3tzESWjM

Note that time is a circle here, not a spiral. There is no breaking of the circle’s symmetry, every subsequent cycle must match the previous cycles. If they didn’t, then one cycle would mark a different cycle and a different time. But there is no “different time” so there can’t be any different cycle.

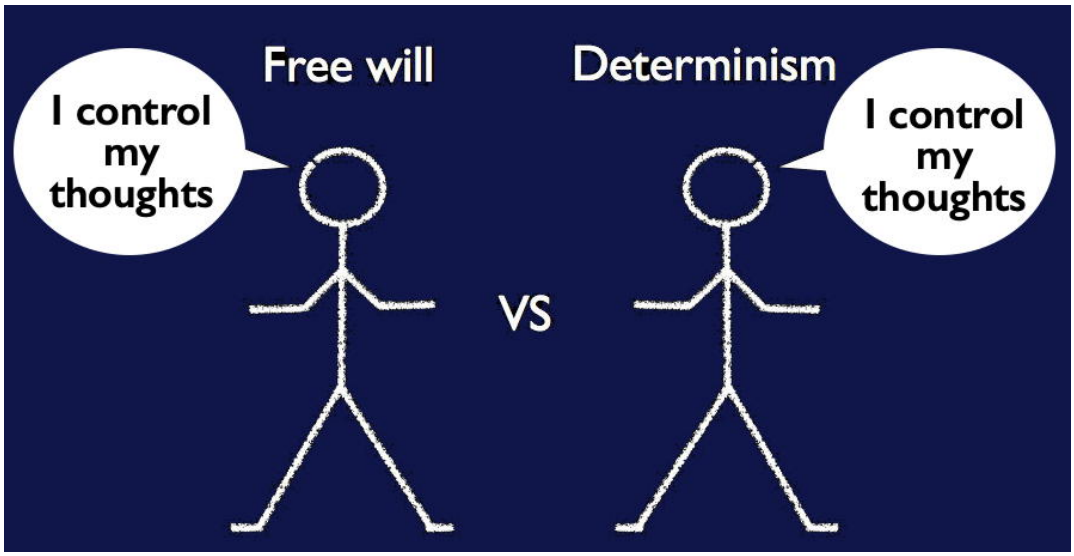
What does this mean for your being? It means that you cannot say to yourself, “Oh, I’ve made the circuit and now I’m on my second time around.” That would be counting the cycles and there is nowhere to “put” that “number two.” If the universe was flat or if it spiraled forward to infinity, then

we could keep counting but here, in a model with closed circles, everything must match and each cycle is the same.

What would this feel like? There are endless ways to match up, but in every case subsequent time loops feel exactly like the first. And, because this universe is also spatially closed, the locations of things also repeat themselves. That is, the location of all things. The configurations of all things repeat themselves as well.

Everything works out. We can draw little pictures representing the state of everything at every point of the surface of our 1+1 dimensional universe. There is no “time” outside of these pictures, they are “inside time.” However you turn the globe, wherever you point your finger, there is a “state of being” that could tell you where it is in time and space, and “being” fells normal at every point.

You could even imagine there is a car crash at some point as long as all the pieces are put back together, cleaned up, put back on track, and returned to motion to be in consonance with the past when it comes back around.



Free Will

“*Confusion of goals and perfection of means seems, in my opinion, to characterize our age*.”
— Albert Einstein

Does the Gödel universe have free will? Well, everything feels just the same as our universe at every point. It only reveals itself as different to those inhabitants who have a memory that persists longer than the duration of the time loop… but there can’t be any since there is no “duration” longer than the time loop.

By clocking the light from old stars it appears our universe is over 10 billion years old, is expanding in size, and is continuing to expand. A Big Bang is proposed at the start, and that wipes out all memory.

We don’t seem to live on closed time loops, but if we did, then the Big Bang would assure that we’d never know it.

There are other models. They are intellectual curiosities. The structure of space-time does not seem to impinge on our notion of free will, even if we live on time loops and ultimately don’t have free will.

We have another definition of free will which pertains to the choices we make at each moment. In a mechanical universe in which every state of things is predetermined, there is no room for free will because there are no choices. There are a number of alternatives to a mechanical universe. Quantum mechanics offers one choice and multi-dimensional models of the world offer others.

The free will of being is not a consequence of time. We can discard time as some fundamental change in being. Time is just the board on which our pieces move. If our universe was closed and consisted of time loops, then we know free will would not exist because, mechanical or not, there would be no room for any other choice the second time around.

Assuming that we don’t live in a closed universe, then there is a chance for free will. This depends on what makes choices happen. This might be subatomic or it might be divine. There is still room for new theories of being. Physics is always wrong as long as there are new realms to be described.

I hope I have confused you. It took me a week to come to these conclusions and I doubt you’ve thought of these situations before. The point of this monolog has been to illustrate how we isolate confusion. As long as we don’t think a confusing issue affects us, it won’t. As long as we agree among ourselves that a confusing issue won’t affect our behavior, it won’t. It won’t until it intrudes. At that point there is dissonance.

The recent movie *Don’t Look Up* tells the story of a pair of astronomers who realize the earth is about to be destroyed by a comet. This is a confusing situation that citizens find too uncomfortable to entertain. The need for consonance is too great so the dissonance is ignored.

Free will engenders choice, and choice can lead to confusion. Our discomfort with confusion feeds back and limits our free will.

In the next installment I’ll have something to say about this, about how confused people deal with their confusion. I don’t yet know, but I’ll think about it.

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