

# Universal Physics Journal

## Question 5: Are centrifugal forces real?

Ethan:

I think centrifugal forces are real. Do you agree? If so, then why are we being told by the experts that they are false or imaginary?

E.R., Mexico City, Mexico.

Hello E.R.:

You are absolutely correct, centrifugal force is a real, measurable, variable, reaction force with testable magnitude and direction. It is easy to demonstrate the reality of its existence, experimentally. Why modern scientists tell us that centrifugal force is "imaginary" is beyond me. I have noticed that this "imaginary" or "false force" conclusion appears to be unanimous among the authors of science books, judging from the position taken in the several Modern Physics texts in my possession. In stark contrast to this modern false force position stands the old-school true force position taken by Professor William B. Anderson regarding the reality of centrifugal force in his college text on Physics titled "Physics for Technical Students" published by McGRAW-HILL BOOK COMPANY, Inc of New York back in 1925. I propose that we do our own experiment to verify Professor Anderson's sensible understanding of the force he referred to as centrifugal force which is but one name for the reaction force we finally recognize today here at Universal Physics as the acceleration/Reaction force or a/R force.

I will try to keep our experiment as simple as possible by employing a short rope, a tension scale normally used to weigh fish, and a paving brick. (It's okay to try this one at home. Just keep the spectators a safe distance away.) The brick will have a hole drilled into one end with an expansion plug installed so that an eyebolt may be screwed into the brick. One end of the scale will be hooked to the brick's eyebolt while one end of the short rope will be tied to the scale's other hook. You can help in this experiment by grasping the rope's free end and whirling the rope/scale/brick combination in a horizontal circle around your rotating person. (Please wear a motorcycle helmet and gloves while rotating on a soft grass surface in case you become dizzy and fall after losing your balance.)

After accelerating the brick up to a steady speed, I want you to concentrate on what you are experiencing. Are you now aware of the considerable inward-directed force you are applying to your end of the rope? This inward-directed force is the acceleration/Action force that is the cause of acceleration of all components beyond your hand. It is scientifically referred to as a "centripetal" force meaning "center seeking". Understand that "center seeking" or "centripetal" means the a/A forces experienced by the rope, scale, and brick are directed toward the center of orbit of these objects around your person. It also means that the accelerations experienced by the rope, scale and brick are also directed toward the center of orbit. But it does not mean that there is necessarily any movement of the orbiting objects in your direction resulting in a reduction in the radial distance of their orbit around your person. In other words, the scale and brick are maintaining their distance from you while continuing to experience inward-directed "centripetal" forces and inward-directed "centripetal" accelerations. So "centripetal" only refers to the direction of the force and the direction of the acceleration, and most definitely should not be taken

as making any reference to an orbiting object's movement or motion along its radius of orbit toward or away from the axis.

Hopefully you have read Article III The Equality of Opposing Forces. If so, then you are aware that as hard as you apply an inward-directed pull on the rope, the rope reactively applies an equal and opposite outward-directed pull on you. This outward-directed pull or force is caused by, and is therefore a reaction to, your inward-directed acceleration/Action force pull on the rope. The faster you whirl these objects by causing them to turn aside in your direction from what would otherwise be (in gravitation's absence) a straight-line path of rest-motion, the more you need to employ the action force of Earth gravitation. You will do this by leaning back more and more in much the same way you lean back while participating in the game of Tug-O-War. Here, by using your body as a lever you effect the conversion of a portion of the vertical action force of your body's gravitation toward Earth into a horizontal, inward-directed, acceleration/Action force pull on the rope. Thus with the indispensable help of Earth gravitation, you are able to pull quite hard on the whirling objects. But what is it that you are pulling hard against? We know from Article III that it is not possible to push or pull with an acceleration/Action force against an object without the presence of an equal and opposite acceleration/Reaction force from that object. Allow me to introduce to you the "centrifugal" acceleration/Reaction force of matter. "Centrifugal" means "center fleeing". Again you need to understand that "centrifugal" or "center fleeing" means that the force applied to you by the rope, scale and brick is an outward-directed acceleration/Reaction force being produced in a reactive manner by each of the myriad of components of the matter of all the objects beyond your hand that are experiencing the activity of inward-directed "centripetal" acceleration caused by the inward-directed acceleration/Action force of your pull. The rope is not moving outward or away from your hand. Instead, it is delivering a reaction force to your hand that is outward-directed away from the center of orbit.

Personally, I think "centripetal" or "center seeking" and "centrifugal" or "center fleeing" represent a poor choice of terms since they imply movement toward and movement away from the center of orbit. This is a mistake for no such movement in either radial direction need occur, nor should such movement or radial displacement be expected to occur by an observer looking for evidence to indicate that either inward-directed or outward-directed forces are present.

To determine the direction and magnitude of the forces present all we need do in this event is consult the tension scale. Neglecting the mass rating of the scale's matter and the downward-directed force of Earth gravitation, as much the rope applies an inward-directed acceleration/Action force on the inner hook of the scale, the brick applies an equal outward-directed acceleration/Reaction force on the scale's outer hook, or using the old misleading terms, centripetal force directed inward by the rope on the scale's inner hook and centrifugal force directed outward by the brick on the scale's outer hook. The force displayed by the scale is all the proof you need as to the existence of this mutual action/reaction pair of equal and opposite accelerational forces.

Some Physics texts explain that the "centrifugal" force cannot possibly exist in this example for if it does exist then when the rope is cut, the scale and brick will "fly" away in a definite outward direction and not in the tangential direction that they actually follow upon release (See Article XI:

Reaction Forces). This position is thought to be true due most likely to a misunderstanding of the role of a reaction force. In rotational events, the outward-directed "centrifugal" force is always a reaction force that is being caused by the inward-directed "centripetal" acceleration-causing action force. So when the rope is cut, all agree that the inward-directed "centripetal" action force will come to an end. With the ending of the inward-directed "centripetal" action force, what reason could one possibly use to expect the outward-directed "centrifugal" reaction force to continue to exist when the force that represents its cause is no longer present? Predictable, the object will follow a tangential path after the cutting of the rope since both the "centripetal" and "centrifugal" forces mutually cease to exist at the same time leaving the object free of any inward-directed or outward-directed force. At this point, the object only has to contend with the rearward-directed acceleration/Action forces of air friction supported by and terminated against the object's forward-directed forces of acceleration/Reaction, and the downward-directed  $a/A$  forces of the object's own gravitation toward Earth supported by and terminating against the object's upward-directed acceleration/Reaction forces. As at all times with every object in the Universe, when all the forces affecting the object are totaled, the sum is always equal to zero, regardless of whether acceleration is present for the object or absent. Why? The Universal Law of Mutual Forces and Newton's LAW III both tell us that it can be no other way. Every force always finds immediate support or opposition against an equal force. This is a natural law to which there are no exceptions. A natural law I might add that is often ignored within what is known today as Modern Physics. "Single force" or "unbalanced force" explanations of events are unreal and therefore untrue. (See Article III: The Equality of Opposing Forces).

In a "last ditch" effort, some Modern physicists will claim that "centrifugal" force does not exist because while the brick is experiencing an inward-directed "centripetal" force from the scale, there is no outward-directed "centrifugal" force of any type affecting any portion of the brick's matter. Nothing could be farther from the truth. During the whirling event, every component of the brick's matter is reactively generating its own outward-directed acceleration/Reaction force. How can we demonstrate this fact? Slice the brick in half, cutting across halfway away from the hook end, attach two more hooks on each side of the fresh cut and move the fishing scale to this new location at mid-brick. Attach the rope to the original eyebolt and begin whirling this new combination of objects. Have a helper observe, from a safe distance, the new force display by the scale. I predict the scale will display about half its former whole brick value since it is now transferring the inward-directed acceleration/Action force responsible for causing inward-directed acceleration for just the outer half of the brick. Now consider that as much as the brick's inner half is applying, through the scale, an inward-directed "centripetal" acceleration/Action force on the brick's outer half, the brick's outer half is applying, through the scale, an outward-directed "centrifugal" acceleration/Reaction force on the brick's inner half. I see this fact as proof that outward-directed "centrifugal" forces are fully present and affecting the inner half of the brick's matter, contrary to the claim that no such outward-directed centrifugal force is affecting any portion of the whirling brick. Continue on by slicing the outer half of the brick in half, move the scale once again, and outward-directed centrifugal forces continue to be revealed. This experimentally provable fact refutes the claim that the brick is only experiencing an inward-directed centripetal "net" force. (See Article V: The Mutual Force Rule)

Finally there are the accelerating-frame-of-reference events that many Modern science authors direct our attention to as providing "proof" that supports their "false-force" beliefs regarding centrifugal force. For a typical accelerating-frame-of-reference event, imagine that a scientist and an untrained observer are riding in an automobile (car) that is traveling straight along a level road but is about to enter a turn to the left. The observer places a billiard ball at the center of the car in the smooth trough between the dash and the windshield. As the car begins to accelerate to the left he observes the billiard ball "accelerate" along the trough toward the right side of the car. The scientist recognizes that an inward-directed centripetal acceleration/Action force resulting from the contact patch between the tires and the surface of the road is causing the car and his body to accelerate in the direction of the center of the road's curve to the left. Further he recognizes that almost no centripetal action force is being applied to the ball. Thus to him it is no surprise to see the car's dash accelerate to the left while causing the ball to do little more than roll in place as it continues to follow a nearly straight-line, nearly non-accelerating path inside the accelerating frame of reference of the car.

In this event the scientist recognizes that it is likely that the untrained observer will say that some outward-directed "centrifugal action force" must be present and acting as the cause of the rolling ball's outward-directed "acceleration". From this point on it is easy for the scientist to logically convince the untrained observer that he is being confused by his observation, that this confusion is being caused by the inward-directed acceleration he is experiencing while making the observation, that the ball's behavior is the result of the absence of an inward-directed centripetal action force beyond the small amount required to cause the ball's rotation, that no outward-directed "centrifugal" action force is present, that the ball is experiencing a minor acceleration in the inward direction and therefore is not accelerating at all in the outward direction, and finally that the untrained observer's use of the term "centrifugal action force" is without meaning since the only action force the ball is experiencing is the inward-directed centripetal action force that is causing the inward-directed and off-center action resulting in the ball's rotation.

Clearly the scientist possesses the greater understanding of this event. But is this low-force event the best scenario within which to decide the reality of centrifugal force? As far as the ball is concerned almost no inward-directed action force is present, almost no outward-directed reaction force is present, and almost no inward-directed acceleration is present. Perhaps most importantly, no force scale is in use. Thus the only determination of the presence of a significant acceleration/Action force acting on the ball is based upon the confused observation of an untrained, accelerating observer who determines that an imaginary outward-directed action force is causing imaginary outward-directed acceleration for the ball as it is observed to speed up in the outward direction by suddenly rolling along the trough from the windshield's center to the right side of the car. Perhaps scientists prefer to use the scenario of this low-force event when deciding the reality of centrifugal force because here it is easy to convince the untrained student that the "centrifugal action force" he may think of as real, is actually imaginary.

Of all the circular or rotational events that exist here on Earth, where an object actually is accelerating at a substantial rate while experiencing a substantial inward-directed centripetal acceleration/Action force and reactively generating a substantial outward-directed centrifugal

acceleration/Reaction force, it is curious to note how often, when deciding the reality of centrifugal force, Modern Physics authors end up selecting an event where not only is the object not experiencing any significant centripetal action force but the observer is untrained and confused by his own acceleration. Given these conditions is it any wonder that the scientist has his way?

If the history of science teaches us anything, it teaches us that there is, at best, little association between having one's way and being successful in accurately describing that which is real and true. Instead of the scientist competing with an untrained, confused observer while attempting to decide the reality of centrifugal force, suppose instead he is forced to compete with someone who recognizes, understands and accepts the reality of centrifugal force. Suppose this someone thinks to bring a small compression scale to the event. How then will the scientist's version of this event fare?

Who is this someone? Why it is you, of course! After considering the scientist's event, have you formed any questions? Are you wondering why when trying to prove the existence of an outward-directed centrifugal reaction force, the scientist chooses an event where the inward-directed centripetal action force is nearly absent? You do realize that these two forces form an action/reaction pair of accelerational forces as defined by Newton's LAW III so how could you be expected to test the billiard ball for the presence of a reaction force when the action force that represents its cause is nearly absent?

Of course you recognize that as the car enters the turn, acceleration is present for the scientist and for yourself as observer. The problem is that acceleration is generally absent for the billiard ball. So to test for the presence of an outward-directed reaction force from the ball, by now you realize that all you have to do is ensure that acceleration is equally present for the ball. As the car enters the turn, against the wishes of the scientist, you place your small compression scale in the trough just to the right of the billiard ball. Your scale prevents the ball from rolling to the right ensuring that it will accelerate to the left at the same rate as the car. In the middle of the turn, you point out to the scientist that your compression scale is displaying a force reading against the ball. He assures you that this is normal for the scale is providing the inward-directed centripetal action force that is causing inward-directed centripetal acceleration for the ball. No surprise here.

But then you point out to him that it is not possible for the scale to push with any force against the ball without the ball pushing back with an equal force. This means, you explain, that the scale is measuring an outward-directed centrifugal reaction force from the ball that is precisely equal in magnitude to the scale's inward-directed centripetal action force upon the ball. It is now obvious, even to the scientist, that by using your small compression scale you have removed the confusion of the scientist's event to reveal that centrifugal force is measurable by scale and therefore is a real and true reaction force present in equal magnitudes whenever an object is experiencing centripetal acceleration caused by some type of centripetal action force. For the rest of the drive, the scientist is not only quiet, he also appears to be, well..., rather confused.

What does your proof of the reality of outward-directed centrifugal forces mean? It means that Modern Physics contains one more misunderstanding regarding the acceleration/Reaction force that continues to remain fully accepted. The belief that centrifugal force is a false force is just

that, a belief without any experimental proof as backing. Professor Anderson got it exactly right, 76 years ago. Clearly his work has been ignored. Isaac Newton referred to the outward-directed forces present during a whirling event as "the forces of receding from the axis of circular motion". Unfortunately, if translated correctly, he used the Latin word that translates to "receding" which strongly implies that an outward motion or radial displacement is occurring, which is definitely not the case.

In the meantime, Modern Physics scientists will continue telling the rest of us, for decades to come, that centrifugal force is imaginary even as the truth to the contrary becomes widely known. In a world where every other discipline is improving by leaps and bounds, scientists work hard to ensure that their version of Physics remains unchanged and outdated, regardless of its flaws. That is why major improvements to fundamental Physics seldom occur and then only with a general changing of the guard.

No matter. The rest of us are not hampered by any such "protective" censorship. We do not have to wait generations to recognize experimentally provable truths. Here at Universal Physics we are free to witness the simple truth and beauty of real and true concepts, such as the  $a/R$  force of matter, that share supporting roles in the founding of the new science of Universal Physics.

Best regards, E.R.,

Ethan Skyler

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