Inconsistencies in *Torque* Parlance

By Ken Hutchins

As many of my readers know, I slam Arthur Jones for his *rotary resistance* phraseology. In strict physics parlance, it is incorrect.

A resistance is a force and a force is always linear. As I have belabored Arthur's misusage in my other works (For example: *The Ten Requirement of Full-Range Exercise Revisited*), I will spare the reader much of this as herein I intend to expose additional and widespread inconsistencies in the reference literature.

In preparing the latest upgrades (April 2022) and additions to the glossary of *Transitioning from TSC to Feedback Statics* with Gus Diamantopoulos and while composing new instructionals with Gus for his PUSH devices, I have read many dictionary references and articles wherein torque is described as a *rotary force*. As Arthur found this indistinction useful for marketing Nautilus, I found the proper distinctions of *torque* and *force* inconvenient and awkward. And I admit that it is much easier to convey the loose idea of *rotary resistance* to laymen, albeit incorrect. Accordingly, Gus and I have applied great discipline and care to write about these concepts truthfully as has Drew Baye and others.

My present mission is to show that *rotary force* is inconsistent in three manners. The manners are:

- Semantic
- Arithmetic
- Graphic

Of course, these inconsistency manners often overlap.

Semantic

If force is linear (translational)—and it always is—the word used to represent it cannot imply rotation.

Movement is either translational or rotational. And although a body can do both simultaneously, the actions are distinct. But we are not discussing movement. This discussion is about force and the PRODUCTION of torque with force through a lever.

Torque is not a rotary or twisting force. It is the *result* or the *effect* or the *expression* of a force and a moment arm (lever).

Torque cannot be a force and the effect of that force simultaneously. This is gibberish.

Some define *torque* as *a tendency to rotate* caused by a force. This seems somewhat acceptable to me but not wholly adequate.

Note that *torque* is correctly termed *moment* or *moment of force*. I prefer the mono-syllabic *torque.* And I believe that these alternate terms are inviting confusion. *Moment*

naturally grabs the mind as an *indefinite length of time*. And extremely few people can distinguish between *moment* and *minute*—a definite length of time. My advice: Don't go down this path; stay with *torque.*

[*Moment arm* is very close phonically with *movement arm*. And both of these terms are special to our discussions of exercise. Perhaps we should use *work arm* instead of *movement arm* to avoid miscommunication.]

[I am confident that some very intelligent people will disagree with my assertion that force is always linear. And this gets into opinion and context.]

Arithmetic

Torque is a product. It is the product of force (F) and lever length (d).

All degreed engineers perform coursework in statics. This work is largely comprised of repeated comparisons of torque as in F x d = F x d OR *force times distance* EQUALS force times distance. And this product is never a force unto itself. In fact, the force is a factor of the product, torque, and the product, has two factors: the force factor and the lever-length factor. It is impossible for one of the factors to also be the product. This is mathematic gibberish. And as my longtime engineer friend, Michele Mingoia, asserts, mathematics is language.

If we consider that the units used in the torque equation to be force expressed in pounds and lever length expressed in inches, we have:

Pounds x Inches = Inch-Pounds OR in-lbs

So, the product is in *inch-pounds*. And the only way to state force from this product is to factor it out, in which case we would no longer have the product we call Torque. This is a reinforcing, circular, and valid argument against calling Torque a force.

Graphic

When graphing lever length, force, and torque, the first two of these vector quantities are represented, by convention, in two dimensions. But when torque is vectored, it is in the third dimension. As a product, its vector cannot be represented in either of the first two dimensions like lever length and force. Figuratively, torque comes up and off the graph paper. And if torque is a force, how does it both remain on the paper AND leap off the paper.

Of course, this graphing convention is arbitrary, but it exists for an important reason. It is a bold statement that we must keep the torque quantity and direction distinct from its factors.

I admit that I was rattled 30 years ago when I first learned of the convention to graph torque in the third dimension. I then struggled to take this in. And please don't get the idea that I now completely understand this

convention, but I do appreciate that it was devised by authorities beyond my expertise.

My Suspicions
I could never know, but I suspect that the conflation of torque with force is due to several possible reasons. One is that there are many writers on today's internet who are not formally schooled. Another is that there is a contextual difference between the engineers and the physicists. And a third is that the coursework in Newtonian physics is dumbed down for non-science majors… somewhat like what Arthur did for his customers.

Addendum: More Semantics
After sending the foregoing to about 20 friends, one of them noted my incorrect use of *foot-pounds* as an expression of *torque*. Please note the following link to an article addressing this indiscretion:

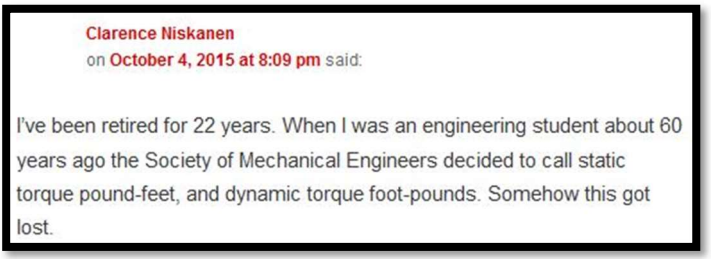
https://www.macsmotorcitygarage.com/foot-pounds-and-pound-feet-the-difference/

For many years I have wondered about the confusion caused by the fact that *work* and *torque* have the same commutative factors and that their products might be indistinguishable without noting specific context. Unbeknown to me, there exists a semantical distinction.

Marc Noel, the SuperSlow master instructor who brought this to my attention, mentioned that he had been berated as pedantic on an automotive repair forum for

properly expressing torque as *pound-feet.* And I immediately checked my three torque wrenches (two beam-style and one an expensive click-style) to find that their scales were marked as *foot-pounds*. I suppose that the engineers who worked for the manufacturer of the wrenches did not get the memo.

This particular semantical issue is important and I promise to change my ways for the future; however, it is not germane to the points I've made about torque NOT being a force. Therefore, I will not edit all my 25 books to correct this. Please forgive.


Clarence Niskanen
on October 4, 2015 at 8:09 pm said:

I've been retired for 22 years. When I was an engineering student about 60 years ago the Society of Mechanical Engineers decided to call static torque pound-feet, and dynamic torque foot-pounds. Somehow this got lost.