

# Art and Science Newton's Third Law: Action = Reaction

Abraham Tamir\*

Ben Gurion University of the Negev, Beer Sheva, Israel

Received: July 01, 2017; Published: July 07, 2017

\*Corresponding author: Abraham Tamir, Emeritus Professor of Ben Gurion University of the Negev, Beer Sheva, Israel, Email: atamir4@012.net.il

## Opinion

Newton's Third Law has been active in the universe as from its creation although it was stated by him only in 1687. Isaac Newton, an English natural philosopher and the most original and influential thinker in the history of science was born on 1642 and died in 1727. His three laws of motion and the law of universal gravitation, which were the keystone of the scientific revolution in the 17<sup>th</sup> century, made it possible to design airplanes, spaceships and satellites, etc. The third law states that when one body exerts a force on the other body, then the second body exerts a force equal in magnitude and opposite in direction on the first body, namely, *action = reaction*. According to Newton, forces always appear in pairs where each force acts on the other body. Mathematically the law is expressed by  $F_{12} = F_{21}$  where F designates force, 1 designates object 1 and 2 is object 2 where  $F_{12}$  is the force exerted by body 1 on body 2 and similarly  $F_{21}$ .

We usually do not pay attention to the fact that the 3<sup>rd</sup> Law is active in "every corner," and that every time we interact with our surroundings we feel the law. For example, when you punch someone in the face, your hand not only applies a force to the person's face; the person's face applies a force to your hand. Since the person's face is softer than your hand, it suffers more from the *interaction*. When we press our lips one against the other we feel some pain in both lips because of the force that is exerted. When we stand on the floor we feel our weight (the *action*) due only to the *reaction* of the floor on our legs. Sprinters usually apply some force with their legs on slanted objects. The reacting force of the object, according to Newton's Second Law, provides an initial acceleration to the sprinter, which is proportional to his mass. The Third Law is very important for space travel. In the cold void of space there is no air for jets to suck or for propellers to churn, and yet spaceships can maneuver in a vacuum. How do they do it? The engines propel gas particles out the back of the spaceship. Since every force has an equal and opposite *reaction* force, the spaceship will be propelled forwards. Because of Newton's 1<sup>st</sup> Law, spaceships do not need very much fuel since once they are moving they will stay in motion because friction, the opposing force, is negligible.

In the following we demonstrate the law by different artworks. (Figure 1) [1] Is a statue of Newton made by the sculptor Louis

François Roubiliac in 1775. His body weight creates a force, *action*, which is transferred to the floor through the shoes. Consequently the floor creates an opposite force, *reaction*, on his shoes, which is transferred to the legs and thus is felt by Newton's body. (Figure 2) [2] Is a sculpture constructed by Dudu Geva (1950-2005), Israeli most famous caricaturist. The sculpture is of David Ben-Gurion (1886-1973), Zionist leader, founder of the state of Israel and Israel's first and longest-serving Prime Minister. Here the weight of Ben-Gurion that creates force, *action*, is transferred to the floor through the head where the *reaction* is created by the floor and acts on the head. (Figure 3) [3] Painted by the Swedish artist Eugene Fredrik Janssen (1862-1915) demonstrates a man pushing weights with his two arms. Here the weights create the *action* on his two palms where the later create the *reaction* on the weights. (Figure 4) [4] Was painted by Rafal Olbinski (1945), a Polish poster designer and painter. Here *action = reaction* is created by the surrealistic press of the two hands. Olbinski also painted (Figure 5). It demonstrates all places in the body indicated by the arrows where the 3<sup>rd</sup> Law is active where the leaning face on the palm is an additional place. (Figure 6) is a demonstration of the musician Rahsaan [5] with his nose flute.

Here the flute is pressing on the nose where the *reaction* is the pressing of the nose on the flute. Playing the piano is an additional situation where Newton's 3<sup>rd</sup> Law is very active where all the fingers are continuously pushing the piano keys, namely, creating an *action*. Consequently the keys create force on the fingers, the *reaction*. (Figure 7) [6] Demonstrates the law by the artwork "Piano Man" of the American artist Justin Bua (1968), a graffiti artist whose artworks are provocative and universally embraced. (Figure 8) [7] Demonstrates an artwork of a missile attack painted by the American artist Edward L. Cooper (1931). The jet airplane that pushes gas backward moves forwards due to the opposite force that the gas activate. (Figure 9) [8] Is an artwork of Fernando Botero (1932), Colombian whose artworks are characterized by voluptuous figures. Here the weight of the dancing couple creates force on the floor and consequently the floor creates an opposite force due to the 3<sup>rd</sup> Law. The latter applies also in the man's hand holding the hand of the woman. So far the 3<sup>rd</sup> Law was described by examples where the equality *action = reaction* has been quantitatively correct.



Figures 1-13: Newton's Third Law

However, this law is applicable also qualitatively, for example, in Psychology where a relatively strong *action* brings to a *reaction* that might be surprising or not surprising. In this case the "equality" is only qualitatively as demonstrated in (Figures 10 & 11) [9] painted by the English fantasy illustrator Brian Froud who was born in 1947 in Winchester. Here the *action* and *reaction* might be looked upon as "Don't push too hard (*action*) because there will be a *reaction*".

A finally what would have happened if the 3rd Law would not have existed, for example there was no "reaction". This is demonstrated in (Figures 12 & 13) where in the absence of *reaction* only a Roentgen photograph in (Figure 13) would have revealed the glass which has penetrated into the head. Thus one can look at the 3rd Law and other basic laws of science as evidence to a superior force which created the order in our universe.

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