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Contact Improvisation:
Concepts of Physics Transformed into Art

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Dr. Jill Nunes Jensen
History of Dance Theatre
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Often dance is strictly defined as a form of artistic expression. However, movement of bodies in space calls for the investigation of the physical laws that apply to all objects on earth. Contact Improvisation is a dance style that is uniquely rooted in the laws of physics. This paper argues that the relationship between the two disciplines is embodied as the movers respond to gravity, momentum, and transference of energy while manifesting Newton's third law of motion.

Isaac Newton, an English physicist and mathematician, came to the notion of gravity when he was in a contemplative mood and witnessed an apple descend to the ground from a tree. He wondered if all objects are attracted to the center of the earth but are stopped from achieving this goal as they are interrupted by the earth's surface. This instinct led Newton to his law of universal gravitation, which states that every object in the universe is pulled to every other object with an attractive force that is called gravitational force. Not only is every object on earth affected by gravity, the attractive force applied by the earth, but also the attractive force applied by each object in the universe (Knight 356). Any attractive force on an object is applied to the center of mass of the object. The center of mass is the balance point on an object where the mass is evenly distributed. Although attractive forces pull on every part of an object, the application of the force is said to act on the object's center of mass (Knight 314).

Contact improvisation is in tune with the concept of universal gravitation based on how the movement style interacts with gravity and fellow dancers. Steve Paxton, an experimental dancer and choreographer accredited as a founder of contact improvisation, explains, "Balance is not defined by stretching along the center columns of the body, as in traditional dancing, but by the body's relationship to that part which is a useful fulcrum, since in this work a body may as often be on head as feet and relative to the partner as often as to the floor" ("Contact Improvisation" 40). In contact improvisation, not only is the body able to balance with its center

of mass statically over the centerline of the body, but also is able to use the body as a total moving system. In this system, the center of mass may shift based on the positioning of the body: stability does not require the body to remain upright.

Certain positions of the center of mass allow for a greater sense of stability. When the center of mass of an object is lower to the ground, and the base of support is wider, the object becomes more stable. This concept is utilized in contact improvisation and shown in Simone Forti's work, *Huddle* (1961). Forti, an Italian-born American post-modern choreographer, showcased *Huddle* in many outdoor locations. The piece involves a clump of people hunched over and supporting one another. One by one, bodies climb on top of this mass of dancers in order to locomote to a different part of the cluster. The dancers in the clump widen their feet in order to create a larger base of support, compared to when your feet are directly under your hips. The dancers combine placement of the feet away from the centerline of the body with a deep *plié* (bend in the knee), which widens the base of support and drops the center of mass of each of the dancers. This placement heightens the stability of the entire group, giving the climbing dancer space for greater possibilities in improvisation.

Conversely to contact improvisation, ballet responds to gravity in a completely different manner. Contact improvisation uses knowledge of the laws of gravity to inspire movement, which allows the dancers to clearly exemplify their being affected by the constant attractive downward force. On the other hand, ballet often tries to defy gravity in its movement. Lincoln Kirstein, the co-founder of New York City Ballet, describes that ballet "accentuates the area of air" and utilizes legwork in an effort to defy gravity (Goldman 66). For example, during the Romantic period of ballet, the narratives often included an otherworldly presence that was unattainable. In order to portray this lifted quality to the audience, the dancers wanted to look as

if gravity did not affect them. Thus, the pointe shoe was invented to physically lift the dancer off the ground. In comparison to ballet, contact improvisation uniquely approaches the concept of gravity by highlighting and utilizing it rather than attempting to rise above it. The harsh contrast between contact improvisation and ballet shows how contact improvisation was innovative in its utilization of natural forces of the earth.

In addition to the response to gravity, Newton's third law of motion also inspires the movement style of contact improvisation. This law states that every force occurs as one part of an action/reaction pair, where the two parts of the pair are equal in magnitude and opposite in direction. In the action/reaction pair, the forces act on different objects. Since both bodies are mutually moving masses that apply forces on each other, motion is still possible. The opposite and equal forces do not cancel each other out because of the location of where the force is applied (Knight 172). Imagine two bodies in a duet system where one partner exerts a force horizontally, using their hand, onto the second partner's shoulder. According to Newton's third law of motion, the second partner's shoulder exerts an equal and opposite force on the first partner's hand.

In the film *Fall After Newton*, Paxton describes how contact improvisation explores Newton's third law of motion by proposing an action and finding many possibilities for a reaction (Paxton 1987). The improvisation lies in the second body's response to the action force. Nancy Stark Smith, a founding participant of contact improvisation, articulates the numerous possibilities of reactions by explaining, "Where you are when you don't know where you are is one of the most precious spots offered by improvisation. It is a place from which more directions are possible than anywhere else" (Cooper Albright 361). The essence of contact improvisation is

found in the moments when the action/reaction pairs are unplanned and authentically affected by the bodies in the space and their relationship to gravity.

In contact improvisation, the floor not only exists but also can act as a second body or partner. The dancers' awareness of gravity and sensitivity to the floor are prevalent even when watching contact improvisers dance in their own. For example, when Nancy Stark Smith dances by herself in the film *Fall After Newton*, she responds to gravity, the forces that she exerts on the floor, and the forces and the floor exerts on her. Also, she transitions from being upright and resisting the force of gravity, to succumbing to the force and retreating towards the ground. Smith exerts forces on the ground in order to provide an acceleration that will propel her back up to standing. She further explains, "I found that falling itself is a dramatic balance. One in which the forces at play—gravity, momentum, and mass—were all operating in their natural order" (Cooper Albright 372). Smith is able to trust her own knowledge of such forces in order to use them as partners throughout her dancing.

In 1972, Paxton debuted the pivotal work of contact improvisation called, *Magnesium*. The piece was originally set on a group of men, including Paxton, from Oberlin College in Ohio. Since this piece played an establishing role in the development of contact improvisation, the frequently utilized concepts of momentum, falling, rolling, and colliding became integral parts of the dance style. The high intensity and physicality of the piece is then contrasted with five minutes of a "small dance" at the end. The "small dance" is when all of the dancers in the piece simply stood still and allowed their bodies to naturally shift with the subtle effects of gravity.

One physics concept that particularly stands out in *Magnesium* is collision. How the dancers deal with the momentum, as well as the change in energy throughout the course of a collision is clear. A collision is a short instant in time where two objects interact with each other

in an isolated system. An isolated system implies that external forces, such as gravity, acting on the system are negligible compared to the impact of the forces that the objects are applying to each other. As a result, the momentum of a system is conserved. This means that the amount of momentum the system starts with will remain at the same value post collision. The large forces exerted in this moment in time are defined as impulsive forces (Knight 220-223).

There are two ways in which a collision can occur, inelastically or elastically. In an elastic collision, the two objects bounce off of each other after they collide, and continue with a mathematically determined velocity. Conversely, when two objects collide inelastically, they stick together post collision, and continue with a common velocity. In both types of collisions, the momentum of an isolated system is conserved, however, the energy is only conserved in elastic collisions. The loss of energy is often due to heat or deformation of the objects. For example, in a car crash when two cars collide inelastically, energy is lost in the form of heat on the pavement and distortion of the cars. An object's momentum is the product of its mass and velocity. Therefore, one can increase momentum by having a larger mass or velocity (Knight 220).

Inelastic and elastic collisions occur between dancers continuously throughout *Magnesium*. In particular, inelastic collisions occur when one dancer jumps toward a second dancer, the second dancer catches the first partner, and they continue to move together as one body or object. In order to deal with the initial momentum of the first partner, it becomes the second partner's job to direct the momentum after the collision. In *Magnesium*, the dancers often resolve the initial momentum of the system by turning while traveling with them. The rotation transforms the initial momentum into angular momentum, or rotational momentum. When the second partner starts to turn together with the first partner after the collision occurs, the initial

momentum translates into the rotational velocity and the combined mass of the two bodies. It is clear that contact improvisers have knowledge of how collisions work because if the second partner did not translate the momentum coming towards them, then the initial momentum would unfold in a way that could be harmful to both dancers.

Although momentum is conserved in situations of inelastic collisions, energy is not. When the two bodies collide there is a substantial amount of energy that is lost when they latch onto each other and continue as one body. The successful transformation of energy comes from the training of the dancers. The way that the dancers chose to morph their bodies in response prevents the movement from becoming potentially dangerous. Throughout Project Nucleus' recreation of Paxton's *Magnesium*, when an inelastic collision occurs, the bodies often move together to the floor (Project Nucleus). The bodies are then able to receive the floor with this expenditure of energy, instead of trying to muscle through the impulse, or change in momentum, of the collision in attempt to remain upright.

Contact improvisation not only utilizes inelastic collisions, but the dance style also interacts with elastic collisions, which are also present in *Magnesium*. The situations differ because the resolution of the initial momentum changes with the dancers' reactions. There are multiple versions of this kind of collision where the two bodies part ways as a result of a collision. Depending on the initial masses and velocities of the two bodies, the result can either be that the bodies bounce off of each other in different directions, or one body comes to rest and the other continues with a velocity. In *Magnesium*, the two bodies mostly bounce off of each other in different directions (Project Nucleus). The nature of contact improvisation is continuous movement, so, it makes sense that the two bodies continue to move separately, both with nonzero velocities, after a collision. There is usually little to no stillness in contact improvisation because

bodies are always affected by gravity. As Paxton articulates, “One moves with gravity always” (*Fall After Newton 1*).

Since these concepts of physics are always true on earth, there is a sense of abandon in contact improvisation. The dancers have knowledge of the certain laws of motion and are trained to feel comfortable in situations where the outcome is out of the dancer’s control. Ann Cooper Albright, writes in her book *Engaging Bodies*, that she teaches her students to “fall without fear, to enjoy that suspension of the upright orientation and the loss of control in that moment of release” (272). There are moments when a dancer takes a risk and they need to trust that the laws of motion will not fail them. If a dancer does not relish the postponement before the fall, then a frantic reaction may cause the situation to become dangerous for the dancer. There is a sense of calmness that is necessary in the moment before a collision or fall when time is distorted to feel lengthened (“Contact Improvisation” 41). When a contact improviser is well trained, and they possess more knowledge of the laws of physics, then there is more room for risk taking in improvisation.

In contrast to the large risk taking moments that happen often in contact improvisation, Paxton developed what is called the “small dance.” For the last five minutes of *Magnesium*, the dancers stand vertically sensing their weight and how gravity is pulling on their bodies. The small adjustments show that there is muscular effort required in order to keep the body upright and resisting the pull of gravity (Cooper Albright 234). Although the shifts are small, the exercise allows the dancers to feel what their bodies are doing on a larger scale. The “small dance” suggests that the body is never actually standing still because every object is constantly affected by gravity, and to deny that is to deny the laws of physics. Also, since the movement is minimal, the “small dance” gives the dancers a chance to “experience the sweat and air on their

arms, their heart beating, the rhythms of their pulses in different places in their body” (Cooper Albright 225). These are all details that easily become overlooked when the body is over stimulated. The “small dance” is an exercise in hypersensitivity, which provides dancers with awareness of themselves internally. As a result, the dancers can be more aware when other bodies become part of the movement. In order for contact improvisers to connect to the world and other bodies that surround them, they must first have a clear understanding of themselves in relationship to gravity on a smaller scale.

The pairing of dance and the concepts of physics only seems natural in light of certain acts of the universe on all objects. External forces on the body inspire authentic and instinctive movement invention. There is a certain “pleasure of moving, [which is] the pleasure of dancing with somebody in a very spontaneous way” (Engelsrud 62). The relationship of contact improvisation and physics is expressed in the movement’s reactions to gravity, momentum, and change in energy, as well as in its investigation within Newton’s third law of motion. Contact improvisation is a form of dance that was established within the foundations of the laws of physics.

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