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Graphical Method of the Winning Mechanism of Taiji

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Abstract – The classical winning mechanism in Taiji push-hand is to attack the opponent's weakness with our strengths. A new software code, which we named "Taiji Master" was developed to calculate Taiji in complicated situations. This program was designed to assist students to learn the correct moves in a graphical method is simple, intuitive and practical manner. The graphical method develops a winning mechanism from the eight movements/philosophies: throw like an arrow; induce to empty; four ounces deflect thousand; optimized strike along connection of the two feet; crotch spiraling to strike narrow stance; crotch turning to assault short stance; waist rotating to beat small stance; buildup advantage to conquer the weak link. Being able to resolve Taiji movements in a mechanical/numerical manner allows the traditional martial arts world to ratify the inheritance of the master; and to allow research studies to determine optimal moves in any specific situation.

Introduction

In push-hand, we need to create our own advantages. We need to look for the opponent's weaknesses, know where our advantages are stronger than the opponent's weaknesses, and we must control the direction of force that we exert, in order to destroy the opponent's balance while maintaining our own center. The problem discussed here is the data that we calculated in early versions of the computer program is able to demonstrate the various mechanisms, but the data, for the lay person, was not easy to understand. What is required is a graphical method that is more intuitive and is able to provides practical uses that might be useful for those practicing Taiji.

For example, when the bow stance and the sit stance duel each other, the calculations show that the bow stance will win when at the mid point (see the example provided in table 1) are pushing forces, and the sit stance will win when at the midpoint the participant employs a pulling force (see table 1 and 2).

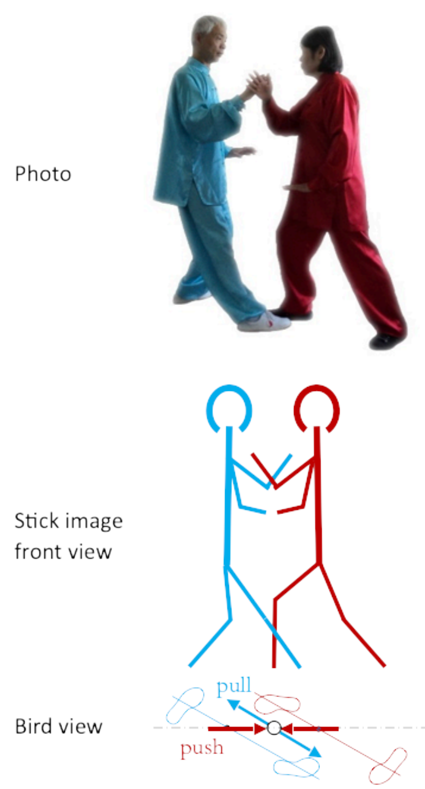

Fig. 1. Bow stance vs sit stance

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Stance Classification	body mass	friction coefficient	critical level	foot length	front rear feet format	front foot horizontal distance	front foot lateral distance	front foot angle	rear foot horizontal distance	rear foot lateral distance	rear foot angle	gravity center height	1st connecting hand height	1st connecting hand horizontal distance	1st connecting hand lateral distance
	m	μ	CrLe	FoLe	Fr/Re	L_{qx}	L_{qz}	FrAn	L_{hx}	L_{hz}	ReAn	H_z	H_1	L_{x1}	L_{z1}
	kg	no	nu	m	str	m	m	deg	m	m	deg	m	m	m	m
Right brush kneebow push/P	60	0.5	1	0.25	RF/LF	0.24	0.12	0	0.56	0.28	-45	0.9	1.1	0.40	0.0
Left sit stance divert push/P	60	0.5	1	0.25	RF/LF	0.56	0.28	0	0.24	0.12	-45	0.9	1.1	0.40	0.0

Stance Classification	1st horizontal force ratio	1st vertical force ratio	1st horizontal force	1st vertical force	Initial force/moment	Normal Stability moment	Critical condition	front foot normal force	rear foot normal force	front foot force tangent	rear foot force tangent	moment in normal direction
	$\varepsilon_{FM}(1)$	$\varepsilon_{FM}(2)$	F_{x1}	F_{y1}				N_q	N_h	$\tan\phi_q$	$\tan\phi_h$	
	no	no	N	N				N	N	no	no	
Right brush kneebow push/P	1.0		136.6	0.0	102.4	67.2	1Nlos	261.4	326.6	0.26	0.22	67.2
Left sit stance divert push/P	1.0		126.8	0.0	95.1	67.2	1Fsli	36.9	551.1	0.50	0.21	62.4

It is also seen that the bow stance gains the advantage by releasing a pushing force, and the sit stance has an advantage when employing a pulling force (see examples in table 1&2)[1]. This argues, in this situation, that both sides have an equal chance to win; and who will wins will depend on who is able to control the force direction.

To release a force that will be result in the person winning the contest, the person will needs to generate both a faster velocity and a higher acceleration than their opponent. It is also important to control the direction and magnitude of the force. Thus, winning is depend on two key points: the gaining of an advantage in stance and the control of the force direction. However, the complexity here is the advantage in the stance is directly linked to the required force direction. In a duel, when you have the more advantageous stance and you control the opposing force direction that matches your chosen stance, you can combine the force of your movements and overcome the opponent's critical force.

Examples

From the author's prior studies[1] the angle of the bow and the sit degree are relative between the two stances of the contestants. The conclusion was that the greater the angle of the bow degree, the greater the chance for the pushing force to win. Here the winning criteria is based on when the front/rear foot loses normal pressure, and the front/rear foot slips in the normal direction which results in a loss of balance. In contrast, the greater the angle employed in the sit degree the better the chance for a pulling force to win. For more detail, on the mathematics and mechanics behind these values see reference 1.

It was also observed in the prior study that the use of an arc movement can make the force direction oblique, that is, the force on the arc has both a radial force and a tangential force. The radial force can be used for movements such as "throw like an arrow" or "induce to empty". The tangential force has the ability to deflect forces, and can be

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linked to the sentence "four ounces deflects a thousand strength": this again being described in more detail in the prior study.[1]

However, though the prior study was useful, and many different examples were analyzed, many practitioners have found it difficult to comprehend the numerical values. So, in order to help the reader understand the forces involved it was decided it would be useful to develop a graphical/pictorial model, which should be more intuitive, and help those who are not experts in mechanics to better understand the forces employed.

To begin Torque has three directions, which can be applied in both defense and offense. These are defined in this study as spiral torque, turning torque, and rotating torque[1]. These link to the lateral distance of the footprint. In practice, if the distance is larger than the opponent, a releasing spiral torque is advantageous; when the longitudinal distance of the footprint is larger than the opponent, the releasing turning torque is advantageous; and when the connecting distance of the footprint is larger than the opponent, the releasing rotating torque is advantageous[1].

An Example of Force Calculation

In order to be able to focus on just the fighting technique, we assume the two opponents have the same weights and heights. The photo in Fig 1 shows the two opponents are doing push hand, and the Blue figure is in the sit stance, and the Red figure is employing a bow stance. The same image is represented by the stick image in Fig. 1 and the plan view is shown at the bottom of Fig. 1. In this battle, both sides have a chance to control the force direction; and in this situation there is only one pair of forces, which occurs at the mid-point between the two figures. The forces are equal in magnitude and opposite in direction.

Table 1 shows the current interface for the computer program. At present this is not a commercial program, and it was developed only to determine the magnitude of the forces and the force vectors. Using this program, again see reference 1 for more details, it was possible to calculate the Red opponent's frontal push force. In this situation with the red opponent employing a faster pushing speed, he is in control and the direction of force is forward horizontal, and the responding passive force of the blue participant is also forward horizontal pushing. Red's ability to push is 136.6 N, and Blue's ability to push is 126.8 N. If Red persists on pushing and reaches Blue's limit at 126.8 N, then Red will win, thus Red's winning factor can numerically be calculated to be 136.6/126.8=1.1.

.Table 2 calculates the case for Blue opponent diagonal pull force. In this situation, due to the faster relative diagonal pulling speed of the Blue opponent, the Blue opponent will be in control; so the direction of force is pulled diagonally backwards, and the passive force of Red is also pulling diagonally backwards. In this case, the Red's ability to pull is 130.7 N, and 65.3 N along the two related perpendicular directions; and Blue's ability to pull is (166.9 N, and 83.5 N along the same perpendicular directions. As can be seen, in this situation, if Blue persists on pulling and reaches Red's limit, which is calculated as 130.7 N and 65.3N, Blue will ultimately be victorious. In this case, mathematically, Blue's winning ratio can be calculated to be166.9/130.7=1.3.

Thus, the primary conclusion is that winning will depend on two interconnected points: the choice of stance and the direction of the releasing force. As stated earlier, in Fig 1, the stances of the two sides have been set, but both sides have the possibility to win. The bow stance holder can win if she pushes, and the sit stance holder can win if a diagonal pull is employed - which will be easier to achieve will depend on training and the skill of the participants. It is also clear that, for example, if the Red opponent now knows that the bow stance is more suitable for pushing, then he or she should push, but this is where experience comes in to play. If Blue opponent knows that the sit stance is suitable for diagonal pulling, and Blue finds that Red is pushing, the Blue opponent the needs to use the grab method to change the pushing to diagonal pulling, and if he pulls persistently, he will be able to pull Red opponent down.

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stanceclassification	body mass	friction coefficient	critical level	foot length	front rear feet format	front foot horizontal distance	front foot lateral distance	front foot angle	rear foot horizontal distance	rear foot lateral distance	rear foot angle	gravity center height	1st connecting hand height	1st connecting hand horizontal distance
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	kg	no	nu	m	str	m	m	deg	m	m	deg	m	m	m
right brush kneebow pull/P	60	0.5	1	0.25	RF/LF	0.24	0.12	0	0.56	0.28	-45	0.9	1.1	0.40
left sit stancedivert pull/P	60	0.5	1	0.25	RF/LF	0.56	0.28	0	0.24	0.12	-45	0.9	1.1	0.40

stance classification	1st horizontal force ratio	1st vertical force ratio	1st horizontal force	1st vertical force	Initial force/moment	Normal Stability moment	Critical condition	front foot normal force	rear foot normal force	front foot force tangent	rear foot force tangent	moment in normal direction
	$\varepsilon_{FM}(1)$	$\varepsilon_{FM}(2)$	F_{x1}	F_{y1}				N_q	N_h	$\tan\varphi_q$	$\tan\varphi_h$	
	no	no	N	N				N	N	no	no	
right brush knee bow pull/P	1.0	0.5	-130.7	-65.3	-98.0	67.2	1R sli	483.5	39.2	0.24	0.50	-52.6
left sit stance divert pull/P	1.0	0.5	-166.9	-83.5	-125.2	67.2	1N los	301.6	202.9	0.31	0.39	-67.2

Table 2. Calculations for the Blue opponent diagonal pull.

How can we change the push force to diagonal pull force? In this case, Blue needs to make the pull speed/acceleration greater than the red push speed/acceleration. If the red side finds that the blue side has changed to pull, they should immediately respond to change from pull to push. Likewise, to change the diagonal pull force to the push force Red will need to make the push speed (acceleration) greater than the blue pull speed (or acceleration), as this will increase the amount of force employed.

Here, it can be seen that the speed of the force releasing is the key in this specific example. The releasing force must always have a faster speed (acceleration) than the opponent, in order to effectively control the direction and the magnitude of the force.

Graphical method for Winning

These simple calculations give the concept behind Taiji's winning mechanism.

The starting point is "Taiji is a martial art that aims to destroy the balance of the opponent, while maintaining one's own balance. For this calculation Newton's three laws were used to derive the formula. The software was developed using VBA language.

As can be seen, the software calculation helps to explain why certain moves are better in certain situations, but it is a bit inconvenient, and difficult to read for those Taiji practitioners who either do not have the software, or are unfamiliar with the terminology used.

For this reason a graphical method is presented below. In much the same way, the graphical method can effectively determine the winning mechanism in both simple situations, and with sufficient practice, it can also calculate complex situations, with multiple directions, multiple forces and in highly complex dynamic situations.

The primary aim is that, ultimately, as many people as possible should be able use the graphical method, and as the first step the “releasing force” on balance is considered to be the core for the graphical method.

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The simplest interpretation of balance is that the vertical line of the gravity center is within the supporting area under the action of external force and gravity. The support area this is defined by the "footprints".

Next, the confrontation between the two opponents is mediated by action forces and reaction forces, and each opponent can be simplified as a free body diagram for analysis.

During a confrontation, the footsteps and footprints are constantly changing, and the relationship between the gravity center and the supporting area will thus also change. The relationship among the gravity center, the support area, and the force direction determines the strengths or weaknesses of both opponents. If you are participating in competitive Taiji, when you gain an advantage and make an offense, you have more confidence to score a point. The advantage is that in the backup of the force direction there is a larger distance from the gravity center to the support area boundary, which is defined as the balance degree (BD).

In the following the Eight standard sentences throw like an arrow; induce to empty; four ounces deflect thousand; optimized strike along connection of the two feet; crotch spiraling to strike narrow stance; crotch turning to assault short stance; waist rotating to beat small stance; buildup advantage to conquer the weak link are now sequentially reviewed.

The software program in [1] delivers detailed calculations. The graphical method in this paper are considered special cases: for simplicity the two opponents have the same weight, same height, and the force and reaction force are horizontal, see Fig 1.1.

To calculate the moment of point O by the law of rotation:

$$\sum M_o = 0 \qquad (1)$$

that is (see reference 1 for further details),

$$Fh + fL - WBD = 0 \qquad (2)$$

Where F is the critical horizontal action and reaction forces between the two opponents; h is the height of the connecting hand; f is the floor force acting on the one of the feet; L is the distance between the front foot and rear foot, W is the weight; BD is the balance degree. When f=0 , the opponent starts to lose their footing, and begins to lose balance.

When f=0, it is then possible to rewrite equation (2) as,

$$F = \frac{WBD}{h} \qquad (3)$$

For Fig 1.1a,

$$F_{SitPush} = \frac{WBD_{SitPush}}{h} \qquad (4)$$

For Fig 1.1,

$$F_{BowPush} = \frac{WBD_{BowPush}}{h} \qquad (5)$$

Measure from Fig 1.1a and b,

$$BD_{BowPush} > BD_{SitPush} (6)$$

Thus,

$$F_{BowPush} > F_{SitPush} \qquad (7)$$

Therefore, when there are pushing forces in the middle, the sit stance will lose balance first, and the bow stance will win.

For Fig 1.1c,

$$F_{SitPull} = \frac{WBD_{SitPull}}{h} \qquad (8)$$

For Fig 1.1d,

$$F_{BowPull} = \frac{WBD_{BowPull}}{h} \qquad (9)$$

Measuring from Fig 1.1c and d,

$$BD_{SitPull} > BD_{BowPull} \qquad (10)$$

So,

$$F_{SitPull} > F_{BowPull} \qquad (11)$$

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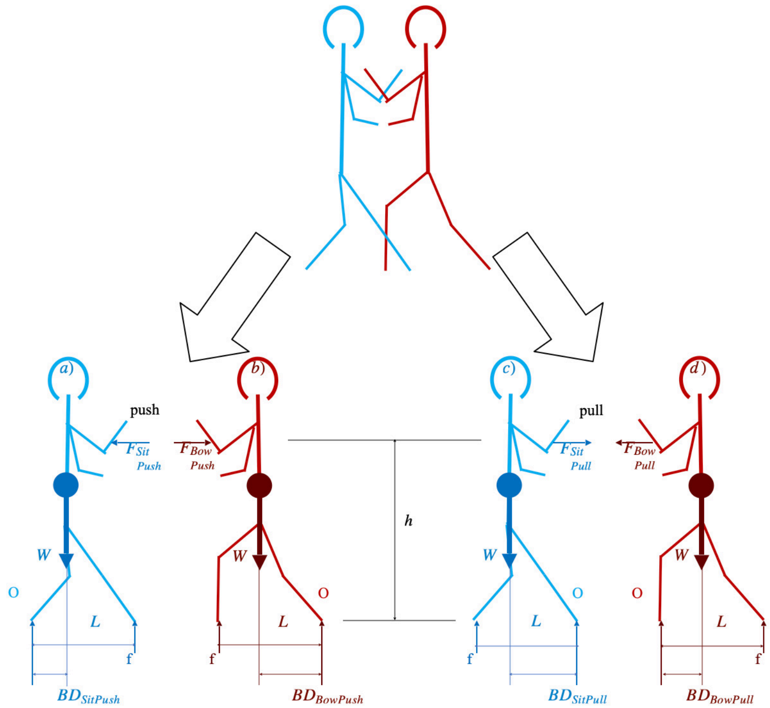

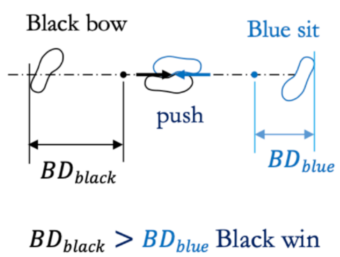

Fig 2 Black bow PUSH Blue sit

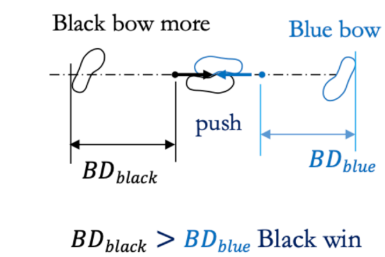

Fig 3 Black bow more PUSH Blue bow

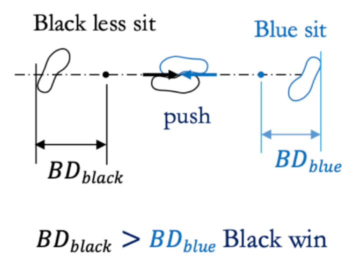

Fig 4 Black sit less PUSH Blue sit

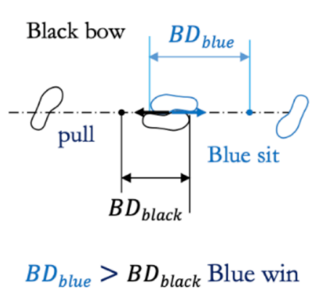

Fig 5 Black bow PULL Blue sit

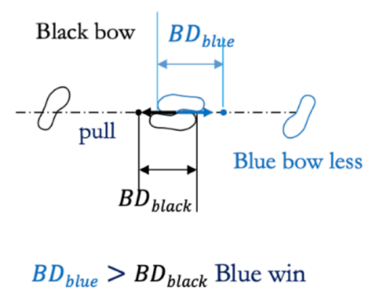

Fig 6 Black bow PULL Blue bow less

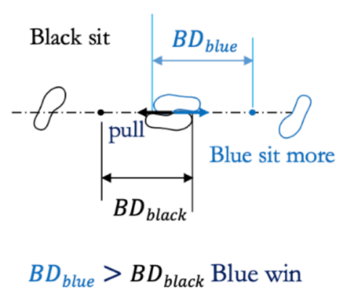

Fig 7 Black sit PULL Blue sit more

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Therefore, when there are pulling forces in the middle, bow stance will lose balance first, and the sit stance wins.

In the following, the figures shown in Fig. 2 through Fig. 30 all have the same convention, but only the bird view figures are provided.

Throw like an arrow (which involves pushing an opponent off balance) means that the distance from the gravity center to the rear foot edge (the push force Balance Degree) should be greater than the opponent's when releasing a push force. In Fig. 2 the pushing force Balance Degree (BD) of the Black's bow stance is greater than that of Blue's sit stance, so Black wins when a pushing force is released (in these situations, whichever side release the force gets the result). In Fig 3., the pushing force Balance Degree of Black's bow stance is greater than that of Blue's bow stance, so Black wins when pushing force is released. In Fig. 4, the pushing force Balance Degree of Black's sit less stance is greater than that of Blue's sit stance, so Black wins when pushing force is released. The bow degree is defined by the distance from the gravity center to the rear foot edge. The pushing force is sent forward, and the bow degree at the rear supports this forward force. Therefore, a larger bow degree is suitable for releasing pushing forces; which gives Black the winning factor. This winning factor is equivalent to the third-order winning factor calculated by the software code[1]. From Fig. 2 to Fig. 4, it is shown that the "Black bow PUSH Blue sit" has the highest winning factor. As discussed earlier, the winning factor must be at least greater than 1 to generate a possibility to win. If the winning factor for Black is less than 1, then Black will lose, such as in the "Black bow less PUSH Blue bow".

Induce to empty *(to pull the opponent off balance)* means that the distance from the gravity center to the front foot edge (the balance degree of the pull force) should be greater than the opponent's employed pull force.

In Fig. 5, the balance degree generated from the pulling force can be measured in the diagram (balance is linked to the balancing of the forces, and the value is directly connected to the distance). So, what we are referencing is a magnitude from the center of gravity. In this case Blue's sit stance is greater than that of Black's bow stance, so Blue wins when a pulling force is released (however, as before, whichever side releases the force can get the result). In Fig. 6 the pulling force balance degree (BD) of Blue's Bow Less stance is greater than that of Black's bow stance, so Blue wins when a pulling force is released. In Fig. 7 the balance degree for the pulling force of Blue's "sit more" stance is greater than that of Black's sit stance, so Blue wins when the pulling force is released. The sit degree is defined as the distance from the gravity center to the front foot edge. The pulling force is sent rearwards, and the sit degree at the front supports the created rearward force. Therefore, a larger sit degree is suitable for a releasing pulling force, and Blue gains the winning factor. From Fig. 5 to Fig. 7, it can be seen that " Black Bow PULL Blue Sit " has the highest winning factor. For Blue, the winning factor must be greater than 1; and if this winning factor is less than 1, then Blue will lose, as seen in "Black Sit PULL Blue Sit Less". It should be noted that the arrows drawn in the diagrams are the forces in the horizontal direction, and these forces are created by the competitors hands. The ability for a competitor to keep their balance refers to the rear foot not becoming detached from the floor. All The actions described in Fig. 2 to Fig. 7 were treated numerically in paper 1, and these diagrams are provided solely to help visualize the mathematics.

Four ounces deflect thousands is a poetic phrase that is often used in martial arts and means use minimal power to defeat a stronger enemy. To *"attack the lateral direction to move the opponent off balance" is less poetic but is perhaps more easier to understand for non-martial artists)*. In this model this means that the distance from the gravity center to the rear foot edge (the balance degree) should be greater than the opponent's when releasing a lateral force. In

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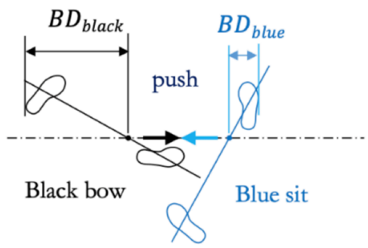
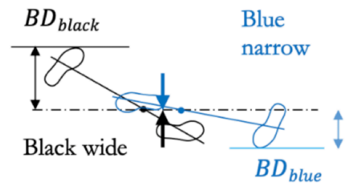


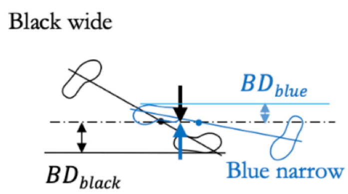
$BD_{black} \gg BD_{blue}$ Black win

Fig 8 Black longitudinal PUSH Blue lateral



$BD_{black} > BD_{blue}$ Black win

Fig 9 Black wide left lateralling Blue narrow



$BD_{black} > BD_{blue}$ Black win

Fig 10 Black wide right lateralling Blue narrow

Fig. 8 the pushing force Balance Degree (BD) of Black's bow stance is greater than that of Black's lateral bow stance, so Black will create a winning position when a pushing force is released: as before, whichever side releases the force will get a result. In Fig. 9 the balance degree in a left pushing force for Black's wide bow stance is greater than that in Blue's narrow bow stance, so Black will wins when a left pushing force is released. In Fig. 10 the Balance Degree within a right pushing force in Black's wide bow stance is greater than that for Blue's narrow bow stance, so Black will win here when a right pushing force is released. From Fig. 8 to Fig. 10, it can be seen that " Black Longitudinal PUSH Blue Lateral " has the highest winning factor. In order to create the highest winning factor, Black will need to maneuver to the lateral direction and employ the correct timing.

It should be noted that the forces described here were referred to as Critical Forces in reference 1,

The phrase “Optimized strike along connection of the two feet” means that the force direction along the line connecting the two feet will optimize the distance from the Gravity Center to the behind foot edge (Balance Degree), This can result in an advantage over a poorly planned direction in an opponent’s footprint. The two feet have the longest distance on the line connecting the feet, and this produces the greatest balance degree. As shown, the force direction along the line connecting the two feet acquired the greatest supporting balance degree, which is the optimized force direction. In Figs. 12 and 13, the opponents both use bow stance, but the orientations of the participants differ. Thus, the connecting direction between the opponents is not parallel. In Fig. 12, Black controls the push force direction with the connecting direction on his own side, and Black's push force Balance Degree is greater than the Blue's “casual”, unplanned directional push force and Balance Degree, so Black wins when a push force is released. In Fig. 13, Blue controls the push force direction to be the connecting direction on his side, thus the Blue’s push force, Balance Degree is greater than the Balance Degree generated by Black's casual directional push force, so Blue wins when a push force is released. Here it is seen that controlling the force direction to the connecting vector/direction is the key to winning. In Figs. 14 and 15, the two opponents again use the same stance, in this case a sit stance, with the orientation slightly offset and the connecting direction between the two opponents is again not parallel. In Fig. 14, Black controls the pull force direction as the connecting direction to his side, and the Black's pull force balance degree is greater than Blue's casual or careless directional pull and the calculated force Balance Degree. So Black will win when a pull force is employed. In Fig. 15, Blue controls the pull force direction as the connecting direction on his side, and the Blue’s Balance Degree generated by the pull force is greater than the Black's casual, unplanned directional pull, so Blue wins when a pull force is employed; and again it can be seen that controlling the force direction to the “connecting direction” is the key to winning.

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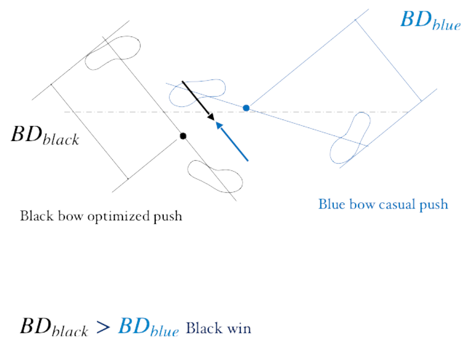

Fig 12 Black bow optimized push Blue random direction

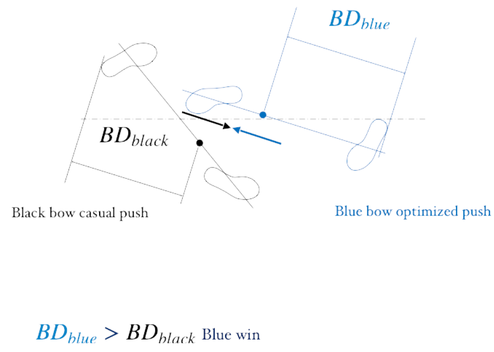

Fig 13 Black bow casual ush Blue optimized direction

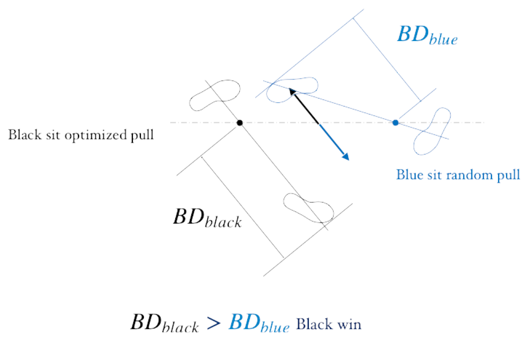

Fig 14 Black sit optimized pull Blue random direction

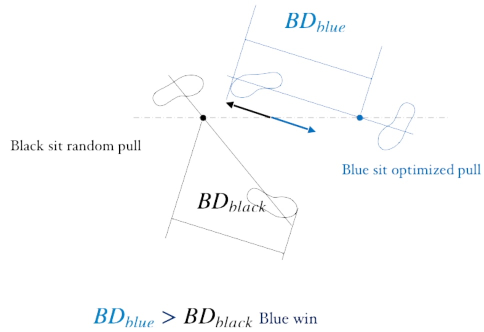

Fig 15 Black sit random pull Blue optimized direction

At this point, the trends shown by these diagrams should now be very clear, but for completeness I will continue to detail the remaining moves.

The *Crotch spiraling to strike narrow stance* involves the situation where Balance Degree generated from the distance from the Center of Gravity to the lateral direction back foot edge should be greater than the opponent's, when releasing a spiral torque. In Fig. 16 the spiral torque's Balance Degree of the Black's Lateral Direction Wide Bow Stance is greater than that of Blue's Narrow Bow Stance, so Black will win when a spiral torque is released. In Fig. 17 the left lift, right press Balance Degree of Black's Wide Bow Stance is greater than that of Blue's Narrow Bow Stance, so Black will win when a combined left lift, right press force is released. In Fig. 18 the right lift force balance degree of Black's wide bow stance is greater than Balance Degree of Blue's Left Press Force narrow bow stance, so Black will win in this situation when Black Right Lift Blue left press forces are released.

The Crotch turning to assault short stance means that the Balance Degree from the distance from the center of gravity to the back direction backup foot edge should be greater than the opponent's when releasing turn torque. In Fig. 19 the turn torque's balance degree in Black's Front-Rear Orientation wide bow stance is smaller than that shown by the Blue's narrow bow stance, so Blue will win when a turn torque is employed. In Fig. 20, the front lift rear press forces Balance Degree of Black's wide bow stance is less than that of Blue's narrow bow stance, so Blue will win when Front Lift Rear Press forces are released. Finally, in Fig. 21, the Balance Degree from a press force bin Black's wide bow stance is smaller than that generated by Balance Degree from Blue's lift force in the narrow bow stance, so Blue will wins when Black press Blue lift forces are released.

Waist rotating to beat the small stance means that Balance Degree generated from the distance from the gravity center to the back direction foot edge should be greater

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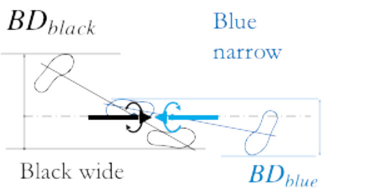
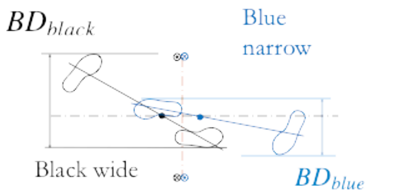


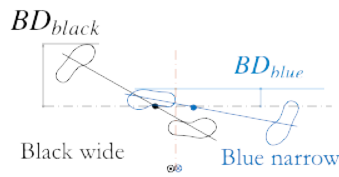
$BD_{black} > BD_{blue}$ Black win

Fig 16 Black wide spiraling Blue narrow



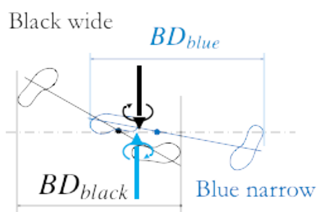
$BD_{black} > BD_{blue}$ Black win

Fig 17 Black wide left lift right press Blue narrow



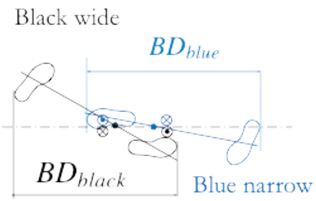
$BD_{black} > BD_{blue}$

Fig 18 Black wide right lift Blue narrow



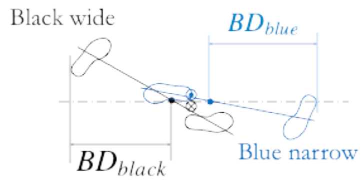
$BD_{blue} > BD_{black}$ Blue win

Fig 19 Black wide turning Blue narrow



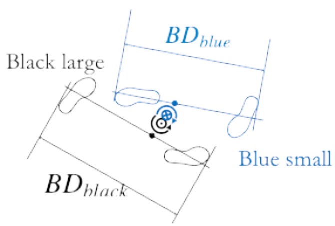
$BD_{blue} > BD_{black}$ Blue win

Fig 20 Black wide front lift rear press Blue narrow



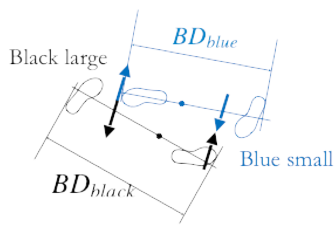
$BD_{blue} > BD_{black}$

Fig 21 Black wide press Blue narrow



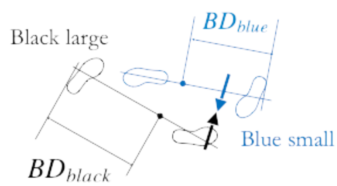
$BD_{black} > BD_{blue}$ Black win

Fig 22 Black large rotating Blue small



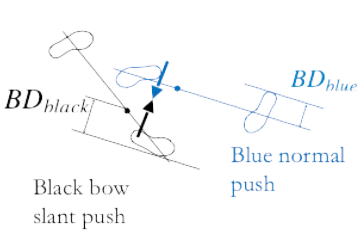
$BD_{black} > BD_{blue}$ Black win

Fig 23 Black large right push left pull Blue small



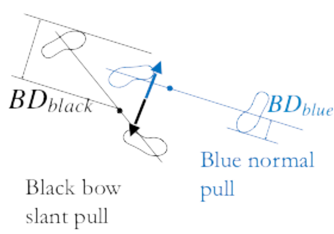
$BD_{black} > BD_{blue}$

Fig 24 Black large right push Blue small left push



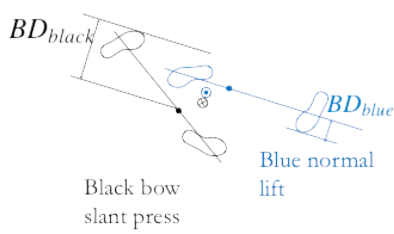
$BD_{black} > BD_{blue}$ Black win

Fig 25 Black bow slant push Blue normal direction



$BD_{black} > BD_{blue}$ Black win

Fig 26 Black bow slant pull Blue normal direction



$BD_{black} > BD_{blue}$

Fig 27 Black bow slant press Blue normal lift

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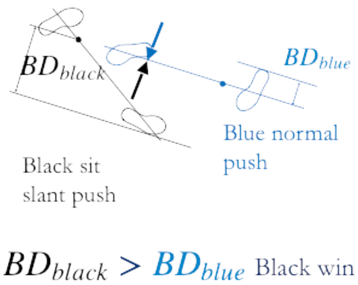

Fig 28 Black sit slant push Blue normal direction

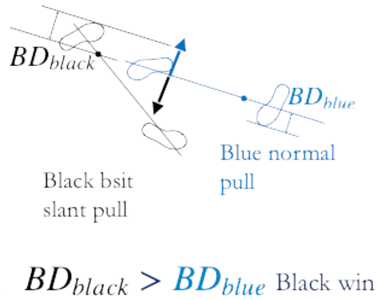

Fig 29 Black sit slant pull Blue normal direction

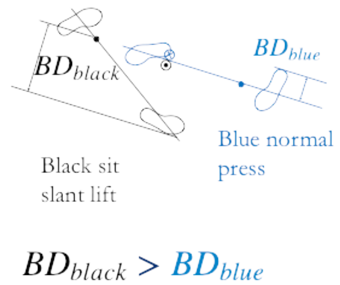

Fig 30 Black sit slant lift Blue normal press

than the opponent's when releasing rotate torque. In Fig. 22 the rotate torque's Balance Degree of Black's connecting direction large bow stance is greater than that of Blue's small bow stance, so Black wins when a rotation torque is released. In Fig. 23, the Balance Degree from the right push left pull forces of Black's large bow stance is greater than Blue's left push right pull forces balance degree employed in a narrow bow stance, so Black wins, in this case, when Black's right push left pull forces are released. In Fig. 24, the right push force balance degree of Black's large bow stance is greater than Blue's left push force balance degree of narrow bow stance, so Black will win when Black's right push Blue's left push forces are released.

Buildup advantage to conquer the weak link means attacking the opponent's weakness ("thin balance degree") with one's advantage ("thick balance degree"). The seven sentences (throw like an arrow; induce to empty; four ounces deflect thousand; optimized strike along connection of the two feet; crotch spiraling to strike narrow stance; crotch turning to assault short stance; waist rotating to beat small stance) all generate advantages to conquer a weak link.

Generally speaking, the normal direction has shortcomings, whereas the oblique direction gains the relative advantage. In Fig. 25, the Balance Degree of the oblique pushing force of Black's bow stance is greater than Blue's Balance Degree in the bow stance's normal direction. Thus, Black will win when Black release a pushing force toward Blue's normal direction. In Fig. 26, the Balance Degree of the oblique pulling force in Black's bow stance is greater than the Balance Degree in the normal direction of Blue's bow stance. So, Black will wins when Black employs a pulling force toward Blue's normal direction. When Fig. 26 is compared to Fig. 25, it can be seen that the winning factor is high when a pulling force is used; thus it is more beneficial to release a normal pull force than a push force in bow stances. In Fig. 27, the Balance Degree of the press force (the vertical downward force) in Black's oblique direction, when employing a bow stance, is greater than Blue's Balance Degree in the normal direction used in Blue's bow stance; so Black will win when Black employs a pressing force toward Blue's normal direction. Black can also use a two-dimensional pulling-pressing force in combination with Fig. 26 and Fig. 27, which can further increase the odds of winning. In Fig. 28, the Balance Degree when using an oblique pushing force in Black's sit stance is greater than the Balance Degree in Blue's normal direction when employing a sit stance, so Black will win when Black release a pushing force toward Blue's normal direction. In Fig. 29, the Balance Degree for an oblique pulling force in Black's sit stance is greater than the Balance Degree for Blue's normal direction in the sit stance, so Black will win here when Black uses a pulling force directed toward Blue's normal direction. Comparing Fig. 28 to Fig. 29, it can be seen that the winning factor is high when a pushing force is used, so it is more beneficial to release a push force in the normal direction, than to use a pull force in sit stances. In Fig. 30, the Balance Degree for the lift force (the vertical upward force) for Black's oblique direction in a sit stance is greater than Balance Degree for Blue's

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normal direction in the sit stance, so Black wins here when Black releases a lifting force toward Blue's normal direction. Black can also release a two-dimensional pushing-lifting force in combination with Fig 28 and Fig 30, to increase the odds of winning.

Buildup advantages to conquer the weakest link is combined in all eight sentences, in other words, one should assemble our advantages and attack the opponent's weaknesses. The above graphical method is based on an equal-weight-scale confrontation. When the weights of the competitors are unequal, the winning factor should take the weight of both sides into account. Here the winning factor is described by the equation,

$$\text{WF} = \frac{W_{black} \times BD_{black}}{W_{blue} \times BD_{blue}}$$

As can be seen, a light athlete, although lighter in weight, could still have a larger WF value than a much heavier opponent, through the use of technique to generate a higher Balance Degree.

Therefore, lighter athletes need to accumulate their own specific advantages and look carefully for their opponent's weaknesses. When their own advantages are higher than the opponent's weaknesses, they can control the direction of force through the use of moves with higher velocity and acceleration, and thus still win the competition. In general, the weak can only beat the strong through making use of this higher Balance Degree (which equates to better technique), to make up for their lack in body weight and strength.

It is believed that for most students of taiji this graphical method is far more intuitive, and simpler to understand. It is also still possible to use these diagrams for computer-based calculations.

Zhuge Liang's "strategies to win thousands of miles away" is based on the idea of using strategies to generate decisive victories. This graphical method reveals, summarizes and improves upon the experience of our predecessors. The graphic method condenses the winning mechanism into eight sentences, which I believe the traditional martial arts world can use it to ratify the inheritance and knowledge of prior masters; a coach can use it to optimize the training of athletes; the push-hand athletes can use it to help win competitions; the routine athlete can use it to make a move more artistic; and Taiji practitioners of all age levels can use it to coordinate the relationship between the Taiji training of the person's strength, amplitude, frequency and physical fitness. To summarize, the Eight Techniques and Five Footworks are Taiji tactics. The Eight Techniques are methods of the body and hands, and the Eight Techniques are not independent. It cannot be said that the Oblique Pull is not necessarily better than the Bounce; and the Squeeze is not necessarily better than the Oblique Pull. The Five Footworks are methods of footsteps and movements, and the Five Footworks are not independent. Thus, it cannot be said that bow stance is better than sit stance. The combination of the Eight Techniques and Five Footworks provides complete meanings for defense-offense.

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