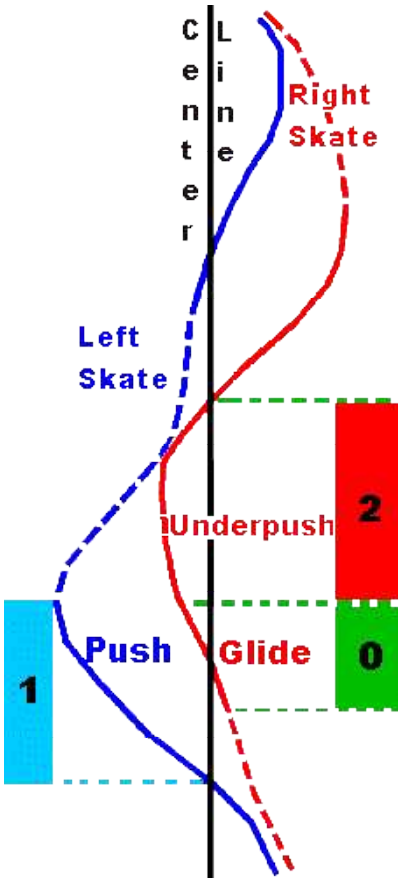
Elements of the Barry Publow Double Push

c. P. J. Baum, February 2002.

02.16.2002

Introduction

Some clarification of the Chad Hedrick Double-Push skating technique was recently presented (1),*HERE*. The discussion on this page is based on analysis of a video clip from breakaway.com (2) taken while Barry Publow was performing his Double Push. An example of that stroke is shown in the animation below and to the left. The figure to the right of the animation shows the ground tracks obtained from the video. What I call the Center Line appears as the solid black line in the drawing below.



In the animation above Barry is, of course, skating out of the screen while in the figure to the right he is moving from the bottom of the screen to the top of the screen. So Blue will represent his left skate and Red will be his right skate.

Matzger and Burger's underpush (3,4) begins exactly on the center line whereas Chad's version begins the underpush slightly over the center line . Here we see that Barry Publow's Double Push (5) has both skates on the ground simultaneously for a period and the recovery skate glides across the center line.

As in my earlier analysis Chad's double-push I term the "push" the first push (corresponding to the classic single-push done on the inside edge on the wheels). Then the "underpush" becomes the second push (on the outside edge). There is some complication in Barry's double-push while both skates are are on the ground so I have added a Glide phase labelled "0" which was not present in the Chad Hedrick Version.

Forces in Barry Publow's Double-Push

Higher-Level Forces

Viewing the animation at the top of this page confirms that the first push is characterized by significant leg extension. However, the second push shows no such extension so we must look elsewhere for the power source of the second push. On a previous page (6) I suggested an inverted pendulum mechanism for powering the second push but this is obscured here by the continuous rise and fall of Barry's upper body. So we must examine his full body extension as well as any lateral flexion which employs the double inverted pendulum mechanism. While the first push seems to be accomplished by lower body (leg) muscles, any other pushes Barry develops rely on midbody muscles for power.

Gravity-power vs. Muscle-power

Now Barry Publow's Double-Push shows significant vertical motion so this is a good place to discuss gravity effects. Very recently Michael J. Ryan (7) discussed the "fall" in skating. He notes: "So we have a vertical acceleration (gravity) that is used to create horizontal motion... The

great thing about this type of motion, to a skater is that it requires no muscular contraction. It only requires a supporting force to translate the force of gravity into a horizontal force that creates motion." So he seems to propose that gravity drives horizontal motion (which would produce forward motion through the skate action). Now everything he says is quite true but there is a lot he didn't say which changes the gravity perspective dramatically. Gravity power makes a lot of sense for a downhill racer where gravity assists the skater continuously down the hill. But, when you skate on a level surface it is far more difficult to find a useful gravity-powered scenario. The only one I have come up with would be to fall to the floor as you cross the finish line so that the gravitational energy of the fall assists your muscle push on the final stroke.

But when you skate continuously on a level surface you can only use use the fall as part of a repetitive or cyclic downward-upward motion e.g. fall-unfall-fall-unfall.... Barry's motion in the video clip above demonstrates this as his head moves cyclically up and down. Here I imagine the upward "unfall" as the opposite of the downward "fall" process. I will argue later that there is no problem in Barry's strategy overall but that gravity is not the main power source overall because what gravity gives during the "fall" it takes away during the "unfall" so it has no net power advantage. On the level gravity is simply a fact of life and it is essential for grip so your muscles can be effective in reacting against the ground.

As a very simple example of the fall-unfall cycle consider the following scenario: you get up out of bed, walk down the hall, and plop down on the sofa. Now Ryan might point out the gravitational energy released as you plop down on the sofa as evidenced by bouncing springs. And I would conclude that that energy was developed by your muscles when you got up out of bed in the first place. This example shows that energy is not free -- you paid the price when you got out of bed. It also shows that gravity is not a very strong propulsive force as your muscles easily overpowered it when you got up. So on the level gravity power is only a transient phase where muscle power is stored as gravitational potential energy during the "unfall" and released during the "fall" in an oscillatory fashion.

There are other compelling reasons to move closer to the ground which have nothing to do with gravity power. One of these is the aerodynamic drag reduction as your body cross section drops as you bend down. Another is the fact from geometry that your leg stroke length increases as you get lower so your muscles can deliver more energy per stroke.

Now a body up-down motion can be used for other purposes than modulating the gravitational energy. One such use would be a full-body extension to generate an inertial force acting along the body and which would react with the ground at skate level for purposes of muscle-driven propulsion or cornering. In this case the generated force is axial or along the body. Still another strategy for a full-body extension would simply be to increase the body length, for example to increase the upper body "lever-arm" length which would subsequently be used in a muscle-powered double-inverted pendulum powering scheme. Here the force would be lateral or perpendicular to the body axis. Shortly I will attempt to see which of these strategies Barry uses in his double-push.

Higher-Level Forces Continued

Now as you watch Barry's rhythmical motion in the animation above there is a clear body extension which moves his head both vertically

up and laterally over the skate which has been set down on the ground. So this can be viewed as a simultaneous upper body extension and upper body lateral flexion. Now during the first push the leg extension moves the upper body and the pushing leg out of a straight line. During the underpush there is a clear upward acceleration but it is not obvious that there is any significant angle developed between the upper body and the supporting leg. I addressed this issue in regard to Chad's double push arguing that he was skating at constant velocity or zero net force so no angular deviation might be apparent. I also stated that the skate delivered power to the ground as fast as it was generated by upper body lateral flexion. Now I am led to think that this process is accomplished by moving the supporting leg laterally (or allowing the supporting leg to move laterally) simultaneously with the upper body lateral motion in the opposite direction. This is consistent with the lack of observed angle between the supporting leg and the upper body.

Now Barry uses the upward body extension while he is nearly straight up over his skates and that is why his head elevates significantly but little cornering force is developed (as shown from the track motion) and the vertical elevation produces minimal sideways reaction force. So it seems that he really wants to extend his body length and the logical motivation for this extension would be to produce lateral force through lateral body flexion.

It is not clear that this up-down motion is harmful compared to the Chad Hedrick double-push. Scaled to their respective heights, Barry is a little lower than Chad when he is down and he is a little higher than Chad when he is up. But his average height is not much different from Chad's so the average wind drag may be comparable for both. The fact that he is a little higher at the top gives him a longer lever arm to exert lateral force through body flexion. The one clear advantage of the Barry Publow technique is stability. The vertical inertial force is likely to produce stronger grip and the fact that two skates are on the ground during the glide means that it is very likely more stable on slippery surfaces.

Double-Push or Triple-Push?

While Chad lifts one skate off the ground at the instant the other touches down Brry leaves both skates on the ground for a while (see ground tracks at the top of this page). This raises a question of what double-push means here. In Chad's case it was defined as alternating pushes and underpushes performed on one skate alone. Now in Barry's case both skates are on the ground and one wonders whether he is simultaneously pushing with both skates which could be another form of double-push or even a triple-push if he pushed with both legs and the upper body simultaneously. The answer to whether he pushes with two skates simultaneously seems to be yes and no. It is very likely that some power is being delivered through both skates simultaneously but observing his leg extension shows that most of the power is generated by only one leg at a time. So if we refer to the body origin of the pushes it turns out to be a double-push and not a triple-push.

Discussion and Conclusions

While the classic style is sometimes called "stroke and glide, Chad's double push seems to be more a "stroke and understroke". And Barry's Double Push looks like a simultaneous "stroke and glide" followed by an understroke. The upper or mid-body develops power during the underpush. So the double push powers continuously and we can say is has a "duty cycle" of 100%.
Chad's underpush power mainly derives from the lower back muscles and it was followed by a torsional flexion. Barry's double-push does not employ the torsional flexion but it does include an axial upper body extension along with the lateral flexion. So Barry's double-push seems to employ muscles higher up in the back than does Chad's double-push and it makes more use of abdominal muscles. Comparing the two it seems that Barry's methods has an advantage on slippery surfaces. On regular surfaces a more quantitative analysis is needed to find an advantage of one over the other.

References/Footnotes

1. *dpfront.html* Elements of the Chad Hedrick Double Push.
2. breakawayskate.com
3. Eddy Matzger and Dan Burger, Dan's Double Push Stripped Bare, Fitness and Speed Skating Times, Early Summer '99, p. 10.
4. Burger et al. DP site
5. Barry Publow, Inline Evolution: The Changing Face Of Technical Character, Speed Skating Times, Aug/Sept 1966.
6. secondpush.html
7. Michael J. Ryan, Waiting For A Push, Fitness and Speed Skating Times V12 No2, 2002 (Pre-Olympic Issue) Page12.

Click to go back to the *INDEX*
