Original Article

How triathletes mount their bikes after the first transition. A classification proposal.

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Abstract:

A proposal is submit for the classification referring to the different ways in which triathletes mount their bikes to start pedalling. This action happens at the end of the transition area (T1) after having gone across on foot, with the bikes at their side, or, led across by hand, in a specific way (Fernandez Rodriguez et al., 2015). These are unique aspects of this sport, compared to other sports in which a bike is also used. The purpose of this research was concentrates in describing and classifying the motor behaviours that occur at the end of the transition area, in front of the “judge’s line” or on the mount-dismount line. This study was based on participants of 3 Spanish Elite Championships and different age groups of different distances (407 triathletes). It was filmed in the moment when they picked up their bikes, passed through the transition area and mounted their bikes. Eleven different ways were discovered on how to mount a bike when passing the judge’s line.

Key Words: triathlon, mounting a bike, mount-dismount line, swimming-riding transition, T1.

Introduction

Millet and Vleck (2000) define triathlon as a complex sport, just as much as being made up of three different sports, as the particular change from one to another defined by the quickness and preciseness through the transitions. In a similar way, Cejuela (2007) defines triathlon as a cycle sport, broken up by the particularity of transactions, which are highly precise actions, of medium-high speeds, causing breaks in the triathletes pace.

Triathlon has been and is being studied at length from different areas of expertise such as physiology, biomechanics or psychology. The “open” concept, which has multiple interpretations, and all from different fields of expertise, is about what happens during the “transition”, and has made for various studies including: quick transaction and analysis of transition time; the lost time in T1 & T2 (Cejuela et al., 2008, 2011); the effects swimming intensity on subsequent cycling performance (Peeling et al., 2005; Bentley et al., 2007); effect of cycling intensity (Hauswirth et al., 2001; Bernard et al., 2007); physiological and biomechanical adaptations to the cycle to run transition (Sleivert and Rowlands, 1996; Hue et al., 1998; Diaz Molina et al., 2009; Daniel et al., 2011); strategy swimming pace (Chatard et al., 1998; Delextrat et al., 2003; Commotto et al., 2011; Rivas Feal, 2011); analysis of performance factors in sprint distance (Cejuela et al., 2007); competitive performance of elite olympic-distance triathletes (Paton and Hopkins, 2005); temporal activity in particular segments and transitions (Cejuela et al., 2013); change in neuromuscular control, running kinematics, muscle recruitment or motor coordination after cycling (Chapman et al., 2008; Chapman et al., 2009; Cala et al., 2009; Bonacci et al., 2010a, 2010b) Bonacci et al., 2011a; Bonacci et al., 2011b); rating of perceived exertion during cycling and subsequent running economy in triathletes (Bonacci et al., 2013) As seen, it seems that researchers address the T1 (or T2) as cardiorespiratory, physiological, metabolic, neuromuscular control problems, or a waste of time, and their influence on the final result, without considering that the simple act of how triathletes mount a bike can determine their end performance (loss of group). On one hand, it is a matter of skill, and on the other hand, choosing the appropriate way depending on the circumstances or the situation in the transition area and the judge’s line.

Only Fernandez Rodriguez et al. (2015) have studied the internal structure of motricity itself in the last part of T1 referring to the way in which triathletes carry their bicycles into the boxes. This area must was covered on foot carrying the bicycle next to you. It was the moment in which, having everything necessary to peddle, the triathlete picks up their bike, and travels through the transition area carrying the bike next to them as fast as possible. The purpose was to determinate how the binomial triathlete-bicycle was moved into the transition area, (hold-riding), in other words, in which part of the bike they put their hands. There were four habitual types of hold-riding bikes in the transition area. Despite being an essential characteristic aspect for the transitions, there has not yet been found any publications that have the same purpose as this study, with the aim of determining how many different ways a triathlete mounts their bike to start pedaling in the judge’s line. It is an original and new study due to the fact that no other studies exist based on the same idea.

Material & methods

The object of the study was “to know the different ways to mount a bike in transitions areas (boxes) and what was being looked for was the greater number of single recordings (T1) as possible, regardless of age, sex or the standard of the triathletes. There weren’t any exclusion criteria because all possible types of triathletes were recorded. In these triathlon competitions were the Spanish national elite, even with some triathletes who are usually in World Championships or European Championships.

Participants

The sample was composed by 407 Spanish triathletes, participants of three Spanish championship triathlons in 2013: medium-distance Spanish championship (elite and age groups, 99 participants: 61 men and 38 women), short distance Spanish championship (elite, 147 participants: 99 men and 48 women) and triathlon-cross Spanish championship (elite and age group, 161 participants: 98 men and 63 women). Full ethical approval was granted for all procedures used in this study by the Málaga University of Ethics Committee.

Procedure

In the different official championships such Spanish ones, the boxes access are closed to the public and this hampers the display of the triathletes in the start of the T1 or the arrival to the T2, because of the large amount of people who watch the event, the existence of fences and other decorative or advertising elements which impede to get closer to have a good view. To solve this problem, the Spanish and the Andalusian Triathlon Federation, and the corresponding chief of press from the different Spanish Championship were asked for their authorization to take images (right of the image). Once these consents were obtained, they had to seek the best position of the cameras in order to obtain the best images for the subsequent analysis.

Equipment

There were two video cameras used, the model was Panasonic SDR-H40 with a tripod.

Design

Previous attempts in minor events were made. It was decided to place two cameras recording at the same time, from different positions or points of view. It was better because there were various test made with only one, but the problem of using just one camera was that, when large groups leave at the same time, triathletes who lead the race cover the athletes behind them, meaning it was not possible to see them passing through the boxes. Placing two cameras helped to alleviate this flaw. Cameras 1 and 2 (Figure I) were placed diagonally from each other, to get the image of the same triathlete both from the front and from the rear.

Basically, what we wanted to know is how many different ways triatheles can mount their bicycles and classify these way. This action was called “mounting the bike” by the authors of this study.

The specific position of each one of the cameras depended on three aspects:

1st. The transition area’s location relative to the sun.

2nd. Real available space. According to the length and width of the transition area, zooms on the cameras were modified.

3rd. Other elements. Amount of judges, motorcyclists, TV cameras which were inside at this time and could distort the shots (generally they are gathered at the end of the transition areas and impede, sometimes, a good frontal shot).

Results

Proposal for classification

There are eleven ways a triathlete can mount their bike (table 1). The way triathletes mount their bikes, at the end of the T1, at the judge’s line, is characterised by these ways of doing so.

Table 1. Ways in which triathletes mount their bikes to start pedaling. Summary.

1. STATIONARY MOUNTING.
1.a. STATIONARY, PASSING FIRST THE INSIDE LEG/FOOT OVER THE TOP OF THE BICYCLE SADDLE.
1.a.1 Mounting of one point; unilateral or asymmetric.
1.a.2 Mounting of double points; unilateral or consecutive asymmetric
1.a.3 Mounting of double points; bilateral or consecutive symmetrical.
1.b. STATIONARY, “WITH SUPPORT” FROM THE OUTSIDE LEG/FOOT, ON THE INSIDE PEDAL:
1.b.1 Double consecutive support on both pedals; first the inside pedal, then the outer pedal
1.b.2. Triple consecutive support on both pedals; first on the inner pedal, then on the outer pedal and then again on the inner pedal
1.b.3. Double simultaneous support on both pedals; the inside and outside pedal at the same time
1.b.4. Stationary mount, placing the outer foot on the inside pedal, and with the other inside foot, pushing various times on the floor
2. SEMI-DYNAMIC MOUNTING WITH A JUMP.
3. DYNAMIC MOUNTING.
3.a. Dynamic mounting, jumping over the saddle.
3.b. Dynamic mounting with support from the outer foot on the inside pedal
3.c. Dynamic mounting with direct support from the outer foot on the pedal, and the inner foot pushing various times on the floor or dynamic pedalling.

The triathlete, before mounting the bike, brings it in to the transition area using one of the “hold-riding” methods These methods, or types, are the following (Fernandez Rodriguez et al., 2015):

1. Hold-riding of the bicycle by the saddle; with one hand on it, and holding the saddle: HBbySADDLE.

1.1 Hold-riding with one hand on the saddle occasionally leaning the other hand (free hand) on the handlebar: HBbySADDLE/HANDLEBAR.

2. Hold-riding of the bicycle by the handlebar; with both hands on the handlebar: HBbyHAND.

2.1. Initial holding-driving with both hands on the handlebar and, finally with one hand on the handlebar and the other on the saddle: (HB2H to 1BAR/1 SADDLE).

3. Hold-riding of the bicycle, always, “by the front/rear”; with one hand on the handlebar and the other on the saddle or the top tube. HBbyFRONT-REAR.

4. Hold-riding of the bicycle by the stem with only one hand on the stem: HBbySTEM.

Once at the judge’s line, all these types of bike hold riding through the transition area, ‘always’ end by the mounting of the bike, with both hands on the handle bars, in order to gain maximum stability and security. In regard to this, we need to point out that regardless of the side on which the triathlete carries their bike, in order to describe the different segments the triathlete passes through in respect to the position of the bike, we can talk about:

- Outside leg-foot: the furthest away to the bike just before mounting.
- Inside leg-foot: the closest to the bike just before mounting.
- Outside pedal: the furthest (the other side of the bike) away from the triathlete before mounting.
- Inside pedal: the closest (next to the triathlete’s body) to the triathlete just before mounting.

Description of the different ways for a triathlete to mount a bike, in order to start the cycling stage

The triathlete can mount a bike in three main ways: Static, Semi-dinamic or Dinamic.

1. Static mounting

Definition. Static mounting is that in which, the triathlete, after running or walking to the transition area, *comes to a complete stop* in order to mount the bike.

Types of static mounting:

1.a. Static over the top of the saddle; “passing” the inside leg-foot over the top of the horizontal bar, or the saddle.

1.b. Static with support from the pedal: “with support”, putting first the outside leg-foot on the inside pedal.

1.a. Static over the top of the saddle: “passing” the inside leg-foot over the top of the horizontal bar, or the saddle

Just before the judge’s line, the triathlete stops “hold-riding” (Fernandez Rodriguez et al., 2015) which they were doing through the transition area, and grabs their bike with both hands. In that moment, the triathlete passes their leg and foot that is closest to the bike (inside leg-foot) over the top tube or the saddle. To do so, the athlete *tilts the bike towards them* so that they lower the bike’s height, in order to pass their leg over the top of it.

Types of mounting. They are three types:

1.a.1. *Mounting of one point; unilateral or asymmetric.*

After passing the inside leg-foot over the bike, the triathlete supports himself with their inside foot on the *outer pedal* (the pedal furthest away from them). They now tend to stop looking forward, and start to look down at the pedals in order to support themselves securely, in which time they aren’t aware to what is going on in front of them (figure 1). In other words, they are mounting stationary, passing their inside leg-foot over the saddle or top tube of the bike, supporting themselves with their inside foot on the outer pedal, followed by a push in order to start a binomial movement of both rider and bike

Fig.1. Mounting of one point; unilateral or asymmetric.

1.a.2. *Mounting of double points; unilateral or consecutive asymmetric (figure 2)*

They mount the bike stationary, passing their inside leg-foot over the saddle or top tube of the bike, followed by supporting themselves by putting that foot *on the floor* (in order to stabilize the body-bike binomial. The triathlete has, at that moment, both feet on the floor and the bike is between their legs) then proceeding to put that foot on the outer pedal, (they then stop looking forward, and start to look down at the pedals in order to support themselves securely, in which time they aren’t aware to what is going on in front of them). They then push themselves off, so that they can start a binomial movement of both rider and bike. In this case, there is double foot support on one side, first on the floor, then on the pedal.

Fig.2. Mounting of double points “bilateral or consecutive asymmetric.”

1.a.3. Mounting of double points “bilateral or consecutive symmetrical”

After passing the inside leg-foot over the top of the bike, and putting it directly on the floor (on the other side), they use it as a pivot, so that the other foot, the outside one or the one furthest away from the bike, can be placed on the inside pedal (they then stop looking forward, and start to look down at the pedals in order to support themselves securely, in which time they aren't aware of what is going on in front of them) in order to start pushing and start the rider-bike binomial (figure 3). In this case, there is a double foot support, however, in difference to the last type (1.a.2), the support is on both sides.

Fig.3. Mounting of double points bilateral or consecutive symmetrical.

1.b. Stationary “with support” from the outside leg-foot on the inside pedal

Just before the judge's line, the triathlete stops “hold-riding” which they were doing through the transition area, and grabs their bike with both hands. During this moment, the triathlete puts his outside leg-foot on the inside pedal, the one closest to him (they now tend to stop looking forward, and start to look down at the pedals in order to support themselves securely, in which time they aren't aware of what is going on in front of them). In this type of mount, they put their foot (with their body half bent over) on the pedal, staying on foot, with both hands on the handlebars. The bike starts to move forward, following the last step, but this time with the other leg-foot, the inside one, passing over the saddle or top bar of the bike. Once they have their leg over the other side, they look for stability by putting their other foot on the pedal, in other words, the triathletes “outer” leg. This action is in order to stabilize the triathlete-bike binomial. That's when the triathlete, with both feet on the cycling shoes (whether or not their feet are in or on top of them) must start pushing, in order to start building up speed with one of the pedals.

Types of mount:

1.b.1. Double consecutive support on both pedals

First the inside pedal, then the outer pedal. The general description (1.b) is followed, and finally, now sitting, the triathlete starts pushing with that foot, on the outer pedal in order to start a binomial movement of cyclist and bike (figure 4).

Fig. 4. Double consecutive support on both pedals.

1.b.2. Triple consecutive support on both pedals; first on the inner pedal, then on the outer pedal and then again on the inner pedal

Stationary mount with support from the outer foot on the inside pedal, then passing the other leg-foot over the saddle or top bar, followed by a slight support by this foot on the outer pedal, and then finally a third support and thrust of the foot on the first pedal; the inner one (figure 5).

Fig. 5. Triple consecutive support on both pedals.

1.b.3. Double simultaneous support on both pedals; the inside and outside pedal at the same time

Once mounted, the triathlete now supports himself on both pedals (figure 6), pushing himself off with either one of the pedals in order to start the binominal movement of cyclist and bike.

Fig. 6. Double simultaneous support on both pedals; the inside and outside pedal at the same time.

1.b.4. Stationary mount, placing the outer foot on the inside pedal, and with the other inside foot, pushing various times on the floor or stationary “pedalling” (figure 7).

A stationary mount is done with the bike at a standstill, and the triathlete supports himself with their outer foot, on the inside pedal or the one closest to their body. During that moment the triathlete-bike binomial is stable. It's not just about getting onto the pedal, but while having one foot on the pedal and the hands on the handlebars, the triathlete carries out as many pushes against the floor with his inside leg-foot (the one closest to the bike) so that he can build up speed. It's then when the triathlete puts his foot on the pedal and his 'pushing' leg passes over the saddle or top bar in order to put it on the outer pedal.

Fig. 7. Stationary mount.

2. Semi-dynamic mounting (with a jump)

Semi-dynamic mounting is that in which the triathlete, after running or walking through the transition area, visibly slows down, but not coming to a complete halt, so that they can mount their bikes in a safe and stable way.

In this study, we have discovered that in the semi-dynamic mounting, the only type involves a “jump”. They mount the bike, not at a standstill or stationary, but at a very slow moving pace. The triathlete runs along with the bike next to them. After passing the judge's line, the triathlete, always at a certain speed (something just a bit slower than they were going before) jumps when landing on the bike saddle in order to pass the other leg over the saddle or top bar, and stop being supported and start pedalling with the other foot

3. Dynamic mounting

Dynamic mounting is that in which the triathlete, after running through the transition area, barely stops to mount the bike. In any case, if it is preceded by a race to the transition area, the triathlete tends to decrease “a little” their speed, in order to mount with stability the bike, in other words, safely. A dynamic mount is when the triathlete mounts the bike while still in movement. The triathlete runs with the bike next to them. After passing the judge's line, the triathlete, at a certain speed (something just a bit slower than they were going before), jumps upon landing on the saddle, and supports himself on the pedal, passing his leg over the saddle and top bar, in order to stop supporting himself, and start pushing the other pedal with the other leg-foot. To do so, there are three different types:

3.a. Dynamic mounting, jumping over the saddle.

3.b. Dynamic mounting with support from the outer foot on the inside pedal.

3.c. Dynamic mounting with direct support from the outer foot on the pedal, and the inner foot pushing various times on the floor or dynamic pedalling.

3.a. *Dynamic mounting jumping over the SADDLE*

It is the same as model 2 or semi-dynamic, but at a faster speed, without barely stopping. The triathlete, at a certain moment, always with both hands on the handlebars, and checking their environment (number of triathletes, obstacles...) decides to jump on the bike. In order to jump, there always has to be one “impulse” leg and the other “flight”. Just before the judge’s line, the triathlete stops “hold-riding”, which they were doing through the transition area, and grabs their bike with both hands. The triathlete in the race, jumps or performs a boost with the outer leg in order to be able to pass their leg and foot (the inside one) over the height of the saddle (figure 8). The triathlete practically flying, and just attached to the bike by holding the handlebars, lands on the saddle looking down at the pedals in order to put their feet properly and push with them.

Fig. 8. Dynamic mounting, jumping over the saddle.

We can distinguish between very different types of jumps:

- A jump with the impulse leg with a distinguished and prolonged contact with the floor. This jump or impulse is always done with the outer leg, or the one furthest away from the bike. There is a clear difference between the “impulse” leg and the “flight” leg, and for this reason we could also call it *jump with one leg*. This type of jumps produces a relatively soft descent onto the saddle.

- A jump in which the impulse leg presents less contact time on the floor, so the difference between timing of the impulse leg and flight leg isn’t so clear, to the extent that sometimes it seems that they are jumping with both legs. Therefore, the flight before the movement of the legs is nearly simultaneous too. This jump produces quite a hard or violent fall onto the saddle. It could also be called *jump with two legs or hard jump*.

3.b. *Dynamic mounting with direct support from the outside foot on the inside pedal*

It is similar to type 1.b.1 but with speed. The triathlete during the race, with both hands on the handlebars, looks for the inside pedal in order to support the outer leg-foot on that pedal (figure 4). Once done this, after losing some speed, the triathlete-bike binomial is stabilized. They place their foot on the pedal, and pass the other leg, the one closest to the bike (inside leg-foot) over the saddle to place it on the outer pedal (figure 9) for support and to start pedalling.

Fig. 9. Dynamic mounting with direct support from the outside foot on the inside pedal.

3.c. *Dynamic mounting with direct support from the outer foot on the pedal, and the inside foot pushing repeatedly on the floor*

It is similar to the stationary mount (1.b.4 and figure 7) but the difference is that in this case, the triathlete that chooses this way, possibly has more experience and technical capability with a bike, and is able to maintain the speed that they had when they arrived at the transition area. In other words, it’s a dynamic mount, with the bike, in movement placing the outer foot on the inner pedal or the one closest to them. In that moment the triathlete-bike binomial is stable despite the speed they are going at. This type is not just about getting onto the pedals, but about how, because in that moment they have lost some speed (precisely due to putting their foot on the pedal) the triathlete has to do at least one thrust with their inside leg-foot in order to maintain the speed they were at before running with the bike. This push is shown in picture 9. The bike gets faster, or at least it doesn’t lose speed, and it’s then when the triathlete stops pushing with his inside leg-foot and puts it on the

pedal, following the previous step made by the other leg, passing it over the saddle or top bar, looking for support from the other foot on the other pedal.

Dicussion

It is the first time that a classification has been made regarding this concrete aspect of T1 triathlon. The triathlon sport needs, after 40 years of history, to start making studies on its “logical or internal operation” (Parlebas, 1984a, 1984b; Hernández Moreno, 1994).

It is important to mention that, during the mounting of the bike, there are some interesting things (and previous) that happen in those few moments (Table 2). The recording reveals various situations that we must take into consideration (Fernandez Rodriguez et al., 2015):

1st The triathlete puts on and does up their helmet.

2nd The triathlete has to take down the bike.

3rd The triathlete leaves the transition area using the “hold-riding” (Fernandez Rodriguez et al., 2015) technique up until the judge’s line.

3.1 They leave *walking* and wearing cycling shoes

3.2 They leave *walking* and bare-footed (the shoes are attached to the pedals).

3.2 They leave *running* and wearing shoes:

3.2.1 They leave running with their cycling shoes on.

3.2.2: They leave running but with their running shoes on

-Because they use platforms (example: Thompson...)

- Because they are beginners and use some type of toe clips.

Or the best way, used by most:

3.4 They leave running bare-footed with their cycling shoes attached to the bike pedals. This way is the best so long as the road is flat or down hill (which is the common way). It is not yet proven to be the best way to leave when running up hills that have more than a 5% angle.

4th During the recordings, we also observed that when a triathlete mounts the bike they can do it:

- Bare-footed / wearing shoes
- Putting or not putting their foot or feet in the shoes, favouring or not the ability to arrive with the rest of their group or falling behind.
- Looking down to find the pedals or shoes / barely looking down.
- Higher or lower loss of riding in a straight line or not. If they are looking down to put their feet on the pedals, or their feet in their shoes, they are always missing out. Although in one of the types of mounting, the ones that don’t look down as much tend to ride in a straight line, and in this case, they are quicker, making it safer to not look down.

In relation on stationary mounting 1.b.3 (double support simultaneously with both pedals). The video recordings demonstrate that some triathletes mount their bikes on the same side, end up pushing it with different legs. We don’t know why, but we can guess that pushing with either one foot or the other is due to:

- The bike cranks are slightly offset, in other words, they aren’t completely parallel with the floor, so the triathlete pushes against the best lever.
- The triathlete, although they mount on the same side as others (which can indicate if they are right-handed or left-handed) they end up pushing with the other leg due to the “force and security” of that leg and not in the other, independent to weather they are parallel to the floor.

Table 2. Diagram of the sequence during T1.

In relation to the stationary mounts:

Use: The observations made in the video (due to lack of studies about these aspects) indicate that these types of mounts are characteristics of Male or female beginners; a greater extent of female than male triathletes; triathletes with low skill level at bike handling.

Observations: This type of mount, at a standstill, can be facilitated or disadvantaged by:

1) External non facilitators;

-The judge’s line is narrow or small.

-There are a lot of triathletes at the judge's line.

2) Internal non facilitators:

-The triathlete's lack of control and insecurity.

In relation to the semi-dynamic mounting, it can be said that they have a similar use and observations to the stationary mounts. Although (due to a lack of studies), it seems that in the first type (stationary mounting) the internal non facilitators are more important, but in the semi-dynamics, they both seem to be as important as each other (external and internal factors). In relation to the dynamic mounts, we can say that (use): The observations made in the video (due to lack of studies about these aspects) indicate that these types of mounts are characteristics of: a greater number of male triathletes than females; male elite triathletes; triathletes with a high skill level at bike handling.

Other observations. This type of dynamic mount can be facilitated by:

1) External facilitators;

-The judge's line is wide or big

-There aren't many triathletes at the judge's line.

2) Internal facilitators:

-The triathlete's normal or high skill level and self-confidence.

In future studies we could:

Carry out a statistical study which correlates the triathlon modality (distance Sprint, Short, Medium, Long, Cross...) or level, age and gender with the hold-ride method; study whether the triathletes mount bare-footed or with shoes and link this with their fitness level, gender and types of triathlon, and then link these types of mount with loss of speed and balance upon leaving, something which often causes collisions and falls, linking it with their gender and skill level.

Conclusions

The triathletes, independent of their age and level, should know well and know how to mount adequately each one of the eleven categories of types of bicycle mounting presented in table 1. It is interesting that these eleven methods of mounting a bicycle are taught in triathlon schools, amateur, elite or professional teams. Knowing how to do this is important like technical and functional background of the different types of transition areas (width, length, distance between the rows of bikes, number of triathletes...)

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