

An Introductory Guide to 4 x 100m Relay Racing

Part I – Team Selection

Nigel Hetherington

Some common misconceptions:

- Pick the four fastest runners available, above all else
- Choose the fastest starter for leg-1
- Place your 200m specialist on leg-2 – the 'longest' leg
- Your fastest runner should run the anchor leg

In following these misconceptions most relay team selectors at club and school level would adopt these basic principles in selecting a team. The question is why? Here I will examine each of the points:

Pick the four fastest runners available above all else

In theory, if you choose your four fastest 100m runners they will produce a faster 4 x 100m relay time than any other selection you might think of from the pool of available athletes. However, the problems start when the fifth and most important team member is introduced. The matter is also further complicated when you consider that the fifth member's time over 400m is less than the sum of the best 100m times of the four squad members.

Here's an example to demonstrate the point taken from a mid-season U20 women's 4 x 100m race (average athlete age = 18) comprising athletes from my squad:

Athlete	100m SB at time
Leg-1	13.40
Leg-2	13.20
Leg-3	12.90
Leg-4	12.40
Total	51.90
(5th member, 400m time)	(49.53)

Ah, that's easy I here you say, you must have four athletes in a 4 x 100m relay squad and one athlete is not allowed to run more than one leg. Therefore, you would expect that the squad might run a time of around 51.90s if they did everything right. The revelation is that the fifth member of the team is actually the baton and 49.53s is the time the team actually took to carry the baton from start to finish in a recent 4 x 100m relay.

So, where did the saving of 2.37s come from between 51.90 and 49.53?

The answer is in the team dynamics and the baton change skills. A well skilled team - which actually breaks down to three well-practiced pairs of athletes i.e. leg-1 / leg-2, leg-2 / leg-3 and leg-3 / leg-4 – is what makes for the fastest lap by the baton. If it is possible to 'save' 2.37 seconds (or more) through good changing it also follows that it is possible to 'lose' time through poor baton handling and slowing down during the baton exchange phase. It is not difficult to envisage a squad of four faster athletes (on paper) running a time slower than

51.90s. Likewise, further development of the skills of baton exchange in the four athletes in the table above can lead to even quicker relay times without the athletes actually running any faster. Remember that the objective is to keep the baton moving at maximum speed at all times throughout the race – the baton must always remain as the fastest member of the squad!

Choose the fastest starter for leg-1

How would we define the fastest starter? - Okay, maybe we could do some time-trials over, say, a standing 30m or maybe we could measure reaction times to the gun. These data would give us good supporting information as to who is the fastest starter. But, what is the benefit and why should it affect selection of our leg-1 runner? After all it is more important that the leg-1 runner is quick all the way and delivers the baton in the shortest possible time to the leg-2 runner and not so important that they are a blisteringly fast starter but tail off to be the ninth fastest available athlete over 100m. (Note: As we will find later on, if a team has one individual who is faster overall than the rest of the team and is also quickest to 30m then they may be the natural choice for the first leg.) The leg-1 runner should therefore be a confident starter, familiar with the use of starting blocks and be able to deal mentally with possible false start scenarios and distractions from other competitors, officials and spectators. The leg-1 runner should be able to hold the baton comfortably and safely in their right hand while in the down start position and have the necessary skills to run the bend well. Finally, the leg-1 runner should be well-skilled in delivering the baton safely into the target left hand of the outgoing runner – this means they should be rehearsed in positioning themselves toward the inside of their lane on approaching the outgoing runner; know when to give the 'hand' command and be able to maintain a balanced sprinting action while delivering the baton. Overall skill in fulfilling this leg-1 role is, therefore, a far greater factor than pure starting speed.

Place your 200m-specialist on leg-2 – the 'longest' leg

This point actually raises a great depth of matters for consideration far beyond the scope of this introductory article. In simple terms, however, due to the length of changeover zones and the allowance of the 10m acceleration zone before the changeover zones it is possible to run all legs of the 4 x 100m event either as 4 lots of 100m or a else a whole series of distance combinations depending on the skill, speed, speed endurance and, importantly, the speed differentials of the 4 athletes. Race tactics may well also play a part in deciding the leg lengths to be run by each athlete. As is shown below, leg-2 can also be the 'shortest' leg - this tends to destroy arguments raised by the inexperienced coach or team manager.

Range of possible leg lengths for the 4 x 100m relay:

Leg	Minimum	Maximum
1	90m	110m
2	80m	120m
3	80m	120m
4	90m	110m

If you have a 200m specialist – i.e. someone with a combination of excellent sprint speed endurance and skill in bend running (at least) then maybe they would be better used on leg-3 which can also be a 'long' leg and also involves running the bend; therefore demanding both of these characteristics more so than leg-2.

Test your understanding by answering this simple question:

"If you have a team of four sprinters with near identical 100m best times and all three baton exchanges are near perfect and occur exactly at the centre point of

the changeover zones - which athlete will have recorded the slowest split time for 100m and why?"

Your fastest runner should run the anchor leg

Examining this misconception can be equally revealing. For example, this might indicate that you are expecting that your team will not be leading the relay race at this stage and so you will need your fastest runner to correct for the mistakes in team selection or running order that you have made prior to this point! Often, the last leg is seen as the 'Glory leg' and therefore the fastest member of the squad should have this position by right in order, perhaps, to satisfy their ego and for them to claim the victory for themselves firstly and their team secondly. Consider, what may happen therefore if this athlete is injured during the day's competition or simply not available on that day? Making the 'obvious' choice and always pre-selecting the fastest runner for the last leg can rapidly become quite a folly for a team manager. Who will now take on the mantle of running the last leg – no one else has ever done it!! The key, once again, is to consider the overall squad dynamics and strengths as discussed above. In training the roles of the squad should be rotated so that each member has the opportunity to demonstrate their strengths (and weaknesses). Every possible combination of positions and changeovers should be practiced to allow complete flexibility in running order selection to cover every eventuality. Only by going through this process will you be able to identify the 'optimum' team and order.

The qualities of the last leg runner are most important and these include the ability to start their leg from the right point and at the right time, to respond positively to the 'hand' command from the incoming runner and to receive the baton securely. Once away the leg-4 athlete needs to be able to maintain their form while under pressure – this is it! – There is no one left to pass to and help you out! Often the leg-4 runner is an 'adrenalin' runner whom you know to become totally fired up during their leg and often demonstrates performance way above anything they achieve in an individual 100m. The skill of the coach and team manager is to be able to recognize this athlete for that quality. Finally, the leg-4 athlete must be experienced in finishing and must be able to adopt the sprint 'lift' technique to hit the finishing line at full speed to maintain the best chance of the team winning.

In conclusion, for optimum performance of a 4 x 100m relay squad, both team selection and choice of running order require a certain level of knowledge, experience and skill on the part of the team manager and coach. The right choices can lead to unprecedented relay performances and serve to build the confidence of the athletes involved to the extent where they will want to develop their skills more to become even faster.

Related articles:

An Introductory Guide to 4 x 100m Relay Racing - Part II - Rules and the Basis of Skills

An Introductory Guide to 4 x 100m Relay Racing - Part III - Coaching Points

An Introductory Guide to 4 x 100m Relay Racing

Part II – Rules and the Basis of Skills

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Some common misconceptions:

- Athletes must start the second, third and fourth legs within the changeover zone
- To maintain baton speed the athlete should stretch out and pass the baton at arms length
- Ideally, athletes should exchange the baton in the middle of the changeover zone
- Athletes can carry the baton in either hand
- An athlete is disqualified if they drop the baton, run out of lane or receive the baton while outside of their changeover zone

These misconceptions are not uncommon in 4 x 100m relay coaching at the novice level. Within the context of the rules of competition, the required skills and the use of appropriate tactics I will examine each of the points:

Athletes must start the second, third and fourth legs within the changeover zone

Firstly, it is important to be able to recognize the changeover zone: The changeover zone for each relay leg is indicated by a pair of yellow 'tick' marks across each lane placed 20m apart. Generally, the mid-point of the zone is marked with a single white line across the lane. (The zones are 'staggered' across the lanes of the track to allow for the differences in the relative start positions of the first leg runners).

Baton exchange must take place between the two 'tick' marks in a given lane. However, the rules of competition allow an outgoing athlete to start their run using the acceleration zone that extends to 10m before the first yellow tick mark and is normally identified by a single orange line across the lane. This means that each outgoing athlete on legs two, three and four has a maximum of 30m to run before they must receive the baton. It is very much part of the skill of sprint relay running to be able to determine from where and when each outgoing athlete should commence their run. The development of these skills will be discussed in Part III of this series.

To maintain baton speed the athlete should stretch out and pass the baton at arms length

The key to good relay baton exchange is to ensure that the baton is exchanged safely at or very close to the maximum speed of the two athletes involved. In practical terms, incoming athletes are often coached to stretch out to deliver the baton to the outgoing runner's hand and are chastised for 'getting too close'. The reality, from the athletes perspective, is that maintaining full sprinting speed while negotiating a bend and holding out one arm is almost certainly going to promote instability in the athlete's running action.

This in turn could create problems with baton exchange or possibly running out of lane and impeding another athlete leading to possible disqualification.

So, what's the solution?

The best method to develop safe baton exchange in terms of the relative positions of the incoming and outgoing athletes is to coach lane position discipline that allows for closer exchange without over-stretching. This means, for example, that at the first changeover between leg-1 and 2 runners the incoming athlete should have aligned their run-in to be to along the inside half of their lane and the outgoing athlete should position their run-out to align with the outside half of the lane. In this way the incoming runner does not see the outgoing runner as a 'block' in their lane and is encouraged to try to 'sprint past' the outgoing runner keeping to the inner half of the lane. In reality, if the outgoing runner has positioned themselves accordingly in the acceleration zone and commenced their run at the right time then the incoming runner will not quite catch them but will come within half to one stride for just long enough to allow a safe baton exchange without over-stretching.

Exchanges are rarely perfect and sometimes the incoming athlete misses the handover the first time. If they had been off balance at this stage due to overstretching then it is unlikely that they will have a second opportunity to exchange the baton and the race will be lost. However, with this modified, closer proximity exchange, there is often a chance to have a second attempt at exchange within two strides provided both athletes have practiced this scenario and are able to maintain their full sprinting efforts, thus rescuing an otherwise lost situation. Passing the baton from a fully out-stretched position can lead to exchange problems.

Ideally, athletes should exchange the baton in the middle of the changeover zone

As discussed in 1, above, the outgoing runner has up to 30m to develop speed before they must have received the baton. Most athletes require at least 30m to approach top sprinting speed and as much as 50 - 60m to attain maximum speed. What this tells us is that for the baton to kept moving at or close to maximum speed it must be exchanged as late as possible within the changeover zone to allow the outgoing athlete to accelerate for as long as possible. However, as the outgoing athlete continues to accelerate, with the commensurate risk that the incoming athlete may be tiring, the risk of the incoming athlete failing to come close enough to effect a safe (or indeed any) exchange grows. This then highlights where the major skill factor lies in sprint relay racing and where there is absolutely no substitute for knowing the athlete you are exchanging with. Exchanging the baton in the middle of the zone is wasting valuable acceleration space and losing the team time!

Athletes can carry the baton in either hand

Well-drilled sprint relay teams soon come to learn the benefits of consistency in how they make exchanges. Developing this is paramount as part of the skill learning process. As discussed in 2, above, it is important that each incoming and outgoing athlete knows where they should be positioned in their lane in order to perform a fast, safe exchange. It follows from this that athletes need to carry the baton in the appropriate hand. The norm is for the baton to start in the leg 1 runner's right hand and exchange successively:

Relay Leg	1	2	3	4
Hand for baton carry	right	left	right	left
Lane position at exchange	inner	outer	inner	outer

This is a simple model and works extremely well with practice. If a given athlete has a problem carrying the baton in one hand or another then it is better to

change the leg they run than completely alter the baton handling routine. Similarly some athletes have a problem receiving the baton in their non-dominant hand and will be seen swapping hands after receiving the baton. This of course means that this runner will present the baton from the opposite side to which the next outgoing runner will be expecting it! This should be coached out of the athlete through good practice or else the athlete should be moved to a different leg. Baton handling errors by athletes on the run cause many relay team 'DNF's' or dropped batons. So athletes can carry the baton in either hand so long as they do not swap hands on the run and the next outgoing runner receives the baton from the correct hand!!

An athlete is disqualified if they drop the baton, run out of lane or receive the baton while outside of their changeover zone

Rules are often the hardest thing to create in an unambiguous written form that everyone can understand! So let's look at the three points in turn:

Dropping the baton: If a team drops the baton they are not disqualified. Whoever had the baton in their hand is allowed to retrieve it and continue with the race. If the baton is dropped during the exchange process then it is the responsibility of the incoming runner to pick it up if they still had hold of it. If they had released it then the outgoing runner should pick it up. If the incoming runner has to pick up then the final exchange must take place in lane and between the tick marks for the team's zone.

Running out of lane: If an athlete runs out of lane then it may not be the end of the race. If by doing this they have gained an advantage e.g. cut across the inside of a bend then they will be disqualified. If they momentarily run out of lane during the exchange process because they ran too close to their team-mate then they will probably not be disqualified unless they impeded another team. If the baton is dropped and lands outside of your lane then the athlete is allowed to run out of lane to retrieve it provided they do not impede another team and that they comply with the points in 'Dropping the baton' above.

Receiving the baton outside of the changeover zone: The judges will be looking at the position of the baton and not the athlete's feet. In other words if, for example, the outgoing runner is right at the end of the exchange zone before they receive the baton and they place a foot outside of the zone before receiving the baton they are not disqualified. They are only disqualified if the baton itself was outside of the zone before exchange was complete – a tricky one to judge – but a plea worth making if a team is disqualified for this infringement.

Related articles:

An Introductory Guide to 4 x 100m Relay Racing – Part I – Team Selection

An Introductory Guide to 4 x 100m Relay Racing – Part III – Coaching Points

An Introductory Guide to 4 x 100m Relay Racing

Part III - Coaching Points

Nigel Hetherington

Coaching 4 x 100m relays from novice to international level can be great fun and enormously rewarding for coach and athletes alike. In Parts I and II we have looked at 'Team Selection' issues as well as 'Rules and the Basis of Skills' for novice 4 x 100m relay runners. We will now look at implementation from a coaching perspective covering the following topics, below, but not necessarily in this order:

- Athlete emphasis for each leg
- Working together and understanding each other – maintaining maximum speed
- Handling and exchanging the baton – skill first, speed second and trust throughout
- Lane positioning throughout the exchange – giving yourself room to manoeuvre
- Competitive pressure – keeping your focus and dealing with 16 athletes in a small envelope

Emphasis for each leg...

In Part I we reviewed the selection of athletes for each leg and what some of their key attributes might be. As a coach here are some of the key skills we might look at developing for our squad. It should be emphasised at this point that all members of the squad must learn all the skills to ensure that each of them can run any of the 4 legs if called upon to do so.

Leg-1 requires a robust and experienced starter, able to deal with all situations. This athlete should be a highly accomplished 100m sprinter who should be coached just as a 100m sprinter for starts. Provide an array of start scenarios for them to deal with including varied length holds in the set position, false starts, immediate recalls, late recalls, dropped batons in their lane, athletes running into their lane to retrieve dropped batons etc. If it is possible for it to happen then it will happen at some point!

In a team of differing sprint performance levels the leg-1 athlete would be one of the two faster athletes in the team over 100m. In a team with one athlete significantly faster than the rest, this athlete should run leg-1 since this is the biggest opportunity for them to use their fullest ability especially over the first 30m. Many team managers / selectors might be wrongly tempted to put this athlete on the last leg - see Part I. Such an ill-informed choice could easily cost the team the race.

Both leg-2 and leg-3 runners must be confident to receive and deliver the baton safely at speed and so the amount of time they practice may be greater than legs 1 and 4 in these combined areas. In reality it is important to coach your squad in teams as well as in pairs and so leg-1 and 2 runners might pair up to develop their exchange at the same time as leg-3 and 4 runners. Leg-2 and 3 will need to work on their exchange in addition to this. It is important to remember that once the running order is assigned for a given competition that each exchange is practiced on the correct bend with the appropriate hands - i.e. bend exit (exchange 1 and 3, right to left) or bend entry (exchange 2, left to right). Exchange drills are given below under 'Coaching baton handling...'

The leg-3 athlete must be a confident and well-practiced bend-runner. The coach should seek to develop powerful bend running in this athlete using rolling starts 30m before the bend and emphasising all the points used in 200m bend running. The leg-4 runner is very accomplished sprinter who will not panic under pressure. Coaching this athlete to deal with all scenarios is vital. This should include handicap runs against other athletes with varying track advantages and disadvantages ranging from plus to minus 15m gaps.

Baton handling...

It is vital that the first leg runner is comfortable holding the baton in their right hand at the start using a modified grip or hand position to accommodate the baton. It is not good practice to allow any athlete to hold the baton in one hand and then exchange to the other once into their stride since this simply introduces an unnecessary potential source of error in baton handling at speed. Various 'safe' options exist for holding the baton at the start including a 'complete' hand grip with an associated modified 'knuckle' hand start position through to a single index finger grip with the remainder of the fingers used in a modified 'bridge' support as usual. Whichever is found most comfortable and safe for the individual should be practiced over and over again. Different baton diameters should be used as well as wet condition when the baton can become slippery. To support exchange to the leg-2 athlete the baton should always be gripped towards the near end with the remainder of the baton protruding in front of the thumb / index finger. Safest getaway is normally affected by an athlete who is a left-leg-back (from blocks) starter since the right arm (and hence the baton) will be driven safely forward and upwards away from the ground by this athlete. However, with practice a competent right-leg-back starter should not experience problems.

Lane positioning...

Leg-1 runners as well as leg-3 runners must be coached to run the shorter distance around the bend by remaining in the inside half of their lane. This also sets up the position for the exchange to leg 2 (or leg 4) since here we must ensure the incoming athlete is toward the inside i.e. left hand side of their lane to facilitate a right to left baton exchange. This must ultimately be coached under pressure to ensure the leg-1 or leg-3 athlete performs this autonomously. Similarly, with exchange 2, the incoming runner must practice running to the outside of the lane into the exchange zone - the natural tendency is for this athlete to run tight into the bend which will make the exchange very difficult with a crossover being required. The athletes can end up dangerously close to each other and fatal errors often occur at this exchange with batons being dropped or much time being lost. The outgoing runner must stay to the inside half of their lane to allow the incoming runner to see 'clear track' ahead of them. A 'blocked' track tends to cause a slowing of pace.

At the exchange, leg-1, 2 and 3 runners must all know when to call the 'hand' command - remember it is the incoming runners responsibility to direct the exchange at this point - this skill must be worked on intensively along with the outgoing runners timing of the commencement of their run. A whole array of individual and team activities can be employed to facilitate this. The incoming runner should not be coached to shout 'go' or any other command that would interfere with the concentration of the outgoing athlete.

Coaching baton handling...

'Start simple and keep it simple' is the best message. Regardless of the level of experience of the athletes introductory baton handling always refreshes the mind. A simple introductory exercise for novices is to have all members of the squad stand one step apart in the same lane and all facing the same direction along the lane. Simply give the baton to the athlete at the back and ask them to pass it forward, in turn, until it arrives at the front. No other instruction is given. This can be enormously revealing for the level of current understanding that the athletes

have - and quite amusing to watch as a coach! From this, progression can be made in terms of encouraging a smooth linear movement of the baton, taking the shortest route 'down the centre' of the lane, to then raising the issue of which hand they should receive the baton in to facilitate this. Finally, the question is normally asked 'how do I know when the baton is coming to me if I can't look back?' This is a good prompt for introducing the notion of a 'hand' command and the importance of continuing to look forward regardless. All this starts to engender a degree of trust in their fellow athlete. From all this it is fairly easy to arrive at the idea of a right to left to right to left pattern of exchange with all athletes looking forward and awaiting a 'hand' command.

Different exchange methods can be tested at this stage. Inevitably the simple down-sweep is the safest version whereas the upsweep or push exchange, which may be a quicker exchange for some athletes to execute, can be practiced once familiarity is gained with the safer down-sweep method. The down-sweep involves the incoming athlete placing the baton in the hand of the outgoing runner with a single downward motion while the outgoing runner offers a hand held out behind them with the palm uppermost and the thumb spread from the other four fingers (which are kept together) so that the baton can be fully gripped at the end furthest away from the incoming runner's hand. As if by magic, when the outgoing runner then moves on to deliver the baton to the next athlete, they have a long length of the baton to place into the target hand. The upsweep and push pass methods do not normally have this benefit. Ultimately the exchange method used should be a matter discussed, agreed and practiced between individual pairs of athletes and the coach. Race day is not the time to be changing the exchange method!

Developing coordination...

Checking for levels of coordination is then a natural development by having the athletes walk along the track in lane, maintaining distance and simply passing the baton forward with the use of the 'hand' command. On arrival at the front of the squad the baton can be placed on the ground and picked up by the rear athlete to keep the baton cycling and to maximise repetition and learning. Reverting to a static exchange setup, now ask the squad to 'run on the spot' just using their arms. This is another good check for coordination and a great way to practice the 'hand' command and timing of the delivery in a close environment where the coach can keep a close eye on things and support rapid progress. Once this form of exchange has been mastered the athletes can now move down the track in a line as before but now at a jog while moving the baton forward and finally developing the pace of this into a fast stride. This is the point where the receiving athlete must understand the importance of only offering the hand when the 'hand' command is called otherwise their ability to accelerate fully is substantially impaired. Repetition at lower speeds will be essential to develop full mastery of the skills involved. Several groups can be worked at once to maximise involvement and development. Rapid progress is often apparent.

Working together and understanding each other – maintaining maximum speed...

To achieve the full potential of the relay squad each of the three baton exchanges must take place as close to maximum running speed of both athletes as is humanly possible. In reality this becomes optimum speed, but this only means that speeds are at the most a few percent below maximum.

The first step here is to have the athletes perform varying distance runs in pairs, initially alongside each other in adjacent lanes, then a stride apart in the same lane and, finally, half a stride apart but in different halves of the same lane.

Several pairings can be worked on at once with a large group or squad. These runs can be made over longer distances initially up to 50 - 60m at medium pace.

As the confidence and awareness of each other grows within a pair, and the lane is being shared, the speed can be increased.

A challenging variation is to then have the athletes run into a zone at a comfortable stride in the same lane and in close proximity to each other and then provide a 'sprint' command at a random point. The pair then accelerates to maximum speed trying to keep their relative position and distance apart in the lane. No baton exchange is necessary at this point. This can be developed to running off a bend and into a bend depending on the pairing.

This process can then be further developed using the same 'sprint' command approach some 10 to 30m before a defined exchange zone - easily marked out with cones. The ultimate objective is for the pair to effect an exchange within the zone. Initially a generous 20m long zone can be provided. Development is to reduce this zone right down to around 5m to effect refined and tighter timing of the exchange.

Depending on lane draw the exchange between the two athletes may well be on a bend rather than a straight area of track. This adds a level of balance, coordination and skill since additional physical forces are at work for the athletes to handle. The tendency is for the athlete running the bend to be thrown outward and off balance right at the moment of exchange and, so, once again exchanges should be practiced in the middle of the bend to maximise this effect and for the athletes to learn to deal with balance issues. If in doubt, ask a 400m hurdler if hurdling on the bend is different to hurdling on the straight!

Once the basics have been established and athletes are starting to work for each other we can introduce the idea of the acceleration zone.

Maintaining baton speed...

The single most important factor in 4 x 100m racing is the close matching of speeds of incoming and outgoing athletes at the point of baton exchange in order to keep the baton moving at maximum speed.

Quick setup for a relay exchange...

For novice athletes there is a quick setup method to allow the exchange skill to be performed at moderate speed that requires very little time to establish. Often an athlete is thrown into a team at late notice and this is one scenario where the following can be particularly useful. Using the orange acceleration zone start mark as the outgoing athletes check mark for the incoming runner take 4 large steps toward that mark from the back of the exchange zone (yellow tick mark) for athletes likely to be running at between 14-15s 100m pace, 3 steps for 12-13s pace and 2 steps for 11s pace. This can then be quickly modified with just two or three trial exchanges to establish an exchange in the middle to second half of the exchange zone. The final takeoff position can then be paced out using foot-lengths or 'pins' from the back of the exchange zone in readiness for the race. This approach can also be used as an introduction in a training situation.

Initial coaching baton speed through the exchange...

The coach should place the emphasis on allowing exchanges to occur early in the first instance since late (or foul) exchanges or non-exchanges are demotivating for athletes and become frustrating for athlete and coach. Gradually move the outgoing athlete further from the acceleration mark and closer to the back of the exchange zone to develop an exchange in the second half of the zone and then finally in the latter 2 to 3 metres of the zone. Points to note here are incoming speed of the athlete which will be affected by how many runs they have done, what recovery they have had, how far out they are running in from and so on. It should be remembered that in the real race the incoming runner would be tiring and slowing rather than accelerating.

Responding to a visual stimulus...

The main coaching point however is developing the ability of the outgoing runner to respond to the incoming runner hitting a check mark on the track. This is clearly different to the 'bang' at the start of an individual race where the athlete is

responding to an audible signal. Now we are coaching the athlete to respond to a visual signal but demanding the same start response and reaction yet from a different physical position as for an individual race. This must be practiced many times. Athletes will respond to an array of prompts and suggestions including imagining the incoming athlete setting off a firecracker as they hit the check mark so that there is an association with a 'bang'. At this point the outgoing athlete will be looking backward over their left shoulder watching the incoming runner, they may even be down in a three-point start position (once higher skill levels are developed). The timing of the run-out is absolutely critical to a successful high-speed exchange. Once the outgoing runner reacts the response must be sure with an immediate turning of the head to the front and a powerful acceleration just as in an individual 100m race - the gun has sounded and they must go! The athlete must not look back from that instant and must only be aware of lane position (outside of lane for legs 2 and 4, inside of lane for leg 3). The onus now turns to the incoming runner to maintain speed and lane discipline and to give the 'hand' command at exactly the right moment (they should focus on trying to catch and overtake the outgoing runner rather than just reach out for them). The outgoing runner then offers the hand on the next backward arm cycle of their running phase and firmly grasps the baton as it is placed in their hand. The outgoing runner should not interrupt their acceleration during the exchange.

Increasing baton speed through the exchange...

Once all of these exercises have been completed the outgoing athlete will inevitably start to feel that they are not approaching full speed at exchange but that the actual exchange is working well and both athletes have gained confidence in the process and assimilated the skills. The full extent of the 10m-acceleration zone and the 20m-exchange zone should be used as soon as possible in the athlete development plan. So this is the point at which the full 30m-acceleration allowance should be introduced and the take-off commenced from after the orange mark. Most sprinters will exceed 95% of maximum speed within 30m. The check mark will now need to be a marker placed on the track typically some 7 to 11m before the orange acceleration mark (depending on incoming runner speed and outgoing runner rate of acceleration). In actual competition, only a small piece of tape placed on the track is allowed as a check mark and it is as well to become familiar with using tape in practice rather than becoming dependent on a large cone or similar.

Checking for effectiveness of the exchange...

An excellent means of assessing how effectively an exchange is being performed is to have a third athlete run alongside the incoming runner in an adjacent lane and for that athlete to run right through the exchange area. Any 'lead' established by this athlete over the exchanging pair can be reduced with improved practice. The ultimate goal is to keep that athlete in check at all times. In addition taking split times for the baton over a 50m zone before and after the exchange (i.e. markers placed 10m before the orange acceleration mark and 10m after the end of the exchange zone) can be very revealing if compared to the 'flying' 50m split times of either individual athlete and can be used as a specific measure of progress with a known 'best possible' time to aim for. Typically the incoming runner would start with a 30m rolling acceleration run to the first marker.

Relay case study...

In Part I we discussed that a given squad of athletes should be capable of producing a 4 x 100m race time significantly less than the sum of their 100m personal bests and we suggested that a 'saving' of approximately 2.5 seconds could be made. The 4 athletes, all of whom I coached, won the Welsh National Schools (senior women's - age 17-18) 4 x 100m race. Their individual season's bests for 100m in 2003 totalled 51.9s whereas, on the day, the team won with a 4 x 100m time of 49.92s some 2 seconds quicker than the combined 100m times.

Based on this, and a host of other data, I have developed a simple spreadsheet relay calculator to help coaches in team selection, choosing the running order and making time predictions. The calculator requires 30m standing / 3-point start times and 100m race / time-trial times for each team member. The calculator suggests that this team was capable of running around 49.6s at that time with the running order used on the day and so the team appeared to perform well notwithstanding the fact that there was still scope for a further 2 to 3m to be gained overall. Interestingly, with individual athlete improvements over the last 12 months this team alone could now be capable of running 48.8s but in a different running order! A further substitution with another athlete from the squad currently showing great form could further reduce this to 48.4s.

On perhaps a more contentious note I estimate that many National and even World records for 4 x 100m for men and women could be significantly reduced with the correct focus in training on maximising the exchange process and employing optimal leg selection for athletes.

The relay calculator is available free of charge as a download

Checking for robustness of the skill...

Well before race day and from time-to-time in training you will want to know how well the exchanges are working between your athletes when under pressure - this is after all a measure of the robustness of the skill. Pressure can be applied in many ways. For example, run two or more closely matched teams together, run single exchanges in parallel with several pairs of athletes exchanging at the same time, run a single athlete alongside the whole exchange process or even double-up with one either side. Spectator noise is another useful training 'aid' The incoming and outgoing athlete will both feel different pressures and have to exercise a host of skills to effect a fast exchange. In reality, in a race situation, any of the three baton exchanges could see 16 athletes spread right across a very short section or envelope of the track all fighting for space and striving to maintain focus.

The team can be 'time-trialled' over 4 x 50m or even 4 x 100m. This can then be repeated with a 'target-time' for improvement. A motivational talk to the team between attempts could serve to raise adrenaline levels and test robustness when athletes are at a higher excitation level. Finally, always remember to rotate the squad around so that all members get to try each leg and exchange with each of the other athletes. Team changes happen on race day for a host of reasons and it will be team that is best prepared that will prevail in this situation.

Finally...

Relay racing is probably the least well-coached track discipline in track and field athletics both in terms of time and progression of skills. From local schools to international level too little importance is given to what is perhaps the most exciting event to coach, to participate in and to watch. Relays carry medals of equal value in the medals table to individual medals (as well as athlete pride and from school to national pride) and yet the same weight is rarely attached in preparation.

Working with athletes performing relay skills work is invigorating and rewarding if performed in a logical, structured and intelligent manner. There should be absolutely no doubt that coaching a squad utilising some of these principles will lead to substantial improvements in race performance. Such training sessions can also double as speed sessions if careful planning is used and appropriate switching around of athletes is employed to support recovery periods.

Important Do's and Do Not's for athletes in 4 x 100m relay racing

Do's	Do Not's
1. Incoming runner	

First leg runner carries the baton in the right hand with most of the baton extending in front of the thumb / forefinger part of the grip	Exchange hands when carrying the baton
Run maximally into the exchange zone when carrying the baton	Slow or attempt to match the perceived slower speed of the outgoing athlete
Run into the exchange zone with the correct lane positioning	
TIP: 'baton should always stay at the centre of the lane'	Give a 'go' command to the outgoing runner
Give a loud and clear 'hand' command only when within 1 - 2 strides of the outgoing runner	Give command to early or too late!
Deliver the baton with a single swift downward motion into the hand of the outgoing runner (or practiced variation on this)	Change the delivery method that has been practiced
2. Outgoing runner	
Outgoing runner commences takeoff with maximal acceleration only when incoming runner reaches check mark. Remember lane discipline	Look back once incoming runner seen to reach check mark
Outgoing runner looks forwards, continues to accelerate and responds immediately to 'hand' command.	Hold out hand awaiting the baton from the start
Offers hand held out flat with palm upwards and thumb / finger spread (or practiced variation on this)	
	Change the acceptance method i.e. the target
Grip the baton firmly with all four fingers and thumb. Continue sprinting	Slow down
3. Squad	
Recruit a coach, practice often, change the leg you run, strive to be better	Leave it all to chance on the day

Related articles:

An Introductory Guide to 4 x 100m Relay Racing – Part I – Team Selection

An Introductory Guide to 4 x 100m Relay Racing – Part II – Rules and the Basis of Skills