The Learning Curve

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Rope movement

In May *The Learning Curve* described the effect of applying effort at different times during the ringing cycle, and how this relates to optimum control of the bell. One reader found it illuminating to realise the similarity between pulling and checking, with the difference being purely when you apply the force. It isn't 'the same' action of course, because retarding as something pulls away from you feels different from pulling it towards you, even though the force is applied in the same downward direction. Hill walkers, for example, might compare walking down a steep slope with walking up one – in both cases, their legs push downwards.

The speed of the rope

What caused puzzlement though, was the statement that the rope 'moves very quickly low down'. It seemed intuitive that since the rope stops at the bottom of the stroke, it must should move slowly before and after. This led to a discussion about how the speed of the rope varies, something most ringers never think about, but which can help to explain the way the rope behaves. So that is this month's topic.

To illustrate the point, *Tail End* drew a sketch to show how the rope speed varies. Subsequent calculation produced an even 'sharper' picture, with more rapid speed changes, but before looking at speed, let's get our bearings by looking at rope position. Figure 1 shows how the rope position varies as the wheel rotates from handstroke (H) to backstroke (B) and back to handstroke (H). The axis represents the height of the rope when the bell is on the balance at handstroke

Following the curve from the left, we see the rope coming down from the handstroke, then rising well past its initial position to the backstroke. It then returns to the handstroke, with its movement mirroring what it has just done. A whole pull takes about 4 seconds for a typical bell, so the intervals on the axis of Figures 1 and 2 are roughly half seconds.

Notice that about half of the time is spent near the top of the rope's travel (the flattish part at backstroke, and a similar period at handstroke joining the right and left hand parts of the curve). That means most of the movement takes place during only about half of the total time.

Now let's look in detail at Figure 2, which shows the rope speed. Where the curve is above the axis, the rope is moving upwards, and where it is below, the rope is moving downwards. The rope is moving slowly where the curve is close to the axis, and more rapidly when it is further from the axis.

Starting again from the left, as the rope descends from handstroke, the downward speed increases. This increase is brought to a rapid halt when the garter hole passes the pulley (see Figure 3(b)). The rope can't go lower, and begins to rise as it starts to wind the other way round the wheel.

So far, so good, but look again at Figure 3(b) and you see the bell still has a long way to swing down from this point, so it is still accelerating – the rope changes direction, while the wheel is still increasing speed, which makes the transition vary rapid. In Figure 2, you can see that within about a quarter of a second of its fastest downward movement, the rope is moving twice as fast upwards. That is why, if you are unwise enough to hang on too long after the handstroke, the rope will give you a nasty jolt.

The maximum speed (top of the curve) comes roughly a second after pulling off at handstroke. This is where the bell passes the bottom of its swing. Thereafter the rope speed reduces as the bell rises towards the backstroke. After another half a second or so, it is moving quite slowly, and it takes a further half second to complete the last bit of the rise to the backstroke.

In the right hand half of Figure 2, as the rope returns from backstroke to handstroke, with the speed reversed. The rope accelerates down from the backstroke, before doing another sudden reversal and rising to the handstroke.

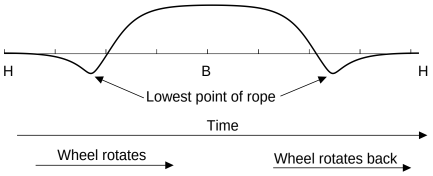

Figure 1: Position of the rope

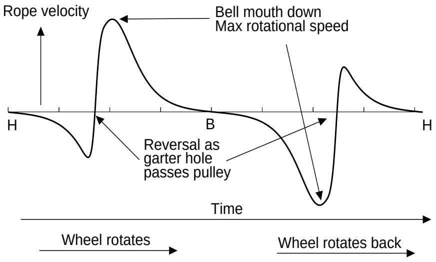

Figure 2: Varying speed of the rope

Figures 1 and 2 are shown above each other so you can correlate them. Notice that the two curves don't cross the axis at the same time. Figure 2 (speed) crosses the axis at the lowest and highest points of the curve in Figure 1. The rope speed is zero at the top and bottom of its travel, not where it passes its initial height.

Why the difference?

Why do the different parts of the curve look different? The rope goes higher at backstroke than at handstroke, but you might expect the rope movement up to the handstroke and backstroke to be the same. Why should it go faster?

In fact the **bell's** swing is the same (apart from the minor difference imposed by the ringer to obtain the open handstroke rhythm). But the rope movement is different because of the position of the garter hole. If this were moved round so it passed the pulley when the bell was at the bottom of its swing, then the rope movement would be the same on both strokes. The rope would rise the same distance as the bell swung each way, and you wouldn't be able tell which stroke was which. You would hold the tail end at both strokes, so there would be no need for a sally, and no worry about catching it. Don't get excited though – it would be impossible to ring such a bell up from rest, so the idea won't catch on.

With the garter hole in its conventional position, the rise and fall of the rope that we know as the handstroke only accounts for about half of the bell's movement on that side of its swing. The rest – the part where it is moving fastest – occurs during the rope's rise and fall to backstroke, which accounts for three quarters of the bell's total swing, including the fastest part.

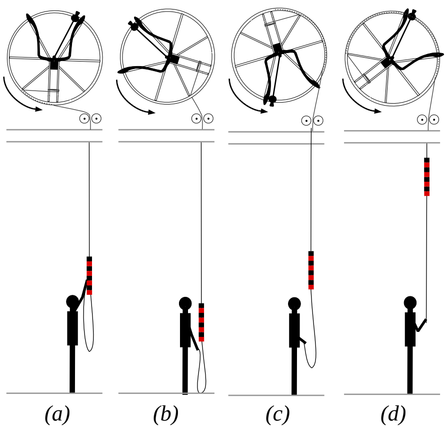
(a) (b) (c) (d)

Figure 3: Rope and wheel movement

So what?

Understanding the mechanics of what happens when you ring can often shed light on some of the things people often find difficult. Failure to adapt properly to the changing speed of the rope movement is the root cause of many rope-related problems.

Under-estimate the speed as the rope rises, and your arms act as a drag on the rope, dropping the bell and making you work harder to keep it up. Under-estimate the speed change on the down stroke, and the rope tries to overtake your hands, going slack, and starting to flop about. The rope also goes slack if you over-estimate the speed increase on the rising stroke, and try to 'push the rope up'.

Sensing the natural speed changes in the rope movement is not only important for good rope control, but essential if you are to feel through the rope, to what the bell is doing. A common problem is failing to let the bell rise fully at the top of the stroke. As you can see from Figure 1, the last little bit of the rise towards the balance is slow and protracted. Near the top, the bell feels light, and you need a delicate touch to detect when it actually gets to the top. If you are heavy handed, the force you put on the rope will stop the bell prematurely and make it drop.

Failure to let the bell rise often causes problems the first time you ring a significantly heavier bell than normal, even in Rounds. It is not so much the extra weight that causes trouble, as the bigger wheel. It takes more rope to wrap round a big wheel, so the rope has to rise and fall further, as shown by the grey curve in Figure 4. If you don't allow for the longer movement, you prevent the bell rising fully, and get drawn into a continual struggle to keep it up.

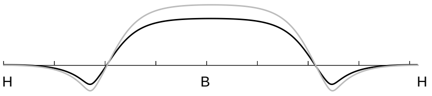

Figure 4: Rope position for different size wheels

Figure 4 also shows the rope going lower between strokes, which is why very big bells are rung from boxes, to prevent the rope piling in a heap on the floor.

Tail End

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