David Dellenbaugh's
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Take advantage of windshifts

If there is one generalization you can make about racing conditions around the world, it's that the wind direction is almost always changing. Very seldom (or never) will you find a breeze that does not shift during a race, or even during a windward leg. That is one of the beautiful, and challenging, things about our sport.

Whenever the wind changes direction, there is always a chance for boats to make big gains (or big losses!). In fact, race results are often affected more by wind shifts than by differences in boatspeed.

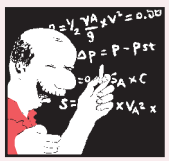
This means that if you want good finishes, you must play the shifts well. That is not always easy, but at least the wind is free. You don't have to buy new sails or use fancy bottom paint in order to be smart about the wind and beat other boats.

And, fortunately, when the wind changes direction, it usually shifts in some kind of pattern. The most common pattern we find on the race course is an oscillating breeze. This type of wind shifts back and forth around an average, or median, direction. It usually stays within a certain range on each side of that median, with shifts occurring at fairly regular intervals over time.

The ability to play oscillating breezes correctly is an art form that requires a good understanding of wind strategies. That's why we have devoted this entire issue to the subject of oscillating shifts – how to recognize them and play them to your advantage.

When you do it right, racing in shifty winds can be very satisfying and rewarding – and lots of fun! •

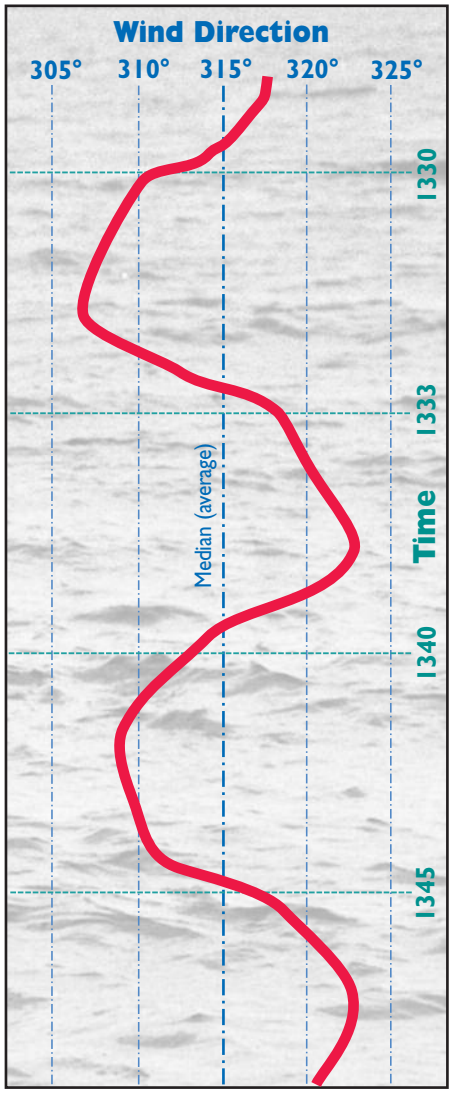
Oscillating shifts



BRAIN TEASER

How much is one end 'favored'?

You are racing a Melges 24 at a national regatta. As you prepare for the first race, you note that the starting line is about 200 yards long and is set so it's square to a wind direction of 225°. The wind has been oscillating between 215° and 235°. Before the start, you ask another boat to help test the starting line. You start on port tack at the pin (left) end of the line and, at the same time, your friend starts on starboard tack at the boat (right) end. Assume the wind is in its left phase (215°) the entire time, and both boats keep going until they converge. Which boat will cross ahead and by how many boatlengths? (See *page 8 for answer*)



OSCILLATING PATTERN
Here is a graphic illustration of an oscillating shift pattern. The red line plots wind direction as a function of time. You can see that these oscillations are fairly regular in duration (about 3 to 4 minutes each) and in magnitude (about 10 degrees either side of the median direction).

It is very helpful to collect this kind of information before each start. By visualizing wind trends before the race, you will hopefully be able to project where the wind direction will be at the start and up the first beat (which is the most critical part of any race).

Gather info about windshifts

If you want to predict how the wind will shift during your race, you must carefully observe wind patterns before the start. When planning strategy, it's critical to figure out whether the wind direction will oscillate or shift persistently in one direction. In order to do this, you need to gather as much information about the wind as possible. Here are some ideas.

◆ Before you leave the dock, try to get forecasts and a description of current conditions from the radio, television or internet. In the U.S., these sources include NOAA weather radio, the TV weather channel and commercial weather services that give you forecasts by fax or e-mail. There is also a growing body of local weather information on the web these days, some available by subscription and some for free.

Listen particularly for wind directions and velocities at different points around your sailing area. A nearby airport, for example, can be a valuable source of clues about the local wind. The same is true if you have any local weather buoys or other data-gathering locations (e.g. yacht clubs) that post wind data on their websites.

◆ Institutional weather forecasts are usually pretty good for the big picture, but they are almost always inaccurate and/or insufficient when it comes to your local racing area. That's why you must depend primarily on your own observations that are specific to your race course and the time of your race.

The wind is never exactly the same from day to day, so figure out how the wind will behave during your particular race. A general radio forecast may say the wind is going to shift clockwise (to the right) all day, but remember the typical windward leg lasts only 10 or 20 minutes, so this could easily include left shifts. General forecasts become less and less relevant as your races get shorter and your course area more confined.

◆ Collecting data about the wind is not as simple as sailing around the starting area and looking upwind. If you really want to get a good idea of what the wind is doing, get out to the starting area early. Sail to both sides of the course and up to the position of the windward mark. Spend a lot of time recording your headings on each tack so you can figure out the windshift pattern.

In an oscillating breeze, I usually sail at least long enough to see the full range of windshifts on each tack. If possible, it's helpful to sail through a wind cycle (extreme left and right shifts) several times to make sure you have good numbers.

I record the range of the shifts (e.g. the high and low compass numbers on each tack), but I don't worry so much about their timing. That's because strategy is usually based on a certain degree of shift, not a particular amount of time.

◆ Don't forget local knowledge. The wind may be different every day, but there are usually trends, or rules of thumb, in any location. Before you go out, talk to sailors who have spent a lot of time racing in the local area. While you are racing, watch where these people go.

◆ When you're trying to find shifts in direction, it's hard to tell much by looking at ripples on the water. It's more accurate to rely on clues like the angle of other boats sailing farther up the first leg.

As I said above, it's critical to decide whether you will play the wind shifts as oscillating or persistent. If you do a good job of collecting info about the wind, you'll increase your odds of making the right choice, and that will surely help you get better race results. •

Port	Starboard
355	265
345	250
356	262
344	255
358	270
350	256
002	268
348	245
355	260

Before every race, I spend a lot of time sailing upwind on each tack and recording the range of starboard and port headings on the deck with a pencil. This is a good way to see whether the windshifts are oscillating or persistent. It also helps in picking a median and makes it easier to remember my high (lifted) and low (headed) compass numbers during the race. I keep adding to this list as the race goes on.

JH Peterson photo

CHECKLIST

How you'll know when the wind is oscillating.

It's very important to figure out whether the wind shifts will be oscillating or persistent, but this is not always easy to do. Here are some visual clues that often mean the wind direction will be shifting back and forth.

Oscillating shifts are the most common type of wind pattern, so if you're not sure what the wind is doing assume it is oscillating until you discover otherwise.

The wind is blowing offshore.
When the wind is blowing from shore, it's almost a sure bet that the land's irregularities will cause oscillating shifts.

Your headings on each tack go up and down.
Your pre-race compass headings on port and starboard tack fluctuate around an average direction (which stays roughly the same). Shifts happen fairly quickly, not gradually.

Boats are lifted and headed on both sides of the course.
As you look across the course, you see boats on both tacks on lifts and headers in a somewhat arbitrary pattern. Boats that are lifted then get headed and vice versa.

You are sailing in a gradient wind after passage of a cold front.
The classic northwesterly in many parts of North America is a great example of oscillating shifts (and puffs) that come with a vertically unstable air mass.

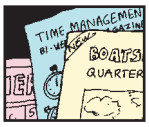
The wind on the water looks patchy and/or puffy.
You look across the course and you can see lighter or darker spots that show puffs or lulls. Sometimes you can even see ripples indicating changes in wind direction. This wind is almost surely oscillating.

On the first beat, each tack is sometimes longer to the windward mark.
As the wind oscillates, so does the longer tack to the windward mark. That is, sometimes your bow points closer to the mark on port tack, and sometimes it points closer on starboard tack.

Boats gain (and lose) on both sides of the course.
As you sail up the beat, boats are as likely to pass (or be passed) on the right side as they are on the left. It all depends on who is in phase with the shifts, not on who goes farther to one side.

The 'favored' end of the starting line switches from one end to the other and back again.
In shifty winds, most starting lines are set square to the median breeze. So when the wind is in a right phase the right (committee boat) end of the line is favored. When the wind is in a left phase, the left (pin) end is favored.

As you come off the starting line, it's very important to know whether you are lifted or headed so you can catch that all-important "first shift." Usually you'd compare your wind instrument number or your compass heading to the numbers you got before the start. But if you don't have instruments or a compass, just look at how the boats are coming off the line. If the boats at the windward end are looking good, then you are probably on a lift. But if the leeward-end boats are ahead, you are probably headed and should tack.



IN THEORY

Ladder rungs and windshifts

A race course for sailboats is a lot like a baseball or soccer field, except in sailing there are no foul lines or goal lines that define the course. There's just a lot of water, some buoys and a bunch of invisible borders like the starting line, laylines and two-length zone.

Perhaps the most useful of all invisible sailing lines are what have become known as "ladder rungs." To understand this idea, imagine a very wide ladder superimposed on the water surface across the race course. The sides of this ladder (which are located outside the course) are parallel to the wind direction, and the ladder rungs are therefore perpendicular to the wind. (For theoretical purposes, the distance between rungs is not critical).

To sail upwind, you have to climb *up* the ladder; to sail downwind, you climb *down* the ladder. When you are beating, all the boats are climbing up the same ladder toward the windward mark. When you're running, all the boats are climbing down this ladder toward the leeward mark.

Unfortunately, the orientation of the ladder is not fixed (that would be too easy!). Whenever the wind direction shifts, the angle of the ladder changes so the rungs remain perpendicular to the new wind (*see conditions at right*). And when the ladder rungs move, every boat gains or loses relative to every other boat on the race course.

In an oscillating breeze, the wind direction (and therefore the angle of the ladder rungs) is changing all the time. If you play your cards right, this provides many opportunities to make gains on other boats. Here are some factors that determine how you will fare when the wind shifts.

1. Direction of the shift.

The basic principle for gain and loss on a windward leg is that when the wind shifts, the boats that are closer to the direction of that shift will gain the most. For example, if the wind backs to the left during the first beat, it benefits the boats on the left side of the course and hurts the boats on the right.

This is easy to understand with ladder rungs. On a windward leg, the boats on the higher rungs are ahead. When the wind shifts, it also changes all the rungs in a way that boats closest to the shift end up on the highest ladder rungs (*see Diagram 2*). The logical strategic conclusion is that you should sail *toward* the next wind shift.

When the wind shifts on a run, the boats closest to the new wind direction still end up on the highest ladder rungs. However, the object of sailing downwind is to get to the lower rungs, so this means the boats closest to the new shift will lose. That's why a basic strategy for running is to sail *away from* the next shift you expect.

2. Magnitude of the shift.

When the wind shifts, the amount that boats gain or lose depends not only on the direction of that shift, but on its size. Basically, the bigger the shift, the more you will gain (or lose) relative to other boats. A ten-degree shift, for example, will produce roughly twice the amount of gain or loss as a five-degree shift. This principle applies to upwind and downwind legs (assuming, of course, that boats do not overstand the next mark).

3. Distance between boats.

A third factor that determines the amount of gain or loss when the wind shifts is the distance between you and your competitors. This "lateral separation" or "leverage" is measured perpendicular to the wind direction (along a ladder rung between the boats).

The farther two boats are apart, the greater will be the relative gain and loss between them when the wind shifts. That's why if you want to minimize risk you should stay close to other boats; but if you need to make a big gain, you should go for more separation.

For a given shift, the amount of

Ladder Rung conditions

Ladder rungs are always perpendicular to the wind direction.
Each rung represents positions of equal progress toward or away from the wind direction, so it must be square to the wind axis.

When the wind direction changes, the ladder rungs shift accordingly.
The rungs always re-orient themselves so they are perpendicular to the new wind direction. Whenever the rungs change, they affect the relative positions of boats on the beat or run.

Ladder rungs do not work when boats are outside the laylines.
Once a boat is overstanding the next mark, she is no longer trying to make progress toward or away from the wind (to windward or leeward), so ladder rungs do not mean anything for her.

All boats on the same ladder rung are even in the race.
Since each rung represents equal progress to windward or leeward, all boats on that rung are even in the race (regardless of which tack they're on). Conversely, boats that are on different ladder rungs are not even in the race.

gain or loss will be roughly proportional to the lateral separation. If a boat that is ten boatlengths on the wrong side of a shift loses three lengths, then a boat that is 20 lengths away will lose 6 lengths.

There is at least one other way that ladder rungs can help you take advantage of oscillating shifts. Sometimes it's difficult to recognize wind shifts on the race course, especially if they are fairly small. But often it's easy to notice the resulting change in ladder rungs.

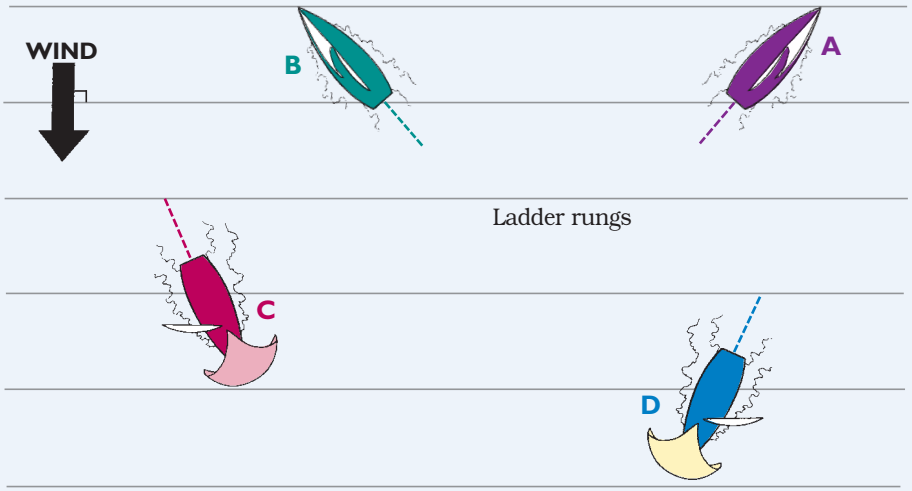
By looking at boats that are fairly far apart, you can usually see subtle changes in their angles relative to each other. For example, if the boats on your windward hip start pointing down slightly toward you (as if you may now be on a higher ladder rung), there's a good chance the fleet has gotten a header (which may have been too small to recognize otherwise). In an oscillating breeze, this is a good time to tack and cross those other boats.

In case you're not sure how to identify the ladder rung that you are on, there are several good ways. My favorite is using another boat that crosses just ahead or behind you and continues on the opposite tack across the course. Assuming you don't have any big shifts, your ladder rung will extend from you through the position of this boat.

If you want to be a little more exact (and not dependent on other boats), you can use a hand-bearing compass to sight a line that is 90° from the direction of your sailing wind. You can also use tacking lines on your deck for this.

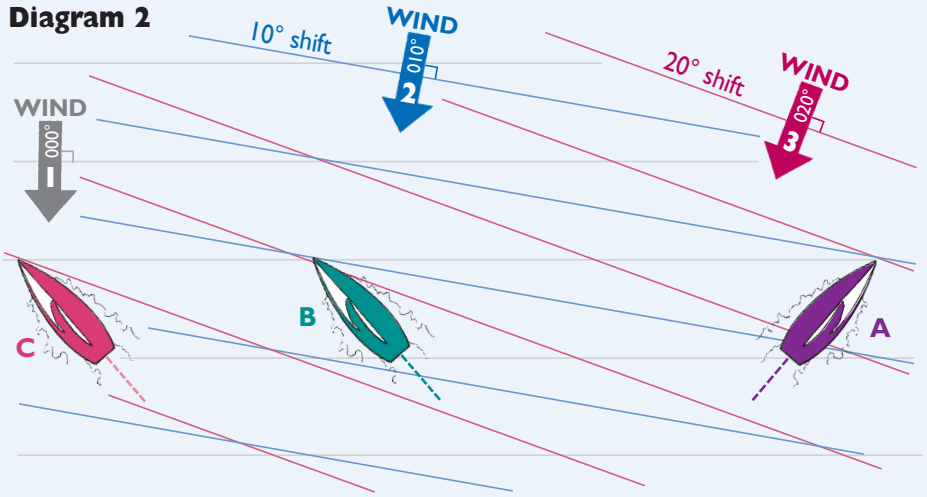
If you understand the basic ideas underlying the ladder rung concept, you should be better able to take advantage of oscillating conditions. After all, playing the shifts upwind is simply a matter of sailing toward the next shift and climbing up the ladder as fast as you can. Even though you may not be able to see ladder rungs on the water, they are always covering the race course. Finding and using them just requires a little experience — and imagination! •

Diagram 1



Ladder rungs are imaginary lines drawn on the water surface perpendicular to the wind direction. Each line represents all the positions that are equally far to windward or leeward in the existing wind. Therefore, if two boats are on the same ladder rung (e.g. A and B) they're even in the race. If two boats are on different ladder rungs (e.g. C and D), then one is ahead of the other. When boats are sailing on a run, the one on the lower ladder rung (D in this case) is leading; on a beat, the boat on the higher ladder rung is ahead.

Diagram 2



Whenever the wind changes direction, the ladder rungs also shift accordingly so they remain perpendicular to the new wind. This process happens constantly while you are racing (especially in an oscillating breeze), so it has a big impact on relative positions of boats in the race.

1. In the diagram above, the wind direction started at 000° (grey arrow). A, B and C were even in the race because they were all on the same (grey) ladder rung.

2. Then the wind shifted 10° right to 010° (blue arrow), and the ladder rungs shifted too (the blue ones). Because A was closest to the shift she ended up on the highest ladder rung and is now ahead of both B and C in the race. Since C was farther away from A, she lost more than B when the wind shifted. (B lost one blue ladder rung while C lost about 1.6 blue ladder rungs).

3. Finally the wind shifted another 10° right to 020° (red arrow), and the ladder rungs shifted again. Once more, A was closer to the direction of the shift so she gained relative to both other boats. In fact, A's total gain in the 20° shift was roughly twice the amount of her gain in the 10° shift (she gained about one ladder rung on B in the first shift and two ladder rungs total after the second shift).

STRATEGY

Strategies for oscillating shifts

When the wind is shifting back and forth (as it usually is), the key to a successful first beat is catching the initial shift after the start and then staying "in phase" with the windshifts until you reach the first mark. Here are some ideas on how to accomplish that:

✔ **Choose a 'median.'** The most important thing for playing windshifts is finding the median, or average, wind direction. This is typically the direction that's half way between the farthest left shift and the farthest right shift you've seen. Since you can't go head to wind (to find the wind direction) while you're racing, what you really need are your closehauled median headings. These are the compass courses you steer on port and starboard tack when the wind is at its median.

During the course of a race, the average wind direction might shift slightly to the left or right. Make sure you keep an eye on this, and don't be afraid to adjust your median numbers accordingly.

✔ **Use your median.** Once you've determined the median headings, you will always know whether you are lifted (sailing higher than the median) or headed (sailing lower than the median). If you are sailing below your median, you should normally tack. By tacking on the header you will have a lift on the other tack (*for more on medians and tacking see pages 8-9*).

In my opinion, it's more important (and easier) to know the range of the oscillations than their timing. However, there are two situations on the first beat where it can be helpful to know about timing, too. One is at the start when you're trying to figure out how soon the first shift will come. Another is near the windward mark when you need to know if the wind will shift again before you get there.

✔ **The last shift.** If you are close enough to the windward mark that the wind will not shift again on this leg, you probably shouldn't tack on the header like you would normally do. Instead, treat the last oscillation as if it is a persistent shift (because it will not oscillate again on this beat). Keep sailing into the header until you are able to tack and fetch the mark.

✔ **Sail in bad air?** In most situations you want to avoid sailing in bad air at almost any cost. Wind shadows make you go slower and point lower. The longer you stay in them, the more you'll lose to boats sailing in clear air.

In oscillating winds, however, it might not be a terrible idea to "live" in bad air sometimes. If you are on a lift, you might lose more by tacking off the lift than you would by sailing in bad air. This is especially true in moderate or heavy winds, when the slowing effect of wind shadows is not so great.

✔ **Choosing lifts or puffs.** When the wind is oscillating in direction, it is also likely to have variations in velocity (i.e. puffs and lulls) across the course. And sometimes you have a tough choice – either sail on a lift or sail toward a puff. Which is better?

Your strategy will depend on several factors, but primarily on the overall wind velocity. If there is already a lot of breeze, a puff won't make much difference, and you should probably go for the lift. But if the wind is light, a puff can give you a huge speed boost (and also a lift because you can sail higher in more breeze), so it may be worth sailing on a header to get there.

✔ **Keep a good lookout.** An oscillating breeze changes all the time, so you really have to keep your head out of the boat in order to sail fast. One idea is to assign a crewmember to look for shifts.

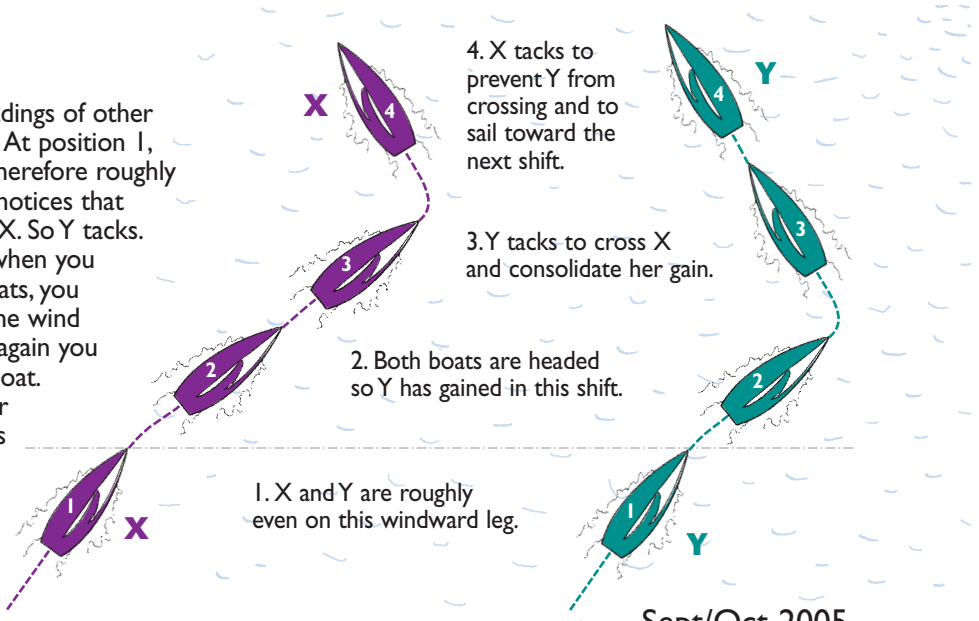
If there's another fleet of racing boats to windward, these make great wind indicators. Watch other "telltales" such as smokestacks, flags on shore, flags on stake or

1. Cross other boats when you can

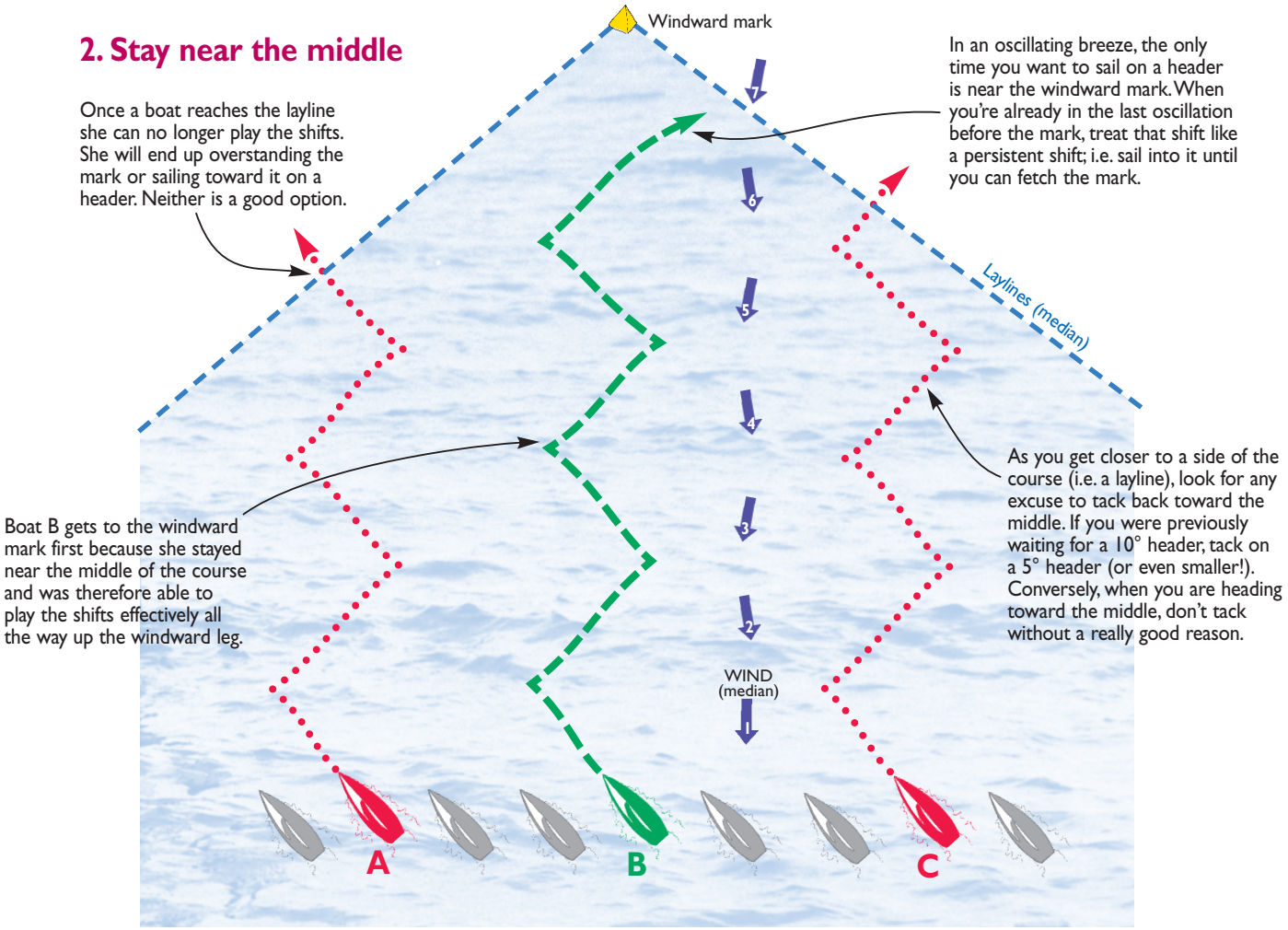
Here's a way to use the relative positions and headings of other boats to help you strategically in oscillating shifts. At position 1, Boats X and Y are on the same ladder rung and therefore roughly equal in the race. A short while later, however, Y notices that (thanks to a header) she can now tack and cross X. So Y tacks.

A good rule of thumb in shifty winds is that when you become able to tack and cross ahead of other boats, you should do so. If you don't consolidate your gain, the wind will eventually shift back the other way and once again you will be even with (or possibly behind) the other boat.

A corollary to this principle is, "Don't let other boats cross you." When X sees Y tack and realizes that Y will cross ahead of her, X tacks to leeward and ahead of Y. This way X will beat Y to the next shift. You almost never want to cross behind a boat that is sailing on a lift.



2. Stay near the middle



committee boats, the swing of anchored boats, and so on. Try to discover a pattern between the actions of these indicators and subsequent changes in the wind.

The other boats in your fleet are also good telltales, especially if they split to opposite sides of the course. And whenever you cross close to another boat, keep an eye on them the next time you come together to see if you have gained or lost.

✔ **Play the middle.** When the wind is oscillating, it usually works to play the middle of the course (one exception is light air and large fleets when the sides usually seem to pay). If you are sailing away from the middle, look for good reasons to tack; when you are sailing toward the middle, don't tack unless you have a very good reason (*see the diagram above*).

This strategy keeps you away from the laylines, which are dead-ends in a shifty breeze. By staying near the middle, you should be able to take full advantage of every shift up to the windward mark.

✔ **Don't chase shifts.** When you see a boat nearby on a huge lift, it is tempting to sail toward that shift and try to get it. However, this rarely works. More often than not, you must sail on a header to reach the other boat. And when you get there, the shift is usually gone.

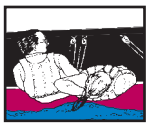
You will probably be more successful if you focus on sailing in the wind you have. Use other boats as a guide to know how much you are lifted or headed, but don't try to sail for their shift (unless it's light air and you're going for pressure).

✔ **Covering in shifty winds.** It's very difficult to "cover" other boats when the wind is oscillating. By covering, I mean staying upwind of the other boat, or between them and the windward mark. If you try this in an oscillating breeze, however, you are likely to lose.

That's because if the boat you are covering is playing the shifts correctly, you won't be (since you are almost always in a different part of the oscillation than they are). In shifty winds, your main priority is to sail your own race – then worry about other boats.

✔ **Sail fast on lifts.** If you are sailing on a lift (and you should almost always be sailing on a lift when the wind is oscillating!), you should sail just slightly lower and faster than normal (assuming you will get at least one more oscillation on the beat). This will get you to the next shift sooner and maximize your VMG in the direction of the median wind (*see pages 10-11*).

✔ **Consolidate your lead.** If the value of your stocks goes up, you won't realize an increase in wealth unless you sell those stocks before they go back down. Playing windshifts is very similar. If you get headed you will gain on all the boats to windward and behind. But you won't be ahead until you tack and cross them (*see page 6*) •



TECHNIQUE

When should you tack in shifts?

When the wind is oscillating, we've all heard the standard advice: "Tack on the headers." But what exactly does this mean? Should you tack as soon as you get a little header, or wait until you get a much bigger shift?

The answer is actually somewhere in between. When the wind is shifting back and forth, your goal is to sail on the lifted tack all the time. This will get you up the ladder rungs as quickly as possible and let you sail more directly toward the windward mark.

The key to sailing on lifts is knowing the median, or average, wind direction (and the corresponding median compass heading on each tack). You have to know the median because all lifts and headers, by definition, are related to this average. Claiming you are on a lift without knowing the median is like saying you have high blood pressure without any idea of what your normal blood pressure should be.

The only way to find the median is by trial and error. Before the race, spend a lot of time sailing upwind on each tack and note your extreme high (maximum lift) and extreme low (maximum header) headings. Your median heading is typically half way between these numbers.

Once you've picked a median (doing this really is somewhat of a subjective exercise), it's easy to know when you are lifted or headed. If you are steering a course that's higher than your median heading, you are lifted. If you're steering lower than the median, you're headed.

When you're racing upwind in an oscillating breeze, you don't want to sail on headers. So if you are steering a course below your median, tack. This will put you on a course that's above your median (i.e. a lift) on the other tack.

This seems fairly straightforward, but it's not the way many people sail in shifts. Most sailors are taught to stay on one tack until they get a pretty good header.

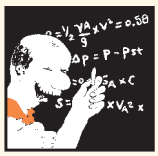

JH Peterson photo

For example, if the wind normally shifts 10° to each side of the median, they will wait until they're headed about 10° below median before tacking.

However, this approach will not get them to the windward mark as quickly as possible because they'll spend roughly half their time sailing on headers. A better strategy is to tack as soon as they get headed to the median (*see page 9*). They will come out of their tack at their median heading on the opposite tack, and then they will start getting lifted. This way they can go up the entire beat without ever sailing on a header.

The above strategy is the fastest when you have regularly oscillating shifts. In the real world, however, you don't always want to tack when you're headed to the median. Sometimes you have to sail farther into the shift to get more velocity, or just to make sure you really are into the shift. Every day is different, so do whatever works best in the existing conditions. •

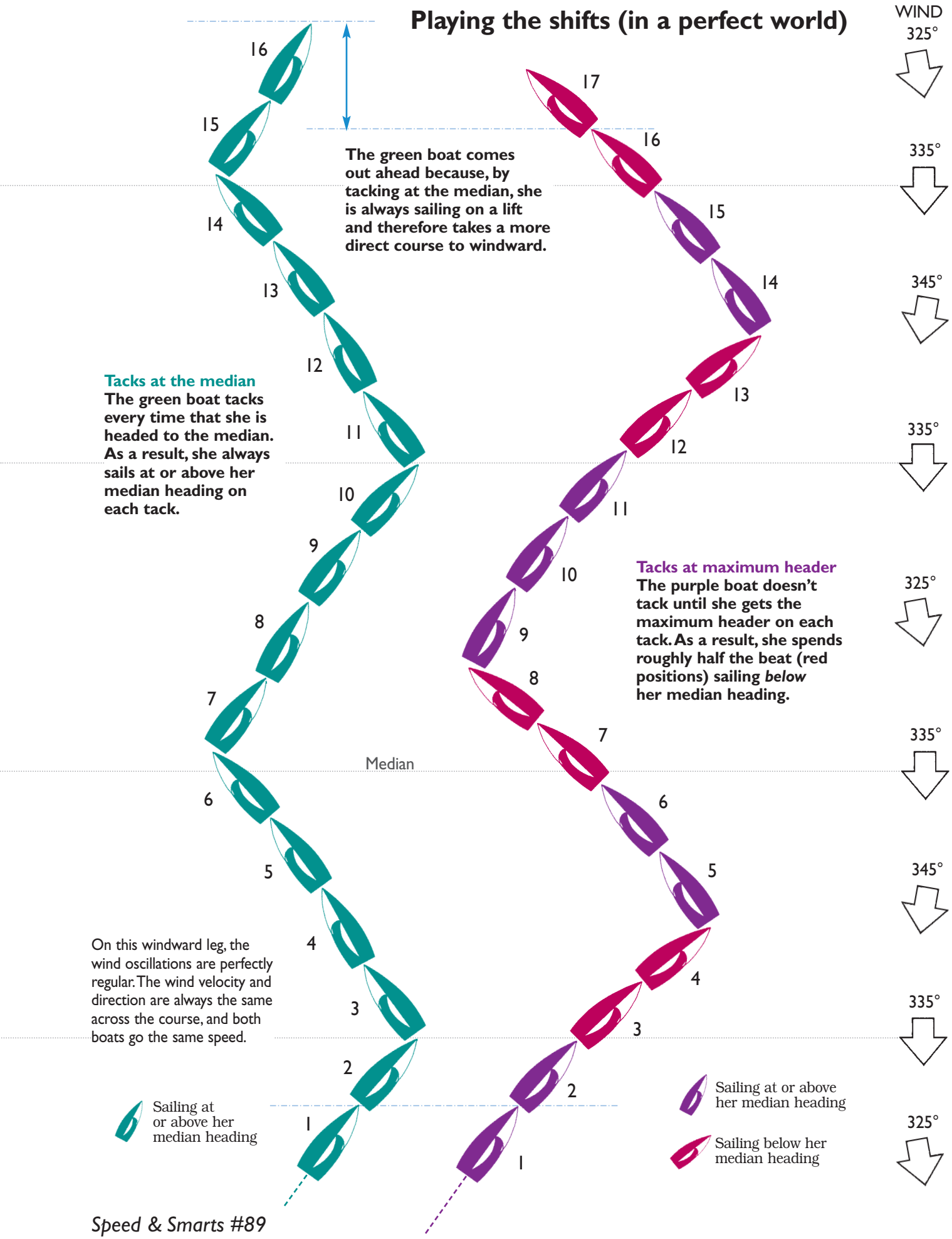
TEASER ANSWER *(from page 1)*

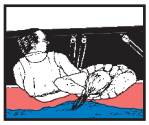


If the wind is in its left phase (215°), that means the port end of the line will be farther to windward (i.e. it's on a higher ladder rung than the starboard end). Since you started at the left end of the line, you will cross ahead of your friend.

How far ahead will you be? Because the line is set square to a wind direction of 225°, the left (pin) end of the line is 'favored' by 10° (225° - 215°). It's like the two of you were even in the race (on the same ladder rung) and then the wind shifted left 10°. The amount you gain in this shift will depend on how far apart the boats are. In a 10° shift, the boat that's closer to the shift gains roughly 25% of the lateral separation between the boats. In this case you started out 200 yards apart (the length of the line). Therefore, you will cross roughly 50 yards ahead (200 * .25). To convert this to boatlengths: 50 yards is 150 feet and the boats are 24 feet long, so you will cross ahead by roughly 6 lengths (150'/24'). •

Playing the shifts (in a perfect world)





TECHNIQUE

On a beat, sail fast in the lifts

JH Peterson photo

When the wind direction is steady, the fastest way to reach the windward mark is simply to get your boat in the "groove" and sail for maximum upwind VMG. But when the wind is oscillating, that's a horse of a different color.

The bottom line is that whenever you're on a lift, you can improve your upwind performance by sailing a little faster and lower than normal. Here's why: In a steady breeze, your goal is to maximize your performance in the *existing* wind direction. After all, the wind you feel at any moment is the same wind you will have all the way up the beat, so you want to climb up the ladder rungs in this direction.

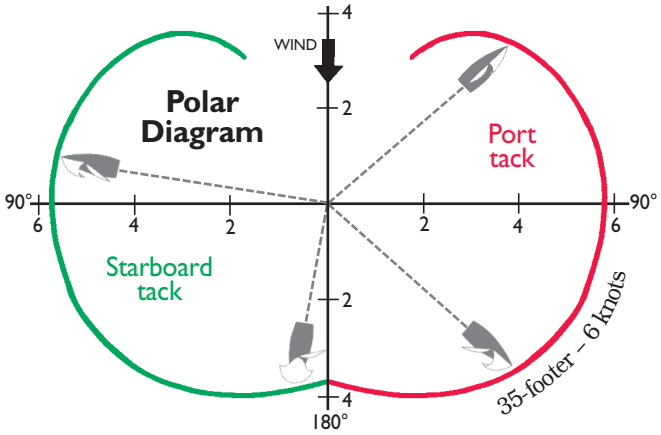
However, when the wind direction is oscillating you have a different goal – to maximize your performance for the *average* wind direction you will have for the entire beat. Your main priority, therefore, is to climb up the ladder rungs of the median breeze, not the ladder rungs of the left or right oscillations.

In order to do this, you should sail a little faster than normal when you're lifted (*see the diagrams for a geometric "proof"*). How much faster? That is hard to say without an onboard computer, but generally it is just a little bit. Perhaps it means sailing with your windward telltales flowing straight back rather than lifting. Certainly you don't want to pinch, or sail with your sheets eased very much.

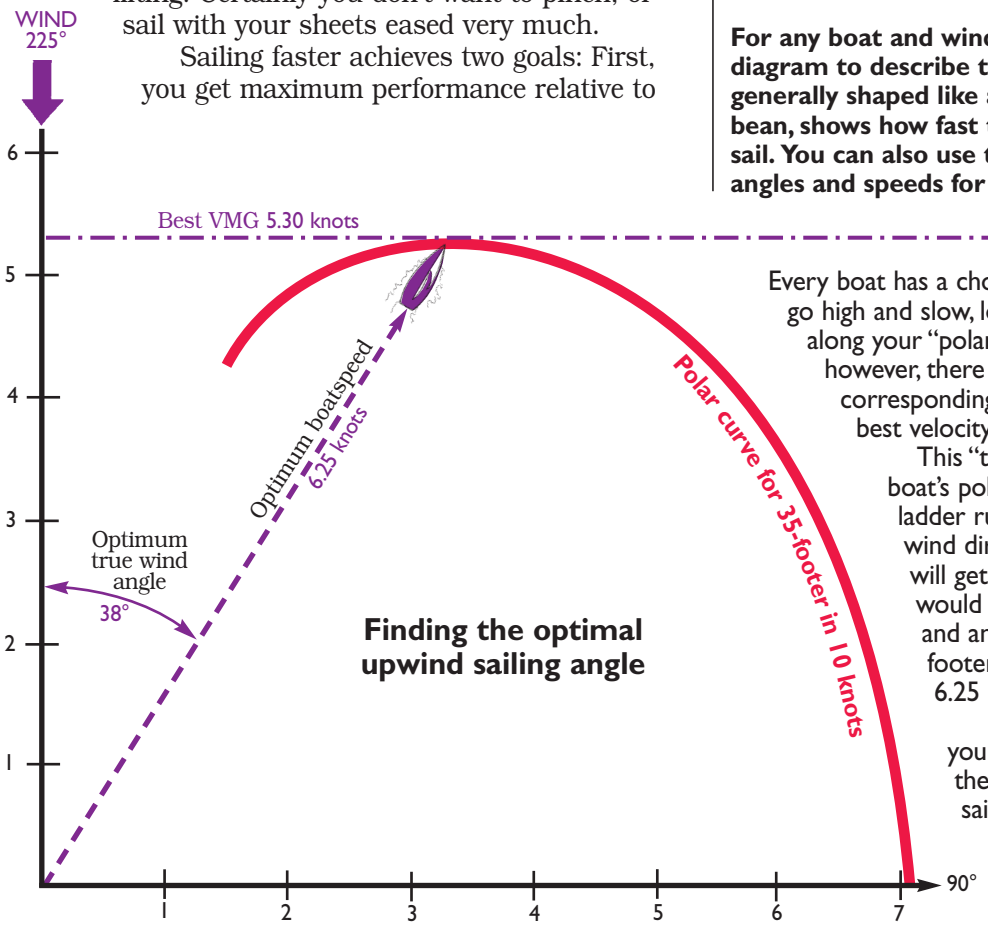
Sailing faster achieves two goals: First, you get maximum performance relative to the average wind direction; and second, you sail faster toward the direction of the next expected shift. The more you are lifted (relative to the median), the faster you should sail. As you get headed toward the median, slow down and head up slightly until you are sailing at your normal speed and angle.

When you should not sail fast and low on a lift

There are certain times when, even though you are lifted, you should sail your normal upwind angle (or even pinch a little bit). These include: ☛



For any boat and wind velocity, we can create a polar diagram to describe that boat's performance. This plot, generally shaped like a cross between a lima and kidney bean, shows how fast this boat will go on all angles of sail. You can also use this tool to figure out the optimal angles and speeds for this boat to sail on beats and runs.



Finding the optimal upwind sailing angle

Every boat has a choice of how to sail upwind. You can go high and slow, low and fast, or any other combination along your "polar curve". For every wind velocity, however, there is usually one boatspeed (and a corresponding wind angle) that will give you your best velocity-made-good to windward.

This "target" speed is the point at which the boat's polar curve intersects with the highest ladder rung (a line drawn perpendicular to the wind direction). By aiming for this point, you will get to a higher ladder rung than you would with any other combination of speed and angle. In the example at left, this 35-footer's target speed in 10 knots of wind is 6.25 knots at a true wind angle of 38°.

In most conditions you should aim for your upwind target all the time. However, there are a few times when you should sail faster or slower, for either tactical or strategic reasons. As we will see on the next page, sailing on a lift in an oscillating breeze is one of these.

Coming off the starting line – If you are lifted at the start, it would be good in theory to sail a little fast. But the reality is you may actually have to pinch a bit in order to hold your lane. At this point the ability to keep sailing the lift in clear air is more important than footing to the next shift.

There's a puff or more lift to windward – Sometimes sailing lower will take you out of the lift or away from better pressure. If it's possible to sail higher into the puff, it may be better to pinch or sail your normal angle until you are confident that you're up into the better breeze.

The wind will not shift again before the mark – If you are nearing the windward mark and you don't expect another oscillation before you reach it, there's no reason to sail faster than normal (because there's no shift to sail toward). Instead, sail your optimal VMG angle for the wind you have.

You should sail fast on runs, too

When you are sailing down a run in oscillating shifts, you will get to the leeward mark faster by using the same strategy. In fact, the potential gains are even greater on runs because you have a much wider variation in headings and speeds.

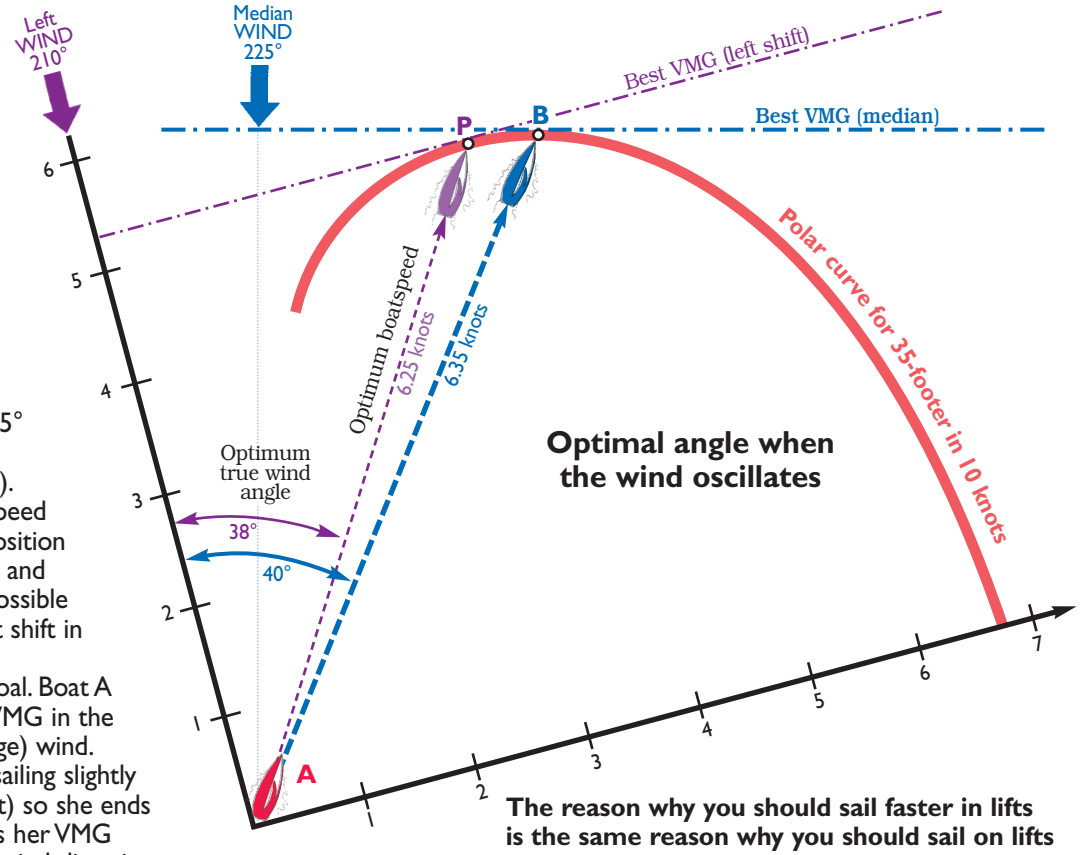
Instead of sailing lower and faster on the lifts, however, on a run you should sail higher and faster on the headers. By sailing higher and faster, you can optimize your VMG to leeward relative to the median wind direction. You will also be sailing away from the next shift faster (which usually is your goal on a shifty run).

Whether you are going upwind or downwind, the key to using this technique is knowing the median wind direction – otherwise you won't be sure if you're lifted or headed. Also, don't get too scared if other boats look like they're gaining while you are sailing fast. Once the next shift comes in you'll be all set. •

When the wind is steady, it's pretty easy to pick your optimal upwind speed and angle. You just aim for the spot where your polar curve intersects the highest ladder rung (see *the diagram on page 10*).

But when the wind is oscillating, this choice is not so clear. In the diagram shown here, the red boat (A) gets a 15° lift on port tack (i.e. the wind shifts 15° to the left of median). If A sails her optimal upwind speed in this lift, she will end up at position P (the purple boat). This speed and angle give her the best VMG possible (purple line) relative to the left shift in which she is sailing.

However, this is not her goal. Boat A really wants to maximize her VMG in the direction of the median (average) wind. The best way to do this is by sailing slightly lower and faster (the blue boat) so she ends up at position B. This optimizes her VMG (blue line) toward the median wind direction and also gets her to the next shift sooner.



The reason why you should sail faster in lifts is the same reason why you should sail on lifts in the first place – so you can maximize your VMG in the direction of the *average* wind.

STRATEGY

Tips for playing shifts downwind

A lot of sailors work hard to play oscillations upwind, but they forget about wind shifts after rounding the windward mark. In fact, changes in wind direction affect runs almost as much as beats, and they often result in big gains and losses. Here are some ideas on how to take advantage of shifts when you're going downwind.

First of all, runs are a lot like beats, so many windshift strategies remain the same. For example, you should sail the longer jibe first, stay away from laylines as long as possible, and cross ahead of other boats when you can (*see page 13*).

In other ways, however, runs are completely opposite to beats. On a run, for example, you want to climb *down* the ladder rungs, not up. So you need to invert some of the upwind rules of thumb.

Instead of sailing *toward* the next shift, you should sail *away from* it. Instead of tacking on the headers to sail the lifts, you jibe on the lifts to sail the headers. These are all described on the next page.

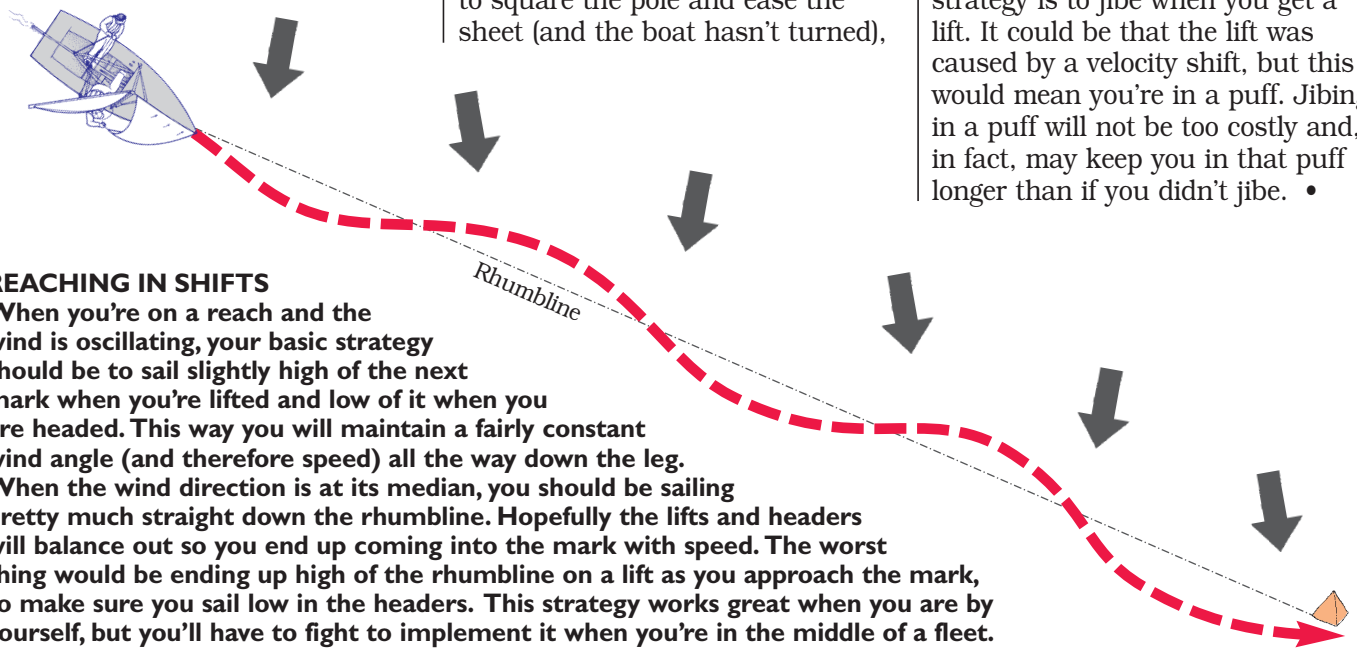
There are also a few other things that are unique to playing oscillations on a run. Here are some thoughts to consider:

- Windshifts last longer on runs than on beats because you are sailing with the wind, not into it. If you see four oscillations on a beat you might sail through only two on a run. This places more of a priority on playing those shifts correctly.
- Changes in wind direction are harder to recognize when you're going downwind, for two reasons. First, the apparent wind you feel is a lot lighter (since you're sailing with the wind). And second, the steering groove is wider and less defined on runs than beats. This means you could have a 10° shift downwind without even noticing it. To prevent this you really must pay attention to your sail (spinnaker) trim and sailing angle.
- On a beat the helmsperson is often the first (and sometimes the only) person to notice a windshift because she is focusing on the jib to keep the boat in the groove. On a run, however, the spinnaker trimmer is usually the one who senses a change in wind direction, since he is concentrating on wind pressure and angle in the spinnaker.

For example, if the trimmer has to square the pole and ease the sheet (and the boat hasn't turned), then there probably was a lift. If he sees a curl in the luff of the chute and has to ease the pole forward, the boat was probably headed. The wind in the spinnaker is key to catching shifts downwind, so the trimmer must openly communicate what he or she sees and feels.

- When the wind is oscillating on a run, the classic strategy is to sail away from the next shift you expect since this will put you on a lower ladder rung when the wind shifts. But you have to be careful here. When the wind changes direction, it often brings an increase in velocity, too. That is something you might want to sail toward, not away from. It all depends on a number of unique factors (e.g. the size of the shift, strength of the puff) that you must evaluate each time.
- On a windward leg, watch out for 'headers' that are due to a decrease in wind pressure (a lull) rather than an actual change in wind direction. If you tack on headers like these, you will probably lose because it was not really a header and, more importantly, you made a turning maneuver during a lull.

On runs, however, it's harder to make this mistake. The normal strategy is to jibe when you get a lift. It could be that the lift was caused by a velocity shift, but this would mean you're in a puff. Jibing in a puff will not be too costly and, in fact, may keep you in that puff longer than if you didn't jibe. •



REACHING IN SHIFTS
When you're on a reach and the wind is oscillating, your basic strategy should be to sail slightly high of the next mark when you're lifted and low of it when you are headed. This way you will maintain a fairly constant wind angle (and therefore speed) all the way down the leg. When the wind direction is at its median, you should be sailing pretty much straight down the rhumbline. Hopefully the lifts and headers will balance out so you end up coming into the mark with speed. The worst thing would be ending up high of the rhumbline on a lift as you approach the mark, so make sure you sail low in the headers. This strategy works great when you are by yourself, but you'll have to fight to implement it when you're in the middle of a fleet.

Strategic principles for runs in an oscillating breeze

Playing the shifts on a run is very similar to a beat, except some of the downwind principles are essentially inverses of the upwind ones. Here's a chart with rules of thumb for runs, plus their counterparts for beats.

RUNS

1. Sail away from the next shift.

On a run your goal is to climb down the 'ladder.' By sailing away from the next wind shift you will end up on a lower ladder rung when the wind changes direction.

2. Jibe on the lifts.

By jibing when you are lifted you will sail on the headed jibe. This will put you on the longer jibe to the leeward mark, sailing away from the next shift.

3. Sail on the headed jibe.

This way you will sail the most direct and shortest course to the leeward mark. It will also give you the best velocity-made-good to leeward.

BEATS

1. Sail toward the next shift.

On a windward leg your goal is to climb up the 'ladder.' By sailing toward the next wind shift you will end up on a higher ladder rung when the wind changes direction.

2. Tack on the headers.

By tacking when you get headed you will sail on the lifted tack. This will put you on the longer tack to the windward mark, sailing toward the next shift.

3. Sail on the lifted tack.

This will let you sail the most direct and shortest course to the windward mark. It will also give you the best velocity-made-good to windward.

RUNS *and* BEATS

4. Sail the longer jibe (or tack) first.

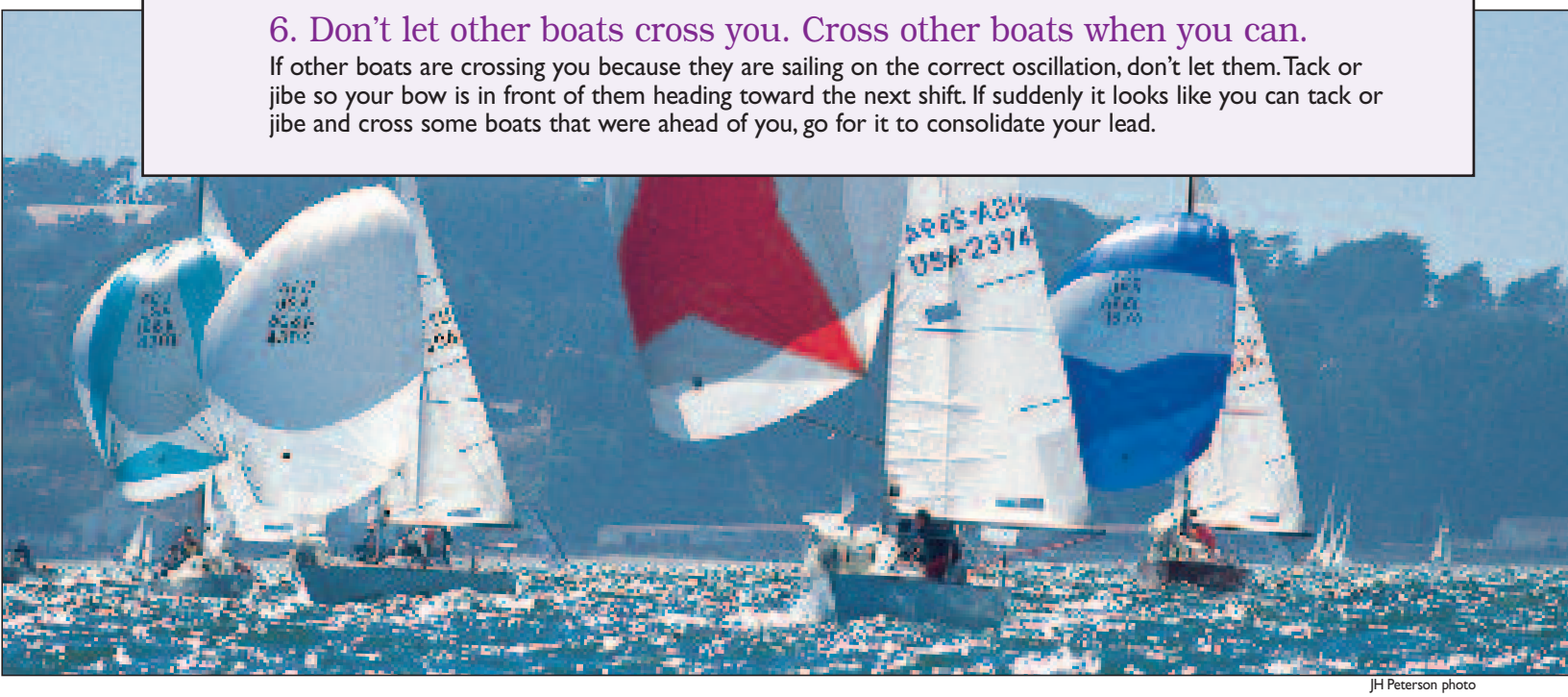
By sailing the longer jibe or tack, you will make more direct progress toward the next mark. This will usually keep you "in phase" with the shifts, and it will help you avoid the corners and laylines. This rule of thumb is especially important on runs because jibing angles are usually much narrower than tacking angles, so it's easier to overstand a leeward mark.

5. Stay away from corners and laylines.

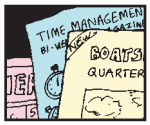
Once you get to a corner or a layline, you can no longer take advantage of windshifts. This is a bad thing when the wind is oscillating back and forth. It's also risky on a shifty run because even small changes in wind velocity can have a large impact on your jibing angle (e.g. a puff near the layline means you will overstand).

6. Don't let other boats cross you. Cross other boats when you can.

If other boats are crossing you because they are sailing on the correct oscillation, don't let them. Tack or jibe so your bow is in front of them heading toward the next shift. If suddenly it looks like you can tack or jibe and cross some boats that were ahead of you, go for it to consolidate your lead.



JH Peterson photo



IN THEORY

Don't be fooled by apparent shifts

A "velocity shift" is a temporary change in your apparent wind direction caused by an increase or decrease in wind velocity. It is not the same as an oscillation in the wind direction, so you must realize this and treat it differently.

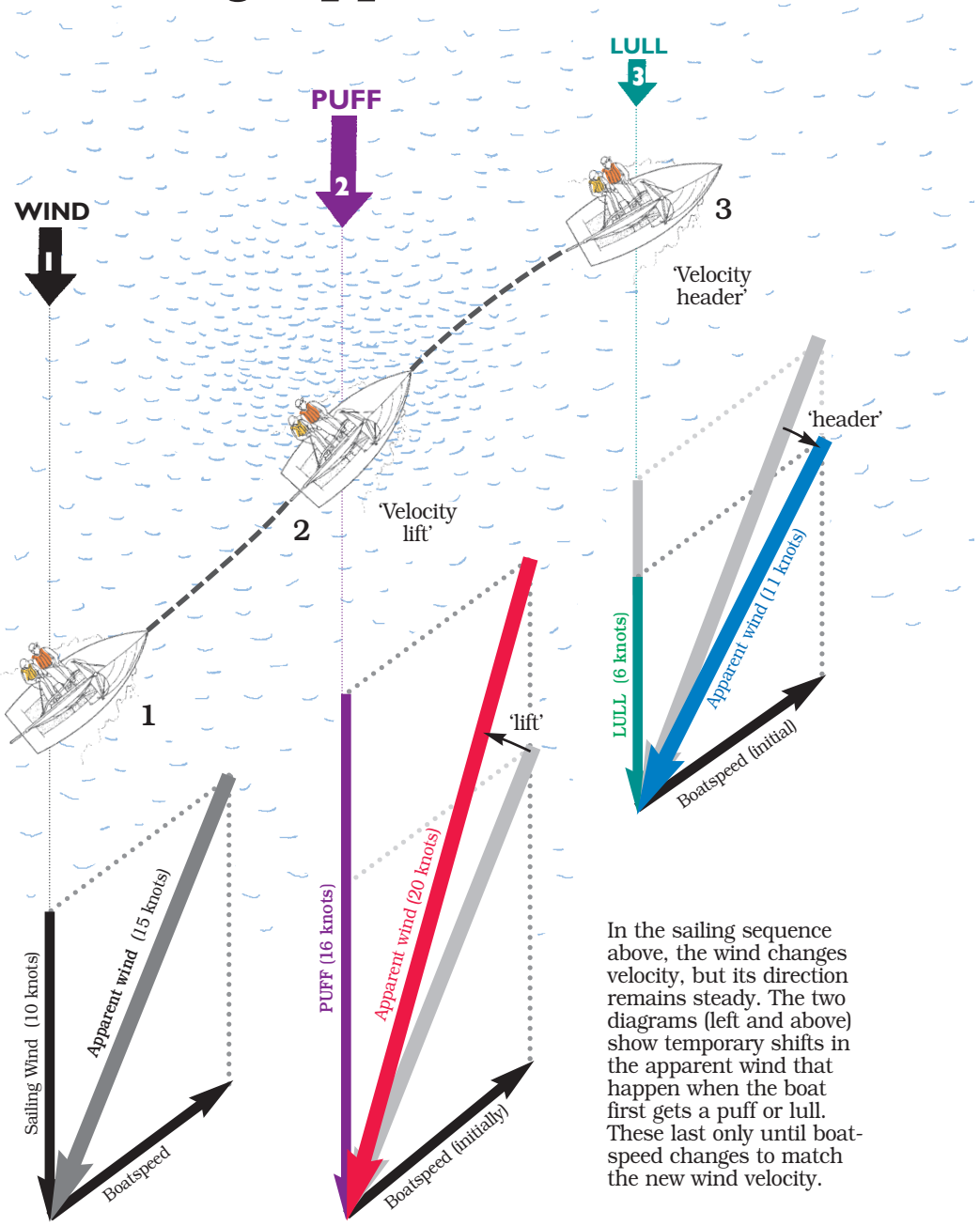
When you sail into a puff, the increased wind velocity moves your apparent wind aft. It seems like a lift, but only for as long as it takes your boatspeed to increase to match the stronger wind. As that happens, your apparent wind shifts back to its original angle relative to your boat. And the "lift" is gone.

Sailing into a lull is similar. The decrease in wind velocity moves your apparent wind forward, which seems like a header until your boatspeed decreases to match the reduced wind strength. As that happens, your apparent wind shifts back to its original angle, and the 'header' disappears.

When the breeze is oscillating, you normally tack on a header. But before you do this, make sure it's a real change in wind direction, not just a velocity header. There are two problems with tacking on a velocity header. First, it's not really a header, so you may end up going the wrong way from a strategic point of view. And second, as far as boatspeed is concerned, tacking in a lull is a costly no-no.

On the other hand, continuing to sail in a velocity lift is not so bad. You have more wind pressure, which is always good, and you may actually be on a lift.

So, how can you recognize a velocity shift from a real oscillation? There are two distinguishing features. First, a velocity shift always comes with a change in wind speed. Second, a velocity shift doesn't last very long. So before you automatically tack on a header, think about whether the wind velocity just decreased. If you're not sure, wait a few seconds to see if the header is going to last. •



In the sailing sequence above, the wind changes velocity, but its direction remains steady. The two diagrams (left and above) show temporary shifts in the apparent wind that happen when the boat first gets a puff or lull. These last only until boatspeed changes to match the new wind velocity.

Why a puff looks like a lift (and a lull looks like a header)

At position 1, the boat above is sailing in a 10-knot breeze, and her crew feels an apparent wind of 15 knots (it's a vector sum of the sailing wind and the wind caused by boatspeed). When a puff hits (position 2), the wind velocity jumps to 16 knots and the apparent wind increases to 20 knots.

The boatspeed will also increase, but this takes at least a few seconds. Before the boat accelerates, her apparent wind (red arrow) is a vector sum of the stronger sailing wind and the wind caused by her initial boatspeed. This temporarily changes the direction of the apparent wind away from the boat's bow, so it looks like a lift.

Sailing into a lull has the opposite effect. The sailing wind decreases right away, but it takes a while for the boat to slow down. This makes the apparent wind (blue arrow) lighter and shifted toward the boat's bow, so it feels and looks like a header. In both cases, the apparent wind will return to its original angle (and the apparent shift will disappear) when the boat's speed changes to match the new wind velocity.

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Lifts and headers and veers . . . Oh my!

Just to make sure we are all talking the same language, here is a basic glossary of terms that relate to oscillating shifts.

Back – A counterclockwise wind shift. This is also called a shift to the left, which I think is easier to understand.

Down – Turning *down* means turning away from the wind (or bearing off), which happens when the wind shifts toward the bow (a header). Therefore, if you say, "We're *down*," it means you're headed.

Header – A windshift where the wind direction moves closer to the bow and you have to bear off to keep the jib full. Headers are described in compass degrees, usually relative to your average heading (median) on each tack: "We've been headed five degrees," or "We're a bit below median."

Knock – Another (less common) word for a header. You might say, "That was a 5° *knock*," or "We've been *knocked* 5°."

Lift – A windshift where the wind direction moves away from the bow and you are able to head up higher. Lifts are often expressed as the number of degrees they allow you to head above the median. For example, if your average heading on starboard tack is 310° and you're now steering 320°, you might say, "We have a 10-degree lift."

Median – The average compass direction of your sailing wind. It is also used to describe your average heading on each tack (i.e. the course you steer in the median wind direction). Usually the median is the compass direction or heading that's between the far left and right shifts. It's very important for oscillating strategy, but doesn't apply to persistent shifts.

Oscillation – A shift in the wind direction that will, sooner or later, be followed by a return shift in the opposite direction. In an oscillating breeze, the shifts go back and forth around an average wind direction.

Phase – Another word for *oscillation*. You might also say, "We're in phase."

Up – Turning *up* means turning toward the wind, which happens when the wind shifts away from the bow (a lift). "We're *up*," means we're lifted.

Veer – A clockwise wind shift, commonly known as a "shift to the right."

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How to talk about windshifts

When you're sailing in an oscillating breeze, it's very important to have good communication about what's going on with the wind. I usually organize my crew so at least one person is responsible for watching windshifts. Ideally this is someone who has a good feel for the wind, plus a clear view of the compass, the wind instruments and other boats on the course.

This crewmember's job is to monitor changes in the wind direction and to call out windshifts in a loud voice for the rest of the crew to hear. He or she may have the most important job on the boat because playing the shifts correctly can do more to improve your finish position than any other factor.

However, before you start jabbering about lifts and headers, you need to do a bit of homework:

☛ Make sure you have enough time to collect wind data before each race. This means you may have to urge your crew to leave the dock earlier, or convince your helmsperson to spend more time sailing upwind before the start. Whenever possible, try to get a wide range of port and starboard upwind headings. Unless you have a really good memory, write these on the deck (my preference) or in a small notebook.

☛ Always know the 'median.' This is the average heading on each tack – the one that's in between your high and low headings. The median is important because it's your baseline reference for knowing whether you are lifted or headed at any time. Make sure you always have a median in mind, and adjust this median during the race if the overall wind shifts in either direction (discuss this with your skipper first).

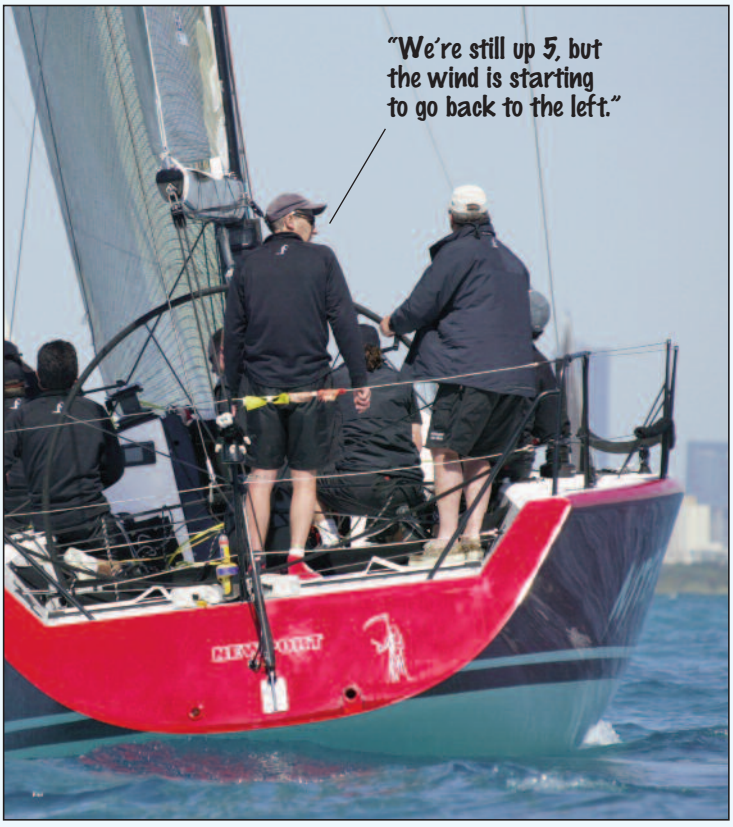
☛ Ask your helmsperson and/or tactician what kind of information they'd like to hear. I think the most effective way to communicate about windshifts is to describe your boat's current compass heading in relation to your median heading on that tack. For example, if you're sailing 345° on port tack and your median (average) is 355°, then you would say, "Up 10."

Over time your wind calls would sound something like this: "Up 10 . . . Up 5 . . . Up 3 . . . Median . . . Down 5 . . . " and so on. This makes it very easy for the rest of the people in your crew to know immediately if you are lifted or headed.

As a helmsperson, I find this much more useful than having someone call out the boat's headings on each tack. When I hear "235 . . . 227 . . . 222 . . . 230" I have trouble remembering how these numbers compare to the median. Also, if you are lifted 10° on port tack and then the wind heads you 5°, you are not "Down 5." You should say "Up 5" because you are still sailing 5° higher than your median on that tack.

☛ Unless you are also the tactician, it's probably better to report the data you observe and leave out your opinions. For example, you should say, "We're down 10°" rather than, "Big header, let's tack!"

Remember that deciphering windshift patterns is a subjective art at best, and there will be times when you have no idea what's going on (and neither will most other sailors). Don't be afraid to admit this or to ask for input from other crewmembers. •



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