Drills for improving *stroke rate* and *stroke length*:

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Ernest W. Maglischo, Ph.D.
ewmaglischo@cox.net
What do I mean by stroke rate?

- The tempo or arm cycling rate of swimmers.

- It can be expressed in two ways:
  - As stroke cycles per minute, i.e. 50 cycles/min.
    - Time per stroke cycle = 1.20 secs.
    - \( \frac{60}{1.20} = 50 \) stroke cycles/min.
  - As time per stroke cycle, i.e. 1.20 secs/cycle.
    - \( 1.15 = \) faster stroke rate
    - \( 1.25 = \) slower stroke rate.
What do I mean by stroke length?

- The distance a swimmer travels forward through the water during one stroke cycle.
  - The usual range is 1.0 to 2.5 m/cycle.
- Computing swimming velocity.
  - Time/cycle = 1.20 (50 cycles/min)
  - Stroke length = 2.30 m/cycle
    - \[ \frac{2.30}{1.20} = 1.92 \text{ m/sec} \]
    - \[ \frac{100\text{m}}{1.92 \text{ m/sec}} = 52.08 \text{ secs} \]
The Inverted “U” Relationship Between Stroke Rate and Stroke Length
How can swimmers increase their velocity?

- By increasing stroke rate with only a minor decrease in stroke length.
  
  \[
  \left( \frac{2.30\text{ sl}}{1.20\text{ sr}} \right) \left( 50\text{ c/min} \right) = 1.92\text{ m/sec (sv)}
  \]
  
  \[
  \frac{2.20\text{ sl}}{1.17\text{ sr}} \left( 51\text{ c/min} \right) = 1.97\text{ m/sec (sv)}
  \]

- By increasing stroke length with only a minor decrease in stroke rate.
  
  \[
  \frac{2.40\text{ sl}}{1.22\text{ sr}} \left( 49\text{ c/min} \right) = 1.97\text{ m/sec (sv)}
  \]
### Range of SR and SL for World-class female swimmers.

<table>
<thead>
<tr>
<th>Events</th>
<th>Stroke Rate in cycles/min</th>
<th>Stroke Length in m/cycle</th>
<th>Strokes/50m (approx.)</th>
<th>Strokes/50y (approx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Freestyle</td>
<td>60 - 64</td>
<td>1.90 - 2.06</td>
<td>19 - 21#</td>
<td>18 - 20#</td>
</tr>
<tr>
<td>100 Freestyle</td>
<td>53 - 56</td>
<td>1.91 - 2.20</td>
<td>19 - 23</td>
<td>20 - 22</td>
</tr>
<tr>
<td>200 Freestyle</td>
<td>48 - 52</td>
<td>1.90 - 2.02</td>
<td>22 - 23</td>
<td>19 - 20</td>
</tr>
<tr>
<td>400/500 Free</td>
<td>45 - 52</td>
<td>1.81 - 2.05</td>
<td>22 - 25</td>
<td>18 - 20</td>
</tr>
<tr>
<td>800/1000 Free</td>
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<tr>
<td>1500/1650 Free</td>
<td>50 - 53</td>
<td>1.79 - 1.85</td>
<td>24 - 25</td>
<td>21 - 22</td>
</tr>
<tr>
<td>100 Backstroke</td>
<td>44 - 49</td>
<td>1.90 - 2.07</td>
<td>22 - 24</td>
<td>18 - 19*</td>
</tr>
<tr>
<td>200 Backstroke</td>
<td>40 - 43</td>
<td>2.08 - 2.22</td>
<td>20 - 22</td>
<td>17 - 18*</td>
</tr>
<tr>
<td>100 Breaststroke</td>
<td>44 - 53</td>
<td>1.56 - 1.90</td>
<td>21 - 26</td>
<td>15 - 18</td>
</tr>
<tr>
<td>200 Breaststroke</td>
<td>42 - 44</td>
<td>1.70 - 1.84</td>
<td>22 - 24</td>
<td>15 - 17</td>
</tr>
<tr>
<td>100 Butterfly</td>
<td>54 - 57</td>
<td>1.69 - 1.90</td>
<td>24 - 27</td>
<td>19 - 22</td>
</tr>
<tr>
<td>200 Butterfly</td>
<td>50 - 54</td>
<td>1.67 - 1.77</td>
<td>25 - 26</td>
<td>22 - 23</td>
</tr>
</tbody>
</table>

Stroke cycles per 50m and 50yds are adjusted for turn and glide distances.

#Includes start for 50 meters long course, start and turn for 50 yds. short course

*Does not include dolphin kick.

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<tr>
<td>50 Freestyle</td>
<td>65 - 70</td>
<td>2.05 - 2.15</td>
<td>18 - 20#</td>
<td>17 - 18#</td>
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<tr>
<td>100 Freestyle</td>
<td>50 - 54</td>
<td>2.14 - 2.30</td>
<td>19 - 21</td>
<td>15 - 17</td>
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<tr>
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<td>48 - 50</td>
<td>2.31 - 2.39</td>
<td>19 - 20</td>
<td>15 - 16</td>
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<tr>
<td>400/500 Free</td>
<td>42 - 45</td>
<td>2.20 - 2.42</td>
<td>18 - 20</td>
<td>15 - 19</td>
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<tr>
<td>800/1000 Free</td>
<td>41 - 44</td>
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<tr>
<td>1500/1650 Free</td>
<td>40 - 43</td>
<td>2.27 - 2.37</td>
<td>19 - 20</td>
<td>15 - 16</td>
</tr>
<tr>
<td>100 Backstroke</td>
<td>48 - 51</td>
<td>1.82 - 1.96</td>
<td>22 - 23</td>
<td>17 - 19*</td>
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<tr>
<td>200 Backstroke</td>
<td>42 - 49</td>
<td>1.90 - 2.10</td>
<td>21 - 23</td>
<td>17 - 19*</td>
</tr>
<tr>
<td>100 Breaststroke</td>
<td>50 - 55</td>
<td>1.64 - 1.74</td>
<td>23 - 24</td>
<td>14 - 15</td>
</tr>
<tr>
<td>200 Breaststroke</td>
<td>40 - 45</td>
<td>1.88 - 2.18</td>
<td>19 - 21</td>
<td>13 - 15</td>
</tr>
<tr>
<td>100 Butterfly</td>
<td>50 - 55</td>
<td>2.01 - 2.20</td>
<td>21 - 22</td>
<td>17 - 18</td>
</tr>
<tr>
<td>200 Butterfly</td>
<td>50 - 55</td>
<td>1.75 - 2.00</td>
<td>23 - 25</td>
<td>18 - 20</td>
</tr>
</tbody>
</table>

Stroke cycles per 50m and 50yds are adjusted for turn and glide distances.

# Includes start for 50 meters long course, start and turn for 50 yds. short course

* Does not include dolphin kick.

Strategies for increasing stroke length

- Correct stroke mechanics.
- Increase height and length of propulsive phases.
- Ride your propulsion where possible and reduce the size and/or length of decelerations between propulsive phases. “Conserve momentum”.
- Reduce drag where possible.
Drills for increasing stroke length

- Streamline drills.
  - Free and Backstroke: Swim with streamlined body as viewed from both above and side.
Backstroke

Coughlin

Coventry
Butterfly: Streamline during the propulsive phases of the stroke - Ian Crocker
Breaststroke
Mike Barrowman & Amanda Beard
Increase propulsive peaks and reduce the time spent in decelerative valleys.
Center of mass velocity in butterfly

Avg. velocity = 1.88 m/cycle = 53.19

Center of mass velocity in butterfly

Avg. velocity = 1.70 m/sec = 58.9
Mike Barrowman velocity graph

Wave propulsion

Velocity in m/sec

Time in 1/100 sec.
Rhythm drills

1. Strive for continuous propulsion. Maintain (conserve) momentum as much as possible.

3. What causes loss of rhythm?
   a. gliding
   b. stroke errors
   c. poor streamlining, particularly during parts of stroke that are non- or minimally propulsive.
Rhythm drills, continued

- Swim with good rhythm but not with a strong pull or kick.
- Feel self being moved forward with each stroke. No hitches or breaks in rhythm.
Drills for increasing stroke length

- Of course swimming lengths with fewer strokes is good.
  - Can help swimmers get the “feel” for changes in technique
  - But, it can also cause them to glide too much and ride their kicks too much.
Drills that incorporates stroke length and stroke rate.

Swolf:

- Swim 50’s or 100’s on reasonably short send-off time.
- Count strokes and notice time.
- Try to reduce strokes without losing time or increase speed without adding strokes.
Drills that incorporate fast swimming

Examples: 4 x 50/1

<table>
<thead>
<tr>
<th>Time</th>
<th>Strokes</th>
<th>Swolf score</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.0</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td>35.0</td>
<td>38</td>
<td>73</td>
</tr>
<tr>
<td>34.0</td>
<td>39</td>
<td>73</td>
</tr>
<tr>
<td>34.0</td>
<td>38</td>
<td>72</td>
</tr>
</tbody>
</table>

Don’t use dolphin kicking on these drills
Drills that incorporates stroke length and stroke rate.

- **Kick ins:**
  - Swim 50’s or 100’s on reasonably short send-off time.
  - Count strokes
  - Swim subsequent repeats trying to take one or two fewer strokes.
  - Stop swimming when you reach the desired number of strokes and kick the remainder of the repeat.
Francisco Sanchez – 8th. 100m Free, 1994 & 1996.

<table>
<thead>
<tr>
<th>Times</th>
<th>1994 South American Championships</th>
<th>1996 Olympic Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke Rate</td>
<td>60/58</td>
<td>56/52</td>
</tr>
<tr>
<td>Stroke Length</td>
<td>2.08 m/1.85m</td>
<td>1.85m/1.78m</td>
</tr>
<tr>
<td>Stroke Rate</td>
<td>62/58</td>
<td>56/52</td>
</tr>
<tr>
<td>Stroke Length</td>
<td>1.87m/1.85m</td>
<td>1.85m/1.85m</td>
</tr>
</tbody>
</table>
Rate and Velocity Maintenance

- Add ons.
  - Swim 3 x 50/45 at 70 to 80% effort. Count strokes and note time
  - Swim 20 x 50/45. Don’t increase stroke count by more than 1 or 2 per 50.
Rate and velocity maintenance

- Add ons.
  - Swim 3 x 100/45 at 70 to 80% effort. Count strokes and note time
  - Swim 20 x 100/45. Don’t increase stroke count by more than 1 or 2 per 100.
The fallacy of stroke length

Brooke Bennett – 1996 Gold Medal
800 m freestyle

SL = 1.65 to 1.83 m/cycle

The other 7 finalists:
SL = 1.76 to 2.19 m/cycle
Drills for increasing stroke rates

- Vary the stroke rate
  - Swim a number of short repeats (12.5 to 25 meters.)
  - Vary rates from slow to fast with each repeat.
- Swim while being pulled (sprint assisted training).
Drills for increasing stroke rates: continued

- Swim long sets on short rest in a short pool. Emphasize swimming repeats fast.
Using stroke rate and stroke length to learn how to pace races

- Find the most effective combination of stroke rate and stroke length for each race distance.
- Learn to control stroke rates to conserve energy.
### Ian Thorpe - 200m Freestyle WR

<table>
<thead>
<tr>
<th>Distance</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td>24.81</td>
<td>51.45</td>
<td>1:18.26</td>
<td>1:44.06</td>
</tr>
<tr>
<td><strong>Split</strong></td>
<td>26.64</td>
<td>26.81</td>
<td>25.80</td>
<td></td>
</tr>
<tr>
<td><strong>Velocity m/sec</strong></td>
<td>1.96</td>
<td>1.86</td>
<td>1.86</td>
<td>1.87</td>
</tr>
<tr>
<td><strong>Stroke Frequency cycles/min</strong></td>
<td>38</td>
<td>41</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td><strong>Stroke Length m/cycle</strong></td>
<td>3.14</td>
<td>2.79</td>
<td>2.85</td>
<td>2.56</td>
</tr>
</tbody>
</table>

- Time for 100m = 48.73
- PEI = 2.72 + 1.16 = 3.88 secs
- Final 5m = NA