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Which Stroke Next? All Strokes Next! Part Two: Strokes for Intermediate and Advanced Swimmers

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Cover Page Footnote

The videos of Figures 1 through 9 were produced and kindly provided by Mr. Ebbe Laakso Horneman of the Maihaugen Folk Museum in Lillehammer, Norway. He has also embedded the videos into the text. He was assisted by Bente Wainös-datter Horneman Laakso, Haakon-Paavo Laakso Nysted and Roar Bye Karlsen. Thank you Benjamin Lunn Karlsen for the excellent demonstrations. The videos of Figures 10a, 10b and 10c are borrowed from video clips produced by Mr. Lee Hammond. They are presented on You Tube on the “Swimproving” Channel. Mr. Hammond is the assistant coach of the Shiverers Swimming Club located in Brighton and Hove, Sussex, U.K. The video clips are presented here with his kind permission.

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Abstract

The primary goal of this two-part project is to answer the rhetorical question of which strokes should be taught first, and which later (Langendorfer, 2013, Stallman, 2014a). As you have seen in Part One, we emphasize (as have many others) the need for a firm foundation before *any* stroke is introduced. When the learner is ready for propulsive motor competencies, there is no stroke which suits all as their first. In Part One we explored the "beginning strokes" all of which are candidates for any given learner's first stroke. We also argued that after mastering their very first stroke the learner should learn the other, "first strokes." This also broadens the base for the learning of other strokes as the learner advances to intermediate and advanced levels. Here in Part Two, we explore additional strokes, chosen as essential because of some unique quality which makes them the best solution in some specific, potential risk situation. They should, therefore, be included in any comprehensive, proactive aquatic educational program.

*Key words***:** essential strokes, front crawl, back crawl, breaststroke, sidestroke, overarm sidestroke, water competence

It is difficult to describe (as is often done), the following strokes as either intermediate or advanced. We argue that they are of roughly equal importance and equal difficulty and that all should be learned. The designation of intermediate or advanced more correctly describes the level of economy of effort and technical efficiency achieved for each stroke and the level of affective and cognitive competence.

The following strokes are in several ways unique enough to satisfy some special need. They thus qualify for selection as essential in the forming of a competence profile offering maximal protection (several skills other than strokes are also considered essential and all are integrated with the affective and cognitive competencies).

We must also remember, however, that all of these strokes must comply with the same laws of physics. Thus, their execution also has much in common. The following strokes are introduced in no specific order. The "All Stroke Iowa Method" (Armbruster et al., 1968), describes how there is considerable benefit from approaching several strokes at approximately the same time thus opening the door for possible transfer of learning and for balanced progress (Stallman, 2014b).

They also confirmed the importance of achieving a broad skill base including a wide variety of strokes. Remember that every learner is different, and individualized teaching is the way to efficient learning. Here we are not suggesting one-on-one teaching but fitting the task to each individual, *especially* when teaching a group (Roberton, 1993). Various pathways will always be necessary to meet individual needs. We are often asked, "What would

you do in *this* situation?" The answer is usually – "I don't know! The question is hypothetical. I need to see, feel, hear this particular learner to have an idea about what *this particular learner* needs". It is only by observing, knowing and interacting with each learner that one can make specific suggestions. We have seen many variations and combinations. There is no specific order which suits all or even most learners. Finally, as we proceed through these strokes, our learner progresses from being a beginner, to being an intermediate and later an advanced swimmer, *irrespective* of the order in which these strokes are assimilated. ***PLEASE! Let the learner show the way!***

Strokes for the Intermediate and Advanced Swimmer

The Elementary Backstroke

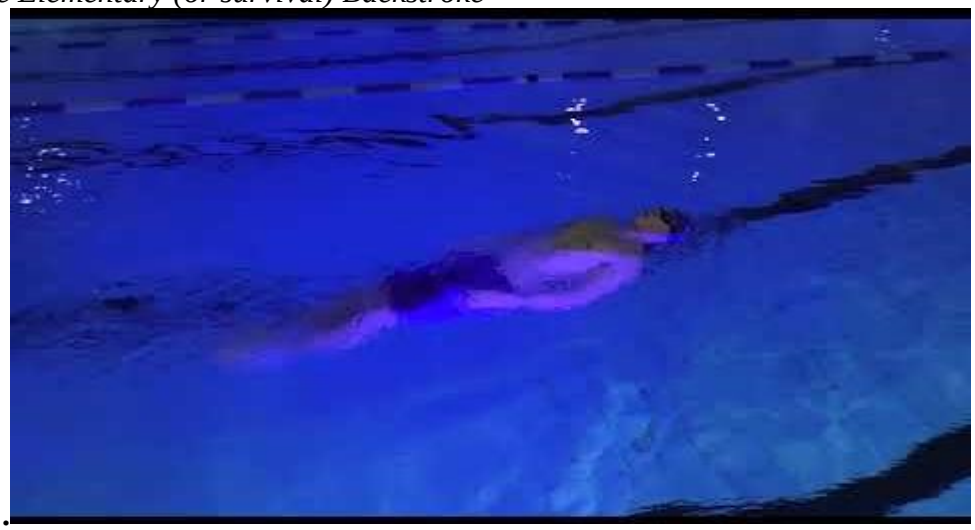
The elementary backstroke or a close approximation has been known for quite some time. The American Red Cross (ARC, 1938) suggests that Nicholas Winman, in *Colymbetes*, described this stroke in 1538.

Later aquatic educators have favored the elementary back stroke as a "resting stroke" extolling the virtues of the long glide and the ease of learning, however, usually naming the disadvantage of difficulty in navigating (ARC, 1938, 1957, 1961; Brown, 1953; Armbruster et al, 1968; Thomas, 1989a; 1989b).

Already possessing the arm stroke (see Part I), one way forward is to address the breaststroke kick, the leg stroke of the elementary backstroke. Experience and expert opinion show that this kick is more easily mastered when performed first on the back (Armbruster et al, 1968; McElroy, 1986; Thomas, 1989a**,** 1989b). Consider sitting on the side of the pool with your feet in the water or wholly in the water with back to the wall and hands on the edge. The main advantage of starting on the back is that the foot, ankle and knee position can be *visually* controlled by the learner until automation is achieved. The arm stroke will provide sufficient propulsion for the learner to progress by continuous swimming while perfecting the kick. Roughly, the arms and legs recover together and push together – gliding with the arms alongside the body (Canadian Red Cross Society, 1977, Arnold and Freeman, 1977, ARC, 1968, 2014, Boy Scouts of America, 1938, 1965). Optimally, the arms and legs should complete their propulsive phase simultaneously. This is augmented by starting the arm recovery slightly before the start of the leg recovery (Thomas, 1989).

Figure 1

The Elementary (or survival) Backstroke



Note: To view the following videos, hold ctrl and click on the picture. Then click on the start triangle. To return to the text, hold alt and click tab or click on the windows icon.

The unique aspects of the elementary (or survival) back stroke include maximal buoyancy with no body parts being lifted above the surface, ease of breathing, a long resting phase, a more easily maintained horizontal body position (relative to swimming on the front) and ease of learning (de Barbadillo and Murphy, 1972). Underwater recovery and the glide with arms along the body reduces its physiological economy (Choi, et al, 2000). As velocity decreased, elementary backstroke compared increasingly more favorably with crawl and breaststroke, both with and without clothes (Choi et al, 2000). Fujimoto, Inokuchi, & Ishida (2001) compared crawl and elementary backstroke. At the same level of perceived exertion for both strokes, the elementary backstroke recorded lower heart rate and lactate levels than the crawl although taking a longer time to swim 200m. This suggests that using the elementary backstroke may be a viable strategy for some in an unexpected emergency (ARC, 1937, 1938). At reduced velocity it offers a valuable resting/survival stroke. A potentially negative aspect is the possible difficulty of navigating in a straight line ('the shortest distance' toward safety). This might potentially be compensated for by regularly alternating swimming on the back and on the front if called upon to swim a long distance in an emergency situation (Moran, 2015). The use of the phrase, "survival back stroke" (US Navy, 1944, Kiefer et al, 1951, McElroy, 1986) is appropriate. No other stroke on the back provides these advantages and at the same time is so easily learned (Corsan, 1910; 1925; Torney, 1950; Armbruster, et al, 1968; Thomas, 1989b). Counting strokes over a fixed distance has been shown to be an effective method for introducing the concept of stroke length and also strengthens the idea and the feeling of the "resting stroke" (Armbruster et al, 1968; Craig & Pendergast, 1979; Stallman & Kjendlie, 2006). The elementary back stroke is the ultimate

resting stroke on the back. For the relatively inexperienced novice, this opportunity to rest has been observed to accelerate the acquisition of confidence (Dalton, 1931; Brown, 1953; Armbruster et al, 1968).

The Back Crawl Stroke

By now the learner is already very comfortable on both front and back. Either crawl or back crawl might be an appropriate next option, or they might be taught simultaneously. They are in many ways the same. In jest, we used to call our backstroking friends, "upside down swimmers". The kick is virtually identical. It is also an easy step from elementary back-to-back crawl once *real* comfort is achieved in the back lying position. In learning the back crawl emphasis should be on a long recovery arm in a vertical plane (Thomas, 1989). Details of the underwater pull – push can come later (de Barbadillo and Murphy, 1972). It is sufficient to focus on catching and gripping the water, pulling the body forward. Watch for and encourage increasing stroke length (Armbruster et al, 1968). Counting strokes over a fixed distance gives immediate feedback on progress (Craig and Pendergast, 1979, Stallman and Kjendlie, 2006). Rolling is gradually introduced, aspiring to clear the entire shoulder on recovery (show your arm pit – Counsilman, 1977, Maglischo, 2003). A useful breathing pattern at this level is usually to inhale on one arm, exhale on the other. Other patterns, if needed, can come later (e.g., in on one arm, out on two arms) (i.e., inhaling on every third arm stroke).

Figure 2

The Back Crawl

If we compare various strokes on the back, all at the same velocity, back crawl is the most efficient (Craig & Pendergast, 1979; Barbosa et al, 2006. Gonjo, et al., 2018) describe the factors which make front crawl faster than back crawl.

Chollet, Seifert and Carter (2008) describe the arm coordination of the back crawl among elite swimmers and its contribution to movement economy. Back crawl (or any stroke on the back) is often given less attention in the educational setting, neglecting its inherent value (Stallman, 2014b). Should one ever be called upon to move quickly on the back, for example to avoid a dangerous hazard, this is the best option. Though front crawl is faster, remaining on the back also allows retaining an overview of a hazard while rapidly escaping. Vision is unrestricted except in the direction of travel (McElroy, 1986). **N.B.**: It is only the fastest when already in motion. From a standstill, and for a short distance, other options are superior (see Back Trudgen).

The Front Crawl Stroke

The front crawl is sometimes mistakenly referred to as the "freestyle," which is an event, *not* a stroke. The obsession with crawl (still present) might be explained by the pursuit of the fastest manner of swimming before strokes were classified for the purpose of competition (Sinclair & Henry, 1893; Thomas, 1904). It is an easy step from the Human Stroke (see Part One) to the Crawl, especially when rotary breathing begins to take shape (Torney, 1950; American Red Cross, 1961; Thomas, 1989a; Thomas, 1989b). First attempts are recommended with no breathing, at a slow pace, over a short distance (e.g., two to three stroke cycles) (Torney & Clayton, 1981). The kick is in place, and the most important part of the arm stroke (that which is under water), is also in place (see Part One). On early attempts it is recommended to exaggerate the rolling action and to emphasize a high recovery, nearly in a vertical plane as rolling is increased (Torney & Clayton, 1981). As in back crawl, the details of the underwater stroke (high elbow position, etc.) can come later (Torney & Clayton, 1981). Focus on catching, gripping and maintaining the grip on the water throughout (i.e., pulling "the body forward" – as opposed to pulling the arm back). Progress is seen when the distance covered by each stroke increases (Stallman & Kjendlie, 2006). At some point it will be developmentally appropriate to focus on the repetitive "work – rest" pattern of the arms. Each arm works under water and rests (relatively) above water (Torney & Clayton, 1981; McElroy, 1986; Thomas, 1989a). Or, while one arm is recovering (resting), the other arm is pulling/pushing (working). Understanding this (at least intuitively) is a turning point in learning the crawl stroke (this applies also to the back crawl).

Figure 3
The Front Crawl

Again, over a century of experience tells us that the front crawl stroke is the fastest of all strokes (e.g., Holmer, 1974; Craig & Pendergast, 1979; Gonjo et al., 2018). This is perhaps its most unique feature. And again, it is fastest because it is also the most economical, (i.e., requiring less energy when compared to other strokes at any given velocity) (Craig & Pendergast, 1979; Barbosa et al., 2006; 2011; Counsilman, 1955). If needing to avoid a threatening hazard **when already in** motion, this is the fastest way on the front to escape that threat. It also allows a good overview forward when needing to navigate in a safe direction (usually but not always, the shortest). Once the stroke is comfortable, it is rather easy to add swimming with the head up, even more easily looking forward (water polo, aquatic art or lifesaver style). While swimming with the head up increases the angle of the body and thus increases drag, (Zamparo et al., 2010; DeJesus et al., 2012; Iglesias et al., 2018), it is a logical next step, broadens one's repertoire (increasing safety) and is not overly difficult. A struggle learning head up crawl simply indicates that the basic crawl stroke is as yet, not well enough developed (Zamparo et al., 2010; Iglesias et al., 2018). As a self-rescue technique, head up crawl allows an overview of a safe landing, for example in the surf (McElroy, 1986; Moran, 2015).

The Breaststroke

Once again, we find ourselves in the position of already possessing many of the needs of this stroke. At the beginning level, the learner explores the arm stroke. The kick has been achieved as part of the elementary backstroke. Combining these on the front should be manageable. Note that we are now in a far different position than if we had attempted to install the breaststroke as the very first attempt at propulsion for the beginner (a century and a half old tradition in much of Europe). A useful strategy is to think of a stroke cycle as both starting and ending in the gliding phase (Armbruster et al, 1968; Torney & Clayton, 1981;

Thomas, 1989a). The simplest way to think is that the arms come first, and the legs come after. Essentially, the arms are finished propelling and are about to recover when the kick begins. It remains useful to ask the swimmer to think – pull – kick – glide! The inhalation comes as the arms complete their in-sweep phase. Both observation of novice swimmers and observation of teaching at the hands of novice teachers shows that many overlook this most important part of the arm stroke. It is well documented that generally the in-sweep phase gives greater propulsion than the out-sweep phase (Schleihauf, in Counsilman, 1977; Maglischo, 1987; Van Tilborgh, 1987; 1988; Coleman et al, 1998). The upper body rises as a natural reaction to the arm stroke. This coordination actually makes it easier to breathe, as the whole upper body rises naturally as a result of the arm stroke (some of the force being unavoidably directed downwards).

Figure 4

The Breaststroke

The breaststroke may be the best of the resting/gliding strokes on the front, although perhaps at the highest levels of efficiency, all strokes may become resting strokes. Swimming the English Channel using the butterfly is an excellent example (Keith, 2019). One can easily swim breaststroke with the head up (not because one must but because one chooses to if needed). Head up breaststroke swimming is clearly less efficient (Stallman, et al., 2010) but easily mastered when desired, offering a valuable addition to one's repertoire of skills, again reducing the risk in an emergency situation. As in head up crawl, it is a logical step in the swimmer's development. It is also easy to maintain a view forward as the breath is usually (but not necessarily) taken looking forward. One or more variations of breaststroke also offer excellent solutions for underwater swimming. The breaststroke in general produces greater force than the other competitive strokes (Magel, 1970; VanTilborgh et al, 1987; Van Tilborgh et al, 1988; Colman et al, 1998) and roughly the same as the side

stroke – thus of great use in rescue towing, water polo, aquatic art (Abraldes et al., 2014). The kick continues to offer excellent strategies for both self-rescue and the rescue of others (Abraldes et al., 2014).

The Sidestroke

Some believe sidestroke to be the forerunner of the crawl, perhaps via the Overarm Sidestroke and then the Trudgen Stroke (i.e., crawl arms with scissors or breaststroke kick (Armbruster et al, 1968). Also thought of as a resting stroke, when mastered the side stroke offers a long gliding phase where rest can be obtained (Thomas, 1989a). It is a versatile stroke, offering the best of both swimming on the front and swimming on the back (American Red Cross, 1938; Armbruster et al, 1968; McElroy, 1986). Care should be taken to lie perfectly on the side (Thomas, 1989b). Many lie slightly more on the back or more on the front. This reduces the effectiveness of the kick (one foot/leg tends to break the surface). The emphasis here is also on coordination. Not overly complex, our intermediate learner will quickly master it (Armbruster et al, 1968; McElroy, 1986; Thomas, 1989b). We think of it again as pull – kick – glide. The learner can think of pulling with the forward arm then pushing with the upper arm and kicking with the legs at the same time. The hands meet at a position in front of the chest/throat. The scissors kick and sidestroke have great application in a rescue context because of its side lying position allowing an overview of both the victim and the nearest safe haven (American Red Cross, 1937; Stallman et al., 2014d). In a recent review of YouTube, several different styles of the so called “combat stroke” were examined. Virtually all of them are only slight variations of either the standard sidestroke or the overarm sidestroke.

Figure 5

The Side Stroke

We believe, as do many, that the sidestroke offers the best of both swimming on the front and swimming on the back. It is both easy to breathe (mouth and nose always above the surface) and easy to see forward or backward; a small movement of the head offers a glance forward or backward at any time (McElroy, 1986). The scissors kick is one of the most useful of all kicks and as described above, the best when used in a side lying position, for rescue towing (American Red Cross, 1937; 1938; Armbruster et al., 1968; Thomas, 1989a; Stallman et al, 2014). It is an extremely powerful kick, roughly equal in energy/propulsion production to the breaststroke kick (Abraldes et al., 2014). As a self - rescue technique, the sidestroke excels. As a towing strategy, it allows contact with a victim with one arm, (with a towing aid in between rescuer and victim) while swimming with the other arm and legs (American Red Cross, 1938; 1961; Armbruster et al, 1968; Torney & Clayton, 1981; McElroy, 1986; Thomas, 1989a; 1989b). It allows an overview of the victim (who may at any moment attack, sink, lose grip on the towing aid, etc.), it permits an overview of the direction of swimming to safety, and it enables continuous progress with ease of breathing. When possible to use, no other towing strategy can match the use of the sidestroke (Juntunen et al., 2006; Stallman et al., 2014).

The Overarm Sidestroke

The overarm side stroke has all of the advantages of the sidestroke and in every way is very similar. The coordination is virtually the same though the upper arm takes slightly less time to recover. Again, the hands meet roughly in front of the chest/throat (Armbruster et al, 1968; Torney & Clayton, 1981; Thomas, 1989a; 1989b). Both the normal side stroke and the over arm side stroke resemble (especially under water) the crawl stroke (as should all strokes). The forward arm pulls (should do) much in the same way as the pull phase of the crawl arm stroke. The upper arm takes over and executes the push phase of the crawl arm stroke. The form of this stroke is integral in rapidly changing direction and/or rolling over while moving forward with any other stroke, as in aquatic art, lifesaving and water polo (Gundling, 1957; Barr, 1964; Hines, 1967; Nitzkowski, 1998).

Figure 6
The Overarm Sidestroke

The overarm sidestroke has reduced resistance as the upper arm is recovered above the surface (Norelius, 1934). It is faster and more efficient than the sidestroke, as a self-rescue stroke (American Red Cross, 1938). Being faster (i.e., an improvement on the standard sidestroke regarding speed), it was once called the English Racing Stroke (e.g., Thomas, 1904) and sometimes described with a double kick (i.e., two scissors kicks per stroke cycle). It is often not applicable in rescue towing as the upper arm is usually engaged in the connection to the towing aid. An exception might be when using a torpedo buoy with both arms free to swim (McElroy, 1986). When conditions allow, a side lying position is superior to all others for rescue towing (Stallman et al, 2014). Both constant visual observation of the victim and the haven of safety are possible. When on the side, the scissors kick is to be preferred. Some weaker lifesavers fall into the trap of using a breaststroke kick when attempting a side lying rescue position. This reduces the effect of the kick, alters the side lying position and increases drag through an increased body angle (Jutunen et al., 2006). This stroke and its variations are considered foundational skills in aquatic art, lifesaving and water polo and are indispensable.

The Trudgen and the Double Trudgen Stroke

This stroke is most simply described as a combination of the crawl arm stroke and either the scissors or breaststroke kick. The very first double over arm strokes were certainly unlike the modern crawl arm stroke (Bachrach, 1924). The simple description, however, remains useful. The coordination is usually described as one kick per arm stroke cycle. Thus, the kick normally always comes with the same arm (or in the Double Trudgen, one kick with each arm) (American Red Cross, 1937). If the arm stroke is more or less continuous, the kick will naturally become foreshortened. The kick selected

(scissors/breaststroke) is often a matter of preference or of need (in some specific situation). The competent swimmer can perform both.

Figure 7
The Trudgen Stroke

This stroke provides, as does no other, the ability to most rapidly accelerate from a standstill to a rapid forward stroke on the surface. Unquestionably the fastest acceleration is produced by the few quick breaststroke or scissors kicks, coupled with a few rapid crawl arm strokes (Barr, 1964; Hines, 1967; Nitzkowski, 1998). Dopsaj and Matkovic (1999) found that water polo players are in a vertical position from 55 to 67% of match time. They must then accelerate as quickly as possible to their next position (Stirn et al., 2014). The initial kick(s) give a kind of imaginary platform from which the swimmer can virtually push off. It is here that this combination is far superior to the crawl with flutter kick (Abraldes, et al, 2014; Cureton, 1930). Observation of water polo players, aquatic artists and lifesavers is ample evidence. The constant ebb and flow of a water polo match or the complex choreography of an aquatic art routine demands that this stop-and-start/ change of direction and body position be done many times (Gundling, 1963). This stroke also has an obvious self-rescue value, as in having to avoid an oncoming boat. Any change in direction is also enhanced by those initial kicks and creating that imaginary platform to push off from. Little wonder that aquatic artists and water polo players make excellent lifesavers and lifeguards (Stallman, 2008).

The Back Trudgen, Back Double Trudgen – (Water Polo Backstroke)
The back trudgen can be simply described as a combination of the backcrawl arm stroke and the breaststroke or scissors kick (one kick for each arm cycle). The "double back trudgen" (as on the front), employs a kick with each arm. In

a survival context, it is easy to imagine having to accelerate when at a standstill though also on the back *(Barr, 1964, Hines, 1967, Nitzkowitz,1998, Stirn et al. 2014).* An emergency scenario might demand remaining on the back (constant view of the hazard) or first rolling to the front (perhaps more rapid escape). In water polo it is sometimes referred to as water polo backstroke. □

Figure 8
The Back Trudgen or Water Polo Backstroke

This stroke is undoubtedly the fastest way to accelerate when motionless at the outset and needing to quickly move a short distance on the back (Barr, 1964; Hines, 1967; Nitzkowitz,1998; Dopsaj & Matcovic; 1999; Stirn, et al., 2014). Both water polo and aquatic art are characterized by many stops and starts as well as constant rolling from front to back or vice versa (the above discussion of the Trudgen stroke on the front applies here as well).

N.B. The above strokes (Figs. 7 and 8) are often denigrated by calling them combination strokes and being relegated to seldom use. The very fact that these strokes are among the bread-and-butter skills of artistic swimmers, lifesavers and water polo players attests to their essential nature. Their neglect attests further to the naïve approach of so many inexperienced swimming teachers. While to the inexperienced, young, modern eye the Trudgen stroke looks like a combination, it was, in fact, the original. Rather, today's crawl kick and crawl arms may be the "combination." No matter! Both are important and should be learned – and taught.

Summary

The nature of a possible future drowning scenario is unpredictable. The *environmental* and *personal* conditions can be any of many possibilities, requiring any of many possible *tasks* as the solution, or part thereof (Langendorfer, 2015). These conditions present a challenge to the swimmer's

safety. A specific challenge usually demands a specific solution. If that vital solution (e.g., attitude, knowledge, skill) is missing, the challenge may not be met. A drowning scenario may ensue. This article is thus an appeal to retain the idea of an all-around development of aquatic competency (here focusing on the various essential strokes). Assimilating the strokes described in this article increases the total aquatic movement repertoire, which can be argued, increases security (i.e., reduces risk).

It is difficult to understand the tendency to focus on only one or on only a few strokes. When time is limited, some argue that they have only time to introduce one stroke. This is common in school swimming settings where time, space and quality instruction are often lacking. Even the competitive swimmer may fail to develop more than one or two strokes. We could even ask whether the individual medley swimmer with only four (my father had only three (i.e., pre-butterfly in 1952; my grandfather had only two in 1904), is really developed in an all-around fashion (i.e., possessing a broad enough repertoire to tackle an emergency).

In addition to the strokes considered above as unique in some protective way, there are still others which have aesthetic, utilitarian, or pedagogical value. The inverted breaststroke, butterfly, double overarm backstroke, the Old English Backstroke, and more, would increase the repertoire of skills, arguably indirectly increasing safety/reducing risk.

Given the unpredictable nature of a drowning scenario, a pre-emptive approach to drowning prevention demands preparing for a variety of possible scenarios. All-around development is a necessary and essential part of water competence (Brenner et al, 2006; Stallman et al, 2017). A broad repertoire of skills includes a variety of strokes (all of which build upon the many foundational skills, and which work in consort with other essential skills). In this article we have argued for the inclusion of a variety of strokes and supported each suggested essential stroke with a description of how that stroke is unique in some specific situation(s). If a given stroke is the best solution in one or more specific situations, it should be included in any comprehensive and pre-emptive aquatic educational program.

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Video links:

Figure 1 The Elementary Backstroke **https://youtu.be/TKsEZjOeu7c**
Figure 2 The Back Crawl **https://youtu.be/ozB7K83WbWYo**
Figure 3 The Front Crawl **https://youtu.be/8qaMLzefmSw**
Figure 4 The Breaststroke **https://youtu.be/6TuQZVjvwUw**
Figure 5 The Side Stroke **https://youtu.be/9cGl7QpPGAY**
Figure 6 The Overarm Sidestroke **https://youtu.be/GdM05eCkv0Y**
Figure 7 The Trudgen Stroke **https://youtu.be/K_2oed5sYCE**
Figure 8 The Back Trudgen **https://youtu.be/5Uo117QMlW8**