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# Teaching Competitive Racing Starts: Practices and Opinions of Professional Swim Coaches

**Andrew C. Cornett, Josh C. White,  
Brian V. Wright, and Joel M. Stager**

The purpose of this study was to gain a better understanding of coaches' perceptions regarding the most important elements of the competitive swim start and the progressions coaches use to teach the skill to novice swimmers. A survey was developed specifically for this project and administered via an e-mail link sent to all registered USA Swimming coaches. The final survey elicited 471 responses. When coaches were asked if a progression was used when teaching starts, 4.6% reported using a written checklist, 89.8% a mental one, and 5.5% none at all. Of those who used a progression to teach racing starts, 78.3% used a personally designed progression while the remaining 21.7% used information provided by a professional organization. The information obtained from the survey suggests that teaching the racing start is an informal process. The lack of an authoritative resource used in teaching racing starts to novice swimmers warrants further investigation with regard to the safety of this complex skill.

The potential for injury exists during the execution of the competitive swim start. One study spanning a 25-year period (1982-2007) reported 13 catastrophic injuries resulting in "permanent severe functional brain or spinal cord disability" specifically within high school and collegiate swimming with all but one incident occurring during the execution of a racing start (Mueller & Cantu, 2007). The number of catastrophic injuries over this time period for all of age group swimming is difficult to estimate as not all competitive swimmers and programs are registered with USA Swimming or any other recognized organizing body.

With a goal to eliminate all preventable injuries, there is an obvious need to understand the essential components as well as dangerous elements inherent in the execution of racing starts as a means of minimizing the risks and subsequently reducing or eliminating the number of catastrophic injuries. Prevention may begin with the teaching practices and the expertise of the coaches and professionals working with novice competitive swimmers on this complex skill. Currently, there is a general lack of literature on the knowledge and teaching practices of professional

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Andrew Cornett is an assistant professor at Eastern Michigan University, School of Health Promotion and Human Performance, Ypsilanti, MI. Josh White is the men's swimming assistant coach at the University of Michigan, Ann Arbor, MI. Brian Wright is the men's and women's head swimming coach at Austin College, Sherman, TX. Joel Stager is the director of the Councilman Center for the Science of Swimming at Indiana University, Bloomington, IN, which is where the research was conducted.

coaches. To date, research on racing start safety has focused primarily on factors affecting the outcomes of competitive racing starts (i.e., head depths and head speeds) in an effort to establish empirically-based racing start regulations.

The literature on racing start safety has examined the effect of water depth (Blitvich, McElroy, Blanksby, Clothier, & Pearson, 2000; Cornett, White, Wright, Willmott, & Stager, 2011a, 2011b), block height (Cornett, White, Wright, Willmott, & Stager, 2011c; Gehlsen & Wingfield, 1998; Welch & Owens, 1986), and start type (Counsilman, Nomura, Endo, & Counsilman, 1988; Gehlsen & Wingfield, 1998; Welch & Owens, 1986) on head depth and speed during the execution of a racing start. Additional work has focused on the ability of competitive swimmers of different ages and ability levels to control the depth of their starts (Blitvich et al., 2000; Cornett, White, Wright, Willmott, & Stager, 2012; White, Cornett, Wright, Willmott, & Stager, 2011). Broad conclusions from this research are that (a) maximum head depth and head speed at maximum head depth vary as a function of swimmer age, water depth, block height, and start type and (b) swimmers regardless of age and competitive experience are able to modify start depth in response to water depth and other factors.

While these works have contributed to an expanding body of knowledge, they have primarily focused on a better understanding of racing start safety through an examination of factors affecting start outcomes. These studies have neither characterized the most important motor skill components of contemporary racing starts nor the methods used by professionals in teaching them. Likewise, the literature has not addressed the common errors in starting technique that experts consider to be dangerous.

As a result, the purpose of the present study is to address this gap in the racing start literature by surveying professional swim coaches on (a) their perceptions concerning the most important features of the racing start, (b) their perceptions on the most dangerous errors in technique associated with competitive racing starts, and (c) the methods coaches most commonly employ to teach the skill. In doing so, it is hoped that providing this information to professional certification agencies and coaches' safety training agencies (e.g. American Red Cross and USA Swimming) will improve coaching education and teaching practices thereby reducing the number of catastrophic injuries resulting from their execution.

## Method

A survey was constructed specifically for this project. The process entailed constructing an open-ended survey, which was first given to ten local coaches for interpretation. The open-ended survey was modified based on the input from the local coaches. Then the open-ended survey was sent to 500 coaches, and 52 completed surveys were returned within 4 weeks. The questions on this survey required written responses to a variety of questions related to teaching competitive swim starts. No information was supplied or implied by the survey at this stage; questions were left "open" for the coaches' interpretations. The responses were used to refine the clarity of the questions and insure that the intended interpretations were effectively conveyed. The responses were reviewed and condensed into those frequently repeated and most commonly given. The responses were categorized and then a shorter, closed form of the survey was created which could be filled out on the internet. Local coaches were

again asked to complete the survey and minor modifications were made as a result of their responses. The final version of the survey was then approved by the university's human subjects committee and a request to participate in the study emailed nationwide by USA Swimming to all of its registered swim coaches with a link to the website.

The final survey consisted of three parts: (a) Participant Characteristics, (b) Teaching of Starts, and (c) Essential Elements of Starts. The first part of the survey was designed to assess the background and experience of each coach. The questions in this part of the survey asked for (a) years of coaching experience, (b) age of swimmers coached, and (c) type of teams coached.

The questions on the second part of the survey were concerned specifically with the teaching of competitive racing starts. For instance, the first question asked, "Defining a *dive* as 'a hand first entry into water,' do you consider the ability to do a dive a requirement for a swimmer before you will begin to teach them a *competitive start*?" Next, the survey questioned the coaches about teaching progressions (i.e., ordered sets of steps, from simplest to the most complex, for learning a skill; American Red Cross, 2004): "With an athlete who can execute a dive, do you have a written or mental progression that you follow when teaching the athlete to do a *competitive start*?" If the coach used a written or mental teaching progression, they were asked to indicate how the teaching progression was designed: "personally designed" or designed using information from another source such as the club for which the coach worked, American Red Cross (ARC), USA Swimming, the YMCA, or the American Swim Coaches Association (ASCA). Then, the coach was provided a list of "certain steps that coaches have indicated they use when teaching a start to an individual who already knows how to complete a dive" and instructed to "select YES next to any steps that you use when teaching a start and place a number next to each of these indicating the order in which you teach them." Subsequently, the coach was asked to specify the age "you typically begin having your swimmers start from the blocks," the oldest age of a "swimmer that you have ever taught to use the blocks for the first time," and the age range that "is most challenging to teach a safe and effective start." Next, the coach was asked what factor made "this group difficult to teach." The final question of the second part of the survey asked what the coach would do "if your swimmers are reluctant to use the blocks."

The third part of the survey consisted of two questions. The first question provided a list of elements (derived from the open-ended survey) of the competitive swim start in the typical order in which they occur. The coach was instructed to "rank the following elements of a competitive start based upon importance to the proper completion of a start on a scale of 1-5" (with 1 being *unimportant* and 5 being *essential*). The second question provided a list of "errors in starting technique" (again, derived from the open-ended survey) and directed the coach to "rate them on a scale of 1-5" (with 1 meaning *that you do not consider the behavior to be dangerous* and 5 indicating that the *behavior is so dangerous that you would prohibit the swimmer from using the blocks until further skills had been learned*).

## Results

The closed-form internet survey resulted in responses from 471 coaches, but not all respondents completed each question. We were not able to determine how many coaches were contacted (or especially how many coaches actually received and/

or read the e-mail from USA Swimming) due to the manner in which the survey was disseminated through USA Swimming. We decided after much deliberation not to estimate a return rate which would have virtually no validity or reliability. Due to the relatively large number of responses from coaches with such diverse backgrounds and experiences, we felt this convenience sample served the study purposes adequately. The years of coaching experience of the surveyed coaches are displayed in Table 1. In addition, the age of the swimmers and types of teams coached by the surveyed coaches are shown in Tables 2 and 3.

**Table 1 Years of Coaching Experience of Surveyed Coaches**

Coaching Experience (yrs)	Percent (%)
0-5	21.3
6-10	20.7
11-15	20.2
16-20	11.5
21-25	8.7
Over 25	17.6

**Table 2 Percentage of Coaches Who Have Previously Coached Swimmers of the Specified Ages**

Age (years)	Percent of Coaches (%)
6 & Under	74.5
7-10	92.8
11-14	94.3
15-18	88.5
19-22	27.0
Over 22	51.2

**Table 3 Percentage of Coaches Who Have Previously Coached Teams of the Specified Type**

Type of Team	Percent of Coaches (%)
Club	93.2
Jr. High School	19.1
High School	61.6
College	27.0
Masters	43.1

For the second part of the survey concerning the teaching of starts, when asked if they consider the ability to do a dive a requirement for a swimmer before teaching them a competitive start, 74.4% of coaches responded “yes” while the remaining 25.6% responded “no.” When asked if they have a written or mental progression that they follow when teaching the athlete to do a start, 89.8% of the coaches used a mental progression, 4.6% used a written progression, and 5.5% did not use a progression. Of the coaches who used a progression to teach starts, the majority (78.3%) said that the progression they use was “personally designed.” The remaining coaches who use a teaching progression indicated that their teaching progression was derived from another source, such as the American Red Cross (6.1%), USA Swimming (1.9%), the YMCA (1.6%), the club for which they worked (1.6%), ASCA (1.3%), “another source” not listed in the survey (6.1%), or “other” (2.9%). Table 4 displays the results from when the coaches were provided “certain steps that coaches have indicated they use when teaching a start to an individual who already knows how to complete a dive” and instructed to “select YES next to any

**Table 4 Percentage of Coaches Using Certain Steps to Teach the Racing Start and the Average Order in Which the Step Is Taught**

Skill	Average Order	Percent Using
Start from the side in deep water	2.4	84.8
Jump into streamline on deck	3.4	27.0
Use of a live or video demonstration	3.8	62.7
Completing a shallow start from the side	4.3	82.5
Jump from the block	4.5	91.8
Practice streamlining after a dive	4.7	79.4
Completing a shallow standing dive	4.8	18.0
Start from the side in shallow water	5.6	46.5
Standing dive in shallow water	5.6	88.0
Standing dive off of a block in deep water	6.0	23.7
Practice streamlining after a start	6.0	53.7
Start from a short block	6.9	24.0
Emphasizing height by instructing the swimmer to go over an obstacle (noodle, hula hoop, etc.) on a start	8.2	73.1
Emphasizing distance by instructing the swimmer to go out and over or past an obstacle (noodle, hula hoop, etc.) on a start	8.6	63.9
Standing dive off of a block in shallow water	9.6	72.7
Work on a pike entry	9.9	52.6

steps that you use when teaching a start, and place a number next to each of these indicating the order in which you teach them.”

The most frequent responses when coaches were asked at what age they typically begin having swimmers start from the blocks were 6 years and under (30.5%), 7-8 years (38.7%), and “age is not a factor, I base my decision solely on skill” (16.1%). Additional responses included 9-10 years (4.7%), 11-12 years (0.3%), 13-14 years (0.3%), and “age is not a factor, I base my decision solely on confidence” (9.4%). Table 5 shows the results for the next two survey questions: “What age is the oldest swimmer that you have ever taught to use the blocks for the first time?” and “What age range is the most challenging to teach a safe and effective start?” When asked why a group was challenging to teach a start, the most frequent responses were “fear” (47.6%), “poor coordination” (20.5%), and “size – large stature” (8.0%). Additional responses included “feel pressure to use the block when they do not want to” (7.4%), “lack of attention” (6.3%), “poor understanding of directions” (5.4%), “weak – insufficient strength” (2.7%), and “lack of fear” (2.1%). The coaches provided four different answers when asked what is done “if your swimmers are reluctant to use the blocks”: “allow them to use the side of the pool until they choose to” use the starting blocks (64.9%), “encourage them to use the blocks” (31.3%), “my swimmers are never reluctant to use the blocks” (3.5%), and “force them to use the blocks” (0.3%).

In the third part of the survey, the coaches rated the importance of various elements of the start and the level of danger of common “errors in technique.” Table 6 displays the ranking, from most to least important, of 20 elements of the competitive start previously identified by swim coaches as “essential.” Table 7 shows the ranking, from most to least dangerous, of 20 common “errors in technique.”

**Table 5 Percentage of Responses for the Oldest Swimmer Coaches Taught to Execute a Start for the First Time and the Most Challenging Age to Teach Safe and Effective Starts**

Age (yrs)	Oldest Swimmer Taught to Execute Start for First Time (%)	Most Challenging Age to Teach a Racing Start (%)
6 & Under	0.6	32.0
7-8	1.3	19.5
9-10	4.8	10.4
11-12	13.5	9.5
13-14	28.1	9.8
15-16	23.9	5.5
17-18	9.0	2.1
Over 18	18.7	11.3

**Table 6 Ranking From Most to Least Important of 20 Elements Identified by Swimming Coaches as Essential to the Competitive Swim Start**

<b>Rank</b>	<b>Elements of a Competitive Swim Start</b>
1	Legs and feet push strongly off the blocks
2	Glide and streamline
3	Head between arms at entry
4	Breakout
5	Toes over the edge of the block
6	Begin kicking
7	Feet placed in proper position
8	Entry through a single hole
9	Balance on the block
10	Proper angle at entry
11	Weight placed on feet properly
12	Arms and hand move forward
13	Head tucked between arms
14	Quick reaction to starting horn
15	Proper head position while on the block
16	Change angle underwater
17	Streamline position in air
18	Listen to starters instructions
19	Hands gripping the edge of the block
20	Knee and feet at shoulder width

**Table 7 Ranking From Most to Least Dangerous of 20 Common “Errors in Technique” for Competitive Swim Starts as Identified by Swimming Coaches**

Rank	Errors in Technique
1	Loss of balance on block
2	Going too deep
3	Attempting to “save” a false start
4	Too steep of an angle of entry
5	Diving downwards off the blocks
6	Swimmer is not comfortable doing a start
7	Poor concentration
8	Arms pushed backwards behind head at entry
9	Toes not over the edge of the block
10	Moving upwards not outwards off the blocks
11	Head too low at entry
12	No change in direction after entry
13	Belly flop
14	Using a pike entry
15	Not pushing downwards during the flight
16	Head too high at entry
17	Not pushing off the blocks strongly enough
18	Head above arms during flight
19	Not looking forwards during flight
20	Poor streamline

## Discussion

The main objective of this study was to identify the features of the competitive swim start perceived by coaches to be important and dangerous and the methods they used to teach starts. The USA Swimming (USAS) registered swim coaches responding to the survey represented all levels of coaching experience (Table 1), despite the fact that no attempt was made to insure a broad, representative sample or equivalent distribution in regard to coaching experience. Within the respondent sample, two categories were somewhat disproportionate; there appear to be fewer coaches with 16-20 and 21-25 years of coaching experience in the sample. It is not clear if the distribution of years of coaching experience in the sample is representative of the population of all USAS registered coaches or if coaches with 16-25 years of experience were less inclined to participate in the study. Values for this variable for all certified coaches in USAS are not available and thus it was not possible to test whether or not the sample differed from the USAS coaching



population in regards to years of coaching experience. In the end, the convenience sample was seen as appropriate for the purpose of the present study in that the “experience” groups were relatively well-balanced with the opinions and practices of each group represented.

## Teaching Progressions for Head-First Entry

The most important findings of this study relate to the progressions used by professional swim coaches to teach the competitive racing start. The American Red Cross (ARC) defines a teaching progression as “an ordered set of steps, from the simplest to most complex, for learning a skill” (American Red Cross, 2004, p. 126) and has attempted to formalize the teaching of dives by developing a “Head-First Entry Progression.” The progression consists of entering the water using five different entry styles: (a) the “sitting position,” (b) the “kneeling position,” (c) the “compact position,” (d) the “stride position,” and (e) the “shallow head-first entry.” In completing the Head-First Entry Progression, the swimmer gradually builds from a head-first entry while *sitting* on the side of the pool toward the final stage, a “shallow head-first entry” while *standing* on the side of the pool. Because of the potentially catastrophic effects of an improperly performed racing start, it was expected that nearly all coaches would utilize a formal progression (such as the ARC Head-First Entry Progression) in teaching novice swimmers to execute the racing start.

Thus, we considered the findings surprising that 5% of coaches reported no use of a progression and nearly 80% of coaches using a progression used one that was “personally designed.” Although we expected that coaches who use a teaching progression would reference the ARC as the source from which their progression was developed, the results indicated that only 1 in 20 coaches actually did so. We do not have any specific explanation for this discrepancy between our results and our original hypotheses.

Perhaps the difference relates to a distinction made by the surveyed coaches between executing a *dive* and a *racing start*. One could easily argue that the ARC Head-First Entry Progression is a progression used for teaching swimmers to execute a *dive*, not a *racing start*. Since three-fourths of coaches reported that they consider the ability to dive as a prerequisite for teaching a swimmer to execute a racing start, the Head-First Entry Progression would likely be considered by coaches as separate from a racing start progression. Neither the ARC nor USAS provide a series of steps for progressing a swimmer from executing a dive to a competitive racing start. Further, the ARC does not provide justification, a source, or verification of effectiveness for the progression that is described. This might then explain why the majority of coaches reported “personally designing” their progression: a progression developed by an otherwise “authoritative source” was not readily available. Regardless of the explanation, because of the potentially catastrophic consequences of an improperly executed racing start, it seems that the teaching of this complex skill needs to become a formalized process.

## Steps Used to Teach the Racing Start

There appears to be an absence of a progression between the final step in the ARC Head-First Entry Progression (i.e., the shallow-angle dive) and the competitive

racing start. Because the coaches were asked to identify the steps used “when teaching a start to an individual who already knows how to complete a dive” and the order in which the skills are taught, their collective responses might provide the general framework for an actual racing start progression.

It may be that the optimal progression for teaching competitive starts begins with the first movements swimmers make when standing on the starting blocks. Maglischo (2003) described the “preparatory” phase as being from when the swimmer is standing on the starting block to when the swimmer is bent at the waist with hands grabbing the front of the starting block. The swimmer holds the preparatory position until the starting command signals the beginning of the race. Survey responses indicate that two of the first steps used by over 80% of coaches to teach the racing start to swimmers (who were already able to execute a dive) were “start from the side in deep water” and “complete a shallow start from the side.” These two initial steps combine Maglischo’s preparatory position with a dive from the side of the pool (i.e., the final skill from the ARC Head-First Entry Progression). In doing so, the coaches gradually progress the swimmer from a shallow-angled dive while standing to a shallow racing start from the side of the pool. Once these steps are mastered, the coaches presented the requisite skills swimmers need to execute a safe racing start. The final challenge was to get swimmers comfortable with performing the movements from an elevated platform (i.e., the starting block).

When asked in the open-ended survey to identify important elements to the “proper completion” of a racing start, the coaches’ 20 most frequently repeated responses included eight that occur during the preparatory phase of the racing start: “toes over the edge of the block,” “feet placed in proper position,” “balance on the block,” “weight placed on feet properly,” “proper head position while on the block,” “listen to starters instructions,” “hands gripping the edge of the block,” and “knees and feet at shoulder width.” Thus, although the preparatory position may seem like an incidental phase of the racing start, the coaches’ perception is that this phase is important. Coaches perceived that proper hand, head, and feet placement require emphasis. In addition, because “loss of balance on the block” was considered by coaches to be the most dangerous common “error in technique,” instructional attention to the maintenance of balance and weight distribution is emphasized.

The final recommended step in the racing start progression was to execute these fundamental skills from a starting platform elevated above the water. Once the swimmer is able to execute a racing start from the side of the pool, the general trend was for coaches to introduce the starting block to the swimmer. It appears that the vast majority of coaches (over 90%) do so by having the swimmers perform a “jump from the block” with a feet-first entry into the water. This is presumably to help swimmers get comfortable standing on and jumping off a starting block that is 0.76 m (30 in) above the surface of the water. Almost one-fourth of coaches follow a “jump off the block” with a “standing dive off a block in deep water.” In doing so, coaches are requiring swimmers to make the transition from a feet-first entry off the starting block to a head-first entry off the starting block. The only difference between a standing dive off a starting block and a racing start is the incorporation of the “preparatory position” into the sequence of the complex movement that the racing start represents.

Sequentially, the last skills coaches reported utilizing while teaching the racing start were “work on a pike entry,” “emphasizing height by instructing the swimmer

to go over an obstacle on a start,” and “emphasizing distance by instructing the swimmer to go out and over or past an obstacle on a start.” While these are identified by coaches as skills needed to perform the racing start, they are perceived to be advanced skills used more to refine or improve starting technique than to teach the skill. The “pike entry” is an entry technique during which the swimmer attempts to minimize resistance by entering the water at a steeper angle than more traditional entry techniques. Because the athletes are entering at a steeper angle, they must “scoop” upwards immediately as a precaution against contact with the bottom of the pool when performed in relatively shallow water. The goal of the technique is to counteract the forces exerted by the water on the athlete that cause the legs to “slap” the water during a “flat” entry. Perhaps more than half of coaches reported teaching this skill because “entry through a single hole” and “proper angle at entry” were rated as two of the ten most important elements of the racing start. Despite its widespread use, coaches acknowledged safety concerns pertaining to the pike entry when they rated “too steep an angle of entry” and “using a pike entry” as two dangerous “errors in technique.” Coaches’ safety concerns are substantiated by the scientific literature which demonstrated significantly deeper head depths for “pike” starts than other starting techniques such as the “flat” and “track” starts (Counsilman et al., 1988; Gehlsen & Wingfield, 1998; Welch & Owens, 1986).

Similar safety concerns exist when coaches emphasize height or distance by having swimmers clear obstacles during a racing start. This skill has the advantage of encouraging swimmers to “push strongly off the blocks” with the legs and feet, which is the element of the racing start considered to be the most important by coaches. The ARC considers these to be “advanced skills” and suggests that they “only be practiced by experienced swimmers in water at least 12-feet deep under the supervision of an experienced coach” (American Red Cross, 2008; p. 12). While start depth and speed have not been measured for athletes practicing these specific skills, logic suggests that the increased height would lead to a steeper entry angle and greater downward vertical velocity at impact than values for other entry techniques (e.g., the “flat” start). Since the majority of coaches report utilizing such skills when teaching starts, it would seem that this is an area in need of research attention.

Although the preceding skills represent a potential teaching progression from completing a head-first entry from the side of the pool to executing a racing start from the starting block, these were not the only skills coaches emphasized during the teaching process. For example, coaches reported practicing various skills presumably designed to establish proper streamlining technique throughout their personalized progressions for teaching the racing start (Table 4). Coaches had swimmers “jump into streamline on deck,” “practice streamlining after a dive,” and “practice streamlining after a start.” This appears to underscore the importance coaches place on streamlining in that the coaches rated the “glide and streamline” and “head between arms at entry” as two of the three most important elements of a competitive racing start.

It is not apparent why coaches place high importance upon the ability to streamline as that specific question was not asked. The ability to “hold a streamline,” however, is clearly important from the perspective of performance as well as the perspective of safety. Blanksby, Wearne, and Elliott (1996) suggest that the “vulnerability of the head when diving must be counteracted by children keeping

the thumbs clasped and the upper limbs extended overhead at all times” (p. 83). Further, Blitvich, McElroy, Blanksby, and Douglas (1999) stated that “the level of risk in any dive entry can be reduced if the diver keeps the hands together and the arms extended beyond the head” (p. 558). While studying first-year university students with varied swimming and diving backgrounds, Blitvich et al. (1999) found that during one out of four dives, the swimmer “pulled both arms backward before or at maximum depth, thus leaving their head totally unprotected” (p. 558). While the authors concluded that this acts to increase the level of risk, the degree to which the head is protected by maintaining proper streamline technique has not been verified. It certainly seems logical that the hands and arms serve to decrease the impact force of the head should a collision with the bottom of the pool occur. No research literature could be found to support this hypothesis and thus the extent to which the arms provide protection to the head and neck should an impact occur is a subject to be pursued in future research.

## Rules and Regulations for Teaching Racing Starts

Survey results indicate that four of the five most dangerous “errors in technique” as perceived by the coaches pertain to those causing swimmers to go too deep during the start (Table 7). Specifically stated, professional coaches identified “going too deep” as the second most dangerous error in starting technique. This leads to a critical question, “What is an appropriate minimum water depth for the teaching of racing starts?” USAS rules state that “minimum water depth for teaching racing starts, prior to certification, in any setting from any height starting blocks or the deck shall be 6 feet (1.84 meters)” (USA Swimming, 2011, p. 44). One study has been located in the research literature that investigated the head depths and speeds of children learning to execute a dive. Blanksby and colleagues (1996) measured head depths and vertical head velocities of children in a learn-to-swim program when performing different developmental stages of diving. They found that at least one swimmer went deeper than 1.52 m in all but one of the developmental stages of diving (the sit dive), and in five of the developmental stages of diving, the swimmer was travelling at “vertical velocities which could dislocate or crush an adult cervical spine” at 1.52 m should an impact occur (Blanksby et al., 1996; p. 82). As a result, these authors concluded that the initial learning stages of the dive should take place “in water deeper than 1.5 m because more depth is required for safe transition from novice to skilled performer” (Blanksby et al., 1996, p. 84). Currently, it is difficult to adequately evaluate the USAS minimum standard of 1.84 m for learning starts as attempts to locate data in the literature that present vertical head velocities at this depth were unsuccessful. Nevertheless, the survey results indicate that professional coaches are acutely aware of the potential for injury due to deep dives into shallow water (Table 7).

Coaches also recognize the importance of the swimmers ability to control the depth of their starts. USAS requires each swimmer to demonstrate to the coach “the ability to safely enter the water” during each stage of the ARC Head-First Entry Progression before being allowed to execute racing starts in a water depth of less than 1.84 m. All swimmers *10 years and younger and/or with less than one year of competitive experience* must demonstrate this ability and “the ability to safely execute a *shallow* racing start from a starting block” in order to be “certified” (USA

Swimming, 2009; emphasis added by author). For swimmers *11 years and older or with more than one year of competitive experience* to be permitted to execute racing starts in a water depth of less than 1.84 m, the swimmer must be “capable of safely controlling the depth of his or her racing starts” (USA Swimming, 2009). Thus, regardless of age or years of competitive experience, a swimmer must demonstrate the ability to control start depth prior to being permitted to execute racing starts in less than 1.84 m. Within the skills used by coaches to teach the racing start (Table 4), the ability to modify and execute shallow dives regardless of water depth is recognized as important.

There have been two studies that have dealt specifically with purposeful modification of racing start depth (Cornett et al., 2012; White et al., 2011). In both of these studies, swimmers were instructed to execute two racing starts: (a) a “typical” racing start and (b) a racing start in which the swimmer was asked to execute a “shallow start.” White et al. found that when asked to execute a shallow start, novice high school ( $14.8 \pm 1.1$  yrs) and experienced collegiate aged swimmers ( $20.1 \pm 1.2$  yrs) completed significantly shallower starts. Using the same methods but studying a different sample, Cornett et al. found that competitive age group swimmers, ranging in age from 6-14 years, also executed shallower starts after being asked to execute a shallow start. Collectively, these studies indicated that swimmers of varying age and competitive experience are able to control the depth of their racing starts when asked to do so. Thus, it seems reasonable to require swimmers of all ages and competitive backgrounds to demonstrate control of start depth prior to being permitted to execute racing starts in a water depth of less than 1.84 m.

The important question remains, “Does the ability to purposefully control start depth increase the safety of swimmers executing starts in shallower water depths?” While this is a difficult question to answer, Blitvich et al. (2000) found that elite junior swimmers completed significantly shallower starts in a 1.2 m depth pool than in a 2.0 m depth pool. The swimmers were not asked to execute a shallow start in this study; instead, they were permitted to warm-up in the pool prior to executing the starts so that they were aware of the water depth. This is a particularly relevant finding because it demonstrated that experienced swimmers made start depth modifications when presented with different starting end water depths by simply being aware of the water depths. As a result, before swimmers are permitted to execute racing starts in a particular pool, swimmers should always be informed as to the water depth at the different ends of the pool and, perhaps more importantly, swimmers should enter the pool feet first until they are “aware” of the water depth.

## Summary and Conclusions

The purpose of this study was to gain a better understanding of the (a) methods used to teach the racing start to competitive swimmers, (b) the perceptions of professional coaches in regards to the essential elements of the racing start, and (c) the most dangerous errors in technique that occur from its execution. In order to accomplish this, a survey was developed and a link to the survey website was distributed to all USA Swimming (USAS) registered coaches. Perhaps the most intriguing results

from the survey responses related to the progressions used to teach the racing start. The majority of the 471 coaches responding to the survey (94.5%) reported using a progression to teach the racing start, but approximately 4 out of 5 of those coaches stated that the progression they used was “personally designed” and 9 out of 10 reported using a non-written “mental progression.” These findings led to the conclusion that the teaching of racing starts is an informal, individualized process.

Perhaps the first step in formalizing the teaching of racing starts is for a racing start progression to be developed and/or endorsed by both the American Red Cross (ARC) and USAS. Currently, USAS endorses a progression developed by the ARC solely for head-first entries. This progression ends with a “shallow-angle dive” from the side of the pool, not a racing start. When they were asked about the steps used to teach the racing start, USAS coaches responding to this survey provided steps that could be used as starting points to develop a racing start progression: “start from the side in deep water,” “completing a shallow start from the side,” “jump from the block,” and “standing dive off a block in deep water.” In designing a racing start progression, the elements of the start perceived by these coaches to be the most important, “legs and feet push strongly off the block,” “glide and streamline,” and “head between arms at entry,” and the most dangerous, “loss of balance on the block,” “going too deep,” and “attempting to ‘save’ a false start” appear relevant to consider.

Coaches are aware of the dangers of deep starts by novice swimmers. Because of the potentially catastrophic effects of “going too deep” during a racing start, rules are in place by USAS such that “uncertified” swimmers are not permitted to execute racing starts in a water depth of less than 1.84 m. In order to execute starts in water shallower than this, the swimmer must demonstrate the ability to “control” the depth of the start. Once swimmers possess an element of control over their starting depth, it is recommended that swimmers enter pools feet-first until they have had the opportunity to become “aware” of the water depth.

This research represents a step forward in the understanding of the procedures used to teach novice swimmers competitive racing starts. The data represent the composite perceptions of nearly 500 coaching professionals, some with minimal experience and some with more than 25 years of coaching knowledge. We propose that the information gained from them help to improve the practices used to safely teach swimmers the racing start because, as the ARC previously stated, “the best protection against possible [head-first entry or racing start] injuries is an informed, safety-conscious swimmer” (American Red Cross, 2008; p. 14).

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