ISSN 1750-9823 (print)
International Journal of Sports Science and Engineering
Vol. 05 (2011) No. 04, pp. 242-256

Investigating Self-as-a-Model Techniques and Underlying Cognitive Processes in Adults Learning the Butterfly Swim Stroke

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(*Received August 24, 2011, accepted September 9, 2011*)

Abstract. Two self-as-a-model interventions, self-modeling and self-observation, were compared with adults learning the butterfly stroke. Thirty-five adults were randomly assigned to a control group, or one of the two intervention groups. A 14-item scale was generated using the Canadian Red Cross swimming standard to assess performance. Analysis showed no differences in group performance during acquisition. At retention, however, the self-modeling group's performance was significantly better than that of the control group. Results on a recognition task showed that all participants were able to correctly identify errors in performance. Along with performance, a think-aloud protocol was used to gain an understanding of the cognitive processes participants engaged in when viewing their video. Verbalizations were transcribed verbatim and an exploratory approach was used to determine the themes that emerged. Surprisingly, no group differences were found; however, it was noted that the emergent themes aligned with various aspects of Zimmerman's (2000) model of self-regulatory learning. Finally, a goal setting question was asked to explore the cyclical nature of self-regulatory processes. Indeed, 53% of the think aloud statements made during the video viewing were also present in goals set by participants.

Keywords: self-regulation, self-as-a-model interventions, think aloud, swimming, adults.

When learning to perform and perfect motor skills we often watch others performing the action to be learnt. In fact, observation is an intervention that has been studied in the learning of various psychomotor skills (e.g., McCullagh, 1986; Hebert & Landin, 1994; Clark & Ste-Marie, 2002; Weiss, McCullagh, Smith & Berlant, 1998). The results of such research typically show that the more similar the model is to the performer, the more the performer relates to the model, and the more effective the learning (Bandura, 1986, 1997; Schunk, 2001). It can easily be argued that the most similar model to any performer is the performer him/herself and, consequently, the observation of the self may likely have a positive effect on skill performance (Bandura, 1977, 1986, 1997). This form of modeling can be considered as a self-as-a-model intervention, which is typically accomplished via video replay. There exist at least two types of self-as-a-model interventions: self-observation and self-modeling (Dowrick, 1999). In a self-observation intervention, performers view themselves performing a skill at their current skill level. In a self-modeling intervention, however, the videos are edited such that a) the best performance of the skill is selected and repeated so that performers view themselves performing the skill only at their best performance (positive self review) or b) the components of a skill are organized in a new sequence so that performers view themselves performing the skill at a higher level than can actually be performed (feedforward type of self-modeling) (see Dowrick, 1999 for a review of these types of self-modeling). As such, the self-modeling videos contain few, if any, errors in performance. The focus for this research is on the positive self review type of self-modeling, so the use of the term 'self-modeling' in this paper will refer to the positive self-review type.

Those that have explored self-observation in the psychomotor domain (e.g., Laguna, 1996; Zetou, Fragouli & Tzetzis, 1999) have shown that its use improves skills more than when no model is used. Similarly, others have investigated self-modeling in learning various physical activities, such as swimming, golf, or basketball (e.g., Dowrick & Dove, 1980; Dowrick & Raeburn, 1995; Drazin, 1985; Melody, 1990). Results from these studies, however, have been mixed; some studies have shown improvement as a function

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of self-modeling (Dowrick & Raeburn, 1995; Starek & McCullagh, 1999) and others show no benefits (Winfrey & Week, 1993; Ram & McCullagh, 2003). Given these mixed results, we deemed it important to continue the study of self-modeling interventions. Further, little research has been done to compare self-observation and self-modeling interventions.

In one study that has compared the two self-as-a-model interventions, Clark and Ste-Marie (2007) examined children learning to swim. With respect to performance, the self-modeling group demonstrated significantly better scores than either the self-observation or control groups. Surprisingly, the self-observation group performed similar to the control group. This is unlike what has been found in other studies (Kintsantas, Zimmerman, and Cleary 2000; Laguna, 1996). The authors postulated that this may be due to the fact that in other studies knowledge of performance was provided to participants during video observation (which the control groups did not receive), while in the Clark & Ste-Marie study knowledge of performance was not provided to their participants during video observation (only during swimming lesson for all groups, including control). However, it is not clear whether similar findings would be found in an adult population. The way in which an individual learns a task through observation is influenced by such processes as attention, retention, cognitive representation, and motivation (Bandura. 1977, 1986, 1997). These processes are reported to depend on the instructor's level of expertise as well as the learner's age and previous experience (Ferrari, 1996). For example, visual attention has been found to be significantly different in children and adults (Bennett, Gordon, & Dutton, 2009). As such, it is probable that adults attend to the self-modeling videos differently than children, which in turn may influence performance and thought processes such as planning and evaluation. In addition, Ashford, Davids & Bennett (2007) proposed that observational modeling may be different for adults and children due to potential differences in stages of learning and development and a reduced ability for children to produce performance relevant for tasks with an ontogenetic basis, such as the swimming task used in Clark and Ste-Marie (2007). In fact, they conducted a meta-analysis and found that the treatment effect for an observational modeling treatment was larger for adults than for children in terms of the quality of the movement performed. To date, no study has compared the use of self-observation and self-modeling for learning a swimming skill in adults. Thus, we examined the possible effectiveness of self-as-a-model interventions with an adult population.

In the present experiment, we replicate the repeated measures design used by Clark and Ste-Marie (2007) and Clark, Ste-Marie and Martini (2006) with an adult population learning the butterfly swim stroke. The study conducted with children, involving a variety of different swim strokes, this study involved only the butterfly stroke as this was the stroke that all participating adults identified as attempting to learn. Given the benefits in adult learning shown by other modeling interventions in other domains such as golf (Drazin, 1985) and basketball (Melody, 1990), we predicted that, similar to the children in the Clark & Ste-Marie 2007 study, the adults in the self-modeling group would show greater changes in performance than the self-observation and control groups, and the self-observation group would, in turn, show greater changes than the control group.

Beyond the anticipated performance benefits, another principal focus was to explore the thought processes engaged in by adults while watching a self-as-a-model video. In line with Clark et al.'s investigation with children's thought processes during self-as-a model interventions (2006), we also used a think aloud protocol to gain insight into those thought processes. A think aloud protocol involves asking participants to say out loud what they are thinking as they are doing the task. Ericsson and Simon (1996) report that think aloud methods will not interfere with the involved task if participants are asked to report only the content of their working memory and not explain or evaluate their thinking. Studies have confirmed that the effect of thinking aloud does not influence a learner's subsequent performances (Leow & Morgan-Short, 2004). Following Ericsson and Simon s guidelines for the think aloud procedure, Clark et al. obtained rich verbalizations from the children and reported that the children actively evaluated both correct and incorrect aspects of performance in addition to planning how they would make future performance corrections (i.e., prescriptive performance comments). The only known research that has used a think aloud protocol with an adult population used a self-modeling intervention, but not a self-observation method, was that conducted by Ram and McCullagh (2003). They explored the verbalizations of volleyball players but unfortunately, reported that their participants verbalized very little about skill performance and made more statements related to the shock and surprise of viewing themselves on videotape. The instructions provided by Ram and McCullagh, however, asked participants to focus on how the video made them feel, whereas, Clark et al. (2006) asked the children to say aloud what they were thinking. Ericsson and Simon (1996) report that the chance that verbalizations obtained do not reflect information retrieved may be influenced by the verbalization task demands. As such, we asked our adult participants to tell us what they were thinking and anticipated greater verbalizations than that obtained by Ram and McCullagh.

While the study of observational modeling can be viewed from various theoretical perspectives such as: a constraint model or visual perception perspective (Scully & Newell, 1985), a symbolic representational theory (Sheffield, 1961, as cited in Ashford, Bennett, & Davids, 2006, p. 186) or a social cognitive theory (Bandura, 1986). We align ourselves with a social cognitive perspective (Bandura, 1986; Zimmerman, 1989) where several researchers have suggested that the use of modeling can have an effect on self-regulatory processes (McCullagh & Weiss, 2001; Schunk, 2001; Zimmerman, 1989, 2000). Goal setting is an essential component of the learning process because it enables learners to assess their learning progress. Three characteristics determine the type of goals: specificity, proximity, and difficulty level (Bandura, 1988). Specificity is determined by whether goals are general (e.g., “do your best”) or specific (e.g., “get two kicks in during recovery portion of butterfly stroke”). Kyllo and Landers (1995) emphasized the importance of determining whether goals are general or specific as one’s progress can more easily be observed using specific goals. Proximity is determined by whether goals deal with the final outcome (outcome goals, e.g., “I want to improve my butterfly stroke”), or are more short term (such as “I want to improve my kicking action in the swim stroke” and part of the process toward the final outcome (process goals). Process goals are proposed to be more realistic and attainable (Bandura, 1997).

Collecting both think aloud and goal setting data within the same experiment allowed us to examine whether the cognitive processes engaged in during video viewing were reflected in the goals set by the participants. Specificity and proximity were the two goal characteristics examined. Taken together, the best coupling is said to be specific, process goals as they are argued to raise one’s self-efficacy beliefs that in turn encourages goal commitment and attainment (Bandura & Schunk, 1981; Locke & Latham, 1990). No research to date, has specifically examined how different self-as-model interventions may influence goal setting with respect to the dimensions of specificity and proximity. Despite the lack of literature on this, we expected that the goals would correspond with the evaluative and prescriptive content that was verbalized during the video observation; thus demonstrating the cyclical nature of self-regulation. Another objective of this study was to examine how different self-as-model interventions may influence the types of goals set with respect to specificity and proximity. Since the self-modeling intervention contains fewer errors than the self-observation intervention, we predicted that the self-modeling intervention would generate more specific, process goals than the self-observation intervention.

1. Method

1.1. Participants

Ethics approval for this study was obtained from a Canadian University Research Ethics Board. Participants were recruited from various masters swim clubs in Ontario. Thirty-five adults (14 female and 21 male), with a mean age of 29.4 ±11.4 years gave written consent to participate in the experiment. Each participant was randomly assigned to an intervention group (self-modeling or self-observation) or control. Two participants, one from the self-modeling and another from the self-observation group, were excluded due to incomplete data, so each group included eleven participants. Participants possessed little to no expertise with the butterfly stroke. In fact, a performance exclusion criterion was established to ensure that participants were not able to perform the butterfly correctly. Specifically, a performance score greater than 35/42 (description of performance scale provided in the performance section below) would have resulted in exclusion from the experiment; however no participants were excluded based on this criterion (pre-test scores are presented in Table 1). Another exclusion criteria of the experiment consisted of participants having low motivation to learn the butterfly stroke. To determine this, participants were simply asked to reply to the following question "how motivated are you to learn how to correctly perform the butterfly stroke"? Participants responded on a scale from 0-100, where 0 corresponds to not at all, 50 moderately and 100 very much so. If a participant had recorded less than 60, they would have been excluded from the experiment; no one was excluded due to this criterion either. The mean score obtained by participants was 82.73 with a standard deviation of 15.52.

1.2. Materials

A JVC digital video camera (GR-D200U) was used to videotape each swimmer’s performance. Based upon the participant’s group assignment (self-modeling, self-observation, or control), specific video clips were created at the end of every session using Microsoft Movie Maker software program (2004). The daily editing ensured that the self-modeling group always viewed their most adaptive performance and those in the self-observation group were able to always view their most recent performance level. The control group viewed a 60 second excerpt from the movie 'Meet the Parents' (De Niro, Roach, Rosenthal, & Tenenbaum, 2000).

For the self-modeling group, videotapes were edited such that only clips of each participant's correct performance attempts of the skill were displayed. These edits were performed by a research assistant who was a certified swimming instructor and swim coach. These tapes were edited so that it appeared that learners were swimming continuously, with their best swim strokes, for approximately a 10-meter distance. Specifically, the videos were evaluated by a swim instructor to select out each adult's best performance of the stroke. This may have been, for example, just the middle 2 m segment of the 25 m videoed swim. This 2 m portion would then be spliced together five times to create a 10 m best performance video. The self-modeling videos were updated by the swimming instructor throughout the experiment, but only if the performance of the butterfly stroke was better than the last self-modeling video that had been prepared. Improvement was determined by scoring the observed performance using the performance measure. The videotapes for the self-observation group were not edited, so participants viewed themselves swimming the 10 meter distance at their current skill level, which typically included errors in performance. The duration of each clip was about 15 seconds. This clip was repeated four times, creating a 60-second long vignette of the skill being learned. The video viewed by the control group was also 60-seconds long. Participants viewed the videos on a 15-inch screen of a Dell Inspiron 2600 laptop computer.

A distinction between the self-observation and self-modeling videos was confirmed by a manipulation check. Two raters, blind to the participants' experimental groups, viewed 50% of the videos and indicated whether they thought each video was a self-observation video or a self-modeling video. The findings showed that for 96% of the videos the raters correctly identified the intervention video. Further, a rater blind to the type of video, scored the butterfly performance of 30% of the videos, using the performance measure (appendix A) explained in detail below. A Mann-Whitney test indicated that the butterfly performance in the self-modeling videos was significantly better than the butterfly performance in the self-observation videos ($Z = -1.964$, $p < .050$).

Two recognition videos were developed for the retention phase of the experiment. For this research, the purpose of these videos was to determine whether participants understood how to perform the butterfly correctly even if they could not execute the stroke correctly (see McCullagh & Weiss, 2001). The first recognition video consisted of a peer model performing a near perfect butterfly stroke for a distance of twenty-five meters. The second recognition video consisted of the same peer model performing the butterfly stroke with four obvious errors (breathing every stroke, head up to high when breathing, improper timing, and bent arms). Both videos were approximately 15 seconds in duration. Each participant viewed the videos and two recognition scores were determined as per Zimmerman's (2000) observational level of regulatory skill where learners are able to identify the major features of a skill from watching a model perform. The first score reflected the decision as to whether the performance was "perfect" or "contained errors". The second measure involved the percent accuracy of identifying the errors that were performed by the adult model. For example, the correct identification of three out of the four errors identified would yield a 75% recognition score.

1.3. Variables

Performance. A butterfly stroke performance measure was generated using the Canadian Red Cross swimming standard as well as some additional criteria (see appendix A). This scale was adapted from that used by Clark & Ste-Marie (2007) and was validated for content by three certified swimming instructors. A swim instructor that was blind to the conditions of each participant scored all performance tapes on a 14-item scale. Each individual component of the butterfly skill was examined according to this scale and an overall score was obtained. The scoring of each item consisted of *0 (not completed), 1 (inconsistent), 2 (fairly consistent) and 3 (consistent)*. Therefore, the maximum score a participant could receive on any stroke was 42 (14 items x 3 point scale) and the minimum was 0. This scale was also used for the aforementioned exclusion criteria of a participant having too much expertise with the stroke from the outset of the experiment.

To assess whether the items of the performance scale formed a reliable scale, a Cronbach's alpha was computed. An alpha of 0.8 was obtained, indicating that the scale used had good internal consistency.

Think-aloud verbalizations. Participants' verbalizations were obtained using concurrent reporting.

Concurrent reporting requires participants to simply think aloud as they are performing the task (Ericsson & Simon, 1996). In this case, the primary task is watching the modeling video. The participants do not explain what they are doing, but rather verbalize the information they are thinking about while watching themselves on the videos. A Sony cassette recorder (TCM-200DV) was used to audiotape the participant's verbalizations. At the beginning of each intervention session, during the viewing of 4 15-sec video clips, participants from the self-modeling and self-observation groups were asked "Tell me everything that goes through your head as you are watching the video." The think aloud protocol was counterbalanced with video viewing (without verbalization) so as to eliminate potential confounding by the verbalizations. If adults were not verbalizing, they were asked to 'keep talking' or 'remember to say out loud what you are thinking about'.

Goal setting. Following the viewing of the video, the following question was asked of all participants to determine goals set for the session "Do you have any goals for the butterfly stroke today?" Responses to this question were transcribed verbatim during the session as well as audio recorded.

Procedures. This experiment consisted of eight sessions over the course of four weeks, with two sessions per week, and was divided into three phases: the pre-test, intervention, and retention phases.

Pre-test phase. The pre-test phase was considered the first session. Participants were instructed to swim the butterfly for 25 meters to the best of their ability. This performance was videotaped, and no feedback was provided.

Intervention phase. The intervention phase took place during the following six sessions over a three week period at the university pool. Each session was approximately twenty minutes in duration and began with participants viewing their self-modeling, self-observation, or control video. The videos were presented on a computer screen with participants sitting approximately 40 cm away. The self-modeling and self-observation video consisted of four15-second clips of the butterfly stroke. For two of the four viewings, participants in the self-modeling and the self-observation groups were asked to provide concurrent verbalizations while watching the videos. The order of trials on which participants were asked to verbalize was counterbalanced across swimming sessions. The participants from the control group were not required to verbalize while watching their video clip of the movie. Immediately following the video observation, all participants were asked to verbalize their goals with respect to the butterfly stroke session that day.

We then asked participants to swim five, 25 meter laps of the butterfly stroke with a short self-paced rest in between laps. The swimming instructor provided verbal feedback to each participant on skill execution and followed a feedback schedule in which the participants received one correct performance feedback (e.g. "good, that time you remembered to breath every second stroke") and one error performance prescriptive feedback comment (e.g. "next time, remember to relax your arms during recovery") after each 25 meter swim. This ensured that all participants, in all three groups, received both the same type of feedback and the same schedule of delivery. In addition, the instructor was responsible for ensuring that each participant had the same amount of practice time.

At the end of each session, we asked participants to swim their best 25 meters of butterfly and they obtained no feedback on that trial. Their performance was videotaped and subsequently used to update the self-modeling and self-observation videos, as well as for later scoring of their performance. To video this performance, a researcher walked along the pool deck, parallel to the swimmer in order to obtain the entire body during the stroke from a close distance and eliminate other potentially distracting information (e.g., a swimmer in the other lane).

Retention phase and recognition test. The retention phase was the final, eighth session. No video intervention or goal setting information was collected. The participants were first asked to swim 25 meters of the butterfly stroke to the best of their ability. We provided no instruction during this swim trial. The retention phase also included the participants' evaluation of a recognition video. We showed participants two video clips of an adult performing the butterfly; the first performance without errors and the second performance contained four errors. After each clip, we asked participants whether or not there were any errors in performance. If they indicated, "Yes, there were errors", they were asked to identify these errors. The researcher recorded the responses of the participants.

2. Data analysis

2.1. Performance and recognition

Even when differences in baseline do not reach statistical significance, as was the case with our data ($F = 1.09$, $p = .349$), they might still be sufficient to affect the results; as such, Stevens' (1992) recommends that when groups are randomly assigned, information gathered before intervention, such as pretest scores, should be used as covariates. By adjusting the outcome measure for the pretest score, the ANCOVA provides a more powerful test (Van Breukelen, 2006) and when sample sizes are small, maintaining power is important.

Hence, to reduce error variance accounted for by performance at pretest, a 3 (Group) X 2 (session) ANCOVA with repeated measures on the last factor and pretest scores entered as a covariate, was conducted on the scores obtained for performance. Since retention scores were obtained under different conditions than during acquisition (no video shown during retention session), these data were analyzed separately using a 3 way univariate ANCOVA with pretest scores entered as a covariate. Effect sizes for both significant and non-significant results are reported as partial eta squared (η_p^2). For the recognition data, separate ANOVAs were calculated, first to determine whether participants correctly identified videos with and without errors, and then to determine the accuracy for detecting the errors on the video containing errors.

2.2. Think aloud and goal setting

We transcribed verbatim the participants' think aloud verbalizations and segmented each protocol according to statements or ideas. This method of segmentation was selected as it places more emphasis on the actual content of the verbalizations. Such a segmentation process is supported by Ericsson and Simon (1996) who stated that "an analysis of the heeded information revealed in a protocol. is a more fruitful approach to protocol analysis of thought processes than is an encoding and analysis in terms of task independent general processes" (p. 215). These segments were then reviewed by a team of two researchers and four research assistants and an initial coding was determined.

3. Result

3.1. Performance and Recognition Data

The three intervention groups did not differ with respect to the time they practiced the stroke weekly or with respect to swimming experience. A univariate ANOVA of pre-test scores for performance determined no significant pre-test differences among the three groups, $F_{(2, 30)} = 1.090$, $p= 0.349$ ($\alpha = 0.05$). As is advised for ensuring the power of an ANCOVA test, a Pearson Correlation analysis indicated strong correlations (greater than .6) between performance pretest scores and dependent variables (mid-session 1 $r = .793$, mid-session 2 $r = .734$, retention $r = .764$).

The participants' swimming skills, in all three groups, improved across sessions, as seen by a consistent increase of the performance scores (see Table 1), this steady increase showed a main effect for Session, $F(1, 27) = 6.124$, $p < .020$ ($\alpha = 0.05$), $\eta_p^2 = 0.185$. However, we obtained no main effect for Group, $F(2, 27) = 1.671$, $p=.207$, $\eta_p^2 = 0.110$ or interaction, $F(2, 27) = 1.773$, $p =.189$, $\eta_p^2 = 0.116$. These numbers indicate that all three groups were improving on the performance of the butterfly stroke at similar rates. For the retention scores, using the adjusted means, the self-modeling group had the highest performance scores as compared to the self-observation group and the control group These differences reached significance, $F(2, 29) = 3.850$, $p = .033$ ($\alpha = 0.05$), $\eta_p^2 = 0.210$, following a 3 (group) ANCOVA of the retention scores with pretest entered as a covariate. Pairwise comparisons (Tukey HSD) indicated that a significant mean difference was found between the control and the self-modeling group, $p = .011$ ($\alpha = 0.05$), $d = 0.923$). However, no significant differences between the control and the self-observation group or between the self-observation and the self-modeling groups were noted.

The recognition test results showed that all participants were able to correctly identify the recognition video clip containing errors, regardless of group. There seemed to be a trend for self-as-a-model groups to be better at identifying the recognition video clip that contained no errors than the control group (self-modeling = 87.5% [SD = .46], self-observation = 81.5% [SD = .52]), control = 69% [SD = .52]), but no significant differences were found among groups $F(2, 29) = 0.253$, $p = .779$, $\eta_p^2 = 0.515$. For the error video clip, there was no difference among groups on accuracy for correct identification of errors (self-modeling = 47%, [SD = .64] self-observation = 25%, [SD = .93] control = 53%, [SD = 1.25]; $F(2, 29) = 1.875$, $p < .173$, $\eta_p^2 = 0.122$.).

3.2. Think Aloud and Goal Setting Data

Twenty one participants (n = 10 self modeling; n = 11, self-observation) were included in the analyses as the control group did not provide think aloud data, two participants were excluded due to incomplete performance data and an additional participant had to be excluded due to incomplete think aloud data.

Coding. As with Clark et al.'s (2006) research no guiding theoretical framework was used for the coding of the data. Nonetheless, we did expect the adults to actively evaluate their performance and make prescriptive performance comments. The themes that emerged from this process and the resultant coding (see table 2) indicated that verbalizations were 79.7% evaluative, 5.7% prescriptive, 0.3% affective, 1% observation, 1.1% causal attribution, 0.9% cognitive dissonance, and 11.2% miscellaneous. Since a great proportion of the statements verbalized were evaluative, it was decided to code these further and a more detailed coding system was devised (see Table 2). Evaluative segments were coded as to whether participants' verbalizations targeted correct performance (e.g., "I'm getting those two kicks in") or errors (e.g., "My legs are still too far apart"). This coding will be referred to as 'evaluation target'. We also coded statements in terms of their focus being on the whole task (e.g., "I'm flopping around a lot") or a part of the task (e.g., "My kick isn't right"). This second level of coding will be referred to as 'evaluation focus'. Finally, the verbalizations that focused on part of the task were coded to determine whether they referred to task parts generally (e.g., "there's something about my knees") or specifically (e.g., "my knees are bending too much"). This third level of coding will be referred to as 'evaluation-part specificity'.

Twenty-five percent of the data were randomly selected and coded, using the resultant coding scheme, by two research assistants. We obtained an inter-rater agreement of 99% for all statements. Since this is a hierarchical coding scheme, a dependent relationship exists between inter rater agreement scores within different levels of the hierarchy (Yeaton & Wortman, 1993). Inter-rater agreement was then obtained for each level of evaluation statements coded. Thus, percent agreement was calculated for each level so as to ensure that agreement estimates were not overestimated. We obtained agreement all evaluative statements: 99.1% agreement was obtained for evaluation target, a 99.7% agreement was obtained for evaluation focus, and a 99.5% agreement was obtained for evaluation-part specificity.

We transcribed the goal setting data for all thirty three original participants and coded according to goal proximity (outcome vs. process) and goal specificity (general vs. specific), so that four categories of goals were generated i) general process, ii) specific process, iii) general outcome, and iv) specific outcome. An inter rater check was done on 25% of the transcribed data and a 91% agreement was obtained.

Think aloud results. We explored the total number of verbalizations made by the twenty-one participants using a 2 (Group) x 6 (Session) ANOVA, with repeated measures on the last factor. We found no differences across sessions, F(3, 95) = 1.9525, p = .097, $\eta_p^2 = 0.088$, nor between groups, F(1, 19) = 0.254, p < .620, $\eta_p^2 = 0.013$.

As evaluative statements were the most prevalent, and to maintain meaningful numbers, only these statements were further coded at second and third levels to probe more deeply into the verbalizations (see Figure 2). First, we wanted to determine whether more evaluative statements overall were verbalized by any one group or during a session as this may artificially inflate frequency results of subsequent coding. A 2(Group) x 6 (Session) ANOVA, with repeated measures on the last factor was used to analyze the total number of evaluative statements made. This analysis showed no difference across sessions, $F(5, 95) = 0.927$, $p = .467$, $\eta_p^2 = 0.044$, nor between groups, $F(1, 19) = 0.002$, $p < .965$, $\eta_p^2 = 0.000$, as such, frequencies were used to compare the two modeling groups on evaluative statements.

We analyzed whether participants' evaluations targeted what they did correctly versus their errors was analyzed using a 2 (Group) x 2 (Evaluation target) x 6 (Session) ANOVA with repeated measures on the last two factors. This analysis showed no difference between the self-modeling and self-observation group, $F(1, 19) = 0.303$, $p = .589$, $\eta_p^2 = 0.016$ and no main effect across sessions, $F(5, 95) = 1.219$, $p = .306$, $\eta_p^2 = 0.060$. A main effect for target was obtained, $F(1, 19) = 20.208$, $p < .001$, $\eta_p^2 = .515$. Participants in both groups focused more on errors ($M = 3.018$, $SD = .199$) than correct performance ($M = 1.625$, $SD = .241$) throughout the six sessions, regardless of whether they were in the self-modeling or the self-observation groups.

The Evaluation focus (i.e., part versus whole) was analyzed using a 2 (Group) x 2(Evaluation focus) x 6 (Session) ANOVA with repeated measures on the last two factors. The results of this analysis indicated no difference between the self-modeling and self-observation group, $F(1, 19) = 0.254$, $p = .620$, $\eta_p^2 = 0.013$, and no main effect across sessions $F(5, 95) = 1.242$, $p = .296$, $\eta_p^2 = 0.61$. However, a main effect for Focus was found $F(1, 19) = 95.623$, $p < .001$, $\eta_p^2 = 0.834$, indicating that participants in both groups focused more on parts of the butterfly stroke ($M = 4.033$, $SD = .296$) than on the butterfly stroke as a whole ($M = 0.610$, $SD = .151$), throughout the six sessions.

A 2(Group) x 2(Evaluation-part Specificity) x 6 (Session) ANOVA with repeated measure on the last 2 factors was used to analyze the third level of coding. A main effect for Specificity, $F(1, 19) = 76.273$, *p*

< .001, η_p^2=.801, was found with no group differences *F*(1, 19)= 0.008, *p* = .931, η_p^2=0.000 or main effect across sessions, *F*(5, 95)= 0.864, *p* = .528, η_p^2= 0.224. Throughout the six sessions, participants in both groups focused more on specific aspects of the butterfly stroke (*M* = 3.569, *SD* = .307) than on general aspects of the stroke (*M* = 0.472, *SD* = .109).

3.3. Goal setting results

Since the goal setting results will be compared to the think aloud results, the control group was not included in this analysis as those participants did not view a self-as-a-model video and no think aloud data was obtained for them. We examined goal proximity and specificity of the self-modeling and self-observation groups using a 2 (Group) x 2 (Proximity) x 2 (Specificity) x 6 (Session) ANOVA with repeated measure on the last three factors. In both cases, we found no differences between the self-modeling and self-observation group. There was no main effect of session nor for specificity (General vs. Specific Goals) F(1, 20) = 3.95, p = .061, η_p^2=0.165, though a trend was noted for specificity with participants in both the self-modeling and self-observation groups verbalizing a greater proportion of Specific Goals (M = 0.413, SD = .04) than General Goals (M = 0.239, SD = .054). Main effects were found for proximity (Process vs. Outcome) Goals F(1, 20)= 84.79, p < .0001, η_p^2= 0.809. Participants verbalized a greater proportion of Process Goals (M = 0.602, SD = .048) than Outcome Goals (M = 0.049, SD = .019). An interaction was obtained for Proximity and Sessions F(1, 10)= 3.504, p < .006, η_p^2= 0.149. The proportion of process goals displayed an initial increasing trend across sessions as the proportion of outcome goals verbalized displayed an initial decreasing trend. We also found a significant interaction between Specificity and Proximity F(1, 100)= 11.59, p <.003, η_p^2= 0.367, participants mostly set Specific Process Goals (M = 4.82, SD =2.97), then General Process Goals were the next most frequent (M = 2.33, SD = 2.29), followed by General Outcome Goals (M = 0.48, SD = 0.91) throughout the six sessions. No Specific Outcome Goals were verbalized.

Also of interest was whether the verbalizations made during the video observation would be reflected in the participants' goal setting statements. A paired t-test was used to compare the number of components focused on during the think aloud and goal setting verbalizations. A significantly greater number of components were identified during the think aloud than during the goal setting T(21) = 6.072, p < .001. This is not surprising as participants had more opportunity to verbalize during the think aloud sessions as compared to the goal setting question. Fifty-three percent of the think aloud statements were also present in the goals set by participants. Moreover, 77% of the goal sets were also present as evaluative statements in the think-aloud.

4. Discussion

The aim of the present research was threefold. First, we wanted to examine the effectiveness of self-as-a-model interventions with adults learning to swim the butterfly stroke. Second, we sought to gain insight into the cognitive processes engaged in during these interventions. Finally, we chose to explore the possible cyclical effect of viewing a self-as-a-model video on goal setting. In terms of the effectiveness of the modeling interventions, while no significant differences were found in acquisition, importantly, significant group differences were noted in the retention phase. The results we obtained at retention are a better indicator of the actual learning occurred as the effect observed during acquisition may be temporary (Schmidt & Bjork, 1992). In this case, the self-modeling group's performance of the butterfly stroke at retention was superior to that of the control group. This was not the case for the self-observation group. The self-modeling showed an advantage over the self-observation group for learning. A reason for the self-modeling group's superior performance may be that the participants in this group viewed their best performance prior to their swim session, which Clark and Ste-Marie (2007) argue modify one's intrinsic motivation and self-efficacy beliefs. In addition, the above authors suggest that as a function of viewing their best performances, participants in the self-modeling group are also more likely to engage in more self-monitoring and self-observation.

Although the self-modeling group's performance score was also higher than that of the self-observation group, this difference did not reach significance. This finding is contrary to what was obtained with the children in Clark & Ste-Marie (2007) where the self-modeling group performed significantly better than the self-observation as well as the control group. While feedback provided during the intervention session contributed to overall learning, given that feedback was a controlled variable, the unique contributions of the video intervention are argued to explain the performance benefits obtained. It seems that the SO video did not add enough new information to enhance the learning experience as did the SM video. It seems that SO may be beneficial for children, but not as beneficial for adults. This may be due to the fact that adult participants probably had more swimming experience than the children, they may have had a stronger transfer effect in their ability to spot and correct movement errors. This could also explain the lack of group differences obtained during acquisition as well as the limited differences noted in the recognition data.

A second objective of the research presented was to gain an understanding of the cognitive processes engaged in during these self-as-a-model interventions. Interestingly, no differences in verbalizations were noted across sessions, despite improvement in performance across the acquisition phase, nor did participant's verbalizations differ as a function of the experimental intervention condition. This lack of a main effect for group is especially remarkable at the evaluation target (error versus correct performance statements) level because the self-modeling video is purported to contain less errors than the self-observation videos. Indeed, a manipulation check of the video content was conducted and confirmed that the self-modeling video performance were in fact better than the self-observation videos. Despite this, observers of a self-modeling video still verbalized as many error comments as the self-observation video participants. This lack of difference could be explained by the greater transfer effect in these adult swimmers' ability to spot and correct movement errors. The fact that all groups focused on stroke errors, stroke parts and specific aspects of their butterfly stroke, seems to suggest that all participants brought considerable experience to the learning context in terms of their ability to identify errors and set goals to improve these areas. Furthermore, the lack of differences in error comments suggests that the improved performance may be related to other factors rather than simply 'informational' ones.

While coding of data was done within a social cognitive framework, it was not specifically guided by a particular theoretical model. However, it is interesting to note that the data reflect various aspects of Zimmerman's (2000) self-regulatory learning model. Self-regulation is a proactive, self-generated and cyclical process involving individuals' thoughts, feelings and actions that influence their acquisition of knowledge and skill (Schunk, 2001). One notes this cyclicality also in Zimmerman's (1989, 2000) triadic analysis of self-regulatory functioning where self-regulation is described as involving a cyclical interaction of personal, behavioural and environmental triadic processes. Within this model, self-as-a-model interventions may be seen as a strategy used within the "environment" which will influence the "person" to engage in increased self-regulation and eventually affect their goal directed "behaviour". An individual's self-regulation is described as occurring across different phases of task performance. The forethought phase refers to processes that *precede* action and enable it to occur (e.g., goal setting, task analysis and self-motivational beliefs), the performance phase concerns processes that occur *during* overt task performance (like self-control and self-observation(i.e., tracking aspects of own performance), and the self-reflection phase involves processes that happen *after* task performance (for instance self-judgment, causal attributions and self-reactions).

Interpreting the data from this framework, self-evaluation, which is a process that would occur in the self-reflective phase of Zimmerman's (2000) model was arguably the most prevalent self-regulatory process during video watching. As noted by Zimmerman, self-evaluation can occur with different comparative standards. In our experiment, participants usually compared their performance on video to criteria for a successful butterfly stroke (e.g., "my head is not coming up as high as it should"), but at times also made comparisons to previous performance (e.g., "I'm getting my two kicks in now").

Although not represented as much as self-evaluation, other self-regulatory processes were also evidenced. For instance, some participants planned what they would do differently to improve their performance (prescriptive comments) on their next attempt as well as verbalized affective comments or causal attributions. The prescriptive comments were much in line with what Zimmerman (2000) has termed strategic planning. More specifically, Zimmerman described that strategies could direct cognitive, affective, or motor aspects of performance and the participants' prescriptive statements were very much targeted towards future motor execution (e.g., "I need to kick bigger when my arms are coming out of the water behind me and then smaller").

With respect to goal setting, a process that would occur in Zimmerman's (2000) forethought phase of his self-regulation of learning model, all participants, regardless of group, set more specific goals than general goals and more process oriented goals than outcome. When combined, the most frequent type of goals set were the specific, process goals. Unlike what we had predicted, there was no difference in goal setting between self-modeling and self-observation groups. This outcome may be related to the previously stated finding that even though the self-modeling videos contained fewer errors than the self-observation videos, the participants still identified as many errors in performance as that obtained in self-observation. Moreover those error statements were specific to a particular component of the movement. Thus the specific, process goals may well have been motivated by the analysis just conducted on the video.

The third aim of the research involved exploring the cyclical nature of self-regulatory processes. To this end, the interactions between the goal statements and the verbalizations made during the self-as-a-model interventions were examined. The logic was that the self-evaluative and prescriptive comments stated in the self-reflection phase (i.e., during the video viewing) may well be carried into the forethought phase (i.e., during goal setting) and framed as goals for the upcoming practice session. Indeed, in line with Zimmerman's (2000) propositions, the data supported the cyclical structure as more than three-quarters of the goals reflected the content of the verbalizations made while viewing the video.

Though, the goals generally reflected the components identified during the self-as-a-model viewings; there were goals set that did not emerge in the think-aloud data. Specifically, 23% of the goals set were not present as statements in the think aloud. When considering this in conjunction with the performance data, i.e., that the self-modeling group improved significantly more than the self-observation group; it is possible that information attended to in the video enabled performance improvement at a more tacit level, and thus not accessible via the think aloud. Perhaps a more in-depth analysis of participants' performance in relation to their verbalizations (i.e., do they do what they say they want to do?) in future research may provide more insight on this matter.

5. General Conclusion

In conclusion, significant performance benefits were obtained for participants who viewed a self-modeling video over those who viewed a self-observation video or no video at all. Although such differences were not found during acquisition, it can still be proposed that self-regulatory processes were important during the acquisition process. In fact, the think aloud data illustrates that participants in both the self-modeling and self-observation groups were engaging in a number of self-regulatory processes during video observation of the self. Specifically, the verbalizations obtained during the video watching reflect key elements in Zimmerman's (2000) self-regulation of learning theory, particularly those of task analysis (planning), and self-reflection (self-evaluation). As such, while self-regulation was engaged in during both video interventions, it does not appear to be explaining the benefits of self-modeling. It may be that examining all phases of self-regulation may help explain the differences. We suggest that Zimmerman's self-regulation of learning model be used as a coding framework for investigating self-regulation in future think aloud analyses. Correspondence between the verbalizations made during the video observation and the goal setting data seem to provide some evidence as to the cyclical nature of the self-regulation phases described by Zimmerman (2000). The use of a concurrent think aloud during each of the different phases of (forethought, performance, self-reflection) would provide insight into the cognitive processes participants engaged in during the entire self-regulation cycle. It would also be of interest to determine whether certain aspects of these processes translate into actual changes in performance and whether these aspects differ depending on age. Such information would be useful in guiding individuals involved in teaching motor skills to varied populations.

6. References

[1] Ashford, D., Bennett, S. J., Davids, K. Observational Modeling Effects for Movement Dynamics and Movement Outcome Measures Across Differing Task Constraints: A Meta-Analysis, 2006.

[2] Ashford, D., Davids, K., & Bennett, S. J. Developmental effects influencing observational modelling: A meta-analysis. *Journal of Sports Sciences.* 2007, **25**: 547 – 558.

[3] Bandura, A. *Social learning theory.* Englewood Cliffs, NJ: Prentice Hall, 1977.

[4] Bandura, A. *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall, 1986.

[5] Bandura, A. Self-regulation and Action Through Goal Systems. In V. Hamilton, G. H. Bower, & N. H. Frijda (Eds). *Cognitive perspectives on emotion and motivation*. Dorderecht, The Netherlands: Kluwer Academic, 1988, pp. 37-61.

[6] Bandura, A. *Self-efficacy: The exercise of control.* New York: W. H. Freeman, 1997.

[7] Bandura, A., & Schunk, D. H. Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology.* 1981, **41**: 586-598.

[8] Bennett, D.M., Gordon, G., & Dutton, G. N. The useful field of view test, normative data in children of school age. *Optometry & Vision Science.* 2009, **86**: 717-721.

[9] Clark, S. E., & Ste-Marie, D. M. Peer mastery versus peer coping models: Model type has differential effects on psychological and performance measures. *Journal of Human Movement Studies*. 2002, **43**: 179-196.

[10] Clark, S. E., & Ste-Marie, D. M. The impact of self-as-a-model interventions on children's self-regulation of learning and swimming performance. *Journal of Sport Science.* 2007, **25**: 577-586.

[11] Clark, S. E., Ste-Marie, D. M., & Martini, R. The thought processes underlying self-as-a-model interventions: An exploratory study. *Psychology of Sport and Exercise.* 2006, **7**: 381-386.

[12] De Niro, R., Roach, J., Rosenthal, J., & Tenenbaum, N. *Meet the parents* [Motion picture]. USA: Universal Pictures, 2000.

[13] Dowrick, P. W. A review of self-modeling and related interventions. *Applied & Preventive Psychology.* 1999, **8** : 23-39.

[14] Dowrick, P. W., & Dove, C. The use of self-modeling to improve the swimming performance of spina bifida children. *Journal of Applied Behavior Analysis.* 1980, **13**: 51-56.

[15] Dowrick, P. W., & Raeburn, J. M. Self-modeling: Rapid skill training for children with physical disabilities. *Journal of Developmental and Physical Disabilities.* 1995, **7**: 25-37.

[16] Drazin, D. M. *The use of self-modeling to improve motor performance in golf.* Unpublished doctoral dissertation, California School of Professional Psychology, San Diego, 1985.

[17] Ericsson, K. A. & Simon, H. A. *Protocol analysis: Verbal reports as data*. The MIT Press: Cambridge, England, 1996.

[18] Ferrari, M. Observing the observer: Self-regulation in the observational learning of motor skills. *Developmental Review.* 1996, **16**: 203-240.

[19] Hebert, E. P., & Landin, D. Effects of a learning model and augmented feedback in tennis skill acquisition. *Research Quarterly for Exercise and Sport.* 1994, **65**: 250-257.

[20] Kitsantas, A., Zimmerman, J., Cleary, T. The Role of Observation and Emulation in the Development of Athletic Self-Regulation. *Journal of Educational Psychology.* 2000, **92**: 811-817.

[21] Kyllo, L. B., & Landers, D. M. Goal setting in sport and exercise: A research synthesis to resolve the controversy. *Journal of Sport and Exercise Psychology.* 1995, **17**: 117-137.

[22] Laguna, P. The effects of model demonstration strategies in motor skill acquisition and performance. *Journal of Human Movement Studies.* 1996, **30**: 55-79.

[23] Leow, R. P., Morgan-Short, K. To think aloud or not to think aloud: The issue of reactivity in SLA research methodology. *SSLA.* 2004, **26**: 35-57. DOI: 10+10170S0272263104261022

[24] Locke, E. A., & Latham, G. P. *A theory of goal setting and task performance*. Englewood Cliffs, NJ: Prentice Hall, 1990.

[25] McCullagh, P. Model status as a determinant of attention in observational learning and performance. *Journal of Sport Psychology*. 1986, **9**: 249-260.

[26] McCullagh, P. & Weiss, M. R. Modeling: Considerations for motor skill performance and psychological responses. In R. N. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.). *Handbook of research on sport psychology.* New York: Wiley, 2001, pp. 205-238.

[27] Melody, D, W. *The influence of self-modeling on free-throw shooting*. Unpublished doctoral dissertation, University of Connecticut, Storrs, Ct, 1990.

[28] Ram, N., & McCullagh, P. Self-modeling: Influence on psychological responses and physical performance. *The Sport Psychologist.* 2003, **17**: 220-241.

[29] Scully, D.M., & Newell, K.M. Observational learning and the acquisition of motor skills: Towards a visual perception perspective. *Journal of Human Movement Studies.* 1985, **11**: 169-186.

[30] Schmidt, R. A., & Bjork, R. A. New conceptualizations of practice: Common principles in three paradigms suggest new concepts for training. *Psychological Science.* 1992, **3**: 207 – 217.

[31] Schunk, D. Social cognitive theory and self-regulated learning. In B. J. Zimmerman & D. Schunk, (Eds). *Self-regulated learning and academic achievement: Theoretical perspectives*. Mahwah, New Jersey: Lawrence Erlbaum Associates, 2001, pp. 125-151.

[32] Starek, J., & McCullagh, P. The effect of self-modeling on the performance of beginning swimmers. *The Sport Psychologist.* 1999, **13**: 269-287.

[33] Stevens, J. *Applied multivariate statistics for the social sciences* (2^{nd} ed.). Hillsdale, NJ: Lawrence Erlbaum, 1992.

[34] Van Breukelen, G. J. P. ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. *Journal of Clinical Epidemiology.* 2006, **59**: 920–925.

[35] Weiss, M., McCullagh, P., Smith A., & Berlant, A. Observational learning and the fearful child: Influence of peer models on swimming skill performance and psychological responses. *Research Quarterly for Exercise and Sport.*

1998, **69**: 380-394.

[36] Winfrey, M. L., & Weeks, D.L. Effects of self-modeling on self-efficacy and balance beam performance. *Perceptual and Motor Skills.* 1993, **77**: 907-913.

[37] Yeaton, W. H., & Wortman P. M. On reliablility of met-analytic reviews: The role of intercoder agreement. *Evaluation Review*, 1993, **17**: 292-309.

[38] Zetou, E., Fragouli, M., & Tzetzis, G. The influence of star and self modeling on volleyball skill acquisition. *Journal of Human Movement Studies.* 1999, **37**: 127-143.

[39] Zimmerman, B. J. A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology.* 1989, **81**: 329-339.

[40] Zimmerman, B. J. Attainment of self-regulation: A social cognitive perspective. In M. Boekaerts, Pintrich, P. R., & Zeidner, M. (Eds.). *Handbook of self-regulation*. San Diego: California: Academic Press. 2000, pp. 13-39.

Appendix A *Swimming Scoring Sheet – Butterfly*

Butterfly	**Consistent 3**	**Fairly Consistent 2**	**Inconsistent 1**	**Not completed 0**
Moves in a continuous motion with hips remaining near the surface				
Legs kick together from the hips				
Knees lead legs during downbeat of the kick (power phase)				
Keeps toes pointed during kick				
Relaxes arms during recovery				
Extends arms/hands in front of head as they enter the water				
Pulls in a key-hole pattern				
Accelerates through the power phase and pulls past hips.				
Co-ordinates two dolphin kicks with one symmetric arm stroke				
Performs first down kick as arms enter water and second down kick as hands exit water				
Breathes every second stroke				
As the arms finish the pull, the head is tilted up with the chin out				
Head only comes out of the water enough for the chin to rest on the surface of the water				
Arms are kept fairly straight as they recover				

TOTAL SCORE: 42

Note: Criteria listed are part of the Red Cross Water Safety Program guidelines, with the exception of the italicized items.

Table 1. *Descriptive statistics for performance*

Group	N	Pre-test		Mid-session 1 (unadjusted)		Mid-session 1 (adjusted)		Mid-session 2 (unadjusted)		Mid-session 2 (adjusted)		Retention (unadjusted)		Retention (adjusted)	
		M	*SD*	*M*	*SD*	*M*	*SE*	*M*	*SD*	*M*	*SE*	*M*	*SD*	*M*	*SE*
Self-modeling	11	22.64	6.5	25.18	5.528	24.879	1.421	28.55	4.298	28.338	1.594	32.18	5.689	31.842	1.435
Self-observation	11	19.36	9.49	22.73	7.824	24.34	1.483	25.82	8.244	27.405	1.663	26.09	7.981	27.789	1.497
Control	11	24.45	8.26	26.36	8.824	24.153	1.476	29	9.654	26.713	1.656	28	9.033	25.804	1.491

Table 2. *Emergent Themes from Think Aloud Verbalizations*

Theme			Description	Example
Evaluative Correct	Whole		A positive-evaluative statement, which generally refers to, the butterfly stroke as a whole, and not the parts.	*I seem to be getting the motion*
	Parts	General	A positive-evaluative statement referring to aspects of the butterfly stroke (BLABT)* in macro fashion.	*My timing is looking good*
		Specific	A positive-evaluative statement referring to specific aspects of the butterfly stroke (BLABT)*. In micro fashion.	*Looks like I'm breathing every second one*
Evaluative Error	Whole		A negative-evaluative statement, which generally refers to, the butterfly stroke as a whole, and not the parts.	*It looks like I'm failing around*
	Parts	General	A negative-evaluative statement referring to aspects of the butterfly stroke (BLABT)* in macro fashion.	*But my toes are not right*
Prescriptive	Whole		Explicit statements referring to what they need to do to improve their swimming performance in future attempts with reference to the butterfly stroke as a whole.	*Gotta slow down today*
	Parts	General	Explicit statements referring to what they need to do to improve their swimming performance in future attempts, focused specifically on the execution of specific components of the stroke (BLABT).	*There is a lot of white water at the feet too, so I'll fix that*
		Specific	Explicit statements referring to what they need to do and particularly how they are going to accomplish this in future attempts, focused specifically on the execution of specific components of the stroke during skill performance (BLABT).	*I need to keep my feet further under water*
Affective			Statements indicating how they feel about swimming at the time of skill observation	*Is that really me, I'm kind of embarrassed*
Observation statements			Descriptions of observed skill. Does not include an evaluative component.	*What I'm noticing is the arms.*
Miscellaneous statements			Statements unrelated to the skill and/or task.	*Okay, well my sunburn looks worse than I thought it was.*
Causal attribution			Statements that justify observed performance.	*I was tired at the time and it is usually what happens when I get tired.*

Cognitive dissonance			Realization that observed performance on video is different than participant's cognitive representation of their performance.	*When I was doing it in the water I thought I was getting it more from the hips.*

***BLABT refers to Body, Legs, Arms, Breathing, Timing, which are all important aspects of the butterfly swim stroke.**