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Perceived Exertion in Coaches and Young Swimmers With Different Training Experience

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Session rating of perceived exertion (SRPE) is a practical method to assess internal training load to provide appropriate stimuli. However, coaches and athletes might rate training sessions differently, which can impair performance development. In addition, SRPE might be influenced by athletes' training experience. The authors studied 160 swimmers of different age groups and different competitive swimming experience and 9 coaches. SRPE was indicated by the swimmers 30 min after the end of a training session and before the training session by the coaches. Training-session intensities were classified into easy (SRPE <3), moderate (SRPE 3–5), and difficult (SRPE >5), based on coaches' perception. We observed that the correlation between coaches' and athletes' SRPE increased with increased age and competitive swimming experience, $r = .31$ for the 11- to 12-y-old group ($P < .001$), $r = .51$ for the 13- to 14-y-old group ($P < .001$), and $r = .74$ for the 15- to 16-y-old group ($P < .001$). In addition, younger swimmers (11–12 y, $P < .01$; 13–14 y, $P < .01$) rated training intensity differently from coaches in all 3 categories (easy, moderate, and difficult), while the older group rated differently in only 1 category (difficult, $P < .01$). These findings suggest that the more experienced swimmers are, the more accurate their SRPE is.

Keywords*:* training, swimming, intensity, performance

Training for a specific sport aims to lead athletes to improve their performance by inducing morphological, metabolic, and functional changes. A well-planned training program should provide appropriate stimuli (ie, training loads) to produce the expected adaptations.[1,2] Therefore, controlling training loads is crucial to ensure optimal performance improvement.

However, monitoring training load is a difficult task. Blood lactate, heart rate, and oxygen uptake are frequently used as markers of internal load. Nonetheless, assessing these markers is usually not feasible in a "real-world set up."[3] Training impulses (TRIMPs) such as those of Banister et al[7] or Edwards[9] have been suggested as ways to quantify training load. Unfortunately, these TRIMPs also need heart-rate data to be calculated, which may hamper their application.

Perceptual assessments have been used during and after exercise. These assessments include the "in-task" rating of perceived exertion (RPE) and session rating of perceived exertion (SRPE). It has been shown that the estimation–production paradigm supports the use of in-task RPE for prescribing, regulating, and assessing exercise intensity.[4] Foster et al[5] proposed using a modified 10-point Borg scale[6] and asking subjects 30 minutes after the end of the session to rate their effort for the entire workout, yielding SRPE. This SRPE correlates to average percentage heart-rate reserve[5] and could replace heart rate as a marker of intensity in the Banister et al[7] TRIMP concept.

SRPE has been used to assess internal training load in different sport disciplines including swimming. Wallace et al[8] reported that, in highly trained swimmers, training-load calculation based on SRPE was strongly correlated with the load estimated by Banister et al ($r = .74$)[7] and Edwards ($r = .75$)[9] and lactate-threshold-zone ($r = .77$)[10] TRIMPs. In addition, they also observed a high correlation between coaches' and athletes' SRPEs ($r = .88$). Despite this high correlation, coaches' and athletes' rated easy (coach SRPE <3) and difficult (coach SRPE >5) sessions differently.[8] Athletes rated SRPE higher during sessions designed to be easy and lower during sessions designed to be difficult, leading to moderate loads. This trend may increase training monotony, which is associated with overtraining syndrome.[1] In addition, Foster[1] suggested that a potential cause for high incidence of poor performance results is the incompatibility between external load planned by the coaches and the internal load perceived by the athletes.

Nevertheless, there are several factors that can affect the accuracy of in-task RPE. Research indicates that athletes' experience, cognition, and memory can affect the precision of in-task effort perception.[11,12] Evidence to support the same influence on SRPE is still lacking, since investigation on this topic has been conducted with in-task RPE. However, it is plausible to suggest that during long-term training programs, swimmers experience different types of stimuli (eg, anaerobic, aerobic),

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which may improve their ability to perceive effort. This improved ability may be due to their capability to remember how the exercise feels based on past experience and to integrate peripheral sensory cues.[13] Therefore, it is conceivable that the differences between athletes' and coaches' SRPEs decreases with increasing athlete age and experience. If this holds true, then coaches should be more careful to adequately monitor and control internal and external loads for younger athletes to avoid training maladaptations.[14]

Therefore, the objectives of this study were to compare coaches' and different age-group swimmers' training SRPEs and to investigate the influence of training experience on coaches' and athletes' SRPE correlation.

Methods

Subjects

One hundred sixty young swimmers of 3 different age groups (11–12 y, n = 46; 13–14 y, n = 65; and 15–16 y, n = 49) participated in this study (Table 1). All participants competed regularly in local, state, and national championships. Of the forty-six 11- to 12-year-old swimmers, 24 were among the best 3 swimmers in the state championship (no national championship is held for this age group). Of the sixty-five 13- to 14-year-old swimmers, 55 and 35 were among the best 3 swimmers in the state and national championships, respectively. Of the forty-nine 15- to 16-year-old swimmers, 40 and 34 were among the best 3 swimmers in the state and national championships, respectively. Furthermore, 9 athletes were part of national junior and youth teams.

Participants were asked to answer which swimming event was their best. In summary, twenty-nine 11- to 12-year-old swimmers participate in 100-m events and 20 in 200- to 400-m, and forty-four 13- to 14-year-old swimmers participate in both 50- to 100-m events, 15 in 200- to 400-m events, and 6 in 800- to 1500-m events. Thirty-three 15- to 16-year-old swimmers participate in both 50- to 100-m events and 16 in 200- to 400-m events.

Nine coaches served as participants (Table 2); 3 of them were chosen as coaches for the aforementioned national teams. This study was approved by a university ethics committee, and before participation parents or guardians provided written informed consent.

Experimental Protocol

A total of 9 training sessions were evaluated. An experienced researcher was responsible for data collection with coaches and athletes. Each training session was designed and conducted by the swimming coaches with no input from the researcher and consisted of different distances and intensities. Training sessions took place in a heated pool (26–28°C) and were performed as part of the specific conditioning phase. All sessions were prescribed to improve aerobic capacity, anaerobic threshold, maximal oxygen uptake, and speed and lasted 60 to 135 minutes, with total distances ranging between 2 and 5 km. Training prescription was based on the average speed of a T-30 test, according to Maglischo.[15] This test consists of swimming the longest distance in 30 minutes, and T-30 average speed is strongly correlated (r = .9) with anaerobic-threshold speed.[16]

The RPE (ie, load intensity) was determined through the SRPE method. This method uses a simple question: "How was your training session today?" The answer was provided 30 minutes after the end of the session, by choosing a descriptor and a number from 0 to 10 (Table 3), which could also be provided in decimals (eg, 7.5). Concerning the coaches, the classification of planned load intensity was done before the beginning of each training session.

Statistical Analyses

Data are presented as mean ± SD. Swimmers' age, years of experience in competitive swimming, and

Table 1 Characteristics of Each of the 3 Age Groups of Swimmers (Mean ± SD)

	Age Group		
	11–12 y	13–14 y	15–16 y
Age (y)	11.2 ± 0.4*	13.4 ± 0.5*	15.4 ± 0.6*
Competitive swimming experience (y)	1.2 ± 0.9*	4.1 ± 1.7*	6.5 ± 1.9*
Height (cm)	146.7 ± 4.5*	158.4 ± 6.9*	169.6 ± 6.1*
Body mass (kg)	38.8 ± 2.4*	49.6 ±5.4*	60.1 ± 5.8*

*P < .05 between groups.

Table 2 Coaches' Age and Experience for Each of the 3 Age Groups of Swimmers

	Age Group		
	11–12 y	13–14 y	15–16 y
Age (y)	38.2 ± 1.7	35.4 ± 2.3	39.4 ± 2.9
Competitive coaching experience (y)	13.2 ± 1.9	12.1 ± 1.7	14.5 ± 2.7

Table 3 The 10-Point Rating of Perceived Exertion Scale[2]

Rating	Description
0	Rest
1	Very, very easy
2	Easy
3	Moderate
4	Somewhat hard
5	Hard
6	—
7	Very hard
8	—
9	—
10	Maximal

anthropometric characteristics were compared by 1-way analysis of variance (ANOVA). The relationship between coaches' and athletes' SRPEs was analyzed using Pearson product–moment correlation. Training-session intensities were divided into easy (RPE <3), moderate (RPE 3–5), and difficult (RPE >5), based on coaches' perception. A 2-way ANOVA was used to compare coaches' and athletes' perceptions at each intensity level (easy, moderate, and difficult). When a significant *F* value was found, a Tukey post hoc test was used for multiple-comparison purposes. Statistical significance was set at $P < .05$.

Results

Figure 1 illustrates SRPE means for coaches and swimmers according to training-intensity categories (easy, moderate, and difficult) in each age group. There was a significant difference between intensity categories ($P < .05$) for the 3 age groups. Agreement between coaches and athletes tended to increase with age and experience. As shown in Figure 1, the younger and less experienced (11–12 y, $F_{2,435} = 28.86$, and 13–14 y, $F_{2,606} = 20.78$) age groups identified SRPE differently from coaches in the 3 training categories (interaction effect). On the other hand, there was no difference between the older (15–16 y) age group's SRPE and coaches' classification in 2 training categories (easy and moderate). However, when the expected coaches' SRPE was higher than 5 (difficult, interaction effect), athletes rated it significantly lower ($F_{2,462} = 10.47$).

Regardless of the age group, there was a positive correlation between coaches' and athletes' SRPEs ($r = .60$, $P < .001$). When each age group was analyzed individually, the group with the youngest athletes (11–12 y) yielded the lowest correlation coefficient ($r = .31$, $P < .001$), whereas the 15- to 16-year-old group presented the highest correlation among the 3 groups ($r = .74$, $P < .001$). The 13- to 14-year-old group presented a correlation of $r = .51$ ($P < .001$; Figure 2).

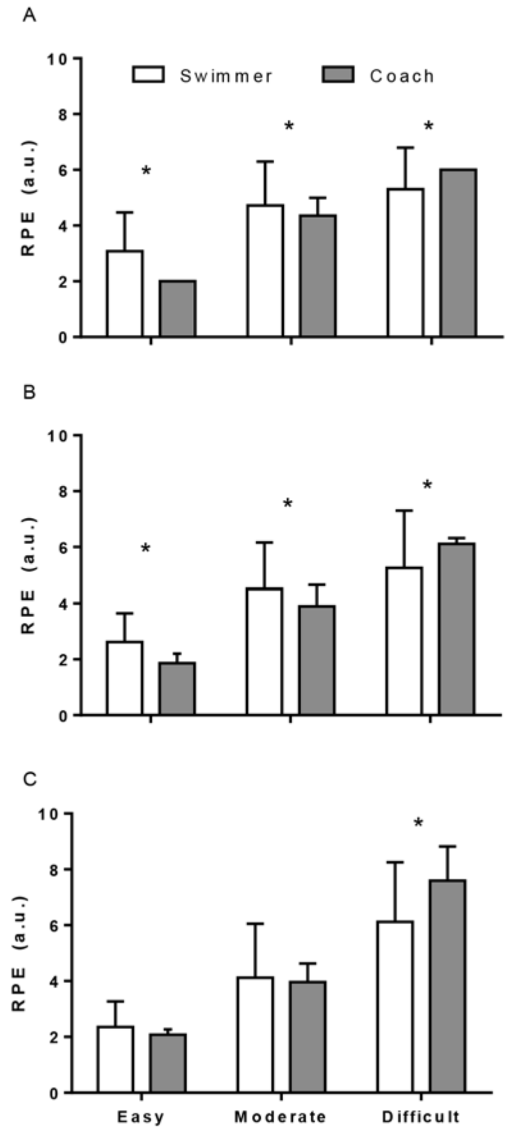

Figure 1 — Session ratings of perceived exertion (RPE) for each age group of swimmers and for coaches. (A) 11–12 y old, (B) 13–14 y old, and (C) 15–16 y old. *$P < .05$ between coaches and athletes.

Discussion

The main aim of the current study was to compare the training SRPE perceived by coaches with that perceived by competitive swimmers in different age groups. Our results demonstrate a positive and moderate correlation between athletes' and coaches' SRPEs ($r = .60$, $P < .01$). Furthermore, this correlation increases with age and experience. A weak correlation was observed between athletes' and coaches' SRPEs ($r = .31$, $P < .001$) for 11- to 12-year-olds; the correlation increased for 13- to 14-year-olds ($r = .5$, $P < .001$) and was stronger for 15- to 16-year-olds ($r = .74$, $P < .001$). In addition, we observed a large variation in athletes' response to the same planned SRPE (Figure 2).

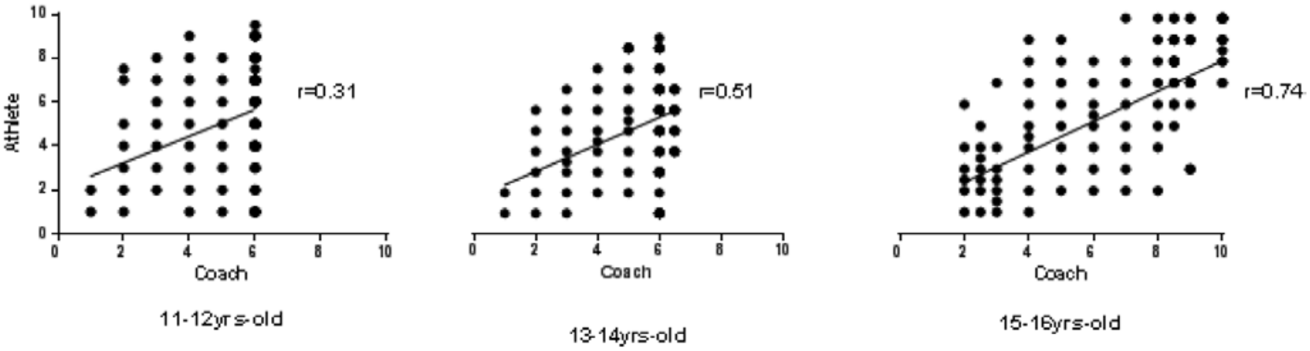

Figure 2 — Scatter plots and Pearson correlation coefficients between coaches' and swimmers' session ratings of perceived exertion.

The relationship between coaches' and athletes' SRPEs has already been observed in other studies with different sports such as soccer,[10] judo,[17] karate,[18] and swimming.[8] Wallace et al[8] observed a strong correlation (r = .88) between coaches' SRPE and a variety of TRIMPs in estimating training load in adult swimmers, which might indicate that swimming coaches are able to prescribe external load in accordance with older swimmers' perceived internal load.

Although the attempt to correlate coaches' with athletes' SRPE is not new, the novelty of this study is that the correlation between athletes' and coaches' SRPEs seems to be affected by athlete age and experience. Our results showed that younger and less experienced (11–12 and 13–14 y) age groups' and coaches' SRPEs were different in the 3 training categories (ie, easy, moderate, and difficult). For instance, when a training session was planned to be easy, athletes rated higher than coaches. Conversely, when the session was planned to be difficult, athletes rated lower than coaches. On the other hand, the older (15–16 y) swimmers' SRPE agreed with that of the coaches in 2 training categories (easy and moderate). Only when the expected coach SRPE was difficult (RPE >5) was athletes' SRPE significantly lower than coaches'.

If the younger and less experienced (11–12 and 13–14 y) age groups' SRPE is always toward moderate loads (Figure 1), it might increase training monotony. Training monotony represents an index of training variability estimated as the result of the division of the daily mean by the standard deviation of the training load over a period of 1 week.[1] High training monotony leads to maladaptive responses and/or overtraining syndrome, hindering long-term performance development.[1] Therefore, care should be taken when prescribing training to young athletes.

This tendency toward moderate training loads is similar to that reported previously in endurance runners,[19] which might suggest that a large component of endurance training is presented in swimming. Our results indicate that training for young swimmers has a large endurance component, which coaches believe is necessary to build an aerobic base for later performance improvements.

These results are hard to reconcile, since this is the first investigation to study the influence of age and training experience on SRPE between coaches and athletes. Nevertheless, based on our results, it is conceivable that more experienced athletes can perceive effort better than less experienced athletes due to greater variability (eg, anaerobic, aerobic) during their years of training. In fact, Eston et al[20] demonstrated that children's (7–10 y old) in-task effort perception (RPE) improved after they performed multiple bouts of exercise at different intensities. This variability in intensity can contribute to improve RPE by allowing athletes to experience and identify a variety of physiological changes (eg, heart rate, ventilation, oxygen uptake, blood lactate),[12] thus creating an internal anchoring for their effort.[21] In addition, Gearhart et al[21] proposed that individuals can more easily identify intensity levels that they experience frequently. Thus, our results corroborate previous suggestions on the importance of athletes' experience in identifying different training intensities more accurately but also add to the current knowledge that SRPE improves with training experience.

In addition, Groslambert and Mahon[11] suggested that in-task effort perception accuracy depends on individual cognitive developmental level and, thus, accompanies children's maturation. Cognitive development allows young athletes to better integrate peripheral sensory cues, which in turn enhances effort perception.[11,13] Even though we did not assess participants' cognitive level, it is plausible that athletes from different age groups were in different cognitive developmental levels,[11] evidencing the influence of age on effort perception. It is important to highlight that research investigating the accuracy of children in perceiving their effort was conducted with in-task protocols. Recent studies[22,23] failed to demonstrate a good agreement between mean RPE (calculated during a continuous or resistance exercise bout) and SRPE. These findings indicate that individuals estimate SRPE and RPE based on different perceptual cues, and thus results from RPE should be used with caution when trying to calculate training load. In addition, it is difficult to extrapolate the findings from a constant-load or resistance-exercise bout to a typical swimming training session in which athletes are required to perform different tasks at different intensities.

One limitation of our study is the lack of another internal load measurement such as Banister TRIMPs,[7] which would provide a physiological assessment of internal load. Nevertheless, our objective was to compare SRPE between coaches and athletes.

Another important point is that the instructions given to the younger athletes should be clearly stated. Misunderstanding of the instructions by swimmers might induce them to perform tasks at different intensities than previously planned, hence affecting SRPE. Thus, coaches should be concerned with how to provide the information to their athletes. However, more studies are necessary for a better comprehension of how instruction can affect the relationship between coaches' and athletes' SRPEs.

Conclusion

In summary, the current findings demonstrate that the relationship between coaches' and athletes' SRPE is improved with increased years of practice, which highlights that training prescription for a group of swimmers, especially at younger ages, may lead to an inappropriate training-load application and hinder performance improvements. Furthermore, it seems important for young athletes to perform training at different intensities to improve their intensity perception.

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