International Journal of Aquatic Research and Education

Volume 2 | Number 4 Article 5

11-1-2008

Aquatic Perceived Competence Analysis in Children: Development and Preliminary Validation of a Pictorial Scale

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International Journal of Aquatic Research and Education, 2008, 2, 313-329

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The aim of this study was to develop and validate a scale for measuring perceived motor competence of children in the water (also known as aquatic perceived competence). One hundred boys and girls four and five years old took part in the study and were given a picture questionnaire featuring a series of images of children engaged in a variety of water tasks. Factor analyses were conducted to test whether the ten-item scale is made up of two major dimensions, the first of them referring to willingness (predisposition or attitudes of the children toward the water) and the second to the perceived skill competence in water. This instrument was shown to have suitable psychometric properties both on the overall scale (α = .92) and on the two subscales: attitude (α = .93) and perceived water skill (α = .85), with the eldest participants registering the highest scores. The Aquatic Perceived Competence Pictorial Scale (APCPS) for children is recommended as an instrument for both researchers and swimming instructors to use for assessing the aquatic perceived competence of their students.

Several authors have studied children's motor development in connection with the water (Erbaugh, 1979; Langendorfer & Bruya, 1995; McGraw, 1935). They described that children between the ages of three and five years are capable of performing and improving swimming movements in a similar and parallel fashion to how they perform and develop motor skills out of the water, since ontogenetically motor competence manifests itself both on land and in the water. This similarity occurs since motor competence is the result of interactions between genetic factors and the contexts in which they must act.

The cognitive behaviors of preschool children often are characterized by apprehension over novel experiences such as entering and moving within the water environment. During the preschool years, children also acquire knowledge of global action and experiences. At this age, many children have their first exposure to group educational experiences as well as their first social imperatives. It is during these preschool years that discrepancies start to emerge between actual competence and perceived competence (Ruiz & Graupera, 2005).

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In this respect, children learn to be competent when they learn to interpret situations that require competent action. These experiences allow them to develop the resources they need to respond appropriately to the demands of the situation, which means they develop a feeling of efficacy to act, of confidence to be able to adapt to problematic situations that arise, and the joy of causing transformations in their own environment (Harter, 1981a). The origin and use of competency have varied interpretations in the psychological and pedagogical literature. Currently, different interpretations could be observed in the literature that have clear interrelations (Ruiz, 2008): one related to motivation, which refers to people's capacity to formulate goals and to perform persistent actions aimed at achieving them; a second related to the perception of oneself as a capable person in a specific area of action; a third that expresses possession of certain skills and resources to meet the environment's requirements; and a fourth related to the possession of certain personality traits that favor an effective behavior.

From an early age, children are capable of perceiving at least in a relative fashion their ability to perform a motor task. Consequently, the first games played in the early childhood period tend to develop toward more complex forms of behavior, where children naturally pursue objectives related to their performance efficacy (e.g., Who can throw the furthest? Who can run farther or faster? Who plays better?). Children who have started to acquire fundamental motor skills have a long way to go until they manage to master those motor skills and be able to adapt them to specific contexts. This expertise acquired over the years is rooted in a teaching and learning process that will enable more economic use to be made of their personal energy resources (Famose, 1992). It makes it possible to develop complex action patterns for performance of tasks in the future. Consequently, developmental experts (Bruner, 1996; Karmiloff-Smith, 1994; Piaget, 1975; Vygotsky, 1988) deem that early experiences are extremely important for attaining later achievements and performances.

It is important to realize that children do not perceive themselves as competent in the same way in different areas of action. Therefore, it is necessary to differentiate dimensions of competence according to Harter's (1978) notions of the mastery of achievement: cognitive competence (which is referred to as intellectual and school achievements), social competence (which are relations the child establishes with peers), and physical competence (which involves combining the results the child obtains in games and sport and which involve a strong commitment to physical activity and movement). Some research (Connolly, 1980; Keogh & Sugden, 1985; Ruiz, 1995) has studied motor competence and considers it to be associated with individuals' behavior when complex motor tasks are performed. During learning, when children experience success in different tasks, this produces intrinsic pleasure, which encourages them to want to persist and improve their competence (Shapiro, Yun, & Ulrich, 2002).

Measurement Instruments of Perceived Motor Competence

In research on the perception of motor competence, the concepts of self-esteem and perceived competence are the center of the formulations that have emerged from theoretical social learning (Bandura, 1977). Other authors defend theoretical

perception (Bem, 1972), social cognition (Lepper & Greene, 1978), and the theories related to intrinsic motivation (De Charms, 1968; Deci, 1975; Harter, 1978, 1981b; White, 1959).

Two of the most well-known instruments are the Coopersmith (1981) Self-Esteem Inventory and Piers-Harris Self-Concept Scale (Piers & Harris 1964; Piers 1969), which include conditional competency subscores in their measurements, such as physical characteristics, personal relations, and affective reactions.

Different foci have been used to construct and handle the instruments used to assess perceived motor competence (Burns, 1990; Villa & Auzmendi, 1992): self-concept, self-esteem, and self-efficacy. Harter (1982) presented a scale measuring self-concept considered to have relative validity, due to its almost exclusive clinical applications. It is divided into various subscales: cognitive (which places emphasis on academic changes, e.g., working well, quickly, intelligently), physical (which emphasizes the importance of doing sports and outdoor games), social (which values the importance of friends in classes), and self-control independent of any behavior (which refers to the state of wellbeing with oneself). In this respect, the motor competence scale for children puts forward the hypothesis that they do not experience competence in the same way in every specific field. Consequently, Harter (1982) points out that before the age of eight years, children do not make specific judgments in different areas on their own; instead they have a constructed vision of self-control with a person forming their self-theory after this age.

One of the most frequently used dimensions of perceived competence is extracted from the PSPP by Fox (1990) and Fox and Corbin (1989). For example, the self-concept scale for children by Martinek and Zaichkowsky (1977) and the pictorial scale of perceived competence and social acceptance for young children by Harter and Pike (1984) are instruments that contain physical and motor items together along with other images drawn from other domains of action. Another is the modified pictorial scale of perceived physical competence for young children by Ulrich and Collier (1990), which was designed to assess the global perception of motor competence of children between the ages of seven and twelve years. Lots and Jongsma-Melcherts (1992) and Van Rossum and Vermeer (1992) adapted Harter and Pike's scale to children with disabilities in Holland, which has been used in physical education contexts with little success (Van Rossum, Vermeer, & Harkema, 1994). Almost all the scales are presented through images, so the child has to choose the drawing he most identifies with or is most like. Normally a competent child is shown at one end of a task continuum, while a not very competent child is shown at the other end.

There are other authors who have specifically analyzed the sources of information of self-efficacy in swimming and motor self-efficacy in general, such as the PSE scale by Balaguer (1994). There are also the "ECOMI" (1997) and the CMPI scales, both validated for the Spanish population by Ruiz, Graupera, and Gutiérrez (2001) and Ruiz and Graupera (2005). The latter CMPI scale was designed for application to four- to six-year-old school children to assess their perceived motor competence, while the main objective of the former, the ECOMI, was to record motor competence in natural situations in 4- to 12-year-old school children in physical education classes.

As Bandura and Cervone (1983) stated, specific assessment instruments of self-efficacy need to be developed in the different spheres and dimensions of motor competence. The review performed by Villa and Auzmendi (1992) of these types of instruments demonstrated how the majority had been designed for children over seven years old, which points out the need to develop instruments that help us to discover perceptions of competence in children under six years. Herein lies the objective of our research study, which was to design a scale to measure perceived motor competence in the water for children less than six years.

Method

Participants

The primary participants in this study were 100 school children (46 boys and 54 girls) ages 4 (n = 55) and 5 (n = 45) years (M = 4.5, SD = 0.67) who attended a school water program consisting of 20 individual class sessions. The water program took place for one hour per week, and was included as part of the school curriculum. None of the participants had prior swimming movement experience before starting the program.

Development of the Instrument

Different measurement instruments of perceived motor competence were reviewed for the construction of this questionnaire (Harter, 1982; Piers 1969; Piers & Harris 1964; Ruiz & Graupera, 2005; Ruiz, Graupera, & Gutiérrez, 2001; Van Rossum & Vermeer, 1992), as well as manuals on water activities for young children (e.g., Cirigliano, 1989; Freedman, 2001; Langendorfer & Bruya, 1995; Moreno & Gutiérrez, 1998; Moreno, Pena, & Del Castillo, 2004), establishing a pool of items that were transferred to pictures showing boys and girls in different scenarios in a swimming pool, grouped into two dimensions according to the theoretical studies reviewed.

Given that the questionnaire was aimed at a target population of boys and girls under seven years old, the basic premise for constructing the scenes to be clear, simple, and to the point so young children could understand their intent. As a first informal test to establish content validity, the instrument was presented to three experts in the spheres of water activities and motor development to determine whether any essential aspect was missing in connection with the objectives pursued and which may not have been envisaged properly. This led to the selection of items where there was 100% agreement. Later, this revised, scaled-down instrument was administered to a small sample selected randomly to analyze whether it was comprehensible to children and to bring any problems to light that had not been discovered previously. This pilot test made it possible to improve the presentation of some of the questions, since they raised problems of understanding, frequently requiring an additional explanation by the researcher. It was observed that the test took too long, which might cause attention problems in children. After the administration of the initial questionnaire, the terminology used was corrected in those questions that presented understanding difficulties, the contents were readjusted and the final questionnaire was written and drawn.

As a whole, the questionnaire items represented scenes related to the water domain in tasks such as flotation, propulsion, manipulation, balance, and breath control, which ranged from the child going into the water individually and with the aid of equipment, to the performance of group games and without any support at all (Figure 1). Scenes referring to the boy or girl's attitude toward the water also were included, with regard to going to the swimming pool and the specific act of getting into the water (Figure 2).

The version of the Aquatic Perceived Competence Pictorial Scale (APCPS) used in this study initially consisted of 22 items that the children could respond to on a Likert-type scale with three options: A (*best*), B (*middle*), and C (*worst*) to the question for each item. Every one of the alternatives was presented individually to the participant with an image (comic strip) to facilitate understanding of the question. With a pencil, the child had to point out which of the images was most like him or herself. To control possible random sources of error, the order of the items was presented randomly to every one of the participants. Similarly, the order of the intraelement presentation (reply option) varied across items.

Procedure

The head teachers of the schools as well as the teachers and parents/guardians of the children were asked for permission to collect the information. Before giving the scale to the definitive sample, the complete set was first administered to a separate pilot sample comprised of 60 participants (Osterlind, 1989). It was observed that some images and words still caused understanding problems. These were corrected and finally the definitive scale was produced, which was administered to the final sample in the study. In the final administration, the participants were told how to fill in the questionnaire. The presentation and application of the scale was performed individually by the main researcher, who showed the sheet with the three drawing answer options to each child, so that after the question had been asked and the three answer options accompanying each drawing had been read, the children could point out which option was most like themselves. The

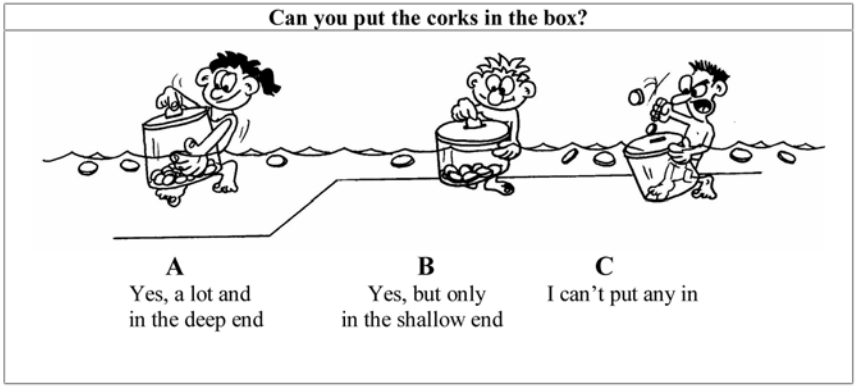

Figure 1 — Example of an item.

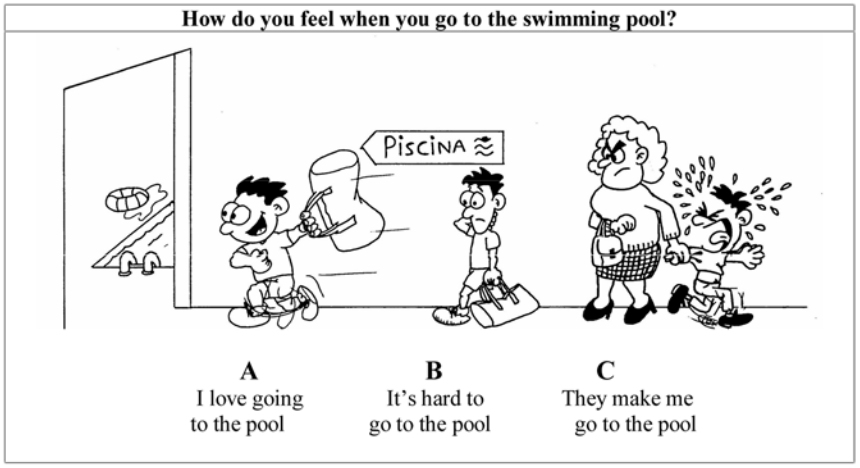

Figure 2 — Example of an item concerning attitude toward the water.

time required to fill in the scale was approximately 10 minutes, varying slightly depending on the participant's age.

Data Analysis

A descriptive analysis of the means, standard deviations, and correlations of all the variables was performed. An exploratory factor analysis was conducted to obtain the scale's factor structure. Next, an internal consistency analysis of the instrument (Cronbach's alpha coefficient) was checked. A MANOVA was performed to obtain the results on the main effects of the interaction among the different variables.

Results

Psychometric Properties

A descriptive analysis (means and standard deviations) of all the items was performed as the first step with the intention of maximizing the scale variance and selecting the items that presented a high discriminatory power, high standard deviation, and mean accepted response scores (Nunnally & Bernstein, 1995). The result was that all the typical standard deviations were above 1, and all the means were around the midpoint of the scale (symmetry close to 0), except for items 5, 10, 13, and 22.

Exploratory Factor Analysis

An exploratory factor analysis was performed of main components with direct oblique rotation with the remaining 18 items. This made it possible to remove those items (12, 17, 18, 19, and 20) that did not obtain enough saturation in a first

analysis, which was established at .40 (Comrey & Lee, 1992; Stevens, 1992). Next, to calculate the discrimination of an item and to increase the internal consistency, the corrected correlation coefficient was calculated between the score in the item and the total obtained in each dimension. Mean interitem correlations were performed obtaining positive correlations between the items that formed part of the same construct (Clark & Watson, 2003). All the correlations showed values over .30 (Nunnally & Bernstein, 1995), except the correlations between items 11, 16, and 21.

A second factor analysis was performed with the ten remaining items (see Appendix), using the main components method with direct oblique rotation, obtaining a factor solution of two large dimensions that explained 76.88% of the variance as a whole, with saturations that were all above .70 (Table 1). The first factor, which was called "perceived motor skill in water," consisted of six items and it had an explained variance of 46.9%. The second factor, called "attitude towards water," had an explained variance of 29.98% and it consisted of four items.

Internal Consistency Analysis

The reliability of the entire scale and of the two subscales was calculated using Cronbach's alpha coefficient. The scale's general coefficient was very satisfactory (α = .92), which highlighted a very consistent response in such young children. The coefficients of the two subscales were equally important.

In the case of motor skill in water, the reliability was also very satisfactory (α = .93). This factor consists of six items, namely, "Can you go up the ladder?" "Can you float?" "Can you stay in the deep end without needing any equipment to help you?" "Can you put the corks in the box?" "How many corks can you put on the rope?" and "When you have a race with your friends in the deep end, what place do you usually come in?"

The attitude toward water factor refers to items that asked about certain attitudes toward water activities. It consisted of four items: "At the swimming pool, how do you put your swimming costume, hat and bathing shoes on?" "How do you feel when you go to the swimming pool?" "How do you get into the water?" "Do your friends choose you to play in the water?" Cronbach's alpha was also acceptable (α = .85).

Test-Retest Reliability

A sample of 45 students aged between 4 and 5 (M = 4.6, *SD* = .82) in early childhood education was used to analyze the scale's temporary stability. These pupils answered the scale twice, with a separation of four weeks. The intraclass correlation coefficient (ICC) was calculated for each of the scale's factors. For motor skill in water, the mean was 1.80 (*SD* = .43) and 1.82 (*SD* = .42) with an ICC of .88. For attitude, the mean changed from 1.57 (*SD* = .50) to 1.58 (*SD* = .90) with an ICC value of .91. ICC values between .70 and .80 show acceptable levels of stability, between .80 and .89 moderate stability, and .90 or more, high stability (Vincent, 1995).

Table 1 Saturation and Explained Variance of the Factors Obtained in the Exploratory Factor Analysis With Direct Oblique Rotation of the Pictorial Scale.

Items	Motor skill in the water	Attitude toward the water
1. At the swimming pool, how do you put your swimming costume, hat and shoes on?		.84
2. How do you feel when you go to the swimming pool?		.85
3. How do you get into the water?		.88
10. Do your friends choose you to play in the water?		.75
4. Can you go up the ladder?	.89	
5. Can you float?	.90	
6. Can you stay in the deep end without needing any equipment to help you?	.91	
7. Can you put the corks in the box?	.86	
8. How many corks can you put on the rope?	.89	
9. When you have a race with your friends in the deep end, what place do you usually come in?	.90	
Explained variance	46.90%	29.98%
Total variance	76.88%	

Means, Standard Deviation and Correlation Analysis

Table 2 shows the means and standard deviations of the scale's subfactors, where it is observed that the mean obtained in the attitude factor (M = 1.62, *SD* = 0.85) was less than the mean of skill factor (M = 1.98, *SD* = 0.55). Attitude and perceived skill showed a positive and significant correlation ($r = .66$; $p < .001$) with each other.

Main Effects and Effects of Interaction of Gender and Age

We performed a MANOVA on the data from the sample, where attitude and perceived skill acted as dependent variables and age and sex as independent variables. With regard to age, the results showed significant differences, Wilks' Lambda = .77, $F(2, 95) = 14.18$, $p < .001$. Specifically these differences existed for both the attitude ($F = 20.20$, $p < .001$) and skill factors ($F = 24.76$, $p < .001$). Other differences, for both the attitude and skill factors, favored older participants (M = 1.38 and M = 1.71, respectively) compared with the youngest (M = 1.82 and M = 2.21, respectively). No significant differences were found for the main effect of sex nor in the age x sex interaction (Table 3).

Discussion

Because water activities can be important for educational and motor development reasons, introductory swimming experiences increasingly are appearing as preferred educational actions during early childhood preschool ages. The authors believe there is evidence to support the importance of many physical, cognitive, socioaffective, and even psychotherapeutic benefits that can be obtained from engaging in water activities. Water experiences seem to have a positive impact on allaying fears based on the self-knowledge and self-control an individual gains. Because of the important benefits that may accrue from early water experiences, having a valid and reliable measurement instrument for assessing the perceived water competence of young children could be very valuable to specialists in aquatic education and instruction.

Therefore, the purpose of our study was the development and preliminary validation of the Aquatic Perceived Competence Pictorial Scale (APCPS) for use with young children. A primary aim of our study and this instrument was to discover the perceptions of aquatic competence that four- and five-year-old children showed in the place where water activities are performed as well as to ascertain whether any significant or meaningful differences existed between different age children and between young boys and girls.

Because of the physical nature of water and the relatively limited experiences most children have moving in the water, the possibilities for measuring their specific perceptions about their aquatic movement competence turns water into an ideal environment for self exploration and experimentation. This early exposure to and acquisition of aquatic skills aim to form the child's future attitude toward the water, which in turn should generate a more positive perception of water motor competence. With experience in the water, children should be able to adjust their

Table 2 Descriptive Statistics, Internal Consistency and Correlation Among the Factors

	M	*SD*	α	Attitude	Skill
Attitude	1.62	0.52	.85	—	.66**
Skill	1.98	0.55	.93		—

** $p < .001$

Table 3 Multivariate Analysis According to Participants' Age and Sex

	Main effects		Interaction effects
Variables	**Age**	**Sex**	**Age χ Sex**
	F	*F*	*F*
Attitude	20.20**	1.23	.00
Skill	24.76**	1.64	.04
Multivariate Analysis			
Wilks' Λ	.77**	.98	.99
Multivariate *F*	14.18	.91	.02

** $p < .001$

perceptions to the reality of their swimming competence as well as perhaps to improve their water competence to match their initial positive perceptions.

The extensive testing process we used for creating our instrument enabled us to validate a pictorial aquatic self-competence instrument consisting of ten items divided into two dimensions (i.e., skill and attitude) assessed by six and four items, respectively. Our preliminary results demonstrated that the APCPS presented satisfactory initial psychometric properties. As hypothesized and consistent with the general developmental literature, the scores from older participants showed a greater perception of skill and a more positive attitude toward water than from younger participants. It is possible this improvement may have been due to more advanced levels of neuromuscular development (Zaichkowsky, Zaichkowsky, & Martinek, 1975) associated with slightly older (i.e., five year old children) compared with younger four year olds.

On the other hand, it is possible that lower perceived water competence at the youngest age may be the cause of reciprocal motivation problems and emotional difficulties regarding water activities. Such a phenomenon is seen in children with developmental motor coordination problems (Causgrove-Dunn & Watkinson, 1994; Ruiz, 2005). The relationships among perceived motor competence, self-esteem, and healthy psychosocial functioning are some things that researchers are constantly concerned about. Preschool swimming teachers potentially could use

our proposed APCPS to discover their pupils' aquatic perceptions as a prerequisite for planning, designing, and selecting the most developmentally appropriate tasks for promoting student-centered learning. Checking the levels of perception of a child's water competence could help the teacher find an optimum path so that children will participate more in water activities. Generally, the perceived competence research shows that higher levels of perceived competence actually lead to higher levels of intrinsic motivation (Bandura & Cervone, 1983; Deci & Ryan, 1985; Harter & Jackson, 1992; Losier & Vallerand, 1994).

In short, the study has served to support the two dimensional nature of perceived water competence among young preschool children, as well as to facilitate an initial analysis of both the factor structure and the internal consistency of the scale in a Spanish context. Future research performed with different sized samples within similar environmental contexts is necessary to actually confirm the factor structure shown in our current research study. One of the study's limitations arises because as children grow from three and six years old, their notions about their own skill competency change fairly dramatically (Suls & Sanders, 1982). Initially they are incapable of defining and expressing specific tasks conceptually. Although the cognitive conceptual understanding of their own skillfulness increases during this period, the cognitive concept is probably not the best measure or indicator of their actual perceptions. Understanding conceptual information during early childhood largely depends upon the importance given to the information concerning both successes and failures experienced during water activities. There is a need to perform confirmatory factor analyses in future studies because we did not conduct them in our study and we recognize this as another limitation of our research.

We conclude by highlighting the importance we expect our study, as well as similar studies already performed or being performed at the moment, may have on our understanding of aquatic perceived competence. Because of the exploratory nature of this study, there is a strong need for swimming instructors to use the APCPS instrument in swimming classes to determine its usefulness in planning. Researchers need to compare the results of the APCPS with objective swimming competence data (e.g., using Langendorfer and Bruya's 1995 Aquatic Readiness Assessment) to discern the strength of relationships that may exist between perceived and actual water competence. In addition, the influences of children's motivation, physical self-concept, and varying teaching strategies on aquatic perceived competence need to be explored. We invite practitioners and researchers to explore using the APCPS to measure aquatic perceived competence and to identify its strengths, weaknesses, and relationships to other areas of behavior.

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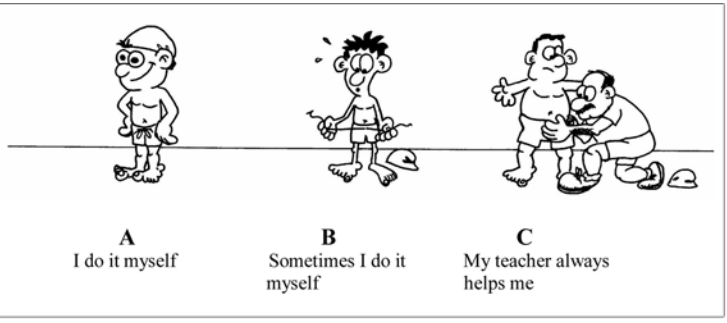
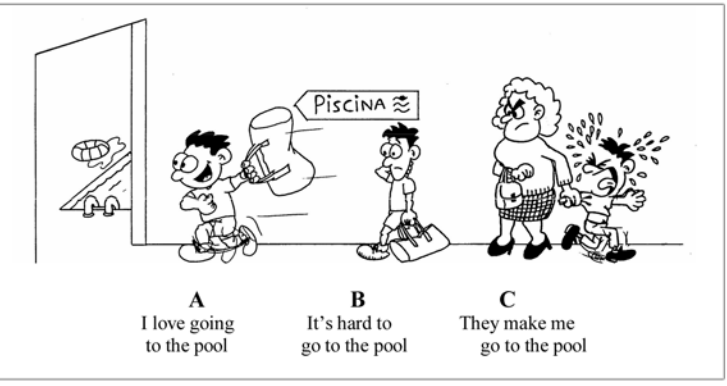
Appendix

Aquatic Perceived Competence Pictorial Scale (APCPS)

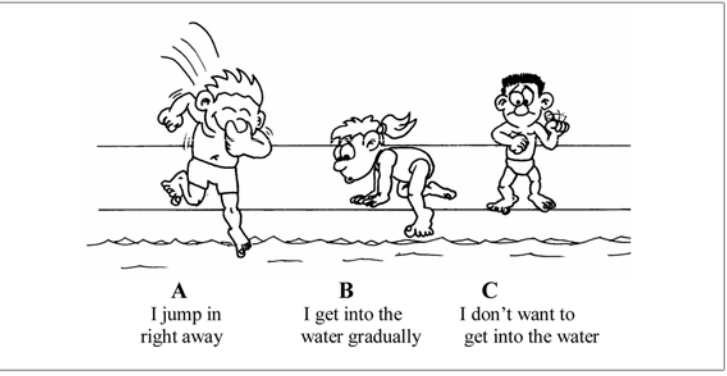
1. At the swimming pool, how do you put your swimming costume, hat and bathing shoes on?



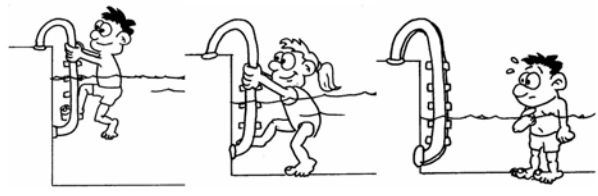
2. How do you feel when you go to the swimming pool?



3. How do you get into the water?



4. Can you go up the ladder?



A I can get up it in the deep end

B I can only get up it in the shallow end

C I can't get up the ladder

5. Can you float?

A I can float on my own

B I can float with the help of floats

C I can't float

6. Can you stay in the deep end without needing any equipment to help you?

A Yes, I can do that

B Only sometimes

C No, I can't do that

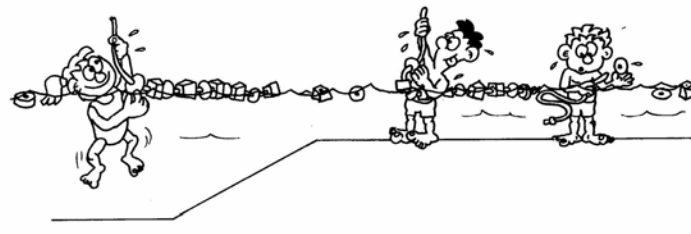
7. Can you put the corks in the box?

A Yes, a lot and in the deep end

B Yes, but only in the shallow end

C I can't put any in

8. How many corks can you put on the rope?

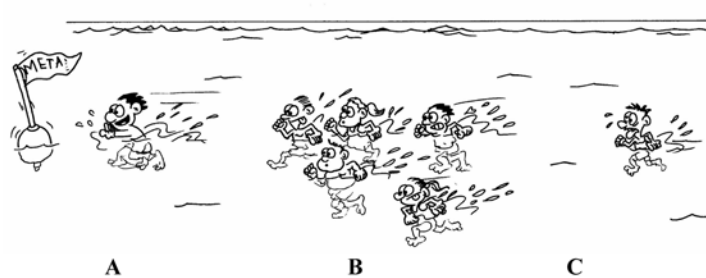


A A lot and in the deep end

B A lot, but in the shallow end

C None

9. When you have a race with your friends in the deep end, what place do you usually come in?

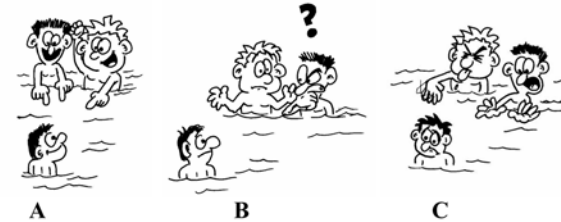


A One of the first

B In the middle

C One of the last

10. Do your friends choose you to play in the water?



A They always ask me to play

B Sometimes they ask me to play

C They never let me play