ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.20242

Design and Validation of a Scale to Measure Fear of the Aquatic Environment in children

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ABSTRACT

Although fear in early childhood is an emotion that permits survival of danger, fear of water can block and limit children's adaptive development towards this very fear. Aquatic competence is an important milestone in the improvement of general health in childhood, but there are no scales that measure how fear of water can hinder a child's development in the aquatic environment. This study aimed to design and analyze the validity of a Scale to Measure Fear of the Aquatic Environment (SFAE) to evaluate the perceived fear of the aquatic environment in three- to six-year-old children. Construct validity was also evaluated by verifying its relation to aquatic competence. The exploratory and confirmatory factor analyses support the use of five dimensions of influence on the perception of fear of the aquatic environment: social context, equipment/installations, attitude, experiences, and competence. The correlation pattern also supports construct validity showing negative and significant relations between fear and aquatic competence. The SFAE shows a promising initial validity for its use in the aquatic environment during early childhood.

KEYWORDS: aquatic activities, adaptive development, measure, early childhood, evaluation instrument.

INTRODUCTION

From a neurocognitive point of view, fear could be defined as an evolutionary emotion triggered when a person perceives a stimulus as dangerous and/or unknown (Silveira & Moreno-Murcia, 2015). Although its origins can be found in both phylogenetic and ontogenetic contexts, it is the latter that helps us understand how it could unfold during some evolutionary stages. Thus, the development of fear during early childhood constitutes a primitive alarm of an adaptive nature that allows a child to avoid situations that could become potentially dangerous (Martínez, 2014). Later, a child's evolutionary development itself progressively facilitates their ability to modulate the types and intensity of fear they perceive, gradually adjusting it to the new demands of the environment (Méndez et al., 2012). However, because each individual may perceive, interpret and act on the same experience differently, the feeling of anguish and lack of control that can cause fear does not always correspond to real and objective situations, so professional help is required. In this sense, research into fear should take into account the great complexity of this variable.

With respect to fear triggers, even today, the classification by Miller et al. (1972) is useful. It has three categories: 1) fears related to physical integrity (fear of suffering physical injury, dying, drowning, etc.), 2) fears related to social threats (fear related to personal worth), and 3) fears related to natural or supernatural dangers (fear of thunder, fear of monsters, etc.). For its part, fear of the aquatic environment is usually experienced by a child as a strong dread of drowning, so it can be incorporated within the category of fear of suffering physical harm. According to the American Psychiatric Association (APA, 2000), fear of water is considered a "specific phobia", which manifests itself as "a marked and persistent fear of clearly discernible, circumscribed objects or situations". The prevalence rate for fear of the aquatic environment in the general population is situated between 2 and 3% (Stinson et al., 2007), and although it is more common during early childhood, it intensifies throughout adulthood (Becker et al., 2007).

Although there are individual differences in how fear of the aquatic environment is experienced and interpreted, like any other fear, it manifests itself on three levels: motor, a child

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Conflict of Interest: Nothing to declare. Funding: To complete or nothing to declare
Manuscript received at 06 08, 2020; Accepted at 09 29, 2020.

shows a desire to avoid contact with actions leading to it; cognitive, a child understands that this medium represents a physical threat and they could drown; and physiological, corporal changes which are typical when a child is in situations that are either threatening or upsetting (Abadía et al., 1998; Méndez, 1999; Pharr et al., 2018). As the aquatic medium is an environment that is different from the one a child usually develops in, their first experiences with this medium can be decisive in causing this fear to appear. In this sense, previous research corroborates that among the reasons self-reported by children about their perception of fear of the aquatic environment, fear of drowning is a very common factor (Berukoff & Hill, 2010; Shank, 1987; Pharr et al., 2018; Whiting & Stembridge, 1965). Other causes indicated in the scientific literature for the origin of the fear of the aquatic environment correspond to stressful situations like ducking and fear of doing a task wrongly, or fears related to installation resources, such as personal fear (of the instructor) or physical fear (of equipment or characteristics of the installations like the depth of the swimming pool.) (Grenfell, 2004; Moreno et al., 1992; Salguero et al., 2004; Valiente et al., 2002). To be exact, it is during the first stages of exploration, discovery, and adaptation to the aquatic environment that some behaviors rejecting the aquatic environment can appear.

However, although scientific literature about fear recognizes that some of these evolutionary fears usually disappear over time, there is a variety of learned or conditioned behaviors whereby a fear can be maintained for many years (Méndez, 1999), as it is linked to unease generated during a previous experience (Shank, 1987; Whiting & Stembridge, 1965). Specifically, some studies have reported that while learning swimming techniques during infancy and childhood, fear of the aquatic environment constitutes the strongest predictive factor of the low ability to learn to swim (Irwin et al., 2010; Ziara, 2005). To address this need, advances in comprehending the reasons that cause fear of the aquatic environment could help designing educational aquatic programs that would be able to achieve a positive adaptation to swimming lessons.

The techniques used to analyze generalized responses about fear in children (Moreno et al., 1992) are centered on interviews, self-reports, inventories, observation and rating scales, self-observation, observation and direct recording, and psychophysiological techniques. However, for the evaluation of fear in the aquatic environment, there are no instruments to date that focus on measuring fear of the aquatic environment in early childhood.

Based on the above arguments, and taking into account the need to design validated instruments that measure fear of the aquatic environment in the child population, this paper establishes two objectives. The first objective was to design and validate an instrument for evaluating fear of the aquatic environment in 3- to 6-year-olds (studies 1 and 2) and analyze its psychometric properties. The second objective was to verify the relation of fear of the aquatic environment with aquatic competence in early childhood to establish the construct validity of the instrument (study 3). This scale would therefore contribute to mitigating the difficulties that this emotion can generate in a child (Irwin et al., 2015) in a learning environment, where their aquatic competence is hindered (Milosevic & McCabe, 2015), and also from a psychological point of view, where there is an increase in their unease towards this medium.

STUDY 1

The objective in this first phase was to create a scale to measure fear of the aquatic environment (SFAE) and also to obtain content validity.

Participants

The Delphi method was used as a strategy to evaluate the instrument to measure fear of the aquatic environment. The validation of the designed instrument would be performed by two groups of humans, established as a coordinating group and an expert group. The coordinating group had a good knowledge of the Delphi Method and comprised academic researchers who were familiar with the subject being studied and were able to intercommunicate easily (Mira et al., 2010). The group of selected experts, who were closely involved and had a wide experience in dealing with this problem, were university lecturers and researchers of renowned prestige in teaching aquatic activities and psychology. Finally, 12 experts were selected, the number indicated by Landeta (2002). The methodological sequence was set out in three phases: initial, exploratory and final.

Initial Phase

The coordinating group was responsible for: defining the research problem; selecting the group of experts and obtaining their commitment to collaborate; interpreting the partial and final research results; and supervising progress, being able to make adjustments and corrections.

Exploratory Phase

Here, the questionnaire was designed in its experimental version for the final version to then be determined (Annex 1). To do this, the first version underwent a first round of analysis and discussion by the members of the Coordinating Group, and certain corrections and adjustments were made

according to the qualitative criteria that had obtained a majority consensus. The agreed version was validated in a second round by the expert group in order to gather information on the most stable quantitative and qualitative criteria. The phases covered by the Delphi method are outlined as follows: 1) selection of experts whose contribution to the study is considered invaluable; 2) Invitation to participate in the process by email; 3) sending and receiving the questionnaire by electronic mail in an attached file, consisting of a first page with a brief introduction and explanation of the research subject, a page for the respondent to fill out with their personal details, a clear description of the study objective and the instructions for completing the questionnaire, followed by the corresponding instrument for validation; 4) validation instrument: Likert type scale with four categories according to adequacy, clarity, coherence and relevance or pertinence of the item to the dimension to be researched, as well as an open question to obtain qualitative valuations about the items or the introduction of any new ones, with a maximum deadline of 30 days; 5) follow-up by email of the selected people; 6) collection of the completed scales; and 7) analysis of information contained in the Delphi scale. The results of this consultation were analyzed by the coordinating group from a quantitative and qualitative point of view, drawing on the opinions expressed by the experts in response to the open question included in the validation instrument.

Final Phase

In the last phase, the results from the whole validation process of the final version of the questionnaire were synthesized.

Procedure

Construction of the instrument

Once the limitations of the instruments available were analyzed, the pictorial SFAE was drawn up to measure fear of the aquatic environment in early childhood (3-6 years old). The content was determined through bibliographical review and with reference to expert opinion (Crocker & Algina, 1986), establishing five dimensions that potentially generate fear of the aquatic environment: influence of social context, influence of experiences, influence of attitude, influence of equipment or installations, and influence of competence. Based on these, an initial bank of items was generated from different questionnaires and scales for evaluating fear of the aquatic environment as well as other instruments and/or constructs for measuring fear during early childhood. A first experimental version was constructed dividing responses to each question into two levels of difficulty.

The coordinating group read and classified each item according to the dimensions: influence of social context, influence of experiences, influence of attitude, influence of equipment or installations, and influence of competence. The choice was made according to the adequacy, rational criterion, and ages of the target sample, resulting in a bank of 25 items. Some of the items included in this version were either taken literally from the original questionnaire, some were reformulated, and the others, the vast majority, were written especially for the occasion. Afterward, it was decided that the questionnaire should appear by alternating the dimensions for the girls and boys. Illustrations were drawn to complement the written information and facilitate understanding; so, text and image complemented one another to make a whole. These illustrations were inspired by didactic materials and children's stories selected by the boys and girls according to their tastes and preferences. The illustrations were later scanned and transformed into an application to be used on a tactile computer. There were two closed response options for each item, where a child could either identify with an adaptative image in relation to the aquatic environment, reflecting well-being, or identify with a non-adaptative behavior, reflecting anxiety.

To reach optimum levels of content validity, the expert technique was used, and a pilot study was carried out to verify its comprehension validity from the perspective of the children as subjects of the study. The experts were asked to value different aspects of the initial information, the questionnaire, the items, and the global valuation of each one (Wieserma, 2001), taking into account the degree of comprehension and the value of the image, among others.

With respect to the items, the degree of pertinence to the subject of the study and to what extent each of them should be included was recorded on a scale from 1 to 4. It was decided that Items with mean values close to 2 should be omitted, items with values around 3 should be modified, and items with values close to 4 should be included. Once these calculations were made, 22 items were decided on for selection.

To verify the comprehension validity of the instrument, a pilot study was carried out. Three experts had administered the questionnaire to a total sample of 122 boys and girls (lasting between 8 and 10 minutes). The protocol for answering the questionnaire consisted of the investigator being placed on a table with the printed images and the child sitting on a chair next to it. When faced with the investigator's questions on each item, the child was asked to indicate with his or her finger which of the two images most closely resembled his or her case, and the image was recorded. The degree of comprehension was analyzed from a qualitative point of

view, recording the participants' questions, doubts, and suggestions (teachers and students).

Data analysis

Qualitative data were analyzed through content analysis. With respect to quantitative data, the preparatory data analysis and the calculation of descriptive statistics were performed using SPSS 25.0 software.

RESULTS

Qualitative techniques were used to obtain evidence about the conceptual, social, and cognitive validity of the instrument and thereby analyze the content of the measures. The qualitative contribution provided was completed with the quantitative contribution of the mean scores that the experts gave for each item. The results were analyzed including the valuations by the coordinating group and the expert group, constituting two independent sources that guaranteed the adequacy of the instrument. Out of the 22 items that were initially included in the questionnaire, twelve did not undergo any modification, since they obtained values close to 4 and the experts did not suggest another version. Two items with values around 2 were eliminated and substituted by new ones following the recommendation from the expert group; and four items, with values close to 3 were modified in accordance with the experts' opinion, and the coordinating group agreed on their final formulation.

STUDY 2

The aim of this second phase was to analyze the exploratory factor structure of the SFAE.

Participants

The sample comprised 384 children, 195 boys and 189 girls. Their ages ranged between 3 and 5 years old, with a mean age of 4.02 (*SD* = .82). Distribution by age was as follows (3, *n* = 126; 4, *n* = 123; 5, *n* = 135). With respect to aquatic experience, the 3-year-olds had none, the 4-year-olds had spent a year doing aquatic activities (one day a week throughout the school year), and the 5-year-olds had had two years' experience (one day a week during two school years)

Measures

Fear of the aquatic environment.

We used the *Scale to measure Fear of the Aquatic Environment* (SFAE) described in study 1. It contains 22 items grouped into five dimensions: influence of social context, influence of experiences, influence of attitude, influence of equipment or installations, and influence of competence. The children answered on a two-option Likert scale: one reflected an adaptative response to the medium and the other a non-adaptative response. Each alternative was presented individually to the child using a comic image to facilitate their understanding of the question. The child had to point to the image that was most similar to themselves. To control possible error sources, the items were presented in random order to each participant, and the intra-element (response option) was also varied per item.

Procedure

The people responsible for the sports installations that had accepted to participate in the study and the swimming instructors were contacted to inform them about the objective of the research and the activities to be evaluated. One researcher from the coordinating group personally evaluated each of the children, going through the different items of the questionnaire while observing the classes, without influencing class dynamics or development. Participation was voluntary, and participants' anonymity was preserved by allocating each child a numerical code and geographical area. Parents were previously informed about the nature of the study and signed a consent form. The study was supervised by the Project Evaluating Body of the institution corresponding to the lead researcher with the reference number DPS.JMM.01.19 and registry number 2019.286.E.OEP. The observation time for each child was approximately 15 minutes.

Data analysis

An exploratory factor analysis (EFA) was performed in order to establish the instrument's factor structure, and the internal consistency of the instrument was analyzed using Cronbach's alpha. Data analysis was carried out with the statistical software SPSS 25.0.

RESULTS

Exploratory factor analysis

An exploratory factor analysis of the main components was performed with oblimin rotation. After a first analysis, four of the items did not reach the established minimum saturation (.30), and they were eliminated. Another analysis was made, where the items were grouped into five areas (Table 1): influence of social context (five items), influence of experiences (three items), influence of attitude (four

items), influence of equipment or installations (four items) and influence of competence (three items). These five factors obtained eigenvalues of 1.00 (9.34, 3.45, 1.78, 1,23 and 1.19, respectively), explaining a total variance of 81.51% (31.11%, 20.14%, 10.15%, 10.10% and 10.01%, respectively).

Analysis of internal consistency

Cronbach's alpha obtained for each of the dimensions was .92 for influence of social context, .87 for influence of experiences, .83 for influence of attitude, .78 for influence of equipment and installations, and .85 for influence of competence.

STUDY 3

The objective of this third phase was to carry out a confirmatory factor analysis with the SFAE and to show how it related to aquatic competence.

Method

Participants

The sample comprised 444 children, 235 boys, and 208 girls. Their ages ranged between 3 and 5, with a mean age of 4.45 (*SD* = .84). Distribution by age was as follows (3, *n* = 134; 4, *n* = 149; 5, *n* = 161). With respect to aquatic experience, 3-year-olds had had experience from that school year, the 4-year-olds had spent two years doing aquatic activities (one day a week throughout the school year) and the 5-year-olds had had three years' experience (one day a week for two school years).

Measures

Fear of the aquatic environment

We used the final *Scale to measure Fear of the Aquatic Environment* (SFAE), obtained in study 2. It finally consisted of 18 items grouped into five dimensions: influence of social context (4 items), influence of experiences (4 items), influence of attitude (4 items), influence of equipment or installations (3 items), and influence of competence (3 items). The response procedure was the same as the one described in study 2.

Aquatic competence

We used the *Instrument to measure Aquatic Competence in Children* (IACC) by Moreno-Murcia et al. (2020). It contains 22 items grouped into three dimensions: socio-affective,

Table 1. Exploratory factor analysis SFAE

	ICS	IE	IA	IMI	IC
If your parents are happy when you go swimming	.95	-	-	-	-
When your parents leave you alone in the changing room	.68	-	-	-	-
When you arrive at the pool and see your classmates	.48	-	-	-	-
When you arrive and your instructor comes over	.96	-	-	-	-
When you're in the pool and you can't touch the bottom	-	.88	-	-	-
When you're in the pool	-	.63	-	-	-
When you're at the pool and they throw you in the water	-	.54	-	-	-
When you're in the water	-	.65	-	-	-
When you arrive at the pool	-	-	.41	-	-
When you have to go in the water	-	-	.41	-	-
When you go to the pool	-	-	.40	-	-
You like swimming	-	-	.44	-	-
When the pool is deep	-	-	-	-.32	-
If the pool is big	-	-	-	-.34	-
When the instructor gets out a floating mat to walk over	-	-	-	-.43	-
When have to jump in the water	-	-	-	-	.37
When you have to swim a long way	-	-	-	-	.43
When you're in the water	-	-	-	-	.37

Note: ISC = influence of social context; IE = influence of experiences; IA = influence of attitude; IEI = influence of equipment or installations; IC = influence of competence.

consisting of seven items; cognitive, with six items; and motricity, consisting of nine items. The child's behavior was evaluated using a five-point rubric score. For example, the item that corresponds to breathing (When the children in the shallow end were asked to make bubbles under the water by releasing air through the mouth and nose…): 1 corresponds to "*Blows without touching the water with their face.*"; 2 "*Blows by only putting the mouth at the level of the water*"; 3 "*Doesn't blow in the water, but puts their face completely on the water*", 4 "*Blows through the mouse and nose, putting their face completely in the water*", and 5 "*Is able to coordinate breathing (takes in air and releases it continuously several times)*". Internal consistency obtained was .84, .79 and .90, respectively, and globally it was .88.

Procedure

The same procedure as the one described in study 2 was used.

Data analysis

A confirmatory factor analysis was carried out to confirm the factor structure of the instrument (CFA). Similarly, the internal consistency of the instrument was measured by Cronbach's alpha, and the descriptive statistics were obtained (mean and standard deviations) as well as the bivariate correlations of all the variables. Also, the predictive power of the dimensions of the scale of fear of the aquatic environment on aquatic competence was verified through a stepwise multiple linear regression analysis. Data analysis was carried out using the statistical software SPSS 25.0 and AMOS 25.0.

RESULTS

Confirmatory factor analysis

The factor structure was measured using confirmatory factor analysis with the 18 items included in the five-factor model. The maximum verisimilitude estimation method was used together with the bootstrapping procedure since the result of the Mardia multivariate coefficient was 786.94, which indicated a lack of multivariate normality of the data. The result showed an adequate fit of the model: ((χ^2 (46, N = 444) = 761.80, p = .000; χ^2/d.f. = 6.09; CFI = .92; TLI = .90; IFI = .92; SRMR = .05). The model proposed presented a reasonable approximation to the data and contributed to supporting the hypothesis of the multidimensionality of the construct. The estimations of the factor saturations for each of the items in their respective factors are illustrated in Figure 1.

Descriptive analysis and bivariate correlations

The dimension of influence of competence had the highest value out of the scale's five dimensions, followed by influence of experiences, influence of equipment/installations, influence of attitude, and influence of the social context. Aquatic competence showed a mean of 4.5 out of 5. All the dimensions correlated positively with each other (Table 2), except for the aquatic competence dimension, which correlated negatively with all the fear dimensions.

Linear regression model

A stepwise linear regression was performed to verify the predictive value of the dimensions of fear of the aquatic environment on aquatic competence (Table 3). According to the fifth step in the linear regression analysis, all the dimensions negatively explained aquatic competence, with an explained variance of 22%, except for influence of attitude. The dimension with the most weight was influence of competence, followed by influence of experiences, influence of equipment/installation, and influence of social context.

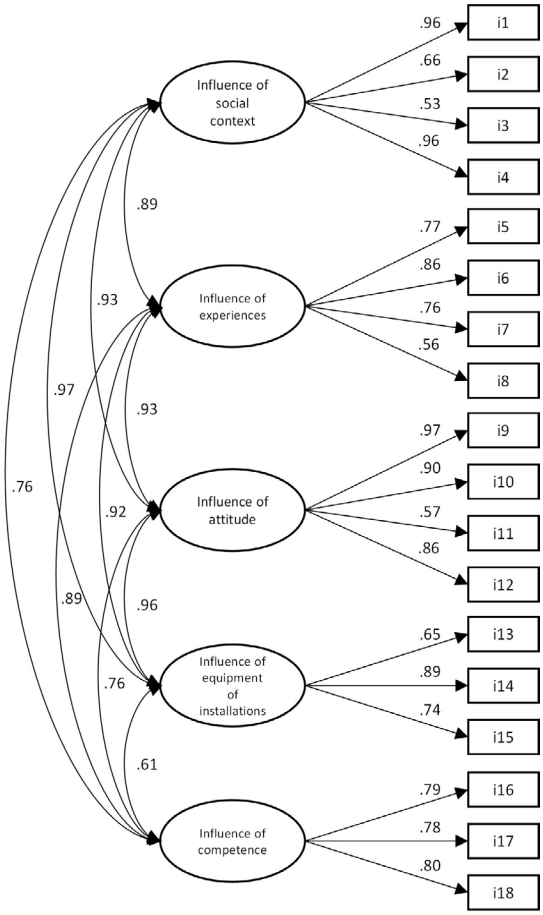

Figure 1. Confirmatory factor analysis SFAE

Table 2. Descriptive Statistics and Correlations for all the Variables

Variables	M	DT	1	2	3	4	5	6
ISC	1.05	.11	-	.77**	.88**	.75**	.63**	-.22**
IE	1.12	.18	-	-	.80**	.79**	.74**	-.37**
IA	1.01	.08	-	-	-	.84**	.68**	-.14**
IEI	1.07	.20	-	-	-	-	.74**	-.16**
IC	1.15	.28	-	-	-	-	-	-.42**
AC	4.15	.65	-	-	-	-	-	-

Note: ** p < .001; ISC = influence of social context; IE = influence of experiences; IA = influence of attitude; IEI = influence of equipment or installations; IC = influence of competence; AC = aquatic competence.

Table 3. Linear Regression analysis for the prediction of aquatic competence through the dimensions of fear of the aquatic environment

	B	SEB	β	ΔR^2
First step	5.47	.30		.04**
Influence of experiences	-1.25	.28	-.21**	
Second step	6.34	.31		.11**
Influence of experiences	-.79	.27	-.13*	
Influence of attitude	-1.21	.16	-.34**	
Third step	6.57	.43		.01**
Influence of experiences	-.77	.27	-.13*	
Influence of attitude	-1.17	.17	-.33**	
Influence of equipment or installations	-.27	.36	-.03	
Fourth step	6.63	.44		.01**
Influence of social context	-.78	.28	-.13*	
Influence of experiences	-1.23	.18	-.35**	
Influence of attitude	-.42	.41	-.05	
Influence of equipment or installations	.14	.19	.04	
Fifth step	6.88	.42		.09**
Influence of social context	-.81	.26	-.14*	
Influence of experiences	-.77	.19	-.22**	
Influence of attitude	-.65	.39	-.08	
Influence of equipment or installations	.59	.19	.18*	
Influence of competence	-.84	.12	-.36**	

Note: *p < .05; **p < .01

DISCUSSION

In the search for information that could diagnose an initial situation with respect to the factors involved in fear of the aquatic environment in children, the main purpose of this study was to develop and validate a pictorial measure instrument (SFAE) to evaluate fear of water in a sample of 3- to 6-year-old Spanish children. The psychometric properties of the design support the version of SFAE with good internal consistency reliability and the five factors that represent different aspects related to the experience of fear of the aquatic environment in children.

Therefore, based on these results, it can be concluded that the initial five-factor structure (influence of social context, influence of experiences, influence of attitude, influence of equipment or installations, and influence of competence) is replicated, showing an adequate fit for factor structure and internal consistency, and complementing aspects of content validity. Thus, by contemplating these five dimensions, the same instrument can be used to value the different triggers that can generate a child's fear of the aquatic environment.

The instrument was composed of the following dimensions. The dimension called influence of social context contained

four items, evaluating the potential influence that family, teacher, instructor, and peers had on children. Another factor was the influence of experiences, which consisted of four items that explore the consequences of being exposed to different situations that can cause fear in a child. Influence of attitude had four items, assessing a child's emotional disposition towards the aquatic environment. The factor called influence of equipment or installations comprised three items related to experiences where a child was able to discover their relationship with equipment resources. Finally, the dimension of influence of competence consisted of three items that gather information about how a child's problem-solving ability contributed to solving different situations in the aquatic environment.

The correlation analysis provided evidence of additional validity relating all the dimensions of the SFAE with one another significantly, and in the expected direction, specifically, the strongest relation was observed for influence of attitude with social context and equipment. This result is in line with studies that come within the Self-determination Theory framework and indicate the importance of social triggers in generating well-being in students (Ryan & Deci, 2017). It would therefore be useful, for example, to choose adequate recreational material that can be adjusted to a child's needs, and in this way help to generate a balanced and confident attitude towards the medium and steer them away from possible stimuli that can generate unease.

The results of this study with respect to the relation between the dimensions of fear of the aquatic environment and competence were in line with previous research, which recommends encouraging aquatic competence to reduce the fear of the aquatic environment (Brenner et al., 2009). To be exact, it was the dimensions of fear of the aquatic environment related to influence of competence and experiences which most robustly related to aquatic competence in children. This finding suggests that to minimize fear of the aquatic environment during childhood, it would be useful for children to acquire swimming competence and positive experiences at an early age, which would provide them with an emotional state of well-being.

Nevertheless, the promising result regarding the validity of the SFAE does not mean it is exempt from a series of limitations that should be taken into account. Firstly, although some works indicate that there may be gender differences in relation to fear (Méndez, 1999; Valdivia, 2000), in this study, an invariance analysis across sex was not considered. It would also be interesting if future research could verify the role of parents' educational styles with the dimensions of SFAE, and also the motivational style of the swimming instructor. Another fundamental aspect would be to verify the evolution of the scores obtained in the SFAE through a longitudinal study. Also, it would be necessary to check the possible differences by age and aquatic experience to avoid a possible bias.

Finally, this study reveals that if children's fear of the aquatic environment is minimized, it is important to further understand the variables that generate their unease towards this medium. The validity of the SFAE helps create new study perspectives that focus on the dimensions of fear of the aquatic environment, which had not received enough attention in this evolutionary stage. Consequently, this could lead to more effective educational decisions towards the integral development of childhood. Likewise, by using a pictorial valuation system, it is possible to make an evaluation that suits early childhood characteristics.

The analysis of the psychometric properties of the SFAE shows that it can be recommended and used in the child population to find out about the triggers of fear of the aquatic environment. Its use can lead to the development of a useful and simple applied tool as a starting point for future interventions that seek to gain further knowledge about the variables involved in a child's evolution towards the aquatic environment.

ACKNOWLEDGMENTS

Nothing to declare.

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