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An Evaluation of the Reliability of the Pictorial Scale of Perceived Water Competence and Its Relationship With Actual Water Competence

Boris Jidovtseff[1], Liliane De Sousa Morgado[1], Arja Saäkslahti¨[2], Kristy Howells[3], Lisa M. Barnett[4], Eva D'Hondt[5], Aldo M. Costa[6,7], and Kristine De Martelaer[5]

[1]Department of Physical activity and Rehabilitation Sciences, Research Unit for a Life-Course Perspective on
Health and Education, CEReKi, University of Liege, Liège, Belgium
[2]Faculty of Sport and Health Sciences, University of Jyvaskyl¨a, Jyv¨askyl¨a, Finland¨
[3]Department of Sport, Exercise and Rehabilitation Sciences, School of Psychology and Life Sciences, Canterbury Christ Church University, Canterbury, UK
[4]Faculty of Health, Institute for Physical Activity and Nutrition, School of Health and Social Development, Deakin University, Geelong, VIC, Australia
[5]Department of Movement and Sport Sciences, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium
[6]Department of Sport Sciences, University of Beira Interior, Covilhã, Portugal
[7]Research Center in Sport Sciences, Health Sciences and Human Development, CIDESD, Vila Real, Portugal

Corresponding Author:
Boris Jidovtseff, Department of Physical activity and Rehabilitation Sciences, Research Unit for a Life-Course Perspective on Health and Education, CEReKi, University of Liege, Allee des sports 2, Liège 4000, Belgium.
Email: b.jidovtseff@uliege.be

Abstract

In its recent development, the Pictorial Scale of Perceived Water Competence (PSPWC) showed good face and construct validity. However, additional reliability and validity research is needed, including test-retest reliability and a demonstration of the relationship between PSPWEC test scores and actual water competence. Toward that aim, we administered the PSPWC to 124 children, aged 5–8 years. We repeated this test administration after one week for a subset of 55 children to determine its testretest reliability, and the remaining 69 children also performed the fully aligned Actual Aquatic Skills Test (AAST) in an indoor swimming pool to provide data for our investigation of the relationship between PSPWC scores and actual water competence. We found good test-retest reliability, both at the global level (ICC = 0.81, n = 55) and at the level of individual skills (Weighted kappa coefficients from 0.58 to 0.90), with no significant differences between these two test scores. We also found a

moderate positive relationship between PSPWC and AAST total scores (r = .64, n = 69), with no significant difference between total scores of actual and perceived water competencies. Children overestimated their competence in three specific skills: the back star, swimming on the front, and diving in deep water. While these results underline specific situations in which children's higher self-perceptions of their water competence are a risk factor for their water safety, these data confirm that the PSPWC is reliable for measuring children's perceived competencies in aquatic education and drowning prevention, and there is further support for its validity through a moderate correlation with actual water competencies.

Keywords
water safety, assessing water competency, psychometric tests of water skills, swimming safety

Introduction

Recently, Morgado et al. (2020) developed a tool for assessing 5-8-year-old children's perceived water competence: the Pictorial Scale of Perceived Water Competence (PSPWC). The PSPWC opens new research possibilities, as it can be used to gain a better understanding of how children assess their own water competencies. It might be especially useful if it was found to correlate with an assessment of children's actual aquatic skills. Used in this way the PSPWC might measure the extent to which children have an accurate perspective of what they are able to do. A comparison between perceived and actual water competencies is important because a significant discrepancy between them can have consequences for children's learning, participation in aquatic activities, and water safety.

According to Harter's model (1978), self-perception plays a key role in the construction of motivation, and it needs to align with actual competence. A child who underestimates their personal competence may have low expectations for future competence, which may, in turn, negatively influence performance outcomes and motivation toward the activity. Several researchers hypothesized that a child who underestimates their actual level of water competencies may become discouraged more quickly and adopt avoidance behaviors towards aquatic activities (Mertens et al., 2022; Morgado et al., 2023). On the other hand, if a child overestimates their actual water competence, they may develop unrealistic self-expectations. Combined with an erroneous estimate of danger, unrealistic self-expectations can lead to dangerous behavior during aquatic activities, with an increased risk of injury and drowning, particularly in unfamiliar aquatic contexts and without close supervision (De Martelaer et al., 2022; Schwebel et al., 2023; Stallman et al., 2017).

When developing a new tool of this type, it is important to check its psychometric qualities. A panel of international experts affirmed the content validity of the items on the PSPWC (Morgado et al., 2023). D'Hondt et al. (2021) then demonstrated good internal consistency of its 17 test items, with Cronbach alpha values that were above >0.8 (when used with children aged 6–9). In addition, face validity protocols confirmed that Belgian and Australian children from 5 to 8 years old were able to understand and use the PSPWC (De Pasquale et al., 2021; Morgado et al., 2020). Another important step in the validation process is to check the extent to which a tool measuring the respondents' perceptions of competence correlates with actual measures of the same competencies. This was first achieved by D'Hondt et al. (2021) who demonstrated that Belgian children aged 6–9 years had a slight tendency to underestimate their actual aquatic skill levels. However, D'Hondt et al. (2021) results are not in agreement with previous research using a different instrument with 6- to 10-year-old Portuguese children who tended to overestimate their level of aquatic skills (Costa et al., 2020). Moreover, other investigators of on land-based motor competencies (MC) have suggested that, during early childhood, children usually lack the cognitive skills to distinguish between perceived and actual competence, ability, and effort as causes of success; and they have had a tendency to overestimate their general motor competence (De Meester et al., 2020). Thus, further work is needed with the PSPWC to help resolve these research discrepancies and to better understand what may explain these relationships in the specific context of an aquatic movement environment.

Apart from this further check on aspects of PSPWC validity, another critically important psychometric property to evaluate is the extent to which this instrument consistently measures the same construct when the measurement is repeated several times under the same conditions by the same participants after a specific time interval (Berchtold, 2016). This psychometric quality of reproducibility or test-retest reliability is often studied by asking respondents (children in this case) to respond to test items twice within a time interval that is neither too long nor too short. If the interval is too short, the child may remember responses from the first administration, and, if the interval is too long, intervening factors (such as maturation or other experiences) may lead to response changes that are due to changing environmental factors, interfering with efforts to measure test consistency. Generally, in the targeted age group, reliability studies on pictorial scales have tested children twice in a time interval of 7 to 14 days (Barnett et al., 2015; Lopes et al., 2016; Robinson & Palmer, 2017).

In the present study, we developed a mixed research protocol to address both of the two concerns outlined here. With a large sample of child participants, we used one participant subset to verify the test-retest reliability of the PSPWC scale measurements, and we used a second participant subset to explore the relationship between the children's self-reported perceived water competence on the PSPWC and

their actual water competence as measured by the Aquatic Actual Skill Tests (AAST; D'Hondt et al., 2021; Mertens et al., 2022).

Method

Research Design

In this mixed protocol we first measured all the children's self-perceived water competence with the PSPWC (Morgado et al., 2020, 2023). Next, some of these children completed the same PSPWC assessment one week later to permit a calculation of test-retest reliability for the PSPWC with this sample. The remaining group of children who initially took the PSPWC next went to an indoor swimming pool to complete the closely aligned Aquatic Actual Skill Tests (AAST) (D'Hondt et al., 2021; Mertens et al., 2022), by letting them perform in-the-water tests of all the aquatic test items of the PSPWC. In this way, we investigated the relationship between actual and perceived water competencies.

Ethical Considerations

All procedures were in accordance with the Declaration of Helsinki concerning Human research and Ethical approval was granted by the Ethical Committee of the University of Liège (ref 2020/7). Parents or their legal representative gave their written informed consent for all child participants in this study, and their school principals also agreed to their participation.

Participants

We recruited children for this study from three French speaking Belgian schools on a voluntary basis. There was one urban school with a moderate to high-income population, and there were two rural schools with middle-income populations. All participants had to speak French and to be free from any illness or mental disorder that could alter their understanding of the pictures and instructions used during these testing occasions.

Characteristics of the participants in this study are presented in Table 1. A total of 124 children, aged from 5 to 8 years, took part in the study, including 55 children who took part in the PSPWC test-retest analysis and 69 children who participated in the comparative analysis between the PSPWC and AAST. There were no differences between the two subpopulations in terms of age, proportion of girls and total PWC score at the first test occasion (Table 1). In this subpopulation of 69 children, additional questions were addressed to parents with the aim to collect information on children aquatic background. There was a mix of children who benefited from regular swimming

Table 1. Participant Characteristics and Their Total Scores on the PSPWC and AAST Measures of Perceived and Actual Water Competency.[a]

Study	N	Girls (%)	Age (yrs)	PWC-T1 (pts/51)	PWC-T2 (pts/51)	PWC-T1[b] (pts/48)	AWC-T2[b] (pts/48)
Total sample	124	56	6.8 (0.9)	44.5 (5.7)	/		/
PWC test-retest	55	54	6.7 (0.8)	44.3 (5.6)	43.4 (6.4)		/
PWC versus AWC	69	58	6.9 (0.9)	44.8 (5.8)	/	42.1 (5.5)	40.9 (6.4)

Note. Total scores for PWC and AWC are determined by means (and standard deviations) of the PSPWC and AAST, respectively.

[a]T1 = test occasion 1; T2 = test occasion 2.

[b]Total score for perceived water competence (PWC) and actual water competence (AWC) excluding situation 7.

activities (i.e., 62% had swimming lessons at least twice a month) and children who did not (i.e., 12% had swimming lessons less than once a month and 27% did not receive any swimming lessons). According to parents'statements, the vast majority of children (84%) went to the pool between 0 and 6 times a year outside swimming lessons (i.e. free time water activities). Around 9% of children went to the swimming pool on average once a month in their free time, and 6% went every week.

Measurement of Perceived Water Competence (PWC)

We measured the children's perceived water competence (PWC) with the PSPWC, using the test instructions from the manual (Morgado et al., 2020). All tests were individually carried out by a trained researcher during school hours in a quiet and isolated room. This tool was specifically developed for 5-8 year-old children, and it covered all aquatic fundamentals. It contained 17 situations of increasing difficulty in which children were asked to self-assess their level of water competence. Each situation corresponded to an aquatic skill and was considered as a test item. For each situation (later called a test item) three pictures of progressive skill levels (Level 1 = "not able to do the skill"; Level 2 = "skill in progress"; Level 3 = "able to do the skill") were presented. Children were invited to watch the pictures and select the one that best represented them if they were performing the skill. The researcher paid particular attention to the child's responses and ensured that the levels selected by the child represented their perceptions as accurately as possible. The researcher was particularly

vigilant to the bias of social desirability, which was easily detectable when a child systematically indicated without hesitation the highest level of competence on each test item. Such a context was very rare, but when identified by the researcher, the evaluation had to be restarted from the beginning, reminding the child of the rules and the importance of accurately identifying the situations that they really thought they could achieve in a swimming pool. The procedure was repeated identically about one week later for the 55 children, who participated in the test-retest reliability study. The score attributed to each test item corresponded to the level declared by the child, and the total PSPWC score was the sum of the item scores obtained for each test item and potentially reached a maximum value of 51 points (i.e., 17 test items x 3 rating scale).

Measurement of Actual Water Competence (AWC)

We measured actual water competence (AWC) with the AAST in an indoor swimming pool located near the children's respective schools. The water temperature ranged between 27 and 29°C. Each swimming pool presented three levels of water depth to evaluate children's actual performance on the 17 aquatic skills illustrated in the PSPWC: shallow water for test item 1; belly-level water for test items 2 to 10 and deep water for test items 11 to 17. The full procedure of the AAST test is described in D'Hondt et al. (2021). As one pool was not equipped with a slide, we removed test item 7 (i.e., water entry by slide) from this part of the research, meaning that total scores for this research question were based on 16 test items (i.e., a maximum value of 48 points) when comparing the PSPWC to AAST.

Training of Assessors

A total of three assessors administered the tests to the children (one tested all the children who took part in the reliability study and two conducted tests for comparing PWC and AWC). All the assessors were trained by the principal investigator before beginning data collection, and we conducted pre-tests with the children to ensure the quality of data collection and a good understanding of the issues involved in each assessment. To reduce inter-individual variation, each child was tested by a single assessor.

Statistical Analysis

We used Excel (Microsoft Corp., USA) and Statistica software (Statsoft, France) for all statistical analyses. Descriptive data are expressed as means (and standard deviations) for the total PSPWC and AAST scores, and as frequency counts for the number of responses per level for each individual test item. We calculated the weighted kappa coefficient to determine the level of agreement in each test item between the two PSPWC measurements. This weighted coefficient was preferred to the classical

kappa coefficient because it takes into account the severity of disagreements which is not the case with the non-weighted coefficient (Sim & Wright, 2005). Coefficients were interpreted according to Sim and Wright (2005). We conducted a Wilcoxon paired test to detect any significant differences between ordinal measurements (for test items) and variables with non-normal data distributions (total sum scores of both the PSPWC and the AAST). We used the Pearson coefficient of correlation to measure the relationship between total sum scores within a group (PSPWC vs. PSPWC or PSPWC vs. AAST according to the study) and interpreted these coefficients according to Dancey and Reidy (2011). We used a two-way random intraclass correlation coefficient (ICC) and the coefficient of variation (CV, in%) to investigate test-retest reliability. For all statistics, we set the critical statistical significance level at $p < .05$.

Results

Test-Retest Reliability (n = 55)

The total PWC score on testing occasions 1 and 2 are presented in Table 1. We observed no significant statistical difference between the scores on the two test occasions, either for the total PSPWC score or for individual scores obtained in each test item. The Pearson correlation coefficient between PSPWC scores of Test 1 and Test 2 was positive and strong ($r = 0.77$; $p < .001$). There was good reliability for the total PSPWC score with an ICC of 0.81 and CV of 7.1%.

Table 2 presents detailed test-retest reliability results for each test item. Frequencies of identical levels, instances of 1 level of difference across the two tests, and instances of 2 levels of difference between them are presented in detail for each test item. The presented weighted kappa coefficients (with their 95% confidence interval) measured and interpreted for each aquatic skills revealed that only the test item S1 (i.e., lying down in prone position) had moderate reliability, while six test item (i.e., S2: standing in the water; S6: front star; S7: water entry by slide; S8: gliding under water; S13: exiting deep water; S15: longitudinal rotation) had good reliability, and the 10 remaining test items had very good test-retest reliability.

In further analysis we analyzed the reliability within each test item. In a very large majority of the cases (i.e., 72.8% on average, with a range of 56.4 to 90.1%), children selected the same level of skills from test to retest. Children sometimes (24.3%; range from 9.1 – 38.2%) changed by one level of self-perceived competence per aquatic skills, and they only very rarely changed by two levels (2.9% on average; range from 0.0%- 7.3%).

Relationship Between Perceived and Actual Water Competence (n = 69)

The total PSPWC and AAST scores were 42.1 (SD = 5.4) and 40.9 (SD = 6.4) respectively. The tendency for children to overestimate their PWC did not quite reach statistical significance (Wilcoxon test: +2.8%; $p = .08$). The Pearson correlation coefficient between both total scores was positive and moderate ($r = 0.64$; $p < .001$). Frequencies of scores for each test item in PSPWC and AAST are reported in Table 3. Wilcoxon paired test results used to compare results from each test item indicated that children significantly overestimated their water competence in three aquatic skills: the back star (S5), swimming on the front (S10) and diving (S12). The results also showed a possible, non-significant tendency towards overestimation ($p < .1$) for gliding under water (S8) and toward underestimation for exiting the deep water (S13).

Table 2. Test-Retest Reliability Results.

Situations	% Identical level	% 1 level difference	% 2 levels difference	Weighted kappa coefficient	Confidence interval (Weighted kappa coefficient)	Reliability Interpretation
S1—Lying down in prone position	74.55	18.18	7.27	0.58	[0.28 - 0.88]	Moderate
S2—Standing in the water	90.90	9.10	0.00	0.74	[0.29 - 1.19]	Good
S3—Blowing bubbles	89.08	9.10	1.82	0.84	[0.63 - 1.05]	Very good
S4—Catching an object	80.00	12.73	7.27	0.87	[0.71 - 1.02]	Very good
S5—Back star	78.19	21.81	0.00	0.88	[0.74 - 1.01]	Very good
S6—Front star	60.00	36.36	3.64	0.73	[0.55 - 0.92]	Good
S7—Water entry by slide	74.55	20.00	5.45	0.70	[0.46 - 0.93]	Good
S8—Gliding under water	70.91	25.45	3.64	0.76	[0.58 - 0.95]	Good
S9—Swim on the back	72.73	27.27	0.00	0.88	[0.77 - 1.00]	Very good
S10—Swim on the front	74.55	21.81	3.64	0.83	[0.69 - 0.97]	Very good
S11—Jump into the water	76.37	21.81	1.82	0.84	[0.68 - 0.99]	Very good
S12—Dive into the water	67.27	32.73	0.00	0.87	[0.75 - 0.98]	Very good
S13—Exiting deep water	56.36	38.19	5.45	0.75	[0.59 - 0.91]	Good

S14—Treading water	65.45	32.78	1.82	0.82	[0.67 - 0.96]	Very good
S15—Longitudinal rotation	60.00	36.36	3.64	0.79	[0.65 - 0.94]	Good
S16—Sagittal rotation	78.19	21.81	0.00	0.90	[0.79 - 1.01]	Very good
S17—Transverse rotation	69.09	27.27	3.64	0.83	[0.70 - 0.96]	Very good
Average	72.8%	24.3%	2.9%			

Note. This table includes (a) frequencies of identical levels: 1 level of difference and 2 levels of difference between PWC-T1 and PWC-T2 on average and for each test item; and (b) individual weighted kappa coefficients, 95% confidence interval, and interpretation per item.

Discussion

In the present study we proposed a mixed protocol to address two research questions related to psychometric support for the PSPWC. This tool was designed to assess 5–8 year -old children's perceived water competence. The aim of the first part of the study, conducted with a subsample of 55 children, was to investigate the test-retest reliability of the PSPWC over a one week interval.

Table 3. Comparisons Between PWC and AWC.

	Frequency of scores						Wilcoxon	
	PWC			AWC			PWC versus AWC	
Situations	Lev1	Lev2	Lev3	Lev1	Lev2	Lev3	Bias[a]	(p value)
S1—Lying down in prone position	0%	4%	96%	0%	1%	98.5%		0.36
S2—Standing in the water	0%	3%	97%	0%	0%	100.0%		0.18
S3—Blowing bubbles	0%	12%	88%	0%	10%	89.7%		0.82
S4—Catching an object	4%	15%	81%	3%	24%	73.5%		0.37
S5—Back star	1%	22%	76%	3%	41%	55.9%	j	0.02[b]
S6—Front star	4%	32%	63%	3%	25%	72.1%		0.18
S7—Water entry by slide	0%	6%	94%	5%	10%	85.0%		0.36
S8—Gliding under water	3%	26%	71%	7%	37%	55.9%	j	0.07[a]
S9—Swim on the back	7%	24%	69%	12%	26%	61.8%		0.17

S10—Swim on the front	3%	32%	65%	15%	40%	45.6%	j	0.002[c]
S11—Jump into the water	4%	29%	66%	6%	25%	69.1%		0.83
S12—Dive into the water	18%	37%	46%	28%	63%	8.8%	j	0.0002[c]
S13—Exiting deep water	10%	38%	51%	9%	24%	67.6%	k	0.08[a]
S14—Treading water	6%	41%	53%	7%	46%	47.1%		0.52
S15—Longitudinal rotation	15%	28%	57%	12%	35%	52.9%		0.99
S16—Sagittal rotation	7%	26%	66%	13%	24%	63.2%		0.27
S17—Transverse rotation	6%	46%	49%	12%	35%	52.9%		0.99

Note. Comparison between PWC and AWC includes frequency of scores for each situation in PWC and AWC and Wilcoxon paired test for significant difference between identical item of PWC and AWC and direction of bias. [a]Significant bias of self-perception: j = overestimation and k = underestimation;

[a] .10; [b] $p < .05$; [c] $p < .01$.

Test-Retest Reliability of the PSPWC

We obtained a high positive correlation between the total PSPWC scores obtained on these two testing occasions with the same 55 children. The absence of significant differences in their overall scores and the high ICC and CV values obtained allowed us to attribute good reliability to this assessment tool for children of this age, even when there had been no familiarization effect. This is an important result, as it is the first study to examine test-retest reliability of the PSPWC. Moreover, the values we obtained (ranging from 0.77 to 0.95) are in line with ICCs obtained for other tools being developed for measuring self-perceived aquatic competence(MorenoMurcia& Perez,2008′) orself-perceived general motor competence in same aged children (Arman et al., 2021; Barnett et al., 2015; Diao et al., 2018; Estevan et al., 2018; Robinson & Palmer, 2017).

We also used the weighted kappa coefficient to check the level of agreement between the children's responses for each of the separate aquatic skills presented in the tool. These coefficients revealed excellent agreement for 10 out of the 17 test items and good agreement for six additional test items, which means that the reproducibility of the individual test item can be considered as good to excellent in 16 of the 17 test items in the PSPWC. Only item S1 (i.e., lying in prone position) presented only a moderate level of reliability. This test item had already been identified as problematic during face validity research, as it seemed not to have been experienced by many of the children and the illustration led to some confusion for some children (Morgado et

al., 2023). These results, combined with those of the present study, suggested that this test item contributes little to the assessment of PWC, and we suggest that it should be removed from the PSPWC.

Relationship Between Perceived and Actual Water Competency

Our second aim of this study was to explore the relationship between total scores on both the PSPWC and AAST in another subsample of 69 children. A previous exploratory study by D'Hondt et al. (2021), also using both tools, found that 6- to 9-yearold children significantly underestimated their actual aquatic skill levels. This result was somewhat surprising as most research comparing land-based perceived and actual motor skills showed that young children overestimated their motor competence (Goodway & Rudisill, 1997; Harter & Pike, 1984; Noordstar et al., 2016; True et al., 2017). Costa et al. (2020), using different tools, also found overestimates of water competencies from young children. Their pictorial scale was developed for children aged 6–10 years, and it was based on eight different aquatic skills including 3 to 5 progressive levels. Their scale also included self-assessment of swimming strokes and evaluated technical skills that were not included in the PSPWC. In our study, children aged 5–8 years showed a slight but insignificant global overestimate (2.8%) of their actual aquatic skills level, placing our results in an intermediate position between the two abovementioned studies which focused on the aquatic movement environment (D'Hondt et al., 2021; Costa et al., 2020). As there were no significantly different scores on these two measures, there was no clear and significant overestimate or underestimate of water competencies in our participant sample.

The ability to self-assess water competence can be influenced by factors other than age. A large meta-analysis recently underlined the lack of clarity on the relationship between actual and perceived motor competence, questioning the influence of age, sex, developmental status and on the strength of association between the tools involved in this research (De Meester et al., 2020). Population characteristics could explain variable research findings in similar age groups. Both our study and D'Hondt et al. (2021) concerned the Belgian population, but the children recruited in D'Hondt et al. (2021) came from a swimming school and therefore benefited from regular aquatic activities that could have increased their AWC more than their PWC and might explain the children's underestimate of their AWC. Others demonstrated that an intervention might differentially affect actual and perceived motor competence (Lander et al., 2019). However, to date there is no evidence for a direct link between actual and perceived motor competencies, and more longitudinal studies in this area are needed (Barnett, et al., 2022b). Our participants were recruited from local schools, with a mix of children who had attended a swimming school on a regular basis and others who had not. Our population is therefore more representative of the Belgian population than D'Hondt et al.'s (2021) participant sample, perhaps helping to explain why the total

PSWPC and AAST scores were lower among our participants than among D'Hondt et al.'s (2021). In Costa et al. (2020), the children were from Portugal and were also involved in regular aquatic activities. Even if differences in these results may be partly explained by crosscultural differences, they may be mostly related to differences in pictorial tools used in the studies. In the Portuguese tool, some of the situations required higher levels of aquatic skill than those found in the PSPWC. In addition, the graphics of the drawings were very different across these tools, with Costa's study using a colorful, rough style drawing, whereas the drawing in the PSCPWC tool were in black and white and full of details. All of these methodological differences may be relevant to variable results obtained. Further work to identify the most important differences will be necessary.

An in-depth analysis of our results (as presented in Table 2) shows that, for certain specific test items, the difference between perceived and actual competence became significant. Children tended at non-significant levels to overestimate their skills for three test items: the back star, swimming on the front and diving into the water. They also seemed to have difficulties assessing the level of skill required to reach the highest performance levels, particularly for the dive which requires a head first descent into the water and also a correct body alignment which is difficult to achieve. Interestingly, in the "getting out of the water" skill, we observed the opposite phenomenon, whereby children tended to underestimate their skills. However, such under-estimation should be considered with caution, since some children reported that they found the "exit from water" item difficult to understand (Morgado et al., 2023). It is possible that, despite the improvements in the pictures, children believed that the task required was more difficult than it really was for them. These results seem to indicate that overestimation and underestimation occur for distinct reasons that can be specific to contexts. Costa et al. (2020) also highlighted that overestimation in water competence concerned certain situations but not all. Additionally, differences in these tools across studies do not allow us to clearly explain results differences we uncovered. It would be useful to study, with the same tools, the extent to which overestimation in a specific situation is associated with risky behavior and should be the subject of particular attention in drowning prevention.

We demonstrated a moderate strength correlation between total PSPWC and AAST scores ($r = 0.64$). This appears to be higher than the weak to moderate correlations De Meester et al. (2020) reported in a recent systematic review on the relationship between land-based perceived and actual motor skill competencies. The fact that our tools for measuring PWC and AWC were perfectly aligned and that we focused on the specific motor competencies of water competence may explain our stronger level of correlation between our measures of perceived and actual competence. Interestingly, one recent Australian research team, using the PSPWC-4, a short and modified version of the PSPWC tool, also obtained a high level of correlation ($r = 0.71$) between PWC and AWC, although their tools for assessing perceived and actual water competence

were not fully aligned (Barnett, et al., 2022a). Further studies are needed to confirm these results, but it seems that correlations are higher for specific versus general motor competencies.

Strengths of This Study

Strengths of this study were that we provided the first confirmation of one-week testretest reliability with the PSPWC and we showed a moderate positive relationship between our two fully aligned measures ofPCWand AWC in a sample of 5- to8-year-old children, some of whom had benefited from swimming lessons and some of whom had not. Our analytical approach helped identify specific aquatic skills that children are more likely to overestimate their competencies for, and this can be critical to their water safety.

Limitations and Directions for Further Research

One limitation of this study was that our sample was drawn from schools and families that volunteered to participate, meaning that we cannot be sure our sample is entirely representative of the Belgian population. The schools selected all had easy access to a swimming pool for their children, which is not the case for all schools, and it seems important to investigate differences between AWC and PWC in populations who have difficult access to swimming pools. By example, it has been demonstrated that ethnic minorities and low socio-economical populations have less experience/practice opportunities and are more exposed to the risk of drowning (Willcox-Pidgeon et al., 2020). A major challenge will be to obtain data from such disadvantaged populations.

Our study not only contributes to the validation process of the PSPWC l, but it also opens new avenues for research. The various results obtained (i.e., good reproducibility, no significant difference between PSPWC and AAST total scores and a positive and moderate level of correlation between PWC and AWC) suggest that the PSPWC could be used to assess global levels of self-perceived aquatic competence within a population. This could be an interesting way of comparing groups and carrying out longitudinal follow-up research, without having to carry out pool tests that are timeconsuming and difficult to organize on a large scale. However, the tool should not be used on its own (without an assessment of actual aquatic skill levels) to identify children who may over- or underestimate their actual water competence.

Conclusion

In this study we confirmed that the total score of the PSPWC has good test-retest reliability, as do all separate test items except S1 (Lying down in prone position) which could be removed from the tool. The correlation of children′s self-perceived with their

actual level of aquatic skills was moderate, and no significant differences were observed for the total score, showing that in general the children (aged 5–8 years) did not overestimate or underestimate their competence. However, on three specific test items, a nonsignificant tendency toward an overestimation of competence was observed, showing that a discrepancy between actual and perceived competence can depend on very specific aquatic skill situations. The results of this study add to previous work on the PSPWC, opening a path toward further research with this tool in both aquatic education and drowning prevention.

Declaration of Conflicting Interests

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Ethical Statement

Ethical Approval

All procedures were in accordance with the Declaration of Helsinki concerning Human research and Ethical approval was granted by the Ethical Committee of the University of Liège (ref 2020/7).

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