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SPORT AND EXERCISE PSYCHOLOGY

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Young children's motivations and social cognitions toward swimming: Testing direct and moderation effects of sport competence in two large-scale studies

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ABSTRACT

Direct and moderation effects of swimming competence using an integrated model of self-determination theory (SDT) and theory of planned behaviour (TPB) were examined in two large-scale studies among young children. Specifically, we examined whether swimming competence had direct and moderation effects on social psychological variables of perceived need support, autonomous motivation, TPB social cognition constructs, and intention. In Study 1, using a cross-sectional survey of 4959 primary school children, swimming competence formed significant positive relationships with all model variables (β =.061 to.330, $p < .05$) except intention (β = -.009, $p > .05$), and its moderation effect on model parameters were small in size or not statistically significant. In Study 2, using a pre-post-test quasi-experiment among 1,609 primary school children, improvement of swimming competence was associated with change-scores in all model variables (β =.046 to.230, $p < .05$) except subjective norm (β =.049, $p > .05$). Swimming competence did not significantly moderate the parameter estimates of the integrated model ($p > .05$) at the change-score level. Findings indicate that swimming competence is associated with higher autonomous motivation; TPB social cognitions of attitude, subjective norm, and perceived behavioural control; and intention. However, swimming competence did not moderate the parameter estimates of the integrated model.

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Swimming ability; social cognition; theoretical integration; self-efficacy; theory of planned behaviour; self-determined motivation

Swimming is one of the most popular sports and leisure-time exercises that has been shown to have important health and social value (Barnsley et al., 2017). It is particularly important for young children to learn swimming at an early age as it may prevent them from drowning (World Health Organization, 2014). Being able to swim is also often regarded as an entry requirement for many aquatic sports (e.g., rowing, canoeing, windsurfing and water polo). Many countries (e.g., United Kingdom, Australia and Jersey Islands) have hence implemented free learn-to-swim programmes to improve the swimming competence of young children (Australia, 2020; Safe, 2021). However, the literature within sport and exercise psychology has not provided a clear picture of the role of swimming competence in the motivational and social cognition patterns of swimming (Kowal & Fortier, 1999). Given the importance of swimming competence to drowning prevention and uptake of aquatic sports, understanding the role of competence in changing the nature of individuals' motivations and beliefs of swimming behaviour may be valuable. This study addresses this knowledge gap in two large-scale studies with samples of almost 7,000 primary school students. Specifically, we examined the role of competence on the psychological constructs underpinning the motivational and social cognition factors of swimming intentions among young children using an integrated model of self-determination theory (SDT; Deci & Ryan, 1985) and theory of planned behaviour (TPB; Ajzen, 1985).

The integrated model of SDT and TPB

This research adopted an integrated model of SDT and TPB used in previous research (Hagger & Chatzisarantis, 2009) that accounts for both the motivational and social cognition processes of human self-regulatory actions. The model and its theoretical predictions have been well supported in the context of sport and exercise (Hagger & Chatzisarantis, 2009, 2014; Hagger et al., 2005, 2009; Hamilton et al., 2012). In the model, it is proposed that supporting individuals' psychological needs (i.e., the basic needs of autonomy, competence, and relatedness) is fundamental to the quality of motivation in a given behaviour. Autonomous motivation is regarded in SDT as the most adaptive motivational pattern, which is characterised by having intrinsic interests and personal values as primary reasons guiding action (Hagger & Hamilton, 2021). This form of motivation, according to the integrated model, is proposed to have a direct and positive influence on the TPB psychological constructs of attitude (i.e., personal evaluation of the behaviour), subjective norm (i.e., perceived social appropriateness and pressure to undertake the behaviour), and perceived

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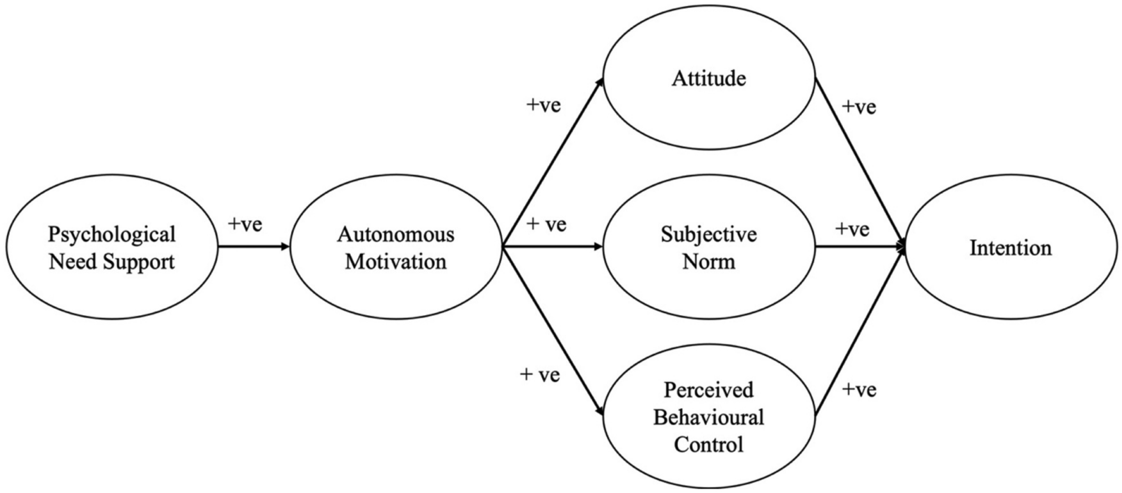

Figure 1. The proposed integrated model.

behavioural control (PBC; i.e., perceived control over executing the action and considered to be synonymous to self-efficacy) (Hagger & Chatzisarantis, 2009, 2014; Pasi et al., 2021). These TPB social cognition constructs, in turn, are proposed to be directly and positively related to intention (i.e., the extent to which an individual plans to perform the action), and mediate the autonomous motivation-intention-behaviour relationships. This is because autonomous motivation is suggested to foster social cognition beliefs, leading to improved intentions and, thus, behavioural action (Hagger & Chatzisarantis, 2009, 2014; Pasi et al., 2021).

The existing body of literature has provided strong evidence to support the pathways of the integrated model (i.e., psychological need support → autonomous motivation → TPB social cognition variables → intention; see Figure 1). However, current literature using the integrated model has primarily focused on more general physical activity as the target behaviour (Hagger & Chatzisarantis, 2009, 2014) or tested the model in other health-related behaviours (e.g., preventive measures for COVID-19 (Hagger et al., 2020; Wan et al., 2022), healthy diet (Vayro & Hamilton, 2016), and injury management (Lee et al., 2020)). Limited studies have tested the psychological pathways of the integrated model among athletes/sport participants in certain sports, although a greater number of studies have tested the tenets of SDT and TPB among specific sporting types (e.g., wheelchair basketball, netball; Palmer et al., 2005; Perreault & Vallerand, 2007). No studies to date, to the authors' knowledge, have tested the integrated model in the context of children's swimming nor tested the role of competence on model pathways.

Direct and moderation effects of competence in the integrated model

Based on prior theory and research integrating SDT and the TPB, it is possible that competence would have important effects in the integrated model. Specifically, according to the basic needs sub-theory of SDT (Ryan & Deci, 2008), perceived support for the psychological need of competence may help to foster autonomous motivation and, indirectly, the sets of beliefs that directly underpin intentions towards, and actual participation in, subsequent behaviour. Thus, within the integrated model, it might be expected that competence would have direct effects on autonomous motivation, and indirect effects on the TPB social cognition constructs of attitudes, subjective norms, and PBC, as well as on intentions and behaviour (Hagger & Chatzisarantis, 2009, 2014; Pasi et al., 2021). Specifically, in the current context of swimming, children who perceive their social environment to support their need for competence might be more likely to report autonomous motivation towards swimming and, as a consequence, report beliefs and intention to participate in swimming in future (Hagger & Chatzisarantis, 2009, 2014).

Prior research has also identified constructs related to competence as candidate moderators of the effects of beliefs and other motivation-related constructs on intentions to perform a given behaviour in future. For example, a key prediction of the TPB is that PBC, a construct that is conceptually close to perceived competence, has been proposed as a moderator of beliefs such as attitudes and subjective norms on intentions, as well as the effect of intentions on behaviour (Ajzen, 1985). Such a prediction suggests that individuals who cite high competence in being able to perform a particular behaviour have greater intention to act as this is consistent with their beliefs, as well as enacting their intentions. However, a synthesis of research examining these effects demonstrated that although PBC moderated the intention-behaviour relationship, there was no evidence for the moderation of beliefs on intention (Hagger et al., 2022). As a consequence, we predicted that competence would have direct effects on autonomous motivation (consistent with SDT), and on the belief-based constructs and intentions (consistent with the TPB), but competence would not moderate the psychological pathways of the integration between the SDT and TPB.

Despite support for the integrated model in the sports, exercise, and health psychology literature (Chan & Hagger, 2012b; Chan, Dimmock, et al., 2015; Chan, Zhang, et al., 2020; Hamilton et al., 2017; Jacobs et al., 2011; Lee et al., 2020; Standage et al., 2012), few studies have tested the moderating effects of competence on model constructs by either longitudinally monitoring the changes in competence in sports or manipulating one's psychological need support (e.g., competence enhancement). Intervention studies based on the integrated model exist (Jacobs et al., 2011; Schneider et al., 2020), however the primary focus has been on promoting autonomy support only and sample sizes are often small with restricted variance of individuals' sport competence. It is not surprising therefore that such studies have been unable to provide strong evidence to demonstrate whether the variables of the integrated model could be promoted by competence training. In addition, these prior studies did not formally examine whether the pathways of the integrated model would remain consistent if individuals had higher (or lower) sport competence. Thus, support for the moderating effects of competence on constructs in the integrated model remains unclear.

Other research gaps of competence in sports

Perceived competence versus actual competence

Previous studies did not evaluate the actual competence level of individuals when applying the integrated model to explain behaviours in physical activity or exercise contexts. It is plausible as physical activity or exercise is typically not competitive in nature, so researchers tended to focus on the volume of the activity rather than the competence or skill level (Kalajas-Tilga et al., 2020; Shen et al., 2018). It is important to note that competence-based psychological variables, such as perceived competence, competence satisfaction, self-efficacy, self-concepts, or PBC, do not fully reflect actual competence itself (Barnett et al., 2015; Moran et al., 2012; Pesce et al., 2018). Previous research in swimming has shown that self-concepts of swimming only accounted for approximately 10% of the variance in swimming performance among world-class swimmers (Marsh & Perry, 2005), and a similar study among gymnastic beginners also reported consistent findings (Marsh et al., 2006). In sum, due to limitations in conceptualising and assessing competence in sport, previous studies were unable to provide solid evidence to reveal whether improving one's actual competence could have any effects on the motivation and decision-making factors in a particular physical activity or exercise setting.

Swimming as a unique type of physical activity/exercise

As different types of physical activity have different performance indicators, standardising measures and attributing a single indicator of overall performance is difficult. Similarly, determining a measurement of competence in a single type of exercise, such as swimming, is not without challenges or limitations. Swimming has received comparatively little attention in exercise and health-related research despite the popularity of swimming as a leisure-time physical activity (Moran et al., 2012). This may, in part, be due to the measurement of swimming competence or skill level, which has traditionally been inconsistent or labour intensive (Chan, Lee, Macfarlane, et al., 2020) with limited validity evidence. Recently, a measurement tool for swimming competence, the Swimming Competence Scale, has been developed and found support for its psychometric properties and validity (Chan, Lee, Macfarlane, et al., 2020). The Swimming Competence Scale evaluates the actual competence of swimming in terms of one's furthest swimming distance (without resting) and one's basic swimming skills (e.g., holding a breath in the water and treading water). The scoring of the scale correlated significantly with objective measurement of swimming competence by swimming coaches (Chan, Lee, & Hamilton, 2020), supporting the ability of the self-report instrument to measure one's actual competence in swimming. Further, the tool allows for the identification of children's high, low, and improvement in swimming competence, thus making it feasible to test direct and moderation effects of competence on constructs in the integrated model adopted in this study.

The present investigation

The present investigation aimed to examine the direct and moderation effects of competence on constructs in the integrated model in two large-scale datasets examining the swimming intentions of young children. This forms part of a larger study that has previously published two papers using the datasets to examine the psychometric properties of the Swimming Competence Scale (Chan, Lee, Macfarlane, et al., 2020) and report the descriptive findings of children's swimming competence (Chan, Lee, & Hamilton, 2020). This study reports on a unique research question and tests the pathways of the proposed integrated model. Study 1 used the dataset from a population-representative cross-sectional survey of swimming competence involving nearly 5,000 primary school students. Capturing a broad spectrum of competence information in a population-representative sample allowed the investigation and testing of moderation analyses for swimming competence. This data allowed us to compare the robustness of the model against children with higher or lower swimming competence. It also allowed natural variances of demographic variables (e.g., age, gender) to be accounted for when testing the effects of competence on young children's swimming patterns, as recommended by previous studies (Nicholls, 1984; Weiss & Williams, 2004).

Given that testing moderation effects in a cross-sectional study is somewhat limited, Study 2 used another dataset from an intervention study whereby swimming competence was measured in approximately 1,600 primary school students before and after a structured learn-to-swim intervention programme. In this pre-post-test experiment, we examined the proposed moderation of swimming competence at a change-score level. That is, whether the improvement of swimming competence after a learn-to-swim programme would successfully moderate the changes in the variables and parameter estimates in the integrated model. These two studies allowed us to examine the proposed moderations of competence on the integrated model in both a cross-sectional study (i.e., testing moderation in cross-sectional relationships) and a quasi-experimental study (i.e., testing moderation at the change-score level).

Based on the tenets of the integrated model in the prediction of physical activity and other health behaviours

(Chan & Hagger, 2012b; Chan, Dimmock, et al., 2015; Hamilton et al., 2017; Jacobs et al., 2011; Standage et al., 2012), as well as the evidence regarding the adaptive role of psychological support of competence (Bagøien & Halvari, 2005; Gunnell et al., 2014), we hypothesised that swimming competence would not moderate the parameter estimates of the integrated model and, instead, expected only direct, positive effects of competence on model variables consistent with the integrated model.

Study 1

Study 1 examined the integrated model on children's swimming as well as direct and moderating effects of swimming competence on model constructs. Due to the cross-sectional design of Study 1, we examined the following hypotheses:

H1 The pathways between psychological need support, autonomous motivation, TPB social cognition constructs, and intention would be consistent with the tenets of the integrated model of SDT and TPB:

- **H1a** Psychological need support would be significantly and positively associated with autonomous motivation.
- **H1b** Autonomous motivation would be significantly and positively associated with attitude, subjective norm, and PBC.
- **H1c** Attitude, subjective norm, and PBC would be significantly and positively associated with intention.

H2 The psychological pathways of the integrated model would hold when including effects of swimming competence; namely, the direct effects of swimming competence (H2a) and the interactions between swimming competence and the variables of the integrated model (H2b).

H3 Swimming competence would be significantly and positively associated with all model constructs. In other words, children with higher swimming competence would have higher psychological need support, autonomous motivation, TPB social cognition constructs, and intention.

H4 The interaction terms representing the moderation effect of swimming competence on effects of model constructs on outcomes would be trivial in size[1] (Hagger, Koch, Chatzisarantis, & Orbell, 2017; Seaton, Marsh, & Craven, 2010), or no different from zero, consistent with the predictions of the integrated model.

Methods of study 1

Participants and procedure

The study was approved by the Institutional Review Board of The University of Hong Kong (no. UW16–407). Invitations were sent to 520 local primary schools in Hong Kong, and 28 schools across 15 districts (out of a total of 18 districts) agreed to participate in the study. Participants were eligible for Study 1 if they were enrolled in a local primary school. No exclusion criteria were applied in the recruitment. Participants were recruited from November 2016 to May 2017. A final sample of 4,959 primary school students (*M* age = 8.632, *SD* = 1.686; age range = 5 to 14 years; female = 54.547%) and their parents/guardians provided informed consent and agreed to take part in the study. After consent was obtained, student participants were asked to complete a paper-based questionnaire with the assistance of their parents/guardians. On average, participants reported that they started swimming at the age of 6.116 years (*SD* = 1.772) and had 2.786 years (*SD* = 1.990) of swimming experience. It was also reported that they swam 2.876 times (*SD* = 3.246) per month and undertook 74.920 minutes (*SD* = 37.228) of swimming activity per session. Other than swimming and demographic information, participants were given questionnaires that measured the current study's variables. All the measures included in the questionnaires are presented in the Supplemental Material (Appendix A), and available online on the Open Science Framework platform (https://osf.io/n6b9u/).

Measures

Psychological need support

Participants' perception of psychological need support from their significant others in the swimming context was measured using the six-item Chinese version of the Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) developed in previous research (Chan et al., 2009). Participants responded to the items with reference to "the most important person who teaches you swimming" on a seven-point Likert scale (1 = *not at all true* and 7 = *very true*). The Chinese version of the scale showed good score reliability in previous studies (α = .93; Chan et al., 2011).

Autonomous motivation

The 12-item Chinese version (Chan et al., 2011) Behavioural Regulation in Sport Questionnaire (Lonsdale et al., 2008) was used to measure participants' autonomous motivation in swimming. Participants' responses were rated on a seven-point Likert scale (1 = *not at all true* and 7 = *very true*). The scale showed good internal consistency (α =.93) in previous studies (Chan & Hagger, 2012a, 2012b).

[1]In this case, it is important to define what a "trivial" effect means in this context. Interpreting effect sizes of interaction terms as well as mediation effects in path analytic models is more complex than interpreting direct effects even when considering standardized coefficients. As a rule of thumb, and consistent with previous research (e.g., Hagger et al., 2017; Seaton et al., 2010), we adopted a standardized coefficient below .10 as representing a small effect size. In the case of the current study, effect sizes for the interaction terms fell well short of this standard.

TPB social cognition constructs

The TPB social cognition constructs of attitude (5 items), subjective norms (3 items), PBC (5 items), and intention (3 items) were measured using the Chinese versions of the TPB scale that were constructed according to TPB published guidelines (Ajzen, 2002). Participants' responses were reported on a seven-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*). Similar methods have been applied in other studies examining physical activity and sports-related behaviours (Chan, Zhang, et al., 2020; Lee et al., 2020, 2021), with acceptable scale score reliabilities reported (ω = .717–.919).

Swimming competence

The Swimming Competence Questionnaire (Chan, Lee, Macfarlane, et al., 2020) was used to measure participants' actual swimming competence. This 11-item scale is a self-report measure that aims to evaluate children's swimming competence through the maximum swimming distance of various swimming strokes (i.e., front crawl, breaststroke, backstroke, and butterfly) and swimming ability in six basic skills (i.e., swimming underwater, holding breath underwater, floating, poolside kicking, kickboard kicking, and treading water). Validation of the scale reported strong support of the factor structure, convergent validity, concurrent validity, criterion validity, predictive validity, test-retest reliability, inter-rater reliability, and ecological validity of the scale, showing that the scale is applicable to primary school children from 5 to 14 years old (Chan, Lee, & Hamilton, 2020; Chan, Lee, Macfarlane, et al., 2020). To ease interpretation, participants' responses in the items of swimming distance and basic swimming skill were converted to a swimming competence index following a specific algorithm developed in the validation study (Chan, Lee, Macfarlane, et al., 2020). A swimming competence index ranging from 0 (i.e., "*incompetent*") to 100 (i.e., "*competent*") may reflect the overall swimming competence of children.

Data analysis

We calculated descriptive statistics, zero-order correlations among the matrix of the integrated model constructs, reliability coefficients of the scales, and collinearity diagnostics using the Statistical Package for the Social Sciences (SPSS) v26. Structural equational modelling (SEM) was conducted to test study hypothesis using Mplus (version 8.4). Prior to SEM analysis, we conducted a confirmatory factor analysis (CFA) measurement model that consisted of the study variables (i.e., psychological need support, autonomous motivation, and TPB social cognition constructs of attitude, subjective norm, PBC, and intention). The convergent and discriminant validity of the scales were examined in the measurement model (Kline, 2015). For convergent validity, we estimated correlations between the integrated model variables. For discriminant validity, we estimated the shared variance between the factors and average variance extracted (AVE) for each factor. We tested H1 to H4 in three separate models. In Model 1, we tested the psychological pathways of the integrated model (i.e., psychological need support → autonomous motivation → attitude, subjective norm, PBC → intention). In Model 2, we added swimming competence as the predictor of all the variables of Model 1. In Model 3, we created the latent variable interactions between swimming competence and each of the variables of the integrated model (e.g., psychological need support x swimming competence). Moreover, the interactions were added as additional predictors of Model 2 to determine whether swimming competence had any moderation effects on the parameter estimates of the integrated model (e.g., psychological need support x swimming competence → autonomous motivation). The interaction terms were created in Mplus using the XWITH command for the latent moderated structural equations (LMS) procedure (Muthén & Muthén, 2017). Demographic variables, including age, sex, parents' income and highest education, and frequency, duration, and years of swimming, were included as covariates in all three models.

Regarding the three models, H1 was tested in Model 1, H2a and H3 were tested in Model 2, and H2b and H4 were tested in Model 3. Conventional fit indices were used to assess model fit: the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and standardised root mean square residual SRMR (Hu & Bentler, 1999). Traditional cut-off criteria of CFI and TLI (i.e., >.90) and RMSEA and SRMR (i.e., <.08) were applied to indicate acceptable fit (Hu & Bentler, 1999). Maximum likelihood estimation with robust standard errors (MLR) was used as the estimator, which has been proven to be an effective method in handling missing data (Shin et al., 2017). Datasets and analytical scripts can be accessed online on the Open Science Framework platform (https://osf.io/n6b9u/).

Results of study 1

Descriptive statistics

Descriptive statistics, zero-order correlations, reliability coefficients, AVE, shared variance, and factor loadings are presented in Table 1. The scores of the study variables exhibited acceptable internal consistency (McDonald's omega = .922 to .948). The measurement model showed excellent fit with the data, χ2 = 2555.394, CFI = .974, TLI = .967, and RMSEA = .033, 90% CI [.031, .034], and SRMR = .053. The integrated model variables were all positively associated with each other (r = .292 to .772), supporting the convergent validity. In general, the AVES of the factors (range = .524 to .852) were higher than the share variance with the study variables (range = .085 to .596), supporting the discriminant validity. Collinearity diagnostics did not reveal evidence of multicollinearity between any of the predictor variables included in the three models examined in this study (i.e., tolerance = .364 to .982; variance inflation factor = 1.018 to 2.751).

Structural equation modelling

In Model 1, the SEM analysis showed adequate fit with the data, χ2 = 6415.388, CFI = .941, TLI = .926, and RMSEA = .042, 90% CI [.041, .043], and SRMR = .068. All proposed paths of the integrated model were positive and significant (β = .189 to .684, p < .01). See Table 2. The model explained a significant proportion of the variance in the endogenous variables of the

Table 1. Descriptive statistics and zero-order correlation matrix of the study variables ($N = 4,959$).

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Psychological Need Support	–													
2. Autonomous Motivation	.505**	–												
3. Attitude	.383**	.577**	–											
4. Subjective Norm	.292**	.484**	.542**	–										
5. PBC	.348**	.516**	.646**	.722**	–									
6. Intention	.298**	.520**	.632**	.772**	.765**	–								
7. Competence	.113**	.283**	.325**	.281**	.403**	.342**	–							
Demographic Variables														
8. Age	−.063**	−.086**	−.009	−.091**	.007	−.036*	.346**	–						
9. Sex	−.010	−.031*	−.044**	−.022	−.011	−.046**	−.004	−.032*	–					
10. Parents' Income	.010	−.016	.022	.078**	.098**	.088**	.200**	−.007	−.074**	–				
11. Parents' Highest Education	.006	.004	.040**	.085**	.125**	.102**	.239**	−.029*	−.068**	.419**	–			
12. Frequency of Swimming	.118**	.244**	.284**	.310**	.338**	.312**	.457**	.021	.047**	.058**	.024	–		
13. Swimming Duration	.058**	.102**	.082**	.029	.039*	.046**	.128**	.216**	−.026	−.065**	−.83**	.123**	–	
14. Years of Swimming	−.019	−.016	.086**	.034	.128**	.089**	.497**	.538**	−.049**	.133**	.131**	.103**	.143**	–
Omega	.939	.939	.922	.924	.942	.948	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mean	4.963	4.573	4.913	3.734	4.188	4.053	45.862	8.632	.453	7.393	2.160	2.876	74.920	2.786
Standard Deviation	1.458	1.340	1.594	2.011	1.927	2.097	32.761	1.686	.497	2.344	.942	3.246	37.228	1.990
Skewness	−.56	−.44	−.61	.10	−.22	−.10	−.01	.01	.28	.65	.34	2.96	1.22	.79
Kurtosis	−.17	−.02	−.35	−1.22	−1.11	−1.30	−1.31	−.84	−1.92	2.17	−.82	14.10	6.60	.84
AVE	.630	.524	.563	.836	.705	.852	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Range of Shared Variance	.085–.255	.234–.333	.147–.417	.085–.596	.121–.585	.089–596	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Range of Factor Loading	.738–.856	.574–.938	.648–.877	.897–.938	.710–.932	.902–.938	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note. AVE = average variance extracted; N/A = not applicable; PBC = Perceived behavioural control.
$^{*}p < .05$ $^{**}p < .01$.

Table 2. Parameter estimates for the proposed SEM in Study 1.

Model	Paths	B	95%CI LB	95%CI UB	β[a]
1	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.574	.540	.607	.530**
	Autonomous Motivation → Attitude	.761	.711	.811	.684**
	Autonomous Motivation → Subjective Norms	.628	.565	.691	.458**
	Autonomous Motivation → PBC	.747	.688	.806	.548**
	Attitude → Intention	.222	.184	.259	.189**
	Subjective Norms → Intention	.426	.391	.460	.448**
	PBC → Intention	.448	.409	.487	.468**
2	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.535	.502	.568	.500**
	Autonomous Motivation → Attitude	.742	.688	.795	.666**
	Autonomous motivation → Subjective Norms	.606	.537	.674	.440**
	Autonomous motivation → PBC	.697	.634	.761	.511**
	Attitude → Intention	.223	.186	.261	.191**
	Subjective Norms → Intention	.426	.391	.460	.450**
	PBC → Intention	.447	.408	.487	.468**
	Swimming Competence Effects				
	Swimming Competence → Psychological Need Support	.224	.183	.266	.165**
	Swimming Competence → Autonomous Motivation	.480	.424	.537	.330**
	Swimming Competence → Attitude	.102	.023	.181	.063*
	Swimming Competence → Subjective Norms	.122	.020	.223	.061*
	Swimming Competence → PBC	.260	.161	.359	.131**
	Swimming Competence → Intention	−.018	−.064	.028	−.009
3	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.616	.580	.652	.458**
	Autonomous Motivation → Attitude	.637	.602	.673	.604**
	Autonomous Motivation → Subjective Norms	.655	.607	.704	.449**
	Autonomous Motivation → PBC	.679	.638	.720	.481**
	Attitude → Intention	.222	.188	.256	.166**
	Subjective Norms → Intention	.488	.451	.525	.504**
	PBC → Intention	.411	.371	.451	.411**
	Swimming Competence Effects				
	Swimming Competence → Autonomous Motivation	.413	.364	.462	.307**
	Swimming Competence → Attitude	.067	.016	.118	.047*
	Swimming Competence → Subjective Norms	.131	.056	.206	.067**
	Swimming Competence → PBC	.310	.241	.379	.163**
	Swimming Competence → Intention	.024	−.023	.070	.013
	Moderation Effects				
	Psychological Need Support x Swimming Competence → Autonomous Motivation	−.026	−.060	.007	−.020
	Autonomous motivation x Swimming Competence → Attitude	.010	−.012	.031	.009
	Autonomous motivation x Swimming Competence → Subjective Norms	.064	.034	.095	.060**
	Autonomous motivation x Swimming Competence → PBC	.042	.013	.070	.030*
	Attitude x Swimming Competence → Intention	.010	−.013	.032	.007
	Subjective Norms x Swimming Competence → Intention	−.011	−.026	.004	−.011
	PBC x Swimming Competence → Intention	.023	.007	.039	.023*

Note. B = Unstandardised parameter estimate; 95% CI = 95% confidence intervals; LB = Lower bound of 95% CI; UB = Upper bound of 95% CI; β = Standardised parameter estimate; PBC = Perceived behavioural control. The effects of the covariates (i.e., age, sex) are omitted from the table to ease presentation but could be obtained from the author on request.
*$p < .05$ **$p < .01$.

integrated model, $R^2 = .351$ to .772, $p < .01$. The H1 (i.e., H1a, H1b, and H1c) was supported.

Model 2 also exhibited adequate fit ($\chi2 = 6521.400$, CFI = .939, TLI = .924, and RMSEA = .042, 90% CI [.041, .043], and SRMR = .074). The proposed paths of the integrated model were also positive and significant (β = .191 to .666, $p < .01$) after controlling for the effects of swimming competence and were consistent with H2a. Swimming competence had positive effects on all the integrated model variables (β = .061 to .330, $p < .05$) except intention (β = −.009, $p > .05$), so H3 was only partially supported. Model 2 significantly explained the variance of the endogenous variables in the integrated model, $R^2 = .340$ to .767, $p < .01$. See Table 2.

In Model 3, all proposed paths of the integrated model were positive and significant (β = .166 to .604, $p < .01$), supporting H2b. Furthermore, we examined the moderation effects of swimming competence on all variables of the integrated model. The interaction terms of swimming competence did not identify any significant relationships with the model variables, except with subjective norms (β = .060, $p < .001$), PBC (β = .030, $p < .05$), and intention (β = .023, $p < .05$). Consistent with our hypothesis (H4), these interaction terms were either very small, falling short of the guideline effect size for a non-trivial effect, or were not statistically significant (see Table 2). The model explained a significant proportion of the variance in the endogenous variables of the integrated model, $R^2 = .377$ to .738, $p < .01$.

Study 2

Study 2 examined the hypothesised direct effects and moderations of swimming competence on constructs/pathways of the integrated model among a group of young children who participated in a learn-to-swim programme. With a pre-post-test quasi-experimental design, Study 2 allowed formal tests of H1 to H4 (of Study 1) at a change-score level. In addition, we tested two additional hypotheses relating to the effects of swimming competence:

H5 The pathways of the integrated model would be invariant across the pre-training and post-training occasions. Given we expected that each of the interaction effects of competence on model effects would be sufficiently small, so as to be non-trivial or not statistically significant before and after the programme, our hypothesis of invariance in these moderation effects is consistent with our overarching hypothesis relating to the moderating effect of swimming competence in the integrated model.

H6 Participants' autonomous motivation, TPB social cognition constructs, and intention would increase after taking part in a learning-to-swim training programme that aimed at enhancing swimming competence. This hypothesis was expected to be consistent with our overarching hypothesis regarding the direct effects of competence on integrated model variables.

Methods of study 2

Participants, procedure, and measures

Ethical approval was obtained from the Institutional Review Board of [organisation masked for blind review] (no. UW-16478). Participants were included if they (1) were junior primary school students in Hong Kong (i.e., P1-P3) and (2) joined the learn-to-swim training programme, involving a maximum total of 20 swimming lessons (1 hour per lesson). Recruitment occurred from February 2017 to July 2017, with follow-up data collection completed in September 2017. Eligible participants were contacted via the learn-to-swim training programme. A final sample of 1,614 children (*M* age = 6.400 ± .524, range = 5 to 9; female = 45.82%) and their parents/guardians provided informed consent and agreed to participate in the study. Participants were junior primary school students in Hong Kong who self-reported limited swimming competence before the training programme. The learn-to-swim training programme consisted of six progressive sections, including warm-up, preparation, kicking, pulling, kicking pulling drills, and technique correction. All sessions were delivered by qualified swimming instructors (see Chan, Lee, Macfarlane, et al., 2020 for details of training content). Participants were asked to complete all swimming lessons (on average, 18.448 ± 3.167 lessons were completed) between February and July 2017 and complete questionnaires used in Study 1 before and after the learn-to-swim programme (mean programme length = 3.259 ± 1.525 months). Participants' swimming competence improved after completion of the learn-to-swim programme ($t(779) = -23.899$, $p < .01$), as reported in a previous study (Chan, Lee, Macfarlane, et al., 2020). Study 2 adopted the same consent procedures and measures as in Study 1, except that participants were asked to complete HCCQ items according to their perception towards "their swimming coaches" instead of "the most important person who teaches you swimming".

Data analysis

First, we examined correlations among predictors and collinearity diagnostics to ensure that there were no significant problems with multicollinearity. We then tested H1 to H4 via three path models (Model 1–3) using standardised residual change scores of the model variables. Change scores were generated by regressing the post-test measures on the baseline measures (i.e., a positive value indicated an increase or positive change over time) for each variable. Standardised residual change scores were suggested to be a more reliable score than simple difference scores (Cronbach & Furby, 1970). Similar to Study 1, Model 1 examined the proposed pathways of the integrated model; swimming competence and then its interaction terms were added in Model 2 and Model 3, respectively, to test the direct and moderation effects of swimming competence. In Model 3, we generated the interaction terms of swimming competence change scores and all the integrated model variables change scores to determine if swimming competence had any moderation effects on the integrated model after using the XWITH command in Mplus. The path models in Study 2 adopted the same estimation strategies and goodness-of-fit criteria as Study 1, but the models only controlled for participants' age and sex because other demographic variables (e.g., parents' income and highest education) were not available in the dataset of Study 2.

To test H5, single-group and multi-group SEM were conducted in Mplus (version 8.4) to examine proposed pathways of the integrated model (i.e., Model 1). First, we performed single-group analyses on pre-training and post-training data independently to determine if they fitted into the integrated model. Second, we examined the invariance of the integrated model between pre-training and post-training data (i.e., H5) using multi-group analysis. Third, all paths were constrained one by one to be equal across samples to explore any similarities, variations, and differences in the integrated model pathways. Chi-square difference tests were conducted to compare the baseline model and the constrained models. Traditional criteria of goodness-of-fit were adopted as in Study 1 (Hu & Bentler, 1999).

To test H6, we conducted a paired sample *t* test to examine whether the constructs of the integrated model were different between pre-training and post-training using SPSS v26.

Results of study 2

Data screening showed that the data for Study 2 was normally distributed (i.e., skewness = −1.136 to .697 and kurtosis = −.844 to .919). Neither the magnitude of the correlations among study variables (the largest correlation was between the change scores of intention and PBC: $r = .751$, $p < .001$) nor the collinearity diagnostics (i.e., tolerance = .372 to .989; variance inflation factor = 1.011 to 2.687) indicated patterns of multicollinearity.

Table 3. Parameter estimates for the proposed path models using standardised residual change scores in Study 2.

Model	Paths	B	95%CI LB	95%CI UB	β[a]
1	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.539	.477	.601	.542**
	Autonomous Motivation → Attitude	.459	.401	.517	.458**
	Autonomous Motivation → Subjective Norms	.494	.446	.542	.493**
	Autonomous Motivation → PBC	.562	.506	.618	.562**
	Attitude → Intention	.118	.070	.166	.117**
	Subjective Norms → Intention	.389	.324	.454	.386**
	PBC → Intention	.364	.303	.424	.360**
2	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.515	.452	.578	.517**
	Autonomous Motivation → Attitude	.436	.378	.495	.436**
	Autonomous motivation → Subjective Norms	.482	.432	.533	.481**
	Autonomous motivation → PBC	.542	.484	.600	.542**
	Attitude → Intention	.114	.066	.163	.113**
	Subjective Norms → Intention	.389	.324	.454	.386**
	PBC → Intention	.358	.297	.420	.355**
	Swimming Competence Effects				
	Swimming Competence → Psychological Need Support	.230	.170	.290	.230**
	Swimming Competence → Autonomous Motivation	.111	.057	.165	.111**
	Swimming Competence → Attitude	.095	.041	.150	.096**
	Swimming Competence → Subjective Norms	.049	−.005	.103	.049
	Swimming Competence → PBC	.086	.032	.140	.087**
	Swimming Competence → Intention	.046	.007	.085	.046*
3	Integrated Model Paths				
	Psychological Need Support → Autonomous Motivation	.475	.405	.545	.490**
	Autonomous Motivation → Attitude	.475	.408	.542	.462**
	Autonomous Motivation → Subjective Norms	.491	.435	.548	.480**
	Autonomous Motivation → PBC	.556	.498	.614	.548**
	Attitude → Intention	.153	.091	.215	.173**
	Subjective Norms → Intention	.370	.295	.445	.416**
	PBC → Intention	.379	.305	.453	.423**
	Swimming Competence Effects				
	Swimming Competence → Autonomous Motivation	.112	.058	.166	.116**
	Swimming Competence → Attitude	.081	.027	.136	.082*
	Swimming Competence → Subjective Norms	.048	−.006	.102	.049
	Swimming Competence → PBC	.080	.027	.133	.082*
	Swimming Competence → Intention	.036	−.002	.073	.041
	Moderation Effects				
	Psychological Need Support x Swimming Competence → Autonomous Motivation	−.022	−.091	.047	−.023
	Autonomous motivation x Swimming Competence → Attitude	−.025	−.093	.043	−.026
	Autonomous motivation x Swimming Competence → Subjective Norms	−.028	−.080	.025	−.028
	Autonomous motivation x Swimming Competence → PBC	−.067	.129	−.004	−.068
	Attitude x Swimming Competence → Intention	.013	−.045	.072	.015
	Subjective Norms x Swimming Competence → Intention	.047	−.028	.122	.052
	PBC x Swimming Competence → Intention	−.055	−.128	.018	−.061

Note. B = Unstandardised parameter estimate; 95% CI = 95% confidence intervals; LB = Lower bound of 95% CI; UB = Upper bound of 95% CI; β = Standardised parameter estimate; PBC = Perceived behavioural control. The effects of the covariates (i.e., age, sex) are omitted from the table to ease presentation but could be obtained from the author on request.
*$p < .05$ **$p < .01$.

Integrated model at the change-score level (H1 to H4)

Model 1 showed acceptable fit to the data, χ2 = 2239.691, df = 27, CFI = .983, TLI = .907, RMSEA = .070 [90% CI = .000 to .059], SRMR = .042. The parameter estimates were positive and statistically significant (β = .117 to .562, $p < .01$). H1 was therefore supported at a change-score level. The model significantly explained the variance of the endogenous variables of the integrated model, R^2 = .207 to .660, $p < .01$.

Model 2 also displayed a good fit to the data, χ2 = 2383.355, df = 33, CFI = .986, TLI = .905, RMSEA = .066 [90% CI = .047 to.085], SRMR = .035. The integrated model pathways were positive and significant (β =.113 to.517, $p < .01$) after controlling for the effects of swimming competence. The results supported H2a. Swimming competence was positively and significantly associated with all variables of the integrated model (β = .046 to .230, $p < .05$), except subjective norms (β = .049, $p > .05$), so H3 was largely supported. The model explained a significant proportion of the variance in endogenous variables of the integrated model, R^2 = .216 to .662, $p < .01$.

In Model 3, all proposed paths of the integrated model were positive and significant (β = .173 to .548, $p < .01$) which were consistent with H2b. The interaction terms of swimming competence on integrated model effects were not statistically significant (β = −.068 to .052, *ps* > .05), consistent with our hypothesis (H4). The model significantly explained the variance

Table 4. Parameter estimates of the single-group integrated model at pre- and post- training programmes controlling for participants' age and sex.

	Sample					
	Pre-Training			Post-training		
		95%CI			95%CI	
	β	LB	UB	β	LB	UB
Psychological Need Support → Autonomous Motivation	.648**	.603	.694	.614**	.562	.665
Autonomous Motivation → Attitude	.730**	.686	.775	.641**	.587	.695
Autonomous Motivation → Subjective Norms	.514**	.461	.568	.563**	.512	.614
Autonomous Motivation → PBC	.635**	.589	.682	.641**	.595	.667
Attitude → Intention	.199**	.124	.274	.121**	.052	.189
Subjective Norms → Intention	.229**	.114	.343	.270**	.144	.395
PBC → Intention	.547**	.411	.683	.566**	.426	.706

Note. 95% CI = 95% confidence intervals; LB = Lower bound of 95% CI; UB = Upper bound of 95% CI; β = Standardised parameter estimate; PBC = Perceived behavioural control. The effects of the covariates (i.e., age, sex) are omitted from the table to ease presentation but could be obtained from the author on request.
**p* < .05 ***p* < .01.

Table 5. Paired sample t test before and after the learn-to-swim training programme.

	Pre-Training		Post-Training		Paired sample *t* test	
	Mean	*SD*	Mean	*SD*	*t*	*p*
Psychological Need Support	4.895	1.344	4.950	1.357	1.147	.252
Autonomous Motivation	5.198	1.357	5.267	1.101	1.937	.053
Attitude	6.033	1.087	5.985	1.071	−1.341	.180
Subjective Norms	5.406	1.454	5.452	1.496	.837	.403
PBC	5.432	1.329	5.504	1.379	1.417	.157
Intention	5.794	1.387	5.681	1.495	−2.052	.040
Swimming Competence	25.867	21.240	40.414	21.109	23.899	.000

Note. PBC = Perceived behavioural control. Positive *t* values indicate improvement.

Table 6. Results of multi-group SEM controlling for participants' age and sex.

	χ2	*df*	Δχ2	Δ*df*	*p*
Total Model (Baseline Model)	2414.033	1048			
Constrained Pathways					
Psychological Need Support → Autonomous Motivation	2415.629	1049	1.596	1	.194
Autonomous Motivation → Attitude	2415.479	1049	1.446	1	.206
Autonomous Motivation → Subjective Norms	2416.985	1049	2.952	1	.083
Autonomous Motivation → PBC	2416.361	1049	2.328	1	.127
Attitude → Intention	2414.735	1049	.702	1	.320
Subjective Norms → Intention	2412.435	1049	−1.598	1	.636
PBC → Intention	2412.635	1049	−1.398	1	.791

Note. PBC = Perceived behavioural control.

of the endogenous variables of the integrated model, $R^2 = .238$ to .577, $p < .01$. Details of the parameter estimates of Model 1, Model 2, and Model 3 are presented in Table 3.

Comparison of pre-training and post-training (H5 and H6)

H5 was tested by examining the proposed pathways of the integrated model (i.e., Model 1) between pre-training and post-training. In the single group analysis, the integrated model using the pre-training (χ2 = 1353.005, df = 496, CFI = .967, TLI = .958, RMSEA = .035 [90% CI = .033 to .037], SRMR = .050) and post-training (χ2 = 968.636, df = 496, CFI = .976, TLI = .970, RMSEA = .030 [90% CI = .0278 to .033], SRMR = .049) data showed acceptable goodness-of-fit. Standardised parameter estimates (β) of the model in the pre-training data (β = .121 to .730, $p < .01$) and post-training data (β = .121 to .730, $p < .01$) were positively and statistically significant, as hypothesised in H1 to H4 (see Table 4). The multi-group SEM analysis revealed an adequate fit to the data (χ2 = 2414.033, df = 1048, CFI = .970, TLI = .964, RMSEA = .033 [90% CI = .031 to .034], SRMR = .051). In support of H5, chi-square difference tests revealed that the parameter estimates of the model were invariant between pre-training and post-training (Δχ2 = −1.598 to 2.952, $p > .05$). Table 5 displays the full results of multi-group SEM.

For the test of H6, paired sample *t* tests revealed no significant improvement of all variables of the integrated model in post-training over pre-training (t(876 to 954)= −1.937 to 1.341, $p > .05$), except intention (t(923) = 2.052, $p < .05$). Intention was higher in pre-training (mean = 5.794; S.D. = 1.387) than in post-training (mean = 5.681; S.D. = 1.495). Although the effect was very small (Cohen's d = .078), the direction was opposite to our prediction. Thus, the results did not support H6 (see Table 6 for the full results of H6).

Discussion

In the present investigation, we examined the direct and moderating effects of competence using an integrated model of SDT and TPB (Hagger & Chatzisarantis, 2009, 2014). These examinations were conducted across a large-scale cross-sectional study and an intervention, to test whether swimming competence would moderate the parameter estimates of the integrated model and whether swimming competence would exert positive effects on the psychological variables in the model. Our findings provide evidence to support the psychological pathways of the integrated model (i.e., positive relationships in psychological need support → autonomous motivation → TPB social cognition constructs → intention; Hagger & Chatzisarantis, 2009, 2014) in a context of young children's swimming intentions (H1 and H5 were fully supported), and the model appeared to be robust against individual differences in competence levels (H2). The moderation effects (i.e., interaction) of swimming competence on proposed pathways of the integrated model were either non-significant or small in size, supporting H4. However, mixed findings were observed regarding the hypothesised positive effects of swimming competence on model constructs (H3 and H6). Specifically, swimming competence generally established positive relationships with the variables of the integrated model either cross-sectionally or at the change-score level (H3 was largely supported). Yet, children who had improved their swimming competence in a learn-to-swim programme did not have any significant improvements in any of the psychological variables of the integrated model (H6 was not supported). Overall, the findings largely supported the robustness of the integrated model in a specific sport context (i.e., swimming) when taking individual differences in sport competence/skill level into consideration.

The integrated model of SDT and TPB

This study is the first application of an integrated model of SDT and TPB in the swimming context. Moreover, current findings have addressed a knowledge gap in the literature by testing the integrated model in a specific sport that has received little attention in sport and exercise psychology. Our findings are in line with the tenets of the integrated model and research that has applied the model in leisure-time physical activity (Hagger & Chatzisarantis, 2009, 2014; Hagger et al., 2005; Standage et al., 2012). Results from this research suggest that intention to take part in swimming, similar to other types of exercise, could be a function of perceived psychological need support, autonomous motivation, and social cognition beliefs (Hagger & Chatzisarantis, 2009, 2014).

The proposed pathways of the integrated model remained consistent when controlling for the effects of competence, implying that the predictions of the model were consistent across different competence levels. From this, the integrated model may explain individuals' motivational and social cognition processes for participating in a given sporting event, regardless of whether they possess high or low competence levels in the sport. Although some research suggests that those with higher competence have greater motivation to participate in sports (Skjesol & Halvari, 2005), other theorists have suggested that those who are highly competent may not feel further motivated. This is because task completion is perceived to be easy (Elliot et al., 2017), resulting in a flattened effect; hence, it may explain why our current model remains consistent across different levels of competence. Our findings also imply that individuals, regardless of their competence level in sport, tend to have lower intentions to engage in sport activity when they have lower psychological need support, autonomous motivation, and social cognition beliefs on the behaviour.

Also, psychological need support, including the need for competence, correlated with autonomous motivation in similar magnitudes between children with high and low competence. This implies that the psychological need for competence does not appear to be less important to children with higher competence in swimming. This could be because children with higher competence might value the adaptive role of psychological need support from their sport instructors in the same manner as those with lower competence (Bailey et al., 2013; Horn, 1985). Therefore, sports instructors should not assume that children with better performance in sports would always have better motivational and social cognition patterns, as psychological need support in the coaching environment appears to be equally important to children regardless of their competence level.

Perceived versus actual competence

Another research gap that our investigation attempted to address was to have a clearer distinction between actual competence and perceived competence. Psychological need support (of competence) and PBC are two variables in the integrated model that have a close theoretical bond with actual competence (Ajzen, 1991; Deci & Ryan, 1985; Hagger & Chatzisarantis, 2014). Our findings showed that swimming competence was correlated with PBC, but the correlation was not close to unity. This finding was consistent with the findings of Marsh and Perry (2005), who revealed that the self-concept (i.e., a construct also reflects one's perception of competence) of elite swimmers only explained approximately 10% of their swimming performance. Therefore, perceived and actual competence shared some degree of commonality, and they were likely to be independent constructs. PBC and swimming competence predicted intention significantly when controlling for their covariance, which means that both the perception and the actual competence of sport behaviour could exert independent predictive power on intention. However, in the current study, children's swimming competence improved after completing a learn-to-swim programme, but they did not report higher PBC. This might imply that sports programmes focusing only on development or performance enhancement might not necessarily improve one's PBC. Plausibly, as PBC is a reflection of one's perceived controllability of the behaviour, it may be affected not only by available resources (e.g., own skill level, access of training facilities) but also by challenges and expectations (Ajzen, 1991). Children with better skill levels in sports might encounter increased levels of challenges and hold higher expectations for performance, so their PBC might not necessarily be higher after a training programme. It is worthy for further studies to test the level of PBC among athletes at various levels and to investigate effective strategies for enhancing their PBC.

Effects of swimming competence

We also showed autonomous motivation and TPB social cognition constructs to be consistently associated with swimming competence, but these psychological constructs of swimming did not improve after a learn-to-swim programme (i.e., a programme that successfully enhanced the competence level of children). Current findings therefore do not support swimming competence as the antecedent of autonomous motivation and social cognition beliefs. This suggests that sport programmes which merely focus on enhancing skill level or performance in sport may not be beneficial to improving children's motivational and social cognition factors of sporting behaviours. Therefore, sports instructors should try to create a psychological need-supportive environment and be aware of individual differences in motivational orientation and decision-making factors of why children take part in sports. All these are likely to be the key factors of a child's long-term commitment to a given sport event.

The mixed findings for intention also warrant discussion. Although the effects of swimming competence on intention were observed in our correlational analyses at the cross-sectional or change-score level, effects in the intervention study were not consistent, and any effect observed was small in size. This suggests that children with higher competence in swimming might not necessarily be more likely to take part in swimming. The learn-to-swim programme, with the purpose of skill enhancement only, did not appear to be helpful in promoting better intentions to swim among children. The findings of intention in our study were therefore consistent with the conclusion we had for autonomous motivation and social cognition beliefs. That is, sport training programmes should not only focus on skill development if they aim to promote individuals' long-term commitment to sport. Future studies should examine whether swimming training adopting the adaptive behavioural strategies suggested by the integrated model (e.g., coaching style that supports the psychological needs of children; Pulido et al., 2018) may lead to long-term commitment towards swimming.

Study limitations

This paper documented two large-scale studies that comprehensively examined the direct and moderating role of swimming competence in an integrated model of behaviour that has been well-documented in the literature concerning physical activity promotion. Despite the unique strengths and novelty of this research, including two-study design, large sample sizes, successful manipulation of competence in sport, and testing the competence effects at a change-score level, study findings need to be considered in light of some theoretical and methodological limitations.

Theoretically, our studies only examined the most central and parsimonious pathways of the integrated model of SDT and TPB, of which the predictive power of the variables (e.g., psychological need support, autonomous motivation, and TPB social cognition constructs) have already been shown to be consistent across physical activity behaviours (Hagger & Chatzisarantis, 2009, 2014; Hagger et al., 2005, 2009; Standage et al., 2012) and other health-related behaviours (Chan & Hagger, 2012a, 2012b; Chan et al., 2011; Chan, Dimmock, et al., 2015; Hamilton et al., 2017; Jacobs et al., 2011). Being mindful of participant fatigue, we did not want to extend the length of the study surveys; thus, neither controlled motivation, amotivation nor maladaptive types of motivational orientations were measured. For a similar reason, we used the short version of the HCCQ to evaluate psychological need support, which was unable to reveal the independent effect of the need support of competence (as well as autonomy and relatedness). In addition, a measure of behaviour was not included, only intention, thus model predictions can only be inferred on theory alone and the temporal order of the model cannot be confirmed. Future studies should address this limitation by including a prospective measure of behaviour and examining model effects longitudinally.

Methodologically, a few limitations should also be noted. First, Study 1 and Study 2 used a cross-sectional design and quasi-experimental design, respectively, so both studies were unable to draw absolute causal inferences. Although swimming competence was manipulated in Study 2, it would be important to have a randomly assigned control group for formal tests on the effects of swimming competence beyond a reference level. Second, the measures of the integrated model were self-reports in a homogeneous format. In this case, the consistency tendency (Chan, Ivarsson, et al., 2015; Chan, Lee, & Hamilton, 2020) could have inflated cross-sectional relationships (i.e., correlations in Study 1 and single-group SEM in Study 2). However, the consistency tendency is unlikely to inflate longitudinal relationships (Chan, Ivarsson, et al., 2015; Chan, Stenling, et al., 2020), so the correlations at the change-score level (as in our Study 2) should not be affected. Third, although the sample of Study 1 was a good representation of the population, the sample of Study 2 was beginner swimmers only, so our findings (i.e., intervention effects of swimming competence) might not be generalisable to advanced swimmers who have undertaken elite sport training to improve their competitiveness in swimming. Also, the use of secondary data analysis meant that we were unable to predetermine the sample sizes of our studies based on statistical power analysis, and the relatively large sample sizes might lead to a higher risk of detecting clinically negligible effects (Faber & Fonseca, 2014). Although the sensitivity of our test of moderation was inflated, our large sample sizes were unlikely to favour the support of our central hypothesis (i.e., not statistically significant moderation of competence on the model pathways). Finally, the sole focus of swimming in our studies made our assessment of sport competence more consistent and comparable, but it also implied that our findings might only be applicable in the swimming context. Future studies should replicate our studies among sports participants or athletes who participate in other sports.

Conclusion

Millions of children take part in sports training programmes such as learn-to-swim programmes with the primary goal of skill development. In two large-scale studies, we showed that the psychological pathways of the integrated model of SDT and TPB were robust among children with different competence levels in swimming. Children's motivation, social cognition beliefs, and intention of swimming correlated positively with swimming competence, but they did not exhibit any significant improvement after completing a learn-to-swim programme that enhanced children's competence in swimming. Our results suggest that sports training programmes for children should not only be inclined towards competence development or skill acquisition but also be more aware of the motivational and social cognition factors that might underpin children's intention to take part in a given sport in the long term.

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