Journal of Physical Education and Sport ® (JPES), 18(1), Art 18, pp. 138 - 148, 2018
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Psychometric analysis of the sport imagery ability measure

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Published online: March 30, 2018
(Accepted for publication January 25, 2018
DOI:10.7752/jpes.2018.01018

Abstract:
Utilisation of imagery training techniques remains a popular approach within the sport psychology field to enhance athletic performance and motivation. Effective and reliable imagery training measures require multi-modal and multi-sensory designs to ensure all facets of the imagery process are represented. The purpose of this study was to examine the reliability, validity and factor structure of the Sport Imagery Ability Measure (SIAM). The study involved 625 participants (328 males and 297 females) with a mean age of 18.84 years. Participants were recruited from school, university and sporting clubs across four levels of competition (local, district, state and national). Internal consistency scores revealed adequate Cronbach alpha values for the 12 subscales, ranging from .68 (speed) to .87 (gustatory). Confirmatory Factor Analysis supported a 3-factor structure for the SIAM, indicating adequate model fit to the data. Re-specification of the model was conducted, revealing improved fit following model refinement based on modification indices and positive par change values. Analysis of demographic variables revealed differences in imagery ability for athletes of different genders and age groups for several subscales. A one-way analysis of variance indicated differences among athletes of different competition levels, with athletes at higher levels of competition having better imagery ability than lower level athletes across some of the subscales. Overall, the results of the present study support the efficacy of the SIAM as a reliable and valid instrument for measuring imagery ability of athletes. Future research possibilities and limitations of the current results in relation to the application and evaluation of the measure are also presented.
Key words: imagery, psychometrics, psychological assessment, sport psychology.

Introduction

Imagery as a process has been identified as a valuable technique for performance enhancement and motivation among athletes, and has been utilized by sports psychologists, coaches and athletes for many years (Cummings & Williams, 2012; Morris, Spittle & Watt, 2005). Researchers have investigated many characteristics of imagery, from imagery use to imagery ability. The multi-faceted nature of the phenomenon has provided a set of interesting developments in the way people think of imagery and the applications it has in sports psychology. Several researchers have described imagery as a cognitive process, while others consider it to be a set of propositions, or explain imagery in terms of motivational functions (Morris et al., 2005; Weinberg & Gould, 2014; Horn, 2008). Many researchers have tried to define imagery with only limited success in developing an all-encompassing universal definition (e.g., Richardson, 1969; Williams and Cumming, 2012; Holmes & Calmels, 2008). Existing literature has presented definitions of imagery in terms of sensory and perceptual experiences, while others define it as the creation or recreation of experiences (Morris et al., 2005; Bhasavanija & Morris, 2014). Holmes and Calmels (2008) define imagery as a top-down process, driven by knowledge in order to generate or re-generate representations in the brain or neural network, and that this process of imagery is a primarily conscious process, allowing an individual to experience or re-experience a situation in their mind. Distinguishing between imagery use and imagery ability has been identified as an important factor to the production of effective imagery training and imagery outcome (Gregg, Nederhof & Hall, 2005). Gregg, O and Hall (2016) emphasised the importance of distinguishing between imagery ability and imagery use when defining imagery. They describe imagery ability as 'quality' of an athlete's images, that is, the quality of generated images, paying special attention to the notion of images to differ in "vividness, controllability, visual representation, kinaesthetic feelings, ease and emotional experiences" (Gregg et al., 2016, p. 141). Imagery use, however, refers to the 'frequency' in which athletes "employ cognitive and motivational functions" (p.141).

A number of sport oriented imagery measures have been developed to investigate the imagery ability of athletes (Watt, Morris & Andersen, 2004; Gregg & Hall, 2006; Williams & Cummings, 2011; Budnik-Przybylska, Karasiewicz, Morris & Watt, 2014) including the Motivational Imagery Ability Measure for Sport, Sports Imagery Questionnaire, the Sports Imagery Ability Questionnaire and the Sports Imagery Ability

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Measure. The psychometric properties for these measures have been generally demonstrated using internal consistencies and confirmatory factor analysis. The Motivational Imagery Ability Measure for sport (MIAMS) was developed to assess an athlete's ability to utilize motivational general-arousal and motivational general-mastery functions of imagery (Gregg et al., 2016). Through confirmatory factor analysis the measure was found to have acceptable model fit (Gregg & Hall, 2006). In a study conducted by Gregg et al. (2016) both the subscales, ease and emotion, obtained sufficient internal consistencies with Cronbach's alpha between 0.68 and 0.72. The Sports Imagery Questionnaire (SIQ) was developed by Martens to help individuals understand how they experience imagery (Ungerleider, 2005). The psychometric properties of the SIQ have not been extensively tested, as Martens failed to validate the measure, making it difficult to obtain how sound the measure is (Bhasavanija & Morris, 2014). The sports imagery ability questionnaire (SIAQ) was developed to assess sport-specific images, as well as cognitive and motivational imagery ability. The SAIQ provides a comprehensive assessment of the imagery ability of athletes across five different types of imagery content including skill, strategy, goal, affect and mastery.

Confirmatory factor analysis revealed that the SIAQ has adequate model fit, with all factors of the five-factor model falling within acceptable limits, and all factor loadings ranging from .62 to .88. Internal consistency was determined through the use of composite reliability (CR) and Average variance extracted (AVE), as there were issues with using Cronbach's alpha (Williams & Cumming, 2011). Each subscale was deemed to have adequate CR scores with figures ranging from 0.74 to 0.86, as well as adequate AVE scores, with figures ranging from 0.50 to 0.67 across the four studies conducted (Williams & Cumming, 2011). Temporal reliability was supported using test-retest reliability scores obtained over a three-month period ranging from 0.75 to 0.86 (Williams & Cumming, 2011).

Investigations of the Sport Imagery Ability Measure (SIAM) have explored the reliability and factor structure of the measure to determine how affective it is at measuring the imagery ability of athletes. Original analysis of the data was conducted using exploratory factor analysis (EFA), and early use of confirmatory factor analysis (CFA), without performing any re-specification on the data (Watt, 2003; Watt et al., 2004). As a part of a more recent study, Budnik-Przybylska et al. (2014) investigated the psychometric properties of the SIAM using a polish sample of participants. Although a CFA was performed using the original 3-factor model they did not undertake any any re-specification of the data. The measurement of imagery ability is constantly being refined to ensure the most accurate and up to date methods for assessing the athletes engaging in psychological training programs and practice sessions. Re-specification of imagery data obtained from the SIAM might serve to clarify the uniqueness of subscales scores, because similarity in certain imagery variables may limit differentiation between each characteristic. The visual and vividness subscales, typically considered as the most commonly employed dimensions of imagery, can be difficult to discern due to the variable descriptors having been used interchangeably in imagery research (Morris et al., 2005). Allowing the error variables to share variance and correlate could reinforce and provide further support for the factor structure of the SIAM as a valid and reliable measure of imagery ability.

Previous researchers have assessed individual differences in imagery ability in the area of sport and sports psychology. Differences between competition levels has been extensively explored (e.g., Mazumder & Ghosh, 2013; Williams & Cumming, 2011). The concept of how males and females use imagery differently to help with performance in sport, as well as explorations into age differences on individual imagery ability to help with sport performance has also been explored in imagery literature, with poor results (e.g., Williams & Cumming, 2011). Mazumder and Ghosh (2013) investigated differences in imagery ability of footballers at different levels of competition. They found that footballers at the state level had higher scores for imagery ability than those competing at a district level. It was proposed that the observed differences in imagery performance might be because footballers at the state level were more experienced and had higher levels of physical competencies, therefore employing more imagery in sports situations (Mazumder & Ghosh, 2013).

Williams and Cummings (2011) found similar results, reporting that athletes at higher competition levels could generate sport images at significantly faster rates, with greater ease, and were found to have higher levels of imagery ability than those participating in lower competition levels. Investigations into competition level differences specifically relating to the SIAM reported that athletes competing at a higher level performed better than athletes competing at lower levels (Budnik-Przybylska et al., 2014; Bhasavanija, Vongjaturapat, Morris, & Muangnapo, 2012).

There has been only a limited set of studies related to gender and age differences in imagery ability, however, researchers that have examined these characteristics reported interesting results. Williams and Cummings (2011) investigated imagery ability differences between males and females and found a significant difference in mean scores for mastery imagery. In a study conducted by Mendes, Marinho and Petrica (2015) males reported significantly higher mean imagery scores on the Movement Imagery Questionnaire than females, especially in regards to the kinaesthetic modality. Bhasavanija et al (2012), investigated age differences for the SIAM, and only found significant differences on the control and duration subscales, with participants in the younger age group obtaining higher scores. Budnik-Przybylska et al (2014) also found limited differences in regards to age with the youngest athletes recording significantly higher imagery ability scores on the tactile and duration subscales of the SIAM.

The main purpose of the current study was to further examine the psychometric properties and factor structure of the SIAM. This involved the determining measure reliability and to ascertain through CFA if the measure had an adequate factor structure to represent the construct of sport imagery ability. Differences in specific demographic details of the athlete sample were also examined, specifically focusing on competition level differences, gender differences and age related differences in imagery ability. The continued validation of the SIAM, therefore will serve to support the efficacy of the instrument as an imagery ability measure applicable to athlete populations.

Methods

Participants

Participants were 625 secondary school students, university physical education and sport science students, individuals from recreational sporting clubs and individuals from elite level sporting clubs, comprising of 328 males and 297 female participants, ranging in age from 15 to 55 years of age (M = 18.84, SD = 4.58). The sample was categorised into two different ages groups, under 18 (n = 353) and over 18 (n = 272). Participants were also categorized in terms of competition level including local/school (n = 85), district (n = 275), state (n = 201), and national (n = 64), with 32 different sporting interests being represented, including, football, basketball. Soccer, softball, water polo, hockey, swimming and gymnastics.

Measures

Demographic information sheet. Participants completed a demographic information sheet containing questions relating to their gender, age, main area of sporting interest and the level of competition in their chosen sporting area. The sheet also contained a participation code number and the date of the test or retest session.

Sports Imagery Ability Measure (SIAM). The SIAM is a task-oriented imagery ability measure that requires participants decide on a specific version of each of six sport-related scenarios in a given sport that is meaningful to them. Participants are given 60 seconds to image each scene. They are then required to respond to 12 items designed to assess imagery dimensions (five items), experience of the senses during imagery (six items), and experience of emotion during imagery (one item). Responses are made on analogue scales, placing a cross at the point on a 100mm line that best reflects their experience of the imagery, with responses ranging from *no feeling* to *very clear feeling*. The test is comprised of 72 items with each item given a score out of 100 by measuring the location of the cross on the line in millimetres from the left end. The relevant sensory item scores for the six scenes (*e.g.* six vividness scores, six visual scores) are added together to calculate the twelve subscale scores, resulting in a score out of 600 for each dimension or modality.

The SIAM was found to have good to very good internal consistency, with Cronbach alpha scores ranging from 0.66 to 0.87 (Watt & Morris, 1999a, cited in Morris et al., 2005, p.74). Budnik-Przybylska et al., (2014) also found good internal consistency with all subscale variables obtaining alpha values above .70. Test-retest reliability conducted over a four-week period revealed moderate to very good correlations, with scores ranging from 0.41 to 0.76 (Watt & Morris, 1999a, cited in Morris et al., 2005). Investigation onto the criterion validity of the measure revealed that the SIAM produces significantly different results between level of competition (Morris et al., 2005). In order to examine the convergent and discriminant validity of the measure the SIAM was compared to other test in relation to self-reported general imagery, movement imagery, objective imagery ability and non-imagery cognitive function, with results yielding small to moderate correlations (0.27-0.48) across the control, vividness, visual and kinaesthetic subscales, demonstrating convergent validity (Morris et al., 2005). Very low to small correlations were reported for the cognitive-ability measures and unrelated dimension and modality variables of other imagery measure in comparison to the SIAM (0.01-0.20), demonstrating discriminant validity. (Morris et al., 2005).

Procedures

For each participant group, various procedures were employed in order to facilitate the testing process in the original study. Individuals responsible for each of the specific groups of participants were contacted and informed about the study and what would be expected of the participants involved. Information and consent forms were provided to the individuals involved in the study. Participants in the school settings received the forms from their teachers after they were posted to the school, and required their parents or guardians to complete them prior to testing. Athlete groups involving students under 18 years of age were also required to access consent from a guardian. Ethics approval for the study was provided by the main researcher's university.

A date was arranged to conduct testing, and the consent forms were collected, along with group testing with a variety of different group sizes being conducted upon visiting the school. Consent forms were provided for participants from both the recreation and elite level sporting clubs prior to testing, and collected before each athlete was involved in any aspect of the study. Testing was conducted in small groups following training sessions over numerous occasions until all testing was completed by all participants. University students participating in the study were provided with the consent forms prior to testing sessions, with the testing being completed as a component of either one lecture or one tutorial session. Consistent administration procedures were followed during testing sessions for all groups involved in the study. Following their completion of the SIAM participants were debriefed and thanked for their involvement in the study.

Data Analyses

Descriptive statistics for the total SIAM subscale variables, age, gender and competition level were calculated. The Internal consistency of the measure was explored using Cronbach's alpha. Independent T-tests were conducted to investigate age and gender differences, with alpha levels >.05 reported as significant. One-way analysis of variance (ANOVA) was conducted to investigate differences in imagery performance (DV) across the various competition levels of the participants (IV), with alpha levels >.05 reported as significant.
Pearson's product moment correlations were conducted to examine the relationships between the SIAM subscale variables. Confirmatory Factor analysis (CFA) including error variables was conducted to examine the factor structure of the measure.

Factor structure was examined through the use of confirmatory factor analysis (CFA). CFA analyses were conducted using AMOS 24 software, using the maximum likelihood estimation procedure. In order to determine the fit of the model a number of different fit indices were considered, including the chi-squared goodness of fit statistic. Due to issues surrounding chi-squared other methods of model were selected. Model re-specification of the data was conducted based on reviewing modification indices and par change values derived from the CFA of the original model. Items that had high modification indices and positive par change values were chosen, and the error between the items was allowed to correlate.

Results

Descriptive Statistics for the SIAM Subscales

The means and standard deviations for each of the SIAM subscales for the total sample and for each of the gender, age and competition level subgroups are shown in Tables 1, 2 and 3. Mean scores for the generation dimension were higher than scores on both the feeling senses and single senses dimensions. The singles senses dimension had the highest amount of variability between the subscales, with the feeling senses dimension having the lowest amount of variability between subscale scores. The visual subscale scores were found to have the highest values for both the age and competition level comparison groups. Males were found to have higher scores on the visual subscale (M = 318.82, SD = 60.42), while females reported highest scores on the vividness subscale (M = 394.89, SD = 67.14). Overall the lowest scores for the total sample, and each of the comparison groups were the gustatory subscale (M = 127.43, SD = 97.91), and olfactory subscale (M = 146.81, SD = 102.42).

Table 1. Total Means and Standard Deviations, Internal Consistency Coefficients and T-test results comparing Age Differences for SIAM subscale scores (N = 625)

	Total			>18 (n = 353)		<18 (n = 272)			
Subscale	*M*	*SD*	á	M	*SD*	*M*	*SD*	t df(623)	*p*
Vividness	309.36	64.32	.76	305.16	63.79	314.81	63.78	-1.86	.06
Control	290.75	74.24	.79	285.46	74.72	297.62	73.19	-2.04	>.05
Ease	312.27	63.78	.69	309.04	63.79	316.47	63.65	-1.45	.15
Speed	310.38	65.68	.68	306.83	66.87	314.99	63.93	-1.55	.12
Duration	295.08	72.98	.77	289.93	74.91	301.75	69.98	-2.01	>.05
Visual	315.55	63.43	.77	309.33	64.81	323.63	69.77	-2.81	>.05
Auditory	248.63	92.14	.76	233.80	94.80	267.88	84.96	-4.66	>.05
Kinaesthetic	267.73	82.29	.77	260.66	85.91	276.92	76.51	-2.46	>.05
Olfactory	146.81	102.42	.85	133.83	98.96	163.65	104.54	-3.64	>.05
Gustatory	127.43	97.91	.87	108.89	91.89	151.49	100.39	-5.52	>.05
Tactile	254.64	89.35	.80	240.66	94.39	272.78	79.90	-4.53	>.05
Emotion	279.74	75.38		272.96	75.55	288.53	74.38	-2.57	>.05

Inferential Statistics

An Independent Samples T-test was conducted to examine subscale score differences in relation to the athletes' age. The results are presented in Table 2. Results of the independent samples t-test revealed significant age differences in SIAM subscale scores for the control subscale, with the <18 years age group obtaining significantly higher scores than scores obtained by the >18 years age group, t(625) = -2.04, *p* >.05. The <18 years age group also obtained significantly higher scores than the >18 years age group on the duration subscale t(625) = -2.01, *p* >.05, visual subscale t(625) = -2.81, *p* >.05, auditory subscale, t(625) = -4.66, *p* >.05, kinaesthetic subscale t(625) = -2.46, *p* >.05, olfactory subscale t(625) = -3.46, *p* >.05, gustatory subscale t(625) = -5.52, *p* >.05, tactile subscale t(625) = -4.53, *p* >.05, and the emotion subscale t(625) = -2.57, *p* >.05. No significant differences were found for the vividness, ease or speed subscale scores.

Table 2. T-test results comparing Gender Differences for SIAM subscale scores (N = 625)

	Male (n = 328)		Female (n = 297)			
Subscale	M	*SD*	*M*	*SD*	t df(623)	*p*
Vividness	313.41	61.48	394.89	67.14	1.66	.06
Control	293.22	73.34	288.02	75.25	0.87	.38
Ease	317.66	61.31	306.33	66.00	2.22	>.05
Speed	315.69	61.81	304.52	69.34	2.12	>.05
Duration	300.12	70.85	289.51	74.99	1.81	.07
Visual	318.82	60.41	311.94	66.53	1.35	.18
Auditory	250.17	90.51	246.93	94.04	0.44	.66
Kinaesthetic	265.78	82.01	269.89	82.67	-0.62	.53
Olfactory	156.44	104.62	136.17	99.01	2.48	>.05
Gustatory	135.57	103.77	118.43	90.33	2.19	>.05
Tactile	261.17	85.15	247.42	93.38	1.92	.06
Emotion	279.53	75.15	279.96	75.76	-0.07	.94

An independent samples T-test was conducted to examine gender differences in subscale scores. The results are presented in Table 2. Results of the independent samples t-test revealed significant gender differences in SIAM subscale scores for the ease subscale, with males obtaining significantly higher scores than scores obtained by females, t(625) = 2.22, *p* >.05. Males also obtained significantly higher scores than females on the speed subscale, t(625) = 2.12, *p* >.05, olfactory subscale t(625) = 2.48, and the gustatory subscale, t(625) = 2.19, *p* >.05. No significant differences were found for the vividness, control, duration, visual, auditory, kinaesthetic, tactile or emotion subscale scores.

A one-ways independent samples analysis of variance (ANOVA) was conducted to examine differences in subscales scores across the four different competition levels. The results are presented in Table 3. The ANOVA revealed significant differences on 6 dimensions of the SIAM, vividness (*F* = 4.06, *p* >.05), ease (*F* = 2.71, *p* >.05), visual (*F* = 2.72, *p* >.05), kinaesthetic (*F* = 3.32, *p* >.05), olfactory (*F* = 2.69, *p* >.05), and emotion (*F* = 3.12, *p* >.05). No significant differences were found for the control, speed, duration, auditory, gustatory or tactile dimensions. Athletes at the national level reported higher scores on the vividness (M = 317.94, SD = 49.22), kinaesthetic (M = 287.88, SD = 74.95 and emotion (M = 290.03, SD = 69.52) subscales than athletes at the local, state and district levels. Athletes at the district level reported higher scores on the ease subscale (M = 315.85, SD = 60.63) than athletes in the other three competition levels, while athletes at the state level reported higher scores on the visual subscale (M = 322.82, SD = 66.82), and for the olfactory subscale athletes at the local level were found to have the highest scores (M = 167.05, SD = 110.11).

Table 3. ANOVA results comparing competition level for SIAM subscale scores (N = 625)

	Local (n = 85)		District (n = 275)		State (n = 201)		National (n = 64)			
Subscale	*M*	SD	M	SD	M	SD	M	SD	F df(3)	*p*
Vividness	289.16	68.54	308.44	64.54	316.42	64.93	317.94	49.22	4.06	>.05
Control	277.42	74.73	288.71	75.24	297.53	74.32	296.50	67.50	1.65	.178
Ease	294.12	74.72	315.85	60.63	314.60	65.06	313.70	53.93	2.71	>.05
Speed	293.01	74.12	314.32	61.46	311.38	69.80	313.39	54.95	2.39	.07
Duration	278.84	78.59	294.96	73.54	298.67	72.50	305.88	61.62	2.05	.11
Visual	300.67	62.23	313.53	62.70	322.82	66.76	321.17	54.10	2.72	>.05
Auditory	247.44	99.00	244.72	99.01	251.45	82.87	258.16	80.03	0.46	.71
Kinaesthetic	255.26	82.73	260.76	82.35	276.14	82.81	287.88	74.95	3.32	>.05
Olfactory	167.05	110.11	142.15	107.21	152.29	93.54	122.75	92.92	2.69	>.05
Gustatory	140.81	109.62	124.19	100.79	132.79	91.99	106.73	84.08	1.79	.15
Tactile	251.67	93.43	251.61	91.80	259.47	83.46	256.41	92.36	0.34	.80
Emotion	267.82	77.76	275.78	73.02	289.02	70.09	290.03	69.52	3.12	>.05

Internal Consistency

Internal consistency results (Cronbach's alpha coefficients) were generated for each of the 12 SIAM subscales. The independent subscale values are presented in Table 1. The Cronbach alpha values revealed moderate to high internal consistencies with coefficients ranging from r = .68 (speed subscale) to .87 (gustatory subscale). Internal consistency was higher for the subscales that were found to have low mean imagery.

Subscale Correlations

The correlation matrix of the 12 subscales of the SIAM is presented in Table 4. Results show that correlations between the SIAM subscales ranged from low to high. The highest correlation was between the visual subscale and the vividness subscale (r = .89), and the lowest correlation was between the gustatory subscale and the duration subscale (r = .23). Correlations between the generation dimension subscales, vividness, control, ease, speed, duration and visual, indicated that all variables correlated strongly with each other (r = .70 – 89). Correlations between the feeling senses dimension subscales, kinaesthetic, tactile and emotion, indicated moderate correlations between the variables (r = .69 - .75). The lowest correlations were found between the single senses dimension subscale auditory, and the olfactory and gustatory subscales (r = .51 - .57), with the exception of the correlation between the olfactory and gustatory variables (r = .81). All correlations reported were found to be significant at the .01 level.

Table 4.Correlations of the SIAM Subscales (N = 625)

Subscale	1	2	3	4	5	6	7	8	9	10	11	12
Vividness(1)	1.0											
Control(2)	.77**	1.0										
Ease(3)	.84**	.76**	1.0									
Speed(4)	.77**	.70**	.89**	1.0								
Duration(5)	.78**	.77**	.76**	.72**	1.0							
Visual(6)	.87**	.74**	.79**	.76**	.74**	1.0						
Auditory(7)	.55**	.46**	.47**	.44**	.46**	.50**	1.0					
Kinaesthetic(8)	.58**	.57**	.52**	.47**	.54**	.56**	.58**	1.0				
Olfactory(9)	.34**	.35**	.33**	.30**	.31**	.33**	.57**	.46**	1.0			
Gustatory(10)	.27**	.27**	.26**	.25**	.23**	.25**	.51**	.41**	.81**	1.0		
Tactile(11)	.59**	.57**	.51**	.45**	.52**	.58**	.64**	.75**	.53**	.49**	1.0	
Emotion(12)	.57**	.51**	.51**	.50**	.51**	.52**	.62**	.69**	.49**	.49**	.67**	1.0

Note. **correlation is significant at the .01 level (two-tailed).

Confirmatory Factor Analysis

Confirmatory Factor Analysis was conducted to examine the a priori 3-factor structure of the SIAM. Figure 1 presents the a priori model with the 12 dimensions loading onto three latent factors. Factor 1, labelled Generation, consisted of the vividness, control. Ease, speed, duration and visual subscale scores. Factor 2, labelled feeling senses, consisted of the kinaesthetic, tactile and emotion subscale scores. Factor 3, labelled, single Senses, consisted of the auditory, olfactory and gustatory subscale scores. Examination of the dimensions revealed low to moderate factor loadings on the latent variables, with the generation and feeling senses dimensions having the highest value (.71). The feeling sense and single sense dimensions had the second highest value (.67), with the generation and single senses dimensions having the lowest value (.41). Results indicated a moderate fit of the data, producing fit indices of CMIN/DF = 11.84, GFI = .86, AGFI = .79, TLI = .89, CFI = .92 and NFI = .91.

Results were determined for the Confirmatory factor analysis of the extended examination of the a priori 3-factor structure of the SIAM to consider model refinement based on the use of modification indices and par change values. Covariance's between errors with high modification indices and positive par change values were identified for ease and speed (MI: 187.30, par change: 537.78), vividness and visual (MI: 54.87, par change: 245.33) and olfactory and gustatory (MI: 7.46, par change: 305.92). Consequently, the model was respecified to allow the errors for the vividness and visual subscale variables, the ease and speed subscale variables and the olfactory and gustatory subscale variables to correlate

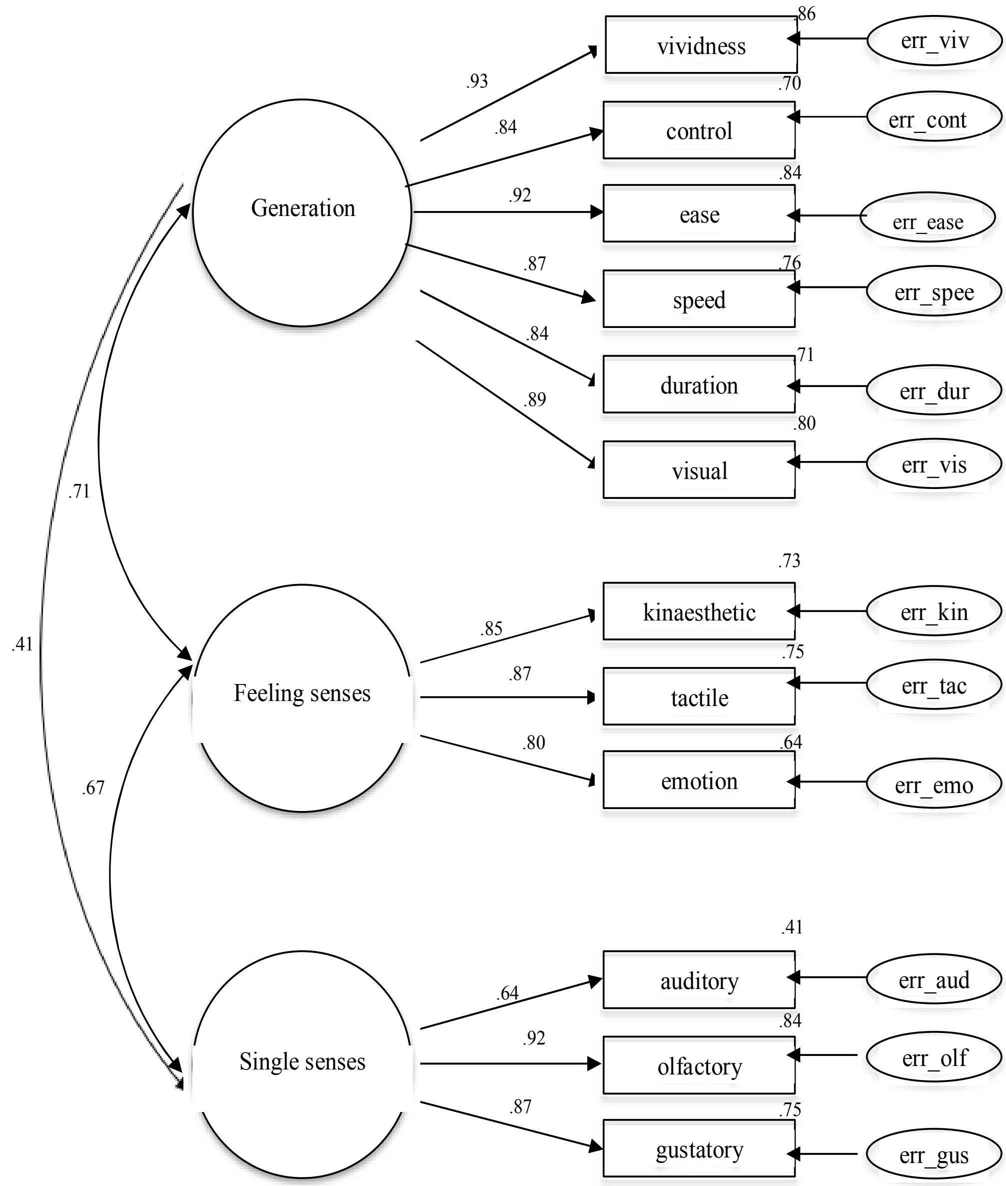

Figure 1

Original Confirmatory Factor Analysis Model for the Sports Imagery Ability Measure

Following the analysis of the respecified model, results indicated significantly improved fit, CMIN/DF = 3.67, GFI = .96, AGFI = .93, TLI = .97, CFI = .98 and NFI = .97. Examination of the model revealed that the olfactory and gustatory subscales reported the highest error factor loadings (.68). The ease and speed subscale variables had the next highest error factor loadings (.58), with the vividness and visual subscales reporting the lowest error factor loadings (.33). Allowing the errors to correlate between the variable improved the factor loadings between the latent variable with the feeling senses and singles senses dimensions reporting the highest value (.87). The feeling senses and generation dimensions reported the second highest factor loadings (.73), with the generation and single senses dimensions reporting the lowest factor loading (.63).

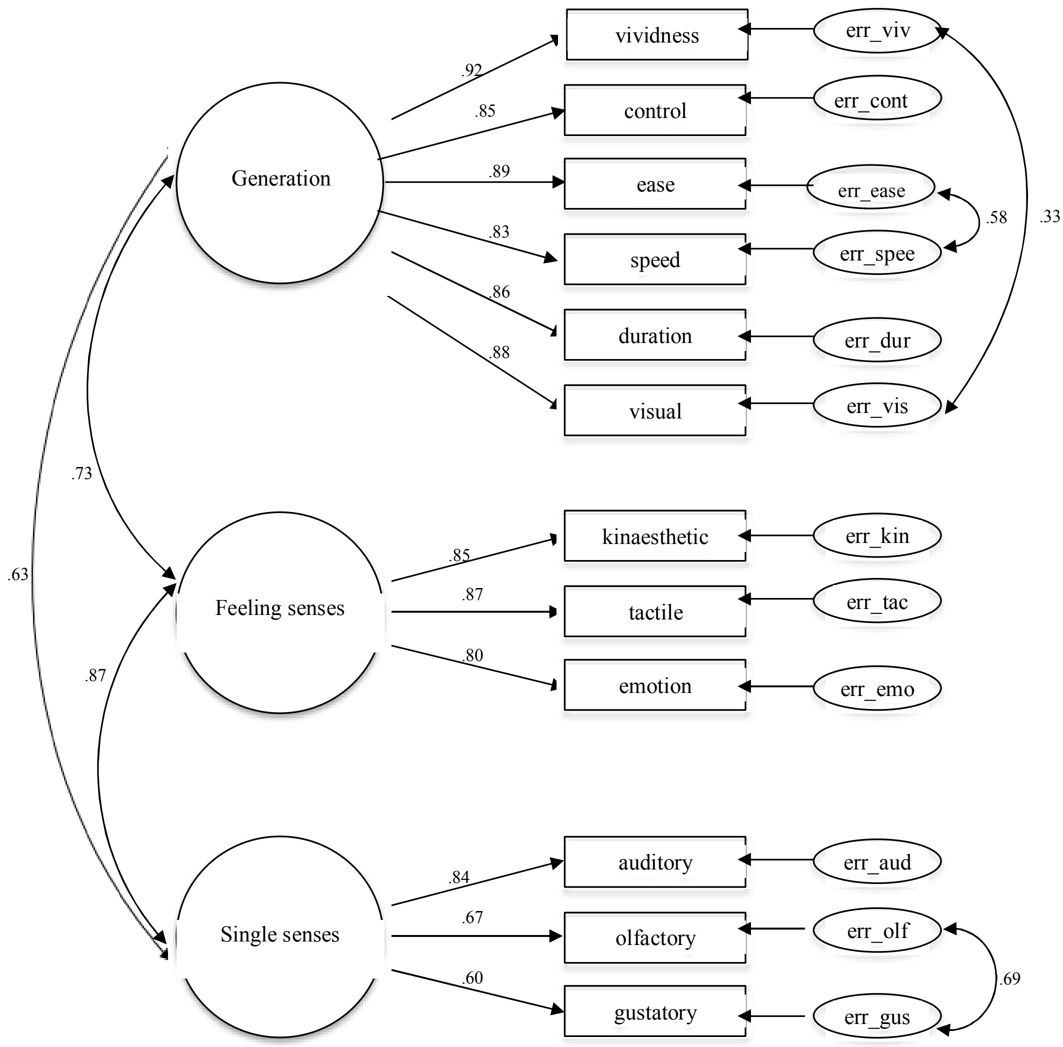

Figure 2

Final Confirmatory Factor Analysis Model for the Sports Imagery Ability Measure

Discussion

The purpose of the present study was to evaluate the psychometric properties of the SIAM to demonstrate the reliability and validity of the instrument and efficacy of its factor structure. Additionally, exploration of differences in imagery ability were conducted between various age groups, gender classifications, and levels of sport competition (local, district, state and national).

A central focus of the research was the CFA examination of the SIAM's 3-factor model with a varied athlete sample. The three factors confirmed by the initial study conducted by Watt (2003) were titled generation, somatic and singles senses. For the purpose of the present study, the somatic dimension was re-labelled feeling senses, as it was thought to describe the subscales it represented more appropriately. The generation dimension revealed the highest correlations between subscales, while the single senses dimension was found to have the lowest correlations between subscales. Correlations between the feeling senses dimension indicated moderate correlations. Consistent with these findings are the results obtained by Budnik-Przybylska et al, (2014). The generation factor was found to correlate with the vividness, control, ease, speed duration and visual subscales, with the highest correlation between generation and the vividness subscales (.86), and the lowest correlation was found with the control subscale (.70). The feeling senses factor correlated with the kinaesthetic, tactile and emotion subscales, with the highest correlation between the tactile subscale (.75) and the lowest correlation between the emotion subscales (.64). The final factor, the single senses was found to correlate with the auditory, olfactory and gustatory subscales, with the highest correlation between the olfactory subscale (.84) and the lowest correlations between the auditory subscale (.41). The factor loadings of the present study are somewhat different to those found by Budnik-Przybylska et al. who reported the highest correlation for the generation to be between the ease subscale and the lowest for the duration subscale. They found that the highest correlations for the feeling dimension was between the emotion subscale and the lowest between the tactile subscale, which is opposite to the findings of this study. The only dimensional correlations that are in line with the present study are those found for the single senses dimension.

Initial results of the present CFA demonstrated a moderate level of fit to the data, with comparable results to the polish study conducted by Budnik-Przybylska et al, (2014). As an outcome of the CFA phase, model re-specification was conducted, whereby error variables with high modification indices and positive par change values would be allowed to correlate in an attempt to improve the fit of the data. This practice had not previously been performed on the data and yielded several interesting findings. The ease and speed error variables were respecified, allowing errors to correlate. The vividness subscale and the visual subscale, and olfactory and gustatory subscales were also respecified, allowing the errors between the variables to correlate. The subscale variables with the highest factor loadings were the olfactory and gustatory, followed by the ease and speed subscales and lastly the vividness and visual subscales. A possible explanation for these particular items correlating is the fact that the variables are of a similar nature. Following the re-specification results revealed that the model fit of the data improved. Correlations between the latent dimensions were also improved following the re-specification of the data, with the highest correlations found between the feeling senses and single senses dimensions, and the lowest correlations between the generation and the single senses dimensions. The initial CFA results of the present study provided support for the 3-factor model of the SIAM. Re-specification of the model improved the data fit, producing comparable fit indices to previous studies investigating the factor structure of the measure (Budnik-Przybylska et al, 2014; Watt, 2003). The results further affirm the factorial validity and applied use of the measure as a tool for assessing the imagery ability of athletes.

Demographic characteristics, including age and gender were examined to determine if there were any differences in the imagery abilities of the athletes. The results provided basic support for age differences, revealing significant differences between ages groups for the control, duration, visual, auditory, kinaesthetic, olfactory, gustatory and emotion subscales. It was found that athletes in the younger age group (>18) had higher imagery scores than athletes in the <18 age group. Previous research investigating age differences provided limited support for the findings of the current study. Bhasavanija et al. (2012) investigated imagery ability among Thai golfers on the SIAM and found that there were only significant age differences for two of the 12 SIAM subscales, with younger athletes scoring higher on the control and duration subscales than their older counterparts. Bhasavanija et al suggested that these results could be due to chance, considering all other subscales yielded non-significant results when comparing them against the different age groups. Along with age differences, gender differences were examined, with the findings of the current study revealing that males obtained significantly higher scores for the ease, speed, olfactory, and gustatory subscales of the SIAM. When examining the existing literature investigating gender differences of imagery ability, it was found that male athletes had significantly higher mean scores of imagery ability when compared to mean scores of female athletes according to Mendes et al. (2015), supporting the findings of the current study. Contrary to the current study's findings, Mendes et al found males scored higher on kinaesthetic imagery ability than females. The findings demonstrated that males report having higher imagery ability, especially in relation to the kinaesthetic modality, providing a possible explanation for males higher scores of imagery. Williams and Cumming (2011) provide limited support for the findings of the current study, identifying gender differences in imagery ability through an investigation incorporating the SIAQ, but only for mastery imagery.

Comparisons of imagery were also considered for the different competition levels, reported in the current study as local, district, state and national. Results revealed significant differences on the vividness, ease, visual, kinaesthetic, olfactory and emotion subscales across the four different competition levels. Athletes at the national level were found to have higher imagery scores than athletes at the local, state and district levels for the vividness, kinaesthetic, and emotion subscales. However, when looking at the results for the ease, visual and olfactory subscale scores it was determined that the national level athletes did not obtain the highest scores. For the ease subscale athletes at the district level were found to have higher imagery scores when compared to the local, state and national level athletes. Athletes at the state level were found to have higher visual imagery scores, and athletes at the local level had higher scores on the olfactory subscales when compared to athletes at the other levels of competition. Research into differences in imagery scores shows support for the findings of the current study, with a study conducted by Budnik-Przybylska et al. (2014) showing athletes at the national and state level of competition reporting higher imagery ability scores than athletes at the local competition level. However, contrary to the finding of the present study, Budnik-Przybylska et al found differences in imagery scores between competition levels across all of the SIAM subscales. A similar study by Bhasavanija et al. (2012) investigating Thai golfer's imagery ability indicated that golfers at the professional level had significantly higher scores on the SIAM subscales than those that were considered to be novice players, except for scores on the gustatory subscales, where no significant difference in scores was found. Other studies that have examined differences in imagery ability across competition level, reinforcing the results of the present study (Mazumder & Ghosh, 2013; Williams & Cummings, 2011). Mazumder and Ghosh (2013) investigated imagery differences in footballers at the state and district level, finding footballers at the state level employ imagery more frequently than footballers at the district level. The researchers proposed that differences found between footballers at the state level and district level may be due to the physicality of the players, with more physically fit players (i.e. state level athletes), employing imagery techniques more often than players that are not as physically fit (i.e. athletes at the district level) (Muzumder & Ghosh, 2013). Results obtained by Williams and Cummings (2011) revealed athletes at higher levels of competition had higher imagery ability than athletes at lower levels of competition. They also found that athletes at higher competition levels were able to generate sports images faster and more easily than athletes at the lower level. The pattern of results of the present study were also consistent with results obtained from previous research into sports imagery (Watt, 2003; Gregg & Hall, 2006; Ruiz & Watt, 2014), who found that higher levels of competition were associated with higher levels of imagery ability.

Limitations of the present study primarily focus on the use of convenience sampling to obtain participants. As a result of the sampling technique there was an uneven distribution of participants to the groups, to ensure a more definitive analysis of age group differences, a balanced number of participants in each of the age groups may have given more accurate results for age differences in imagery ability. There was also disproportionate number of males to females in the sample which may account for some of the limited gender differences found in the present study. Balancing of the number of males and females in future samples may yield different results regarding gender differences. Another limitation was the unequal numbers of participant representing each of the types of sports in the sample, meaning that some sports were over represented while others were under represented. Ruiz and Watt (2014) suggested that research investigating differences in imagery against specific groups should attempt to recruit balanced samples. Another limitation of the present study is the self-report measure of the SIAM. This allows for participants to either over represent or under represent themselves and their abilities, providing information that they feel the researcher is looking for, rather than providing answers that are a true reflection of their abilities.

Future investigations into the reliability and factor structure if the SIAM as a measure of imagery ability would benefit from exploring the relationship and differences that exist between imagery ability and specific types of sports. Similarly, it could be important to consider different classifications of sports in relation to imagery ability. Perhaps athletes who participate in contact sports employ imagery more than athletes from non-contact sports, or perhaps they employ different imagery methods. An online version of the SIAM has been developed, whereby all questions in each part must be completed before moving onto the next section. Future researchers may find it useful to utilise an online version of the SIAM, making administration of the measure easier for participants. It would be interesting to see if future investigations of the on-line version yield similar results regarding improved model fit after re-specification of the data has occurred,. Furthermore, it could be beneficial for future research to consider implementing pre-training evaluation of imagery ability and post-training evaluation, using the SIAM to evaluate whether imagery ability is enhanced after imagery training, or whether ability remains consistent irrespective of training.

Conclusion

The findings of the present study have provided valuable support for the model design of the SIAM, and the resultant psychometrics continue to reinforce the efficacy of the measure. Results in relation to the demographic variables highlight the importance of considering individual differences in imagery ability, and it could be valuable to investigate imagery ability based on sporting classifications, in addition to competition level. Results of the CFA substantiate the three-factor model of the SIAM, providing additional verification that the subscales of the measure accurately assess imagery ability across different dimensions and sensory modalities. Re-specification of the data provided evidence to demonstrate that some of the subscales share variance, and that allowing the error between subscales to correlate serves to improve the fit of the model. The findings of the present study further validate the SIAM as a reliable and valid measure of imagery ability, and provide support for its continued psychometric evaluation and development and utilisation in applied research.

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