

## Influence of Physical Education and Sports on Social Cognition: an Analysis Based on Structural Equation Models

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### ABSTRACT

Social factors are positively associated with social awareness related to physical activity. Participation in physical activity is linked to positive health outcomes and deliberate exercise in physical education and sports that improves mental health. This study presents a structural equation model (SEM) to evaluate the variables that most effect social awareness; empathy and compassion. The present study has used a representative sample of 32 students from a volleyball sport club of An Giang University, Vietnam National University Ho Chi Minh City, Vietnam. The sample was selected taking into account the 5% error rate and 95% confidence level. The results of the Kaiser-Meyer Olkin (KMO) global test and the Bartlett test show that factor analysis is complete, all works are statistically significant. Suitability tests show the model is suitable for the data. The findings of the present study conclude that, in all structures considered: interaction with authority figures, interaction with the opposite sex, evidence, confirming dissatisfaction, interaction with strangers and acting in public, the structure that most influences the underlying "empathy" is interaction with the opposite sex. The structure most likely to affect the underlying "empathy" is an assertion of discomfort.

**KEY WORDS:** SOCIAL COGNITION, SEM, PHYSICAL EDUCATION, SPORT, BRAIN, EXECUTIVE FUNCTIONS.

### INTRODUCTION

This study presents the development of a structural equation model (SEM), which seeks to examine variables affecting social awareness (empathy and empathy) in An Giang university students, of the volleyball sport club. Five constructs were considered: Interplay with authority figures (TA), Interplay with the opposite sex (TB), be in evidence (TC), favored expression of discomfort (TD),

interplay with strangers (TE) and act in public (TF) and two latent variables were used, empathy and sympathy. Social awareness is defined as the processes in which we draw inferences about the beliefs and intentions of others and how we consider social situational factors in making these inferences (Alvarez -Astorga et al, 2019).

Social awareness is impaired in a large number of neurological problems, including neurodegenerative diseases, neurological disorders and neurodevelopmental syndrome, and has become an important factor in differential diagnosis (Duclos et al 2018). Social awareness plays a role in teamwork and physical education in aspects like the player themselves because they have to evaluate what is going on, what they have to do to succeed and they must respond and adjust their playstyle based on teammates and rival teams (Koples, 2019).

### ARTICLE INFORMATION

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The remainder of the paper presents the general context of social awareness, the methods used and the analysis of results. Finally, the study concludes. Social cognition refers to the mental operations involved in understanding other people's thoughts and intentions, recognizing and perceiving emotions and understanding social interactions (Adolphs, 2001). Although social and non-social cognition share some overlapping operations (e.g. working memory, perception, etc.), some brain regions and networks have specifically been linked to processing social information (Green et al., 2015). Neural systems involved in processing social-affective stimuli, such as facial emotion and nonverbal social cues, include the amygdala, ventral striatum, ventromedial prefrontal cortex, anterior cingulate cortex and superior temporal regions (Adolphs, 2009). Higher level social cognition processes, such as inferring the intentions of others, are most commonly associated with activations in a broad 'mentalizing network' including the medial frontal cortex, paracingulate and posterior cingulate cortex, temporal-parietal junction, superior temporal sulcus, and the temporal pole (Adolphs, 2009).

Social awareness is a concept introduced by neurologists, referring to a mental process that has been studied over the past few years in various clinical conditions such as schizophrenia and autism, increased attention deficit hyperactivity and antisocial personality disorder. It is defined as the ability of an entity to perform emotional processing, interpreting the intentions and beliefs of others in social situations (Christidi et al 2018). Neurosocial awareness is explained by the many neuronal connections of the cortical and cortical structures, with specific dominance of the frontal lobe. This concept studies the neurobiology of responses of empathy, sympathy, moral reasoning, recognition of the gaze and internalization of social rules, (Fede et al., 2016). Many physical education and sports, whether it be a team physical education and sport or an individual physical education and sport, include social cognition in multiple aspects. Studies have also shown that physical activity can increase and improve cognition in adults, which is one of the many benefits that playing physical education and sports can have, (Catalina et al, 2020).

The role of social cognition is present in individual physical education and sports competitions such as figure skating because the skater needs to pay attention to the program they are performing while also being sure not to fall on a jump and if they do, they need to adjust their performance to score higher on interpretation of music as well as knowing what the other competitors performed so they can try and score higher (Koples, 2019). The judgement of a physical education and sport can be biased and can impact the way the individual performs. If a team loses, the attitudes of players is most likely to have feelings of unfair judgements, on the other hand, the winning team would be more likely to feel they were judged fairly (Catalina et al, 2020). This puts an emphasis on the social aspect involving the referee or judge and how they determine what is right or wrong. Another aspect to consider while playing physical education and

sports is the audience. It is also proven that physical activity leads to feelings of high self-confidence which can positively impact the individuals involved and if an individual is confident in what they are doing, they are more likely to perform well, opposed to having doubts in their abilities leading to a more negative outcome (Catalina et al, 2020).

**Empathy and sympathy:** Common sense is evoked by raising awareness and caring for others. The suffering of others by recognizing or responding to their suffering or needs. Sympathetic contexts appear to promote creative solutions, because people who empathize with others in suffering tend to seek new, desirable and prosperous solutions to alleviate suffering and promote happiness (Yang & Yang, 2016). Empathy, sharing and understanding the feelings of others, is a fundamental aspect of social capacity and a lack of empathy associated with aggressive behavior (Jolliffe & Farrington, 2004). Empathy is the ability to put yourself in another pair of shoes and really imagine how others must feel. Empathy is the ability to recognize and feel suffering or pity for others' suffering (Chapman, 2012). These abilities are even shown in specific parts of the brain. Sympathy is thought to use recognition functions in the frontal lobe of the third layer of the brain, while empathy is thought to include function in the lower right lobe of the brain (Chapman, 2012). Figure 1, shows the appearance of each lobe:

Figure 1: Sympathy and empathy regions



Sympathy can motivate a person to improve a situation, but it can cloud proper design judgment, and complicate relations with the person for whom you are researching and designing. Empathy, on the other hand, helps designers to increase their understanding while remaining objective (Chapman, 2012). Sympathy and empathy are different in another way as well. It is considered "easier" to feel sympathy than to feel empathy. Why is this? When we feel sympathy, we feel for another, but do not understand what the other person is truly feeling. When we are empathetic, we have built an understanding of another's emotions and feelings (Chapman, 2012).

## MATERIAL AND METHODS

Structural equation modelling (SEM) is a class of multivariate models used for learning a causal

relationship among variables (exploratory modelling) or for testing whether the model is best fit by given data (confirmatory modelling). A general SEM includes the observed and latent variables, while their relationships are explained by a linear model whose parameters

explain the cause or influence from one variable to another (Pruttiakaravanich & Songsiri, 2020). SEM has been widely used in behavioral research, such as in psychology, sociology, business and medical research (Price et al 2009).

Table 1. Social Abilities Questionnaire		
Construct	Action	Variable
Interplay with authority figures (TA)	Write on the blackboard	T1
	Having to speak to a teacher	T2
	Ask me the teacher in class	T3
	Ask a question in class	T4
Interplay with the opposite sex (TB)	Start a conversation with the girl that i like	T5
	To tell a girl whom i like something from her	T6
	Give a kiss for the first time the girl that i like	T7
	Ask him to go out to the girl that i like	T8
Be in evidence (TC)	I make a joke in front of others	T9
	Make a fool of myself in front of others	T10
	I criticize	T11
	Stay without stuttering or voice, the voice that I tremble to speak	T12
Favored expression of discomfort (TD)	Telling a friend that does not take my things without my permission	T13
	Tell a colleague who i did not like what he has said to me	T14
	Tell a partner who does not bother me when I am working	T15
	To tell a partner that is not always the center of attention	T16
Interplay with strangers (TE)	Being with other kids that don't know	T17
	Playing with a group of guys I know little	T18
	Ask for something to a colleague that almost don't know	T19
Act in public (TF)	Start talking with guys who don't know	T10
	Participate in a work of theater in the school	T21
	Singing in public	T22
	Dancing in front of everyone	T23
	Play an instrument in public	T24
Source: author's elaboration		

We analyzed the relationships between six constructs (interaction with authority figures, interaction with the opposite sex, be in evidence, assertive expression of

discomfort, interaction with strangers and act in public) and two latent variables (empathy and sympathy), which enables to analyze physical education and

sportsman’s’ attitudes in the social cognition. This was used as a database that met the responses from a survey of the, “The Social Abilities Questionnaire”(Caballo et al., 2012). The survey was applied to a representative sample of 32 volleyball players in a physical education and sport club in An Giang University, Vietnam. The sample was selected considering a margin of error of 5 % and a confidence level of 95 %. We used multivariate statistical techniques; regression and factor analysis in the statistical software SPSS 20.0

### RESULTS AND DISCUSSION

Tables present the results of the Kaiser Meyer Olkin (KMO) test, any KMO is below 0.5, which is why it can be said that factor analysis is valid. The evidence of sphericity rejected at any level of significance considering the results of the Bartlett’s sphericity test, the matrix of correlations is not an identity matrix. In the construction of the SEM model was used the builder tool of the statistical software SPSS 20.0. Was developed an analysis of main components of six constructs (interaction with authority figures, interaction with the opposite sex, be in evidence, assertive expression of discomfort, interaction with strangers and act in public).

Figure 2, presents the model developed: All signs of the slope coefficients are positive, showing a strong and direct correlation between the underlying variables and structures. Regarding the potential co-sensibility, the more influential structure is the interaction with the opposite sex, which has a coefficient of 0.99 (average). For its part, the structure that has the most effect on the empathy of the underlying variable is the assertive expression of discomfort, with a factor of 1.01 (average). There is a direct relationship between two latent variables (empathy and empathy), estimated with covariance 54, indicating that both variables are strongly correlated.

Table 3, presents the results of the goodness of fit test: Comparative Fit Index (CFI) and Tucker Lewis Index (TLI), which take values of 0.891 and 0.901 respectively, results that indicate a good fit. Finally, the Coefficient of determination was 0.86, is approaching 1 that indicates a good fit. The lower and upper limits of the statistic RMSEA are 0.051 and 0.253 respectively, which indicates that the setting is good. These results allow us to conclude that, the SEMs model developed is properly adjusted to data.

Table 2. Results of KMO and Bartlett’s sphericity test

Construct	Variable	Measurement of sample adequacy of (KMO)	Approximate Chi square	Bartlett’s sphericity Test	Sig
Interplay with authority figures (TA)	T1	.501	27.423	3	.000
	T2	.572	261.342	1	.000
	T3	.565	23.981	1	.001
	T4	.561	110.171	1	.000
Interplay with the opposite sex (TB)	T5	.549	119.509	3	.000
	T6	.531	121.465	1	.000
	T7	.538	120.691	1	.000
	T8	.528	32.231	1	.000
Be in evidence (TC)	T9	.500	34.223	3	.002
	T10	.592	111.302	1	.000
	T11	.665	223.781	1	.000
	T12	.541	23.130	1	.000
Favored expression of discomfort (TD)	T13	.543	23.509	3	.000
	T14	.581	25.465	1	.001
	T15	.522	127.691	1	.000
	T16	.528	26.233	1	.000
Interplay with strangers (TE)	T17	.511	112.423	3	.000
	T18	.651	25.425	1	.001
	T19	.502	27.691	1	.000
	T20	.525	116.233	1	.000
Act in public (TF)	T21	.661	32.443	3	.000
	T22	.581	115.415	1	.000
	T23	.542	227.601	1	.000
	T24	.573	136.203	1	.000
Source: author’s elaboration					

Physical education and sport directly influences social cognition. The SEM developed in this work allows identifies the influence of the constructs; interaction with authority figures, interaction with the opposite sex, be in evidence, assertive expression of discomfort, interaction with strangers and act in public on the social cognition abilities. The model has identified a positive relationship and direct link between the six constructs and the two latent variables considered (empathy and sympathy). It has also identified a direct correlation between the two latent variables analyzed, for which an increase or decrease in any of them, will generate the same effect in the other.

Figure 2: SEM model diagram

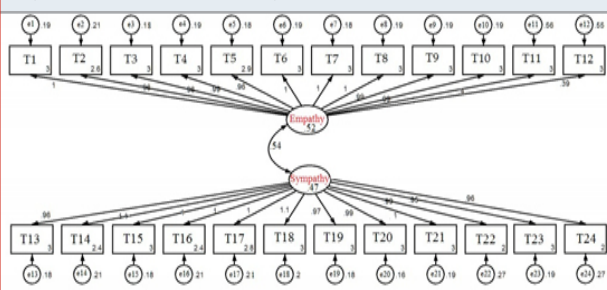


Table 3. Goodness-of-fit statistics of the estimated model

Fit statistic	Value	Description
Population error RMSEA	0.068	Root mean squared error of approximation
90 % CI, lower bound	0.051	Probability RMSEA <= 0.05
Upper bound	0.253	
p closed	0.061	
Information criteria		
AIC	14594.403	Akaike's information criterion
BIC	16774.232	Bayesian information criterion
Baseline comparison		
CFI	0.891	Comparative fit index
TLI	0.901	Tucker-Levis index
Size of residuals		
SRMR	0.07	Standardized root mean squared residual
CD	0.86	Coefficient of determination

### CONCLUSION

The results of the Kaiser-Meyer Olkin (KMO) global test and the Bartlett test show that factor analysis is complete, all works are statistically significant. Suitability tests show the model is suitable for the data.

The findings of the present study conclude that, in all structures considered: interaction with authority figures, interaction with the opposite sex, evidence, confirming dissatisfaction, interaction with strangers and acting in public, the structure that most influences the underlying "empathy" is interaction with the opposite sex. The structure most likely to affect the underlying "empathy" is an assertion of discomfort.

### REFERENCES

Alvarez-Astorga, A., Sotelo, E., Lubeiro, A., de Luis, R., Gomez-Pilar, J., Becoechea, B., & Molina, V. (2019). Social cognition in psychosis: Predictors and effects of META-cognitive training Prog Neuropsychopharmacol Biol Psychiatry 2019 Aug 30;94:109672 doi: 10.1016/j.pnpbp.2019.109672. Epub 2019 Jun 19.

Adolphs & R. Adolphs (2001). The neurobiology of social knowledge Curr. Opin. Neurobiol., 11 (2) , pp. 231-239

Adolphs & R. Adolphs (2009). The social brain: neural basis of social knowledge. Annu. Rev. Psychol., 60 , pp. 693-716

Caballo, V. E., Arias, B., Salazar, I. C., Calderero, M., Iruiria, M. J., & Ollendick, T. H. (2012). A new self-report assessment measure of social phobia/anxiety in children: the social anxiety questionnaire for children (saq-c24). Behavioral Psychology/Psicología Conductual, 20(3).

Catalina Q. L., Víctor daniel G.V., Carolina V.L., & Jennifer C.A. (2020). Impact of sport on social cognition: an analysis based on structural equation models. Journal of Physical Education and Sport , 20 (1), pp. 31 - 36. DOI:10.7752/jpes.2020.01004

Chapman, L. (2012). What's empathy got to do with it? Retrieved September 5, 2019, from Human-Centered Design website: <http://maya.com/blog/whats-empathy-got-to-do-with-it>

Christidi, F., Migliaccio, R., Santamaria-García, H., Santangelo, G., & Trojsi, F. (2018). Social cognition dysfunctions in neurodegenerative diseases: neuroanatomical correlates and clinical implications. Behavioural Neurology, 2018.

Duclos, H., Desgranges, B., Eustache, F., & Laisney, M. (2018). Impairment of social cognition in neurological diseases. Revue Neurologique, 174(4), 190-198. <https://doi.org/https://doi.org/10.1016/j.neurol.2018.03.003>

Fede, S. J., Harenski, C. L., Borg, J. S., Sinnott-Armstrong, W., Rao, V., Caldwell, B. M., ... Calhoun, V. D. (2016). Abnormal fronto-limbic engagement in incarcerated stimulant users during moral processing. Psychopharmacology, 233(17), 3077-3087.

Green, M. Green, W. Horan, J. Lee (2015). Social cognition in schizophrenia. Nat. Rev. Neurosci., 16 (10) , pp. 620-631

Jolliffe, D., & Farrington, D. P. (2004). Empathy and offending: A systematic review and meta-analysis. Aggression and Violent Behavior, 9(5), 441-476. <https://doi.org/https://doi.org/10.1016/j.avb.2003.03.001>

Koples, J. (2019). Sports and Social Cognition. Retrieved September 6, 2019, from University of Lethbridge



website: <https://socialcognition-2019.wordpress.com/2019/07/12/sports-and-social-cognition/>  
Price, L. R., Laird, A. R., Fox, P. T., & Ingham, R. J. (2009). Modeling dynamic functional neuroimaging data using structural equation modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, 16(1), 147–162.  
Pruttiakaravanich, A., & Songsiri, J. (2020). Convex formulation for regularized estimation of structural equation models. *Signal Processing*, 166, 107237. <https://doi.org/https://doi.org/10.1016/j.sigpro.2019.107237>

Stata. (2019). Stata software. Retrieved September 10, 2019, from <https://www.stata.com/>  
Yang, H., & Yang, S. (2016). Sympathy fuels creativity: The beneficial effects of sympathy on originality. *Thinking Skills and Creativity*, 21, 132–43. <https://doi.org/https://doi.org/10.1016/j.tsc.2016.06.002>  
Social cognition in psychosis: Predictors and effects of META-cognitive training. *Progress in NeuroPsychopharmacology and Biological Psychiatry*, 94, 109672. <https://doi.org/https://doi.org/10.1016/j.pnpbp.2019.109672>