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Title

(Re)Defining Motor Competence: empirical exploration based on a moderated mediation approach

Authors

Manuel Segura-Berges¹, Carlos Peñarrubia-Lozano² (0000-0002-3776-2901),
Juan Carlos Bustamante^{3*} (0000-0002-8201-0469)

¹ Colegio Compañía de María, Zaragoza, Spain.

² Department of Musical, Plastic and Corporal Expression, University of Zaragoza, Zaragoza, Spain.

³ Department of Psychology and Sociology, University of Zaragoza, Zaragoza, Spain.

*Corresponding author: jbustama@unizar.es (JCB)

Universidad de Zaragoza, Facultad de Educación, calle Pedro Cerbuna, 12,
50009, Zaragoza (Spain), jbustama@unizar.es

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IRB Approval

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Keywords

Motor competence, moderated mediation, conditional processes analysis

Abstract

Purpose: The aim of the study was to empirically support a broader motor competence moderated mediation approach in which motor coordination is the predictor variable and motor competence self-perception is the outcome variable, anxiety and self-esteem are mediator variables, and gender is the moderator variable. **Method:** 327 year-4 Primary Education pupils participated. A conditional processes analysis was performed by macro PROCESS v.3.4. **Results:** For the moderation effects, interactions appeared between motor coordination and gender when taking self-esteem, anxiety and motor competence self-perception as outcome variables. Interactions were found between self-esteem and gender when anxiety and motor competence self-perception were taken as outcome variables. An interaction appeared between anxiety and gender when motor competence self-perception was considered an outcome variable. A significant direct effect was noted between the motor coordination variable and motor competence self-perception for both genders. The moderated mediation indices supported the indirect conditional effects of motor coordination when partially and jointly bearing in mind the moderator effect of gender on motor competence self-perception by means of self-esteem and anxiety. **Conclusions:** The results reveal the importance of understanding motor competence by more globally contemplating not only students' motor learning, but also their cognitive and psycho-emotional reality.

Keywords: Motor competence, moderated mediation, conditional processes analysis

1. Introduction

In the last 15 years, child health data have become alarming. The percentage of obese children (> 30% body fat) within our borders has tripled (from 5% to 16%), and about 30% of our schoolchildren are already overweight (> 25% fat) (Marín and López, 2020; Méndez *et al.*, 2009). Therefore, new cognitivist and socio-constructivist perspectives advocate that motor competence (MC) should become a key competence in the educational context. MC is outlined as latent functional performance during Primary Education schoolchildren's development, when motor, cognitive, social and psychosocial factors are present (Gerlach *et al.*, 2017; Strotmeyer *et al.*, 2019). A more extensive MC

study, in which the role played by all motor, cognitive, social and psychosocial variables is known in this construct, would offer researchers and teachers in general a large quantity of information to, in turn, allow to orientate educational practice with scientific criteria in related knowledge areas (Herrmann *et al.*, 2019; Brown & Cairney, 2020; Carcamo-Oyarzun & Herrmann, 2020).

1.1 Motor Competence Concept

Motor competence has been defined and generally studied only according to motor components, such as motor coordination levels (Barnett *et al.*, 2016; Scheuer *et al.*, 2019). However, the most recent conceptualisations encompass the set of all dimensions present in the concept and open a path of interest to study the relations also established between other different non-motor dimensions (Ramón-Otero, 2015). This allows us to approach the explanation of the concept with a global vision that would analyse the situations in which motor, cognitive, psychosocial and socio-demographic are mixed together (Ruiz-Pérez, 2014).

Regarding the motor dimension, there is previous literature about this, which states that motor coordination is formed as a factor or indicator of schoolchildren's MC (Ruiz-Pérez *et al.*, 2008). Thus within the motor dimension, coordination is established as one of the backbones of MC by is, in turn, shaped as a complex function that manifests itself when acting in the different facets of our lives (Barnett *et al.*, 2016). According to the cognitive dimension of the concept, the conceptual models of Stodden *et al.* (2008) and Arruza *et al.* (2011) also contemplate that MC self-perception forms part of the broader MC concept by being a closely related variable to coordinative skills. On the psychosocial dimension, Ramón-Otero and Ruiz-Pérez (2015) indicate that a study field about the MC area has emerged to analyze the possible relations between optimum motor coordination levels and other variables like anxiety or self-esteem. Finally, Hellín *et al.* (2006) specify the influence of socio-demographic variables like age or gender. Gender is taken mainly as a social variable of interest to study MC (Gosselin *et al.*, 2020). In relation to motor competence, and taking into account previous studies such as Chalabaev *et al.* (2013), the term gender is used to represent the social construct rather than any biological differences that may exist in relation to

motor competence between males and females. **1.2 Relations between concept-related variables**

1.2.1 Relation between coordination and motor competence self-perception according to gender

The motor coordination level is related to cognitive variables like MC self-perception. Former research has shown that schoolchildren with motor coordination problems less perceive competence compared to those who present no type of difficulty (Skinner & Piek, 2001). So, a relation apparently exists between MC self-perception and coordinative capacities (García-Cantó *et al.*, 2013). Along these lines, the study of García-Cantó *et al.* (2013) reports that most subjects have a medium level of coordination, and both boys and girls indicate intermediate levels of MC self-perception (50.1%). They also show that 95.7% of the female students with high coordination levels state having enough MC self-perception. In turn, 92.6% of the male students with high coordination levels indicate that they have sufficient MC self-perception. Ramón-Otero (2015) establishes that females are characterised by having a lower motor coordination level, as well as less MC self-perception, compared to males.

1.2.2 Relation between coordination and psychosocial variables according to gender

Coordination levels are also related to psychosocial-type variables like anxiety or self-esteem (Piek *et al.*, 2005). On the anxiety construct, former studies evidence a relation between these motor coordination levels and anxiety by showing that both variables are significantly related (Piek *et al.*, 2010). Kowalski and Schermer (2019) show in *post hoc* comparisons that girls with high motor coordination (HMC) (45%) and medium motor coordination (MMC) (47%) have lower mean anxiety scores (mean HMC=18.67 and mean MCM= 20.71) compared to those with low motor coordination (LMC) (8%), whose average anxiety is higher (mean LMC=22.05). These differences are statistically significant ($p<0.001$). For the male gender, the majority group is that of MCM (40%).

Posso-Pacheco *et al.* (2021) state for motor coordination that 89.09% of the participants lie at a medium level and 10.91% achieve a good level. In the same order for the self-esteem variable, 90.91% of subjects take at the medium level, with 9.09% at a high level. Piek *et al.* (2006) report significant differences between boys and girls for the coordination/self-esteem relation,

and indicate that boys obtain higher scores for overall motor coordination exercises and self-esteem than girls.

1.2.3 Relation between psychosocial variables and motor competence self-perception according to gender

Authors like Carrasco *et al.* (2015) present statistically significant differences in the relation between the dimension "perceived MC" and gender [$t(110)=4.04$; $p\leq 0.001$], and also between "error anxiety" and gender [$t(111)=-3.198$; $p\leq 0.01$]. We can appreciate that boys are more committed to learn ($M=3.65$; $SD=0.58$) than girls ($M=3.60$; $SD=0.58$) and better perceive MC ($M=2.95$; $SD=1.00$) than girls ($M=2.23$; $SD=0.86$). It is on the anxiety dimension before the error where girls obtain higher scores ($M=2.43$; $SD=0.86$) than boys ($M=1.96$; $SD=0.69$).

On the relation between self-perceived MC and self-esteem, Schmidt *et al.* (2015) conclude that some gender differences exist in the relation between self-perception and self-esteem. Comparing the two models between boys and girls reveals that both models are significant ($\Delta\chi^2_{380} = 28.85$, $df = 16$, $p = .025$). In summary, it can be stated that MC self-perception is related to self-esteem in both boys and girls.

1.3 Research purpose: variables of interest in our study

The objective of the present study is to deal with the MC concept from an interrelated multivariate perspective by performing a moderated mediation analysis to, thus, better understand the interrelation between the different related variables as far as direct/indirect effects and moderation are concerned. We carried out a study based on mediation and moderation components to know the role that each one plays in the MC construct. As in previous cross-sectional studies related to our research field (Tsafou *et al.*, 2016; Gómez-Baya *et al.*, 2019; Jankauskiene and Baceviciene, 2019), our analyses would demonstrate concomitant or covariant relations among the motor, cognitive, social and psycho-emotional variables. It is not a matter of performing partial analyses of the relations among these variables, but of taking a step further in this direction by considering existing trends within the motor development and MC framework to propose empirical evidence related with a more global approach (Gallahue & Ozmun 2006; Fort-Vanmeerhaeghe *et al.*, 2017; Mancini *et al.*, 2018).

Moderated mediation attempts to reflect situations in which the relation mediated among different variables varies according to a moderator variable's levels. It is a matter of establishing the Conditional Indirect Effect of a predictor variable on an outcome variable in relation to a moderator variable's different values (Iacobucci, 2008). In our study, motor coordination is taken as a predictor variable, and self-perceived MC as an outcome variable. In turn, anxiety and self-esteem are taken as mediator variables between motor coordination and self-perceived MC while, in turn, gender is established as a moderator (see Figure 1).

Sackett and Edwards (2019) establish that coordinative capacities are directly related to one's self-perceived motor performance, and in such a way that the higher the motor coordination level, the better MC is perceived by subjects. Likewise, Skinner and Piek (2001) show that schoolchildren with motor coordination problems feel less competent and, thus, perceive their competence as being worse than those schoolchildren who have no difficulties coordinating. Between performing a motor skill and one's perception of that performance, psychological constructs that influence this relation are presented. Thus when studying MC, it is also necessary to take into account the psycho-emotional implications that schoolchildren show during their personal development (Skinner & Piek, 2001). In this sense, and according to the relations set out by other studies between MC and other socio-emotional constructs (Ekornas et al., 2010; Harris et al., 2021), the intention is to investigate the mediational effects that anxiety before error in different teaching-learning situations and general self-esteem, understood as the constructs present in schoolchildren's personal and evolutionary development, have on MC development. Indeed self-esteem is taken as the primary mediator variable, whereas anxiety is established as the secondary mediator variable. Perpiñán (2013) indicates that children with positive self-esteem tolerate anxiety or stress more effectively when facing difficulties and, thus, tend to display better emotional balance. Bos *et al.* (2010) reveal that having higher self-esteem levels implies displaying lower anxiety levels in terms of making mistakes and failure.

Finally, the gender variable is taken as the moderator variable. In line with what has already been set out, all these relations are determined by the gender factor. Mickle *et al.* (2011) stress the importance of bearing in mind each child's or adolescent's individualities by means of variables like gender, which comes over as being a fundamental principle of subjects' motor development and MC. In short, direct effects are expected between motor coordination and self-perceived MC, and the indirect effects of the self-

esteem and anxiety variables are expected for the relation between coordination and self-perceived MC.

2. Materials and Method

2.1 Participants

This research applied convenience sampling, which was carried out between September and December of academic year 2018/2019. Considering this non-probabilistic proven technique, the following criteria were considered: schools' accessibility, teaching staff availability, adequacy of the material that schools have, and the school being public or state-assisted. The principal investigator contacted the schools' headmasters/mistresses and offered the possibility of participating in the research study. They were informed about having to fill out authorisation from both the school and the participating students' families. During a meeting held at the beginning of the course, the responsible teachers informed of the tests that the students were to carry out if they participated in the study. Seven schools participated. The study participants were formed by 327 year-4 Primary Education pupils with a mean age of 9.08 years ($SD = .27$). Of them, 125 (38.2%) went to public schools and 202 (61.7%) to state-assisted schools. Of the 327 participants, 148 (45.25%) were male and 179 (54.74%) were female. This study was appraised favourably by a Research Ethics Committee in its Minutes N.: 14/2020. Participation in the study was based on parents' written informed consent.

A methodological aspect regarding sampling was to consider threats to the project's internal validity to avoid confusion in the inference process and to seek a stricter criterion to obtain validity and consistency in the statistical results (Bland & Altman, 1995). First, the researcher/teacher responsible for administering tests and batteries in each classroom and school was trained following the same administration protocol to, thus, avoid any measurement bias. Reliable valid instruments were used for the study population (Primary Education schoolchildren) at the same times during the academic year (end of the first term, beginning of the second term). Research was carried out in different locations and schools. The fact that students knew that they were in a research situation affected them insofar as a certain naturalness of the more usual school environment was lost. To mitigate this effect, research was framed within the Tutoring and PE schedules, and was compatible and coherent with the curricular approach, and also with the objectives of the areas and the Primary Education stage.

2.2 Data collection

Data collection was carried out in person at schools, and tests were individually performed. The fact that students knew that they were immersed in a research situation affected them insofar as a certain naturalness of the more usual school environment was lost. To mitigate this effect, research was framed within the Tutoring and PE schedules, and was compatible and coherent with the curricular approach, as well as with the objectives of the areas and PE area.

To carry out the motor tests, schools' conventional material in the PE area, and their recreation spaces or playgrounds, were used. The regulations, and the distances and spaces of these tests, were respected. The organisation of both tests and material was the responsibility of each school's PE teacher, who received the relevant training in administering the motor test, as well as the informative documents and rubrics to evaluate motor behaviour with the scores determined by tests. One of the fundamental criteria was to comply as much as possible with instructions about the materials to be used, direction of travel and distances, and the motor execution times in each proposed test. In the motor tests, the performance time depended on the participant's own response, although being rigorous with the time frame established for interventions was necessary.

The other tests, which were related to the cognitive, psycho-emotional and social variables, were administered in school classrooms in a tangible format using the Tutoring schedule to perform them. Some of these types of tests or questionnaires were answered using the quantitative procedure called Likert Scale (1 to 5), with which students answered each statement based on their degree of agreement from 1 "Completely disagree" to 5 "Completely agree". Others follow a similar format or logic, but do so qualitatively, with the options being "always, often, sometimes or never". First of all, a socio-demographic questionnaire was created, which assigned a code to each participant, with which the following data were collected: gender, age, academic year, place of residence, if physical activity was practiced, and the socio-educational level of each participant's family. To measure and collect other data, the following tests and scales were used, and their reliability indices were noted after being applied to the sample:

Motor coordination. Cenizo-Benjumea *et al.* (2017) developed the 3JS motor test to evaluate the general coordination level of boys and girls aged 6-11

years (Cronbach's α was applied to our sample = .81). To carry out the motor tests of the 3JS test, the conventional material of the school in the PE area and the recreation space or sports centre were used, the regulations, and the distances and spaces of the said tests, were respected. In relation to students, the performance time depended on the participants' own response, and the performance of tests was individual. One of the fundamental criteria was to comply as much as possible with the instructions in terms of the materials to be used, the direction of travel, and the distances and motor execution times in each propose tests. The 3JS test uses the total sum of the scores in each task, such as the motor competence level. To perform a more in-depth analysis of coordination, the 3JS test groups scores in relation to an absolute criterion and within intervals that allow different levels to be defined. This division of scores uses an absolute measure (standard deviation), which makes it possible to assess each subject's distance in relation to the mean of the age group. All the intervals or pentas correspond to a different motor coordination assessment (Cenizo et al., 2015). By way of example, some items in the questionnaire were as follows:

Jump with both feet together

Move by running doing slaloms

Throw a ball in a goal.

Self-perceived MC. The Spanish version of the Pictorial Scale of Perceived Movement Skill Competence for young boys and girls was used (Estevan *et al.*, 2019) (Cronbach's α = .81) (Estevan et al., 2019). It has 13 pictographic scales with which the participants perceive the degree to which they perform locomotion-type skills and other skills related to controlling objects. This scale goes from 1 to 4, where 4 is the highest score by a process that considers a double dichotomy (e.g., subjects have to choose one of two images: one image represents them self-perceived as being competent, and the other represents them self-perceived as not being that competent). After this phase, the subjects have to once again choose one of the two options. If they chose the competent action image in the first phase, they have two options: "very good" (4 points) or "quite good" (3 points). For the not so competent image, they also have two options: "fairly good" (2 points) or "not very good" (1 point). By way of example, some items in the questionnaire were the following:

Are you very good or quite good doing jumps and spreading legs and arms? / Are you fair or very bad doing jumps and spreading legs and arms?

Are you very good or fairly good at hitting a ball? /Are you fair or very bad at hitting a ball?

Self-esteem. The Self-Esteem Scale Test in Primary Education with 17 questions and illustrations was used (Ramos *et al.*, 2006) (Cronbach's $\alpha = .82$). The instrument called Evaluating Self-esteem in Primary Education (A-EP) addresses pupils in years 4 to 6 of PEd (Ramos *et al.*, 2006). The A-EP is a test suitable for evaluating self-esteem in students from 4th to 6th grade of PEd. Use plain and clear language, adjusted to these ages, with brief questions and no denials. It includes colour illustrations to accompany all 17 test items. These two characteristics make it ideal for these courses. It is a very suitable test to help to detect students with low self-esteem. It includes 17 questions which come with illustrations to exemplify the wording, for example: "Am I happy?", "Am I an important person?", "Do I like myself as I am?". The response options for each question are: "Yes" (2 points), "Sometimes" (1 point) and "No" (0 points). The total self-esteem scores are obtained from their corresponding manual scores (Cronbach's $\alpha = .82$).

Anxiety. In order to collect anxiety data, the AMPET test was employed, specifically the "Anxiety about making mistakes and stressful situations" dimension (Ruiz-Pérez *et al.*, 2015) (Cronbach's $\alpha = .87$). Fifteen items are related to the anxiety construct, whose scale goes from 1 to 5, where 1 is "Totally disagree" and 5 is "Totally agree". These items are related to the stress and anxiety that might be noted in the school context in situations requiring motor performance. By way of example, some items in the questionnaire were the following:

When I have to participate in class, I often make jokes because I'm afraid of making mistakes.

When I participate in class in a competition, I sometimes wish to escape from there because I'm afraid of losing.

The times in which students had to complete questionnaires were as follows:

- Demographics questionnaire: 25 minutes

- AMPET test: 45 minutes
- The Self-Esteem Scale Test: 15 minutes
- The Spanish version of the Pictorial Scale of Perceived Movement Skill Competence: 25 minutes

2.3 Statistical analysis

A conditional processes analysis was performed by macro PROCESS v.3.4 to obtain the indirect effects and to determine the role played by all the variables of interest related to the construct (Hayes, 2013). This analysis gives a confidence interval based on sample distribution, and it can be assumed that indirect effects are significant and this mediation occurs if the zero value lies outside the 95% confidence interval (95%CI; Preacher & Hayes, 2008). All these analyses were performed using SPSS (version 21.0, <https://www.ibm.com/es/es/analytics/spss-statistics-software>).

Preacher and Hayes (2008) indicate that performing this type of conditional processes analysis is relevant and offers advantages if adapted to test different mediators simultaneously, which does not require assuming normal sampling distribution. Other methodological advantages are lowering the probability of Type 1 errors, and it functions better than the conventional Sobel test in real situations with finite samples (Santos & Passos, 2013).

Therefore, a moderated mediation index calculation was done to analyze if a moderated mediation effect would be generated (Hayes, 2018). This index represents the quantification of the linear relation between the moderator and the indirect effect. Similarly, if the zero value lies beyond the 95% confidence interval (95%CI), it is considered to be a result that backs the moderated mediation effect. To determine the indirect effects in relation to the moderator's values (indirect conditional effects), under which conditions the mediation effects actually take place, the "spotlight analysis" was performed (Spiller *et al.*, 2013).

3. Results

To confirm that the obtained variables were related, we display the correlation effects between the variables of interest of the study in Table 1.

For the moderation effects, we found that the interactions between motor coordination and gender were statistically significant when these outcome variables were considered: self-esteem ($b=-.3248$, $s.e.=.1200$, $p<.05$), anxiety ($b=.0687$, $s.e.=.1756$, $p<.05$) and self-perceived MC ($b=-.3856$, $s.e.=.3123$, $p<.05$). These results suggest that gender moderates the motor coordination effect on self-esteem, anxiety and self-perceived MC. Moreover, the interactions between self-esteem and gender were also statistically significant when taking anxiety ($b=-.3389$, $s.e.=.1756$, $p<.05$) and self-perceived MC ($b=.8816$, $s.e.=.3297$, $p<.05$) as outcome variables. This suggests that gender moderates the self-esteem effect on both anxiety and self-perceived MC. There was also evidence for an interaction between anxiety and gender when self-perceived MC was taken as an outcome variable ($b=.0100$; $s.e.=.1767$, $p<.05$). This implies that gender also moderates the anxiety effect on self-perceived MC.

For the direct effects, a significant direct effect was evidenced between the motor coordination variable and self-perceived MC for both the male ($b=1.0913$; $s.e.=.2362$, $p<.05$) and female ($b=1.4569$; $s.e.=.2043$, $p<.05$) genders.

For the conditional indirect effect of motor coordination on self-perceived MC through self-esteem (motor coordination \rightarrow self-esteem \rightarrow self-perceived MC), and depending on gender, we observed that the moderated mediation index supported this effect (see Table 1). By analysing under which conditions self-esteem mediation took place to establish indirect effects in relation to the moderator's values, we found that the indirect effect was significant for boys (95%CI: .09 to .57), but not for girls (95%CI: -.03 to .04) (see Table 2).

For the conditional indirect effect of motor coordination on self-perceived MC through anxiety (motor coordination \rightarrow anxiety \rightarrow self-perceived MC) and depending on gender, we observed that the moderated mediation index also supported this effect (see Table 1). Likewise, we observed that the indirect effect was significant for boys (95%CI: .08 to .19), but not for girls (95%CI: -.03 to .29) (see Table 2).

Finally for the conditional indirect effect of motor coordination on self-perceived MC through self-esteem by considering anxiety (motor coordination \rightarrow self-esteem \rightarrow anxiety \rightarrow self-perceived MC) and depending on gender, we observed that the obtained moderated mediation index was

significant (see Table 1). Besides, the indirect effect was significant for boys (95%CI: .06 to .34), but not for girls (95%CI: -.09 to .09) (see Table 2).

4. Discussion

The present study specifically offers empirical evidence for the mediator/moderator role played by social and psychosocial variables in the relation between motor coordination and self-perceived MC. This allows to obtain a more broadly conceptualise MC by bearing in mind the progressive changes that children undergo, as well as various intervening factors (Ruiz-Pérez *et al.*, 2008). Psycho-emotional variables are an implicated part in schoolchildren's evolutionary development, and they also influence motor development and, therefore, MC as an implicated part of this development. Pre-adolescence is a complex stage in which many changes very quickly occur, and not only physically, but also emotionally and mentally. Therefore, it would make sense that variables like self-esteem and anxiety, considered from a more general perspective by bearing in mind different situations in the school context, should be taken into account. Specifically, our correlational analyses showed significant and bidirectional connections among motor coordination, self-esteem, anxiety and MC self-perception. These results allowed a prior and plausible context to be created to carry out a moderated mediation analysis. Thus given that both variables there were mediational effects of (error anxiety and general self-esteem), and by even considering the moderating effects of the gender variable, it would seem relevant to take into account these socio-emotional variables when understanding the MC construct.

By considering what the predictor variable, the outcome variable and both mediator variables constitute, the results evidenced a mediation effect for the male gender. This would imply that those boys with good motor coordination would present a higher self-esteem level and lower anxiety levels, and would better self-perceive their MC. These results support the influence that psychological constructs could have in the MC area by stressing the impact that the emotional level could have on self-perceived MC in boys of school age (Carrasco *et al.*, 2015).

Likewise, by taking into account what each mediator shaped with both the predictor variable and outcome variables, the results also evidenced mediation

effects for the male gender. Self-esteem influenced the degree of self-assessment and personality with a physical (Bos *et al.*, 2010) and psychological (Broc, 2014) impact. This variable is very important for MC and how subjects perceive motor tasks by, on the one hand, allowing them to perceive that they can be efficiently overcome and performed and, on the other hand, also perceiving them as more of a threat (Adie *et al.*, 2008). The role played by anxiety as a mediator variable is also relevant owing to the pressure and stressful situations that this variable entails insofar as being afraid of an external negative assessment, as well as the negative perception a subject has about performing the task, which may have negative effects while performing motor actions (Prieto, 2016).

The moderated mediation test results highlighted gender as a variable that plays a key role, which may vary and model some relations among variables of a motor, cognitive or psychosocial nature (Carcamo-Oyarzun *et al.*, 2020; Lodal & Bond 2016). This aspect reveals and confers empirical consistency to the fact that gender acts as a key moderator to determine and modify relations around the MC concept (Brown & Cairney, 2020). So the obtained moderated mediation effects in relation to masculine and feminine genders made us think about the importance of gender differences, and also about the development stage that they are in. Although girls tend to physically develop earlier, boys display greater motor development and accomplish higher MC levels at pre-adolescent ages, which influences boys' well-formed self-perceived MC more than girls (Córdoba & Romero, 2016). This means that these differences could also appear in the development stage that boys are in, when the prepuberty period is a determining stage that can influence subjects' overall development (Santrock, 2006).

If we bear these aspects in mind, then the presence of moderation effects by gender as regards the aforementioned different existing relations evidences that, in a broader MC concept, it is important to consider social variables like gender, and also motor and psychosocial levels. So it is relevant to take each child or adolescent's personal individualities, as well as gender differences, as the fundamental principle of subjects' motor development and MC (Myer *et al.*, 2011; Rodríguez-Negro *et al.*, 2019).

Finally, our results could reveal a partial supplementary mediation effect because the indirect effects and the direct effect showed the same sign (Zhao *et al.*, 2010). The fact that this effect appeared could involve the presence of

other possible potential mediators in the direct effect. Thus one of the main strong points of this study lies in the interpretative scope of moderated mediation (Hayes, 2013). Moreover, this work centres on an age group whose developmental stage implies considerable development in motor terms and in reinforcing motor capacities (Groselj *et al.*, 2019).

Regarding limitations, although our objective was to describe the relations and interactions between the involved variables, using cross-sectional data limits interpretations to non-causal inferences. It would be interesting to contemplate longitudinal studies to better establish the temporal precedence and to determine the causal processes that link predictors and outcomes. Likewise, it also seems necessary to consider another type of variables that relates to MC, such as learning commitment (Márquez-Barquero & Azofeifa-Mora, 2019) or the influence of other agents like families or teachers (Estevan *et al.*, 2018). Moreover, creation of empirical model can be considered in future directions. Therefore, future studies could analyze the MC concept by bearing in mind other variables related to student engagement in class, the vision and perception of this related agents construct with students, such as PE teachers or family relations, or even variables related to the habit of practicing physical activity.

By way of conclusion, understanding MC more globally seems important (Ulrich, 2007). As this concept is broad, Gil *et al.* (2008) state the importance of knowing the variables involved in this construct in infancy because this life stage is when children discover the main ways of coming into contact with reality and them acquiring their first knowledge of their environment in both their body and movements. This study allows teachers to know about the role that the different variables involved in developing MC play. Therefore, to understand, evaluate and promote it, not only is an external and objective evaluation of the coordinative levels displayed by schoolchildren necessary, but so is bearing in mind that students' self-perception of their own MC and their psycho-emotional reality intervene in the teaching-learning motor process.

5. Disclosure statement.

The authors report there are no competing interests to declare.

6. References

- ARRUZA, J.A.; ARRIBAS, S.; OTAEGI, O.; GONZÁLEZ, O.; IRAZUSTA, S. & RUIZ, L.M. (2011). Percepción de competencia, estado de ánimo y tolerancia al estrés en jóvenes deportistas de alto rendimiento (Perception of competence, mood state and stress tolerance in young high performance athletes). *Anales de psicología*, 27(2): 536-543.
- BARNETT, L.M.; LAI, S.K.; VELDMAN, S.L.C.; HARDY, L.L.; CLIFF, D.P.; MORGAN, P.; ZASK, A.; LUBANS, D.R.; SHULTZ, S.P.; RIDGERS, N.D.; RUSH, E.; BROWN, H.L. & OKELY, A.D. (2016). Correlates of Gross Motor Competence in Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Medicine*, 46: 1663–1688.
- BLAND, J. M. & ALTMAN, D. G. (1995). *Statistics notes: Calculating correlation coefficients with repeated observations: Part 1—correlation within subjects. Bmj*, 310(6977):446.
- BOS, A.E.R.; HUIJDING, J.; MURIS, P.; VOGEL, L.R.R. & BIESHEUVEL, J. (2010). Global, contingent and implicit self-esteem and psychopathological symptoms in adolescents. *Personality and Individual Differences*, 48(3): 311–316.
- BROC, M. Á. (2014). Harter's Self-Perception Profile for Children: an adaptation and validation of the Spanish version. *Psychological Reports*, 115(2):444-466.
- BROWN, D.M.Y. & CAIRNEY, J. (2020). The synergistic effect of poor motor coordination, gender and age on self-concept in children: A longitudinal analysis. *Research in developmental disabilities*, 98: 103576.
- CARCAMO-OYARZUN, J. & HERRMANN, C. (2020). Validez de constructo de la batería Mobak para la evaluación de las competencias motrices básicas en escolares de Educación Primaria (Construct validity of the MOBAK test battery for the assessment of basic motor competencies in primary school children). *Revista Española de Pedagogía*, 78(276): 291-308.
- CARCAMO-OYARZUN, J.; ESTEVAN, I. & HERRMANN, C. (2020). Association between Actual and Perceived Motor Competence in School Children. *International journal of environmental research and public health*, 17(10): 1-15.

CARRASCO, M.; PARRA, D. & PÉREZ, C. (2015). La competencia motriz y su percepción en el alumnado de cuarto curso de Educación Secundaria y Bachillerato (The motor competence and its perception in the student of Secondary Education). *Calidad de vida y salud*, 8(2): 70-87.

CENIZO-BENJUMEA, J. M., RAVELO-ALFONSO, J., RAMÍREZ, J. M. & FERNÁNDEZ-TRUAN, J. C. (2015). Assessment of Motor Coordination in Students Aged 6 to 11 Years. *Journal of Physical Education and Sport*, 15(14): 765-774.

CENIZO-BENJUMEA, J.M.; RAVELO-ALFONSO, J.; MORILLA-PINEDA, S. & FERNÁNDEZ-TRUAN, J.C. (2017). Test de coordinación motriz 3JS: Cómo valorar y analizar su ejecución (Motor Coordination Test 3JS: Assessing and analyzing its implementation). *Retos*, 32: 189-193.

CHALABAEV, A.; SARRAZIN, P.; FONTAYNE, P.; BOICHÉ, J., & CLÉMENT-GUILLOTIN, C. (2013). The influence of sex stereotypes and gender roles on participation and performance in sport and exercise: Review and future directions. *Psychology of Sport and Exercise*, 14(2): 136-144.

CÓRDOBA, T. & ROMERO, R. (2016). *Cooperar en l'activitat física i l'esport. 50 propostes pràctiques*. Barcelona, España: Institut Barcelona Esports-Ajuntament de Barcelona.

EKORNÅS, B.; LUNDERVOLD, A. J.; TJUS, T. & HEIMANN, M. (2010). Anxiety disorders in 8–11-year-old children: Motor skill performance and self-perception of competence. *Scandinavian journal of psychology*, 51(3): 271-277.

ESTEVAN, I.; MOLINA-GARCÍA, J.; BOWE, S.J.; ÁLVAREZ, O.; CASTILLO, I. & BARNETT, L.M. (2018). Who can best report on children's motor competence: Parents, teachers, or the children themselves? *Psychology of Sport and Exercise*, 34: 1-9.

ESTEVAN, I.; MOLINA-GARCÍA, J.; QUERALT, A.; BOWE, S.J.; ABBOTT, G. & BARNETT, L.M. (2019). The new version of the pictorial scale of Perceived Movement Skill Competence in Spanish children: Evidence of validity and reliability. *Revista Internacional de Ciencias del Deporte*, 55: 35-54.

- FORT-VANMEERHAEGHE, A.; ROMÁN-VIÑAS, B. & FONT-LLADÓ, R. (2017). ¿Por qué es importante desarrollar la competencia motriz en la infancia y la adolescencia? Base para un estilo de vida saludable (Why is it important to develop motor competence in childhood and adolescence? The basis for a healthy lifestyle). *Apunts. Medicina de l'Esport*, 52(195): 103-112.
- GALLAHUE, D. & OZMUN, J. (2006). *Understanding Motor Development Infants, Children, Adolescents, Adults*. New York: McGraw-Hill.
- GARCÍA-CANTÓ, E.; PÉREZ-SOTO, J.J.; RODRÍGUEZ, P.L. & MORAL, J.E. (2013). Relación de las capacidades coordinativas con la competencia motriz autopercibida en adolescente (Relation of coordination capabilities with motor competence self-perception in adolescents). *Trances*, 5(3): 213-22.
- GERLACH, E.; HERRMANN, C.; JEKAUC, D. & WAGNER, M.O. (2017). Diagnostik motorischer Leistungsdispositionen. In U. Trautwein & M. Hasselhorn, *Begabungen und Talente. Jahrbuch der pädagogisch-psychologischen Diagnostik, Tests & Trends* (pp. 145-158). Göttingen: Hogrefe.
- GIL, P.; CONTRERAS, O.R. & GÓMEZ, I. (2008). Habilidades motrices en la infancia y su desarrollo desde una educación física animada (Motor skills in childhood and their development through animated physical education). *Revista iberoamericana de Educación*, 47: 71-96.
- GÓMEZ-BAYA, D.; MENDOZA, R.; PAÍNO, S. & GILLHAM, J. E. (2019). Respuestas al afecto positivo y ajuste psicológico en la adolescencia. *Terapia psicológica*, 37(1): 25-37.
- GOSELIN, V.; LEONE, M. & LABERGE, S. (2020). Socioeconomic and gender-based disparities in the motor competence of school-age children. *Journal of Sports Sciences*, 24: 1-10.
- GROSELJ, J.; OSREDKAR, D.; SEMBER, V. & PAJEK, M. (2019). Associations between balance and other fundamental motor skills in pre-adolescents. *Medicina dello Sport*, 72(2): 200-215.
- HARRIS, S.; WILMUT, K., & RATHBONE, C. (2021). Anxiety, confidence and self-concept in adults with and without developmental coordination disorder. *Research in Developmental Disabilities*, 119: 104-119.

HAYES, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guildford Press.

HAYES, A.F. (2018). Partial, conditional, and moderated mediation: Quantification, inference, and interpretation. *Communication Monographs*, 85: 4-40.

HELLÍN, P.; MORENO, J.A. & RODRÍGUEZ, P.L. (2006). Influencia social del género y de la percepción de competencia en la valoración de las clases de educación física (Social influence of gender and of the perception of competence in the assessment of Physical Education classes). *Revista Española de Educación Física y Deportes*, 5: 37-49.

HERRMANN, C.; SEELING, H.; FERRARI, I. & KUHNIS, J. (2019). Basic motor competencies of preschoolers: construct, assessment and determinants. *German journal of exercise and sport research*, 49(2):179-187.

IACOBUCCI, D. (2008). *Mediation analysis*. Thousand Oaks, CA: Sage.

JANKAUSKIENE, R. & BACEVICIENE, M. (2019). Body image and disturbed eating attitudes and behaviors in sport-involved adolescents: the role of gender and sport characteristics. *Nutrients*, 11(12): 3061.

KOWALSKI, C. M. & SCHERMER, J. A. (2019). Hardiness, perseverative cognition, anxiety, and health-related outcomes: A case for and against psychological hardiness. *Psychological reports*, 122(6): 2096-2118.

LODAL, K. & BOND, C. (2016). The relationship between motor skills difficulties and self-esteem in children and adolescents: a systematic literature review. *Educational psychology in practice*, 32(4): 410-423.

MANCINI, V.O.; RIGOLI, D.; ROBERTS, L.D.; HERITAGE, B. & PIEK, J.P. (2018). The relationship between motor skills and psychosocial factors in young children: A test of the elaborated environmental stress hypothesis. *British journal of educational psychology*, 88(3): 363-379.

MARÍN, P. G. & LÓPEZ, N. F. (2020). Asociación de la competencia en las habilidades motrices básicas con las actividades físico-deportivas extracurriculares y el índice de masa corporal en preescolares. *Retos: nuevas tendencias en educación física, deporte y recreación*, 38: 33-39.

MÁRQUEZ-BARQUERO, M. & AZOFEIFA-MORA, C. (2019). El compromiso y entrega en el aprendizaje, la competencia motriz percibida y la ansiedad ante el error y situaciones de estrés: factores de motivación de logro durante las clases de educación física en adolescentes (Learning delivery and commitment, perceived motor competence, and anxiety when making mistakes or under stress: Motivating factors in adolescents for achievement during Physical Education classes). *Revista en ciencias del movimiento humano y salud*, 16(1): 1-12.

MÉNDEZ-GIMÉNEZ, A.; LÓPEZ-TÉLLEZ, G. & SIERRA, B. (2009). Competencias Básicas: sobre la exclusión de la competencia motriz y las aportaciones desde la Educación Física (Key competences: on the exclusion of the motor competence and the contribution from the Physical Education). *Retos*, 16: 51-57.

MICKLE, K.J.; MUNRO, B.J. & STEELE, J.R. (2011). Gender and age affect balance performance in primary schoolaged children. *Journal of Science and Medicine in Sport*, 14: 243-248.

MYER, G. D.; FAIGENBAUM, A. D.; FORD, K. R.; BEST, T. M.; BERGERON, M. F. & HEWETT, T. E. (2011). When to initiate integrative neuromuscular training to reduce sports-related injuries in youth?. *Current sports medicine reports*, 10(3): 155.

PERPIÑÁN, S. (2013). *La salud emocional en la infancia: Componentes y estrategias de actuación en la escuela (Emotional health in childhood: components and strategies for action at school)*. Madrid, España: NARCEA.

PIEK, J.; BARRET, N.C.; SMITH, L.M.; RIGOLI, D. & GASSON, N. (2010). Do motor skills in infancy and early childhood predict anxious and depressive symptomatology at school age? *Human movement Science*, 29(5): 777-786.

PIEK, J.; BARRETT, N.C.; ALLEN, L.S.; JONES, A. & LOUISE, M. (2005). The relationship between bullying and self-worth in children with movement coordination problems. *British Journal of Educational Psychology*, 75: 453-463.

PIEK, J.P.; BAYNAM, G.B. & BARRETT, N.C. (2006). The relationship between fine and gross motor ability, self-perceptions and self worth in children and adolescents. *Human Movement Science*, 25: 65-75.

- POSSO-PACHECO, R. J.; OTÁÑEZ ENRÍQUEZ, N. R.; CÓNDOR CHICAIZA, J. D. R.; CÓNDOR CHICAIZA, M. G. & LARA CHALA, L. D. R. (2021). Educación Física remota: juegos motrices e inteligencia kinestésica durante la pandemia COVID-19. *Podium. Revista de Ciencia y Tecnología en la Cultura Física*, 16(2): 564-575.
- PREACHER, K.J. & HAYES, A.F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40: 879–89.
- PRIETO, J. M. (2016). Relación entre competitividad, ansiedad social y compromiso con variables deportivas y académicas en futbolistas jóvenes. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte*, 11(2): 193-200.
- RAMÓN-OTERO, I. & RUIZ PÉREZ, L.M. (2015). Adolescence, motor coordination problems and competence. *Educación XXI*, 18(2): 189-213.
- RAMÓN-OTERO, I. (2015). La coordinación motriz en la Adolescencia y su relación con el IMC, hábitos de práctica y motivación en E.F: Estudios transversal y longitudinal (Motor coordination in adolescence and its relationship with BMI, practice habits and motivation in Physical Education: Cross-sectional and longitudinal studies). Unpublished doctoral thesis. Madrid, España: Universidad Politécnica de Madrid.
- RAMOS, R.; GIMÉNEZ, A.I.; MUÑOZ-ADELL, M.A. & LAPAZ, E. (2006). *A-EP Cuestionario de Autoestima para Educación Primaria (A-EP Self-esteem Questionnaire for Primary Education)*. Madrid, España: TEA.
- RODRÍGUEZ-NEGRO, J.; HUERTAS-DELGADO, F.J. & YANCI, J. (2019). Motor skills differences by gender in early elementary education students. *Early child development and care*, 189: 1-11.
- RUIZ-PÉREZ, L.M. (2014). De qué hablamos cuando hablamos de Competencia Motriz (What do we talk about when we talk about Motor Competence? *Acciónmotriz*, 12: 37-42.
- RUIZ-PÉREZ, L.M.; LINAZA, J.L. & PEÑALOZA, R. (2008). El estudio del desarrollo motor: entre la tradición y el futuro (The study of motor development: between tradition and the future). *Revista Fuentes*, 8: 243-258.

- RUIZ-PÉREZ, L.M.; MORENO, J.A.; RAMÓN-OTERO, I. & ALIAS-GARCÍA, A. (2015). Motivación de logro para aprender en educación física: adaptación de la versión española del test AMPET (Achievement motivation for learning in Physical Education: An adaptation of the Spanish version of the AMPET test). *Revista Española de Pedagogía*, 260: 157-175.
- SACKETT, S.C. & EDWARDS, E.S. (2019). Relationships among motor skill, perceived self-competence, fitness, and physical activity in young adults. *Human movement Science*, 66: 209-219.
- SANTOS, C. & PASSOS, A.M. (2013). Team mental models, relationship conflict and effectiveness over time. *Team Performance Management*, 19(7/8): 363-385.
- SANTROCK, J. W. (2006). *Psicología del desarrollo: el ciclo vital*. New York, EEUU: McGraw-Hill.
- SCHEUER, C.; HERRMANN, C. & BUND, A. (2019). Motor tests for primary school aged children: A systematic review. *Journal of Sports Sciences*, 37(10): 1097-1112.
- SCHMIDT, M.; BLUM, M.; VALKANOVER, S. & CONZELMANN, A. (2015). Motor ability and self-esteem: The mediating role of physical self-concept and perceived social acceptance. *Psychology of sport and exercise*, 17: 15-23.
- SKINNER, R. & PIEK, J.P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. *Human Movement Science*, 20: 73-94.
- SPILLER, S.A.; FITZSIMONS, G.J.; LYNCH, J.G. & MCCLELLAN, G.H. (2013). Spotlights, Floodlights, and the Magic Number Zero: Simple Effects Tests in Moderated Regression. *Journal of Marketing Research*, 50(2): 277-288.
- STODDEN, D.F.; GOODWAY, J.D.; LANGENDORFER, S.J.; ROBERTON, M.A.; RUDISILL, M.E.; GARCIA, C. & GARCIA, L.E. (2008). A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. *Quest*, 60: 290-306.

STROTMEYER, A.; KEHNE, M. & HERRMANN, C. (2019). Motorische Basiskompetenzen: Zusammenhängemit Geschlecht, Alter, Gewichtsstatus, außerschulischer Sportaktivität und Koordinationsleistung. *German Journal of Exercise and Sport Research*, 50: 82-91.

TSAFOU, K. E.; DE RIDDER, D. T.; VAN EE, R. & LACROIX, J. P. (2016). Mindfulness and satisfaction in physical activity: A cross-sectional study in the Dutch population. *Journal of health psychology*, 21(9): 1817-1827.

ULRICH, B. (2007). Motor Development: Core Curricular Concepts. *Quest*, 59: 77-91.

ZHAO, X.; LYNCH, J.G. & CHEN, Q. (2010). Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis. *Journal of Consumer Research*, 37(2): 197–206. ADIE, J. W.; DUDA, J. L. & NTOUMANIS, N. (2008). Autonomy support, basic need satisfaction and the optimal functioning of adult male and female sport participants: A test of basic needs theory. *Motivation and Emotion*, 32(3):189–199.

Table 1. Correlation effects between the variables of interest

		Motor coordination	Self-esteem	Anxiety	Self-perceived motor competence
Motor Coordination	Pearson Correlation	1	.155**	-.160**	.498**
	Sig. (2-tailed)	-	.005	.004	.000
	N	-	327	327	327
Self-esteem	Pearson Correlation	.155**	1	-.132**	.543**
	Sig. (2-tailed)	.005	-	.005	.000
	N	327	-	327	327
Anxiety	Pearson Correlation	-.160**	-.132**	1	-.455**
	Sig. (2-tailed)	.004	.005	-	.000
	N	327	327	-	327
Self-perceived motor competence	Pearson Correlation	.498**	.543**	-.455**	1
	Sig. (2-tailed)	.000	.000	.000	-
	N	327	327	327	-

N, number of participants

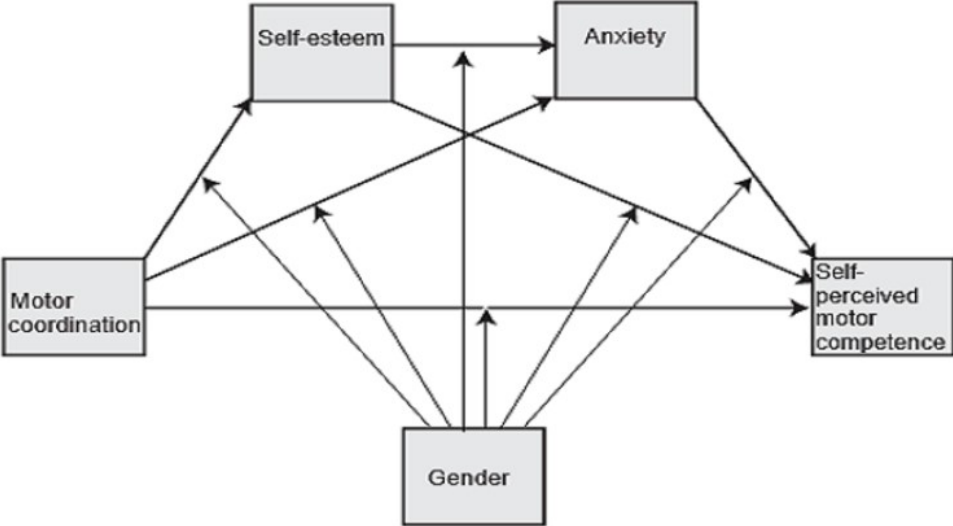
**Correlation is significant at the 0.01 level (2-tailed)

Table 2. Indirect and moderated mediation effects

Motor coordination → Self-esteem → Self-perception				
Moderator variable values: gender	Effect	SE	LLCI	ULCI
Male	.36	.16	.09	.57
Female	-.09	.02	-.03	.04
Moderated mediation index				
	Index	SE	LLCI	ULCI
Gender	.2064	.1225	.7118	.7558
Motor coordination → Anxiety → Self-perception				
Moderator variable values: gender	Effect	SE	LLCI	ULCI
Male	.22	.06	.08	.19
Female	.10	.08	-.03	.29
Moderated mediation index				
	Index	SE	LLCI	ULCI
Gender	-.0415	.1078	.12	.28
Motor coordination → Self-esteem → Anxiety → Self-perception				
Moderator variable values: gender	Effect	SE	LLCI	ULCI
Male	.17	.07	.06	.34
Female	.02	.04	-.09	.09
Moderated mediation index				
	Index	SE	LLCI	ULCI
Gender	.21	.08	.14	.22

Note: Bootstrap N = 5000. Effect: average estimate for the indirect effect from the bootstrap samples. Index: Moderated Mediation Index. SE: standard error estimate. LLCI = lower limit of the 95% confidence interval. ULCI = Upper limit of the 95% confidence interval.

Figure 1. Conceptual diagram of relationships between variables of interest



POST