Self-confidence and flow in judo

Authors' Contribution:

✍ **A** Study Design
📁 **B** Data Collection
📈 **C** Statistical Analysis
📄 **D** Manuscript Preparation
📚 **E** Funds Collection

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Abstract

Background & Study Aim: One of the issues that has aroused most interest in sports competition is how a sports person attains flow state to be able to perform at the highest level. However, there are few studies that have analyzed the precursor variables of this state in elite judokas. This study aims to propose and test a theoretical model based on the hierarchical model of intrinsic and extrinsic motivation so as to find out some of the precursors of flow state.

Material & Methods: One hundred twenty eight elite Spanish judokas completed questionnaires referring to basic psychological needs (BPN: autonomy, competence and social relations), self-determined motivation, pre-competition self-confidence and flow state in competition.

Results: The structural equation analysis revealed that satisfaction of the needs – competence and relation – predicted self-determined motivation, which in turn predicted pre-competition self-confidence which itself acted as a flow state precursor.

Conclusions: The results are in line with the self-determination theory, and show pre-competition self-confidence as an important determining factor for judokas to reach an optimum psychological state during competition.

Keywords: combat sports, pre-competition, psychological needs; self-determined-motivation, self-determination theory

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Uchi mata – throwing technique in judo (**thigh throw**)

Harai goshi– throwing technique in judo (**hip sweep**)

Tori and Uke – tori, the person who applies a technique in *judo* training. The receiver of the technique is refered to as **uke** [72].

INTRODUCTION

Several studies have analyzed the importance of psychological variables in sports performance, and flow state is the one that has aroused the most interest. It is known as the optimum psychological state for attaining a better sports performance [1, 2]. Csikszentmihalyi [3, 4] defined it as being made up of nine dimensions: challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task at hand, sense of control, loss of self-consciousness, transformation of time and autotelic experience.

At present, questions are being asked as to whether all these dimensions make up flow state, or whether, to the contrary, some of them could be pre-conditions to be able to achieve it, while others could be a consequence of this state. In this line, some authors [5] understand that "challenge-skill balance", "clear goals" and "unambiguous feedback" are antecedents of flow. The first of these three dimensions is related to sports people's belief that they are prepared for the situation they are going to face, which is the definition of self-confidence [6, 7]. Some authors consider self-confidence as a dimension of anxiety state with positive connotations [8-10].

Within the theories that are concerned about explaining the relation between anxiety and performance, the Multidimensional Anxiety Theory MAT; [10, 11] understands that self-confidence has a positive lineal relation with anxiety. In spite of this, results from a study of senior Turkish judokas [12] do not reveal any significant relations between judokas' self-confidence before competing and their prior ranking.

On the other hand, in a study of young female rhythmic gymnasts Tsopani et al. [7] show that self-confidence positively predicted performance during a competition. Another point out the positive effects that self-confidence presents in sports people's performance because of its mediator effect on anxiety [13]. In this line, López Torres et al. [6] made a study of elite Spanish swimmers; through interviews and a retrospective methodology they concluded that high levels of self-confidence coincided with participants' best success experiences and controlled the effects of anxiety, leading them to achieve flow state. It seems logical that many researchers concerned about sports performance have looked into the antecedents of flow state [14-16] and have found that motivational aspects play a key role in its appearance [17].

In the last thirty years, the motivational theory that best explains the behavior of human beings through their motivations is the SDT [18-21] based on which Vallerand [1] created his Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM). The SDT considers people as active organisms who interact with the environment that surrounds them (social factors) in order to satisfy their three basic psychological needs (BNP; autonomy, competence and relations with others). According to this theory, the greater the ability to make decisions and the more skilful and better related judokas are, the more self-determined their motivation will be; which would lead to more adaptive consequences on an affective, cognitive and behavioral level.

The most self-determined motivation is intrinsic, in which case the reasons for practicing are inherent in the activity itself, such as learning, improvement and enjoyment. When the reasons for practicing are external to the activity itself, they belong to extrinsic motivation, which includes different regulations; from the most self-determined to the least self-determined, they are: integrated, identified, introjected and external regulations. Finally, demotivation occurs when judokas do not find reasons to practice.

Vallerand [1] understands that these motivations are produced on three hierarchical levels where relations are established between the one immediately above or below; these are: situational (belonging to a precise moment), contextual (belonging to certain contexts like academic, work, sports, etc.) and global (which refers to personality traits). It is true that studies of high performance sports people in the context of SDT are scarce, which is probably because researchers have no access to this type of population. Nevertheless, the theory has proven to function well in the sports context in general [22, 23] and specifically in high performance sports [24-26]. A study of elite Ukrainian judokas, although outside the theoretical framework which SDT presents, has shown that high motivations towards achieving success and towards avoiding failure lead to more adaptive psycho-physiological states for performance [27].

Given the interest in flow state that has arisen among sports people, trainers and psychologists in the context of high performance [14, 28-30], the role that motivational aspects seem to play in its appearance [17], and considering that some authors have indicated that self-confidence is an essential quality in high performance sports people [31], this study aims to test an SDT based model in order to see whether BPN, self-determined motivation and pre-competition self-confidence present relations which may explain to a certain extent the appearance of flow in competition. On the basis of the SDT principles, BPN is expected to positively predict self-determined motivation, as occurred in previous studies [32-34] in the context of high performance sport HPS, and this will predict pre-competition self-confidence, considered an adaptive consequence according to the HMIEM proposal of contextual motivational effects on situational variables.

We expect that a BPN could present direct relations with pre-competition self-confidence on the basis of other studies where this has occurred with other consequences of an adaptive nature [35]. Finally, self-confidence prior to the competition is expected to positively predict flow state experienced by judokas during the competition, appearing as an antecedent of this optimum psychological state.

This study aims to propose and test a theoretical model based on the hierarchical model of intrinsic and extrinsic motivation so as to find out some of the precursors of flow state.

MATERIAL AND METHODS

Participants

The sample for this study was made up of 128 Spanish judokas (68 boys and 60 girls) from the Spanish national team with an international level, and aged between 12 and 35 (mean = 17.05 ±5.01). Local bioethics committee has given consent to the study.

Procedure

Participation was voluntary and all the judokas were informed about the aims of the study and about how to complete the questionnaires correctly. Those older than 18 signed the informed consent themselves, while minors were authorized to participate by their parents or tutors. The "Real Federación Española de Judo y Deportes Asociados" (RFEJYDA) (The Royal Federation of Judo and Associated Sports) also collaborated, permitting judokas from the senior, sub 23, junior, cadet and juvenile national team to be measured.

The study design required each participant to complete the measures concerning their BPN and contextual motivation fifteen days before competing in what for them was an important competition. Some hours before the start of the competition, pre-competition self-confidence was measured, and just after finishing it, they completed a questionnaire about the *flow* state they experienced during the tournament.

Each judoka participating in the study took part in one of the following competitions: Senior World Cup of Austria and Hungary 2007, qualifying tournament for the Olympic Games Beijing 2008, juvenile and cadet European Championship 2007 and sub 23 International Tournament of Alicante 2007.

Measure of basic psychological needs

The Spanish translation [36] of the Basic Psychological Needs in Exercise Scale (BPNES) by [37] was used. The inventory consists of 12 items grouped into three dimensions (four items per dimension): autonomy (e.g. *"when I train, I can contribute the things I consider important to my judo according to my criteria"*), competence (e.g. *"I think I am good at judo")* and relations with others (*e.g. " the club judokas get on well with each other").* The preceding sentence is "*At judo training ....."*. The answers are scored on a Likert scale from 1 (totally disagree) to 5 (totally agree). Past research showed the factorial scale of the BNPS and presented adequate levels of internal consistency for the three factors that make it up. The internal consistency analysis in this study showed satisfactory results for competence ($\alpha = 0.70$) and relations ($\alpha = 0.76$). However, the autonomy factor ($\alpha = 0.45$) did not reach the required minimum level of 0.70 [38] which indicates that it did not measure correctly and was therefore eliminated from subsequent analyses.

Measure of contextual motivation

Sport people's motivation towards judo was evaluated using the Spanish version of the Sport Motivation Scale (SMS), translated and adapted to Spanish from the English version [39]. It was translated [40] in a study where seven factors and good reliability were validated, with Cronbach alphas of between 0.70 and 0.80. It uses a Likert scale with response ranging from 1 (totally disagree) to 5 (totally agree) and the preceding sentence is: "*I take part and make an effort to practice my sport ....".* The instrument is made up of 28 items divided into 7 factors, with 4 items per factor. Out of these 7 factors, three correspond to intrinsic motivation, three correspond to extrinsic motivation (identified, introjected and external motivation) and a last factor corresponds to demotivation. The seven factors can be combined in a composite index of self-determined motivation [e.g. 1, 41] called the self-determination index (SDI).

This index reflects the degree to which motivation is more or less self-determined. To calculate it, the average of the scores for intrinsic motivation items was multiplied by +2, the average of the scores for identified regulation was multiplied by +1, the average for the items of introjected regulations and the average for external regulations were added together, multiplied by 1 and divided by two, and the average for the items corresponding to demotivation was multiplied by 2.

All products obtained were added up to calculate the final score for the SDI. Consequently, high scores in this index reflect a more self-determined motivation. Previous research confirmed the factorial structure of the Sport Motivation Scale and showed adequate internal consistency values, and satisfactory test-retest reliability and construct validity [42].

The internal consistency analysis for the seven subscales in this research was satisfactory: intrinsic motivation towards knowledge ($\alpha = 0.83$), intrinsic motivation towards stimulation ($\alpha = 0.80$), intrinsic motivation towards execution ($\alpha = 0.85$), identified regulation ($\alpha = 0.73$), introjected regulation ($\alpha = 0.71$), external regulation ($\alpha = 0.73$) and demotivation ($\alpha = 0.60$). Although the value for demotivation is below 0.70, it can be considered as acceptable

in accordance with Loewenthal [43] who indicates that values of between 0.50 and 0.60 are valid for factors of 4 or fewer items.

Measure of pre-competition self-confidence

The intensity dimension of the Competitive State Anxiety Inventory-2 [10] was used, which was validated to the Spanish context [44, 45]. It consists of five items (e.g. "I am sure I can face the challenge"), preceded by the phrase "How do you feel before the competition?". Each item is answered on a Likert scale which goes from 1 (not at all) to 4 (a lot). Internal consistency for our study was 0.73.

Measure of flow state

The Spanish version of the Flow State Scale [30] was used. In our study, we have used the translation [46] which showed adequate validity and reliability with a sample of more than 2000 sports people. Similar results were found in adaptation studies of this instrument in other languages [47, 48]. It is an inventory where answers are given on a Likert scale from 1 (totally disagree) and 5 (totally agree) and the preceding sentence is, "think about how you felt in the competition which you just took part in and answer the following questions ...". The inventory consists of 36 items which make up a general second order factor called *flow* state ($\alpha = 0.89$) and nine first order factors: challenge-skill balance ($\alpha = 0.72$), action-awareness merging ($\alpha = 0.70$), clear goals ($\alpha = 0.75$), unambiguous feedback ($\alpha = 0.88$), concentration on task at hand ($\alpha = 0.80$), sense of control ($\alpha = 0.82$), loss of self-consciousness ($\alpha = 0.70$), transformation of time ($\alpha = 0.79$), and autotelic experience ($\alpha = 0.85$).

Data analysis

First, a descriptive and correlational analysis was made of all the variables in the study. Second, the two step method [49] was carried out to verify the relation between the proposed variables. In the first step, the measure model's construct validity was tested by means of a confirmatory factorial analysis (measure model). In the second step, a structural model was used to analyze the predictive relations between the variables analyzed. All the analyses were developed using the statistical software SPSS 19.0 and Amos 19.0.

RESULTS

Descriptive and correlational analysis of all the variables

Positive and moderate correlations were achieved between all the variables studied with the exception of the basic psychological need of relations and pre-competition self-confidence, which did not have a significant relation. The highest correlations occurred between pre-competition self-confidence and *flow* state, followed by those of competence with self-determined motivation, pre-competition self-confidence and *flow* state (Table 1).

Measure Model

In order to be able to carry out the measure model analysis and to test the structural equation model (SEM), the number of observable variables per factor was reduced; this is especially advisable when the sample size is not particularly large compared with the number of variables of the model [50]. This reduction can be achieved by putting the items into pairs. So, half of the first items from each sub-scale were averaged to form the first block of items, and the second half were averaged to form the second block of items, and so on until the last one. Marsh et al. [50] proposed the use of item pairs because their results are more reliable, they tend to be distributed more normally, and the ratio of the number of measured variables in the model and the number of participants required for the model is halved.

Since the Mardia coefficient was high (39.30), the maximum verisimilitude method was used along with the bootstrapping procedure, which allowed data to be

Table 1. Averages (M), SD and correlations of all variables.

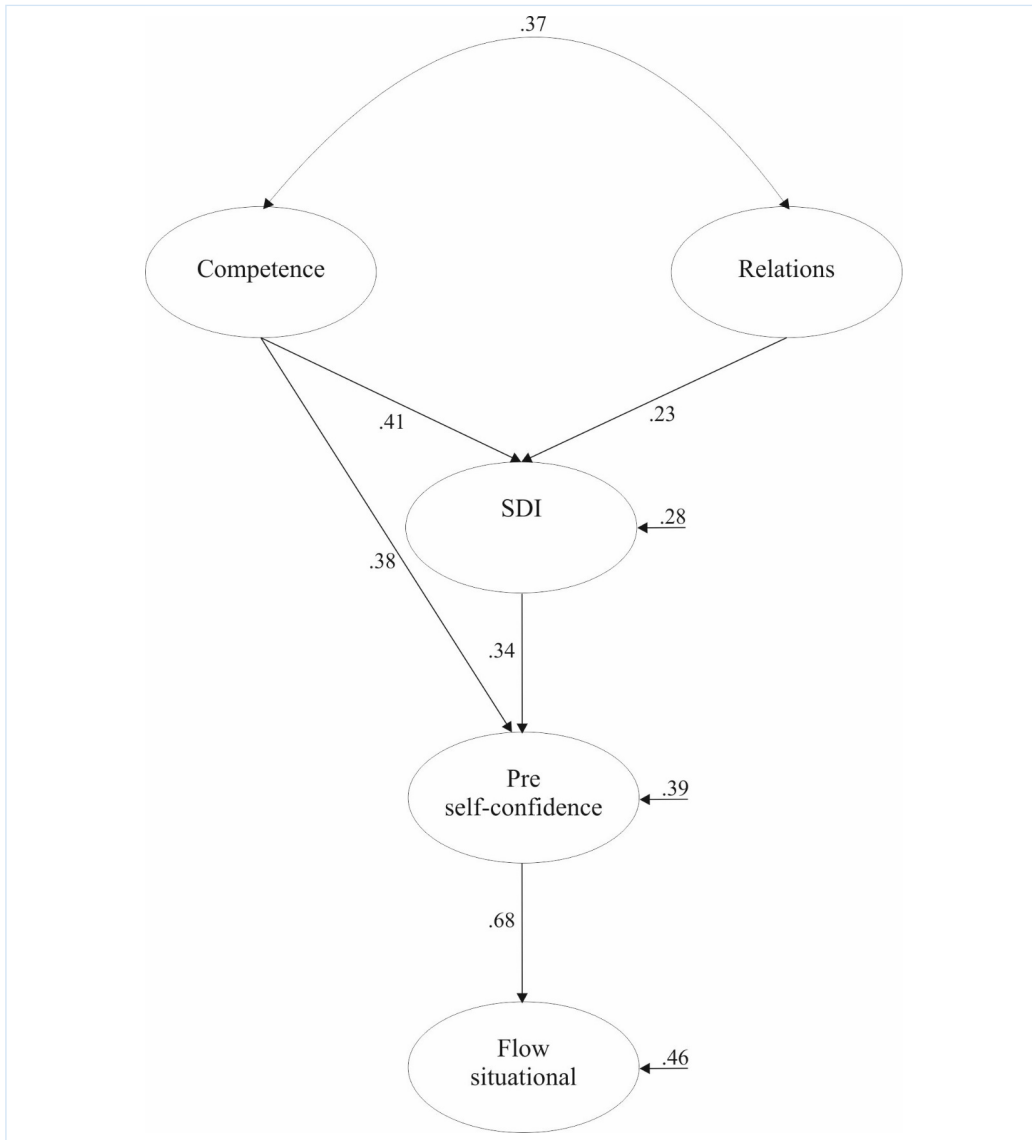| Variables	M	SD	1	2	3	4
1. Competence	3.68	.64				
2. Relations	4.48	.59	**.368****			
3. SDI	5.16	2.27	**.397****	**.328****		
4. Pre. Self-confidence.	3.15	.57	**.396****	.089	**.379****	
5. *Flow* State	3.31	.51	**.396****	.089	.338**	**.533****

** p<0.01

Figure 1. Results of Structural Equation Model

assumed as robust in the presence of the lack of normality [51]. Likewise, a series of fit coefficients was considered to evaluate the measure models' goodness of fit with the empirical data. Therefore, based on the contributions by different authors [52-55], the fit indices or goodness of fit indices that are considered for evaluating the measure model were: χ^2, χ^2/d.f., RMSEA (Root Mean Square Error of Approximation), SRMR (Standardized Root Mean Square Residual) and the incremental indices (CFI, IFI and TLI).

The goodness of fit indices are considered acceptable when the χ^2/d.f. is lower than 3 [56], the incremental indices (CFI, IFI and TLI) are higher than 0.95 and the error indices (RMSEA and SRMR)

are lower than 0.06 and 0.08 respectively [57]. The indices obtained after the analysis were: χ^2 = 98.72, p<0.001; χ^2/d.f. = 1.05; CFI = 0.99; IFI = 0.99; TLI = 0.99; RMSEA = 0.02; SRMR = 0.05. The discriminant validity of the model was also examined, respecting that the correlation between latent variables, attenuated by the measurement error (+/– 2 times the measurement error), was lower than 1.0. Therefore, according to the previous indications, the results showed that the measure model was adequate.

Structural equations model

The Structural Equation Model was used to analyze the relations between the variables belonging to the proposed model (competence, social relations,

self-determined motivation, pre-competition self-confidence and *flow* state). As the Mardia coefficient was high (39.30), the maximum verisimilitude method along with the bootstrapping procedure was used, which allowed data to be assumed as robust in the presence of the lack of normality [51]. The examination of the goodness of the model showed the following fit indices: χ^2 = 105.49, p<.001, χ^2/d.f. = 1.07, CFI = 0.99, IFI = 0.99, TLI = 0.99, RMSEA = 0.02, SRMR = 0.06. These data are adjusted to the established parameters, so we can accept the proposed model as adequate [56]. Likewise, the contribution of each factor to the prediction of other variables was examined through standardized regression weights. The "t" value associated to each weight was taken as a measure of contribution, so values higher than 1.96 are considered as significant.

Competence and social relations are observed to positively predict self-determined motivation (both explained 28% of the variance), which in turn positively predicted pre-competition self-confidence (Figure 1). Competence also positively predicted pre-competition self-confidence, which together with self-determined motivation explained 39% of its variance. Finally, the model shows that pre-competition self-confidence predicted *flow* state (explaining 46% of variance).

DISCUSSION
In studies was to tested a model where BPN would predict self-determined motivation towards doing judo, which would act as a predictor of pre-competition self-confidence in judokas, which in turn would predict *flow* state in competition. Furthermore, within the model tested, a BPN was expected to present direct relations with pre-competition self-confidence. The results obtained support this hypothesis, demonstrating that the model has an acceptable fit, with the practical implications that this leads to.

These results partially support the SDT hypotheses and confirm that the satisfaction of the needs – competence and social relations - is associated with self-determined motivation on a contextual level, as occurred in previous studies in the amateur sports context [58, 59], in high performance sports people [32, 33] and in Spanish competitive judokas [60]. However, when we carried out the psychometric analysis of the instruments in order to test how adequate they are in our study, the autonomy need did not reach the minimal acceptable values of reliability,

indicating that the instrument used did not correctly measure this factor. For this reason, this basic psychological need could not be included in the final model. Some previous studies have already questioned the use of this scale for measuring Spanish sports people [36, 61] so we suggest that research should be continued in order to design an instrument which would present better psychometric properties to measure the BPN in a Spanish sports context.

On the other hand, self-determined motivation positively predicted pre-competition self-confidence, as we hypothesized, and was in line with the HMIEM and its proposal of interaction between contextual and situational level. Therefore, self-determined motivation towards doing judo would lead to sports people experiencing greater self-confidence some hours before the competition, with the positive connotations that this has for performance [7, 62].

According to these results, it would seem apt to encourage trainers to use strategies which facilitate the achievement of this type of motivation in high level sports people, so that they can face the competition with the sense that they are prepared for surpassing the challenge. In this line, it seems that by facilitating flexible situations where sports people can feel that they are able to give their opinion and what they say is taken into account [26, 63], where positive feedback is given [64], and where trainers are affective or promote personal improvement as a criterion of success [65] have resulted in useful strategies for satisfying BPN and achieving self-determined motivations in competitive sports people.

Furthermore, a BPN was expected to directly predict self-confidence, and in this case it is competence. This finding seems logical if we understand that feeling competent should lead to sports people believing they are prepared for surpassing the challenges they are faced with. In this line, it would be recommendable for trainers to put some strategies into practice in order to contribute to this perception of sports people's competence, such as: correctly planning goals in order to correctly adjust the judoka's level to what is expected of him, such as designing learning stages, so that judokas can reach complex goals through the achievement of partial goals.

For example, to learn throwing techniques on one foot while balancing the other, such as *uchi mata* or *harai goshi*, can be very complex if similar situations are not worked first where judokas control unipodal

balance. In this direction, it can also be useful to first work on techniques in situations of maximum collaboration with the *uke* (companion) and to progressively move on to try these techniques with rivals of a lower weight or level, to finally put them into practice with rivals of a higher level. Furthermore, trainers should give technical feedback after judokas perform, pay attention to the aspect they did well in to later correct what they aim to improve, finish with encouraging words before trying again, provide them with the feeling that they are progressing in the right direction and enable them to perceive that they are competent at what they do.

Taking into account that self-confidence and *flow* have monopolized the attention of many researchers concerned with explaining the keys that lead towards sports performance [13, 66], it was finally hypothesized that pre-competition self-confidence could be a possible antecedent of *flow*. Since one of the main characteristics of this construct is that the task represents a challenge which sports people should feel they are prepared for [5, 67], it seemed logical that self-confidence prior to the competition could mean a good trigger, as confirmed in our study. In view of these results, we believe trainers could also apply strategies so that sports people will feel more confident when facing the competition and in such a way that they can reach the desired *flow* state during the competition. In this line, Hatzigeorgiadis et al. [13] carried out an experimental study on 72 tennis players, where sports people underwent three weekly training sessions in order to acquire the skill of self-instruction.

The results showed that this type of training increased the tennis players' self-confidence significantly. Another type of strategy, for the days prior to the competition, such as visualization or stress coping strategies by focusing attention on the aspects which can be controlled, has been proven to be very useful in previous studies with sports people from different levels and different types of sports [68-70], and could help increase pre-competition self-confidence. So, by making a study of rivals through videos, spotting their special techniques, the pre-indices that usually give away the moment they are going to do and work technical-tactical sequences based on this previous study and where sports people train for the situations that will be reproduced before different opponents will make judokas feel that they have resources to solve the problems that arise during combat in the moments before the competition.

In view of these results, pre-competition self-confidence is shown as a precursor to the flow state experienced by judokas in the competition. These findings will feed the debate about whether the nine dimensions that make up flow, according to Csiksenmihalyi [3, 71] in the first instance, totally represent this optimum psychological state, or to the contrary some are precursors and others are consequences. Csikszentmihalyi et al. [5] establish challenge-skill balance, clear goals and unambiguous feedback as pre-conditions of flow. In this line, we provide a proposal where we agree with this assertion, but also understand that "transformation of time" and "autotelic experience" could be consequences. The latter could borderline between being considered a consequence or a characteristic of flow, since it can be understood that being in a flow state leads the sports person towards enjoyment, but we can also think that a sports person finds himself in a state of flow, among other things, because he is enjoying himself. Therefore, on the basis of our proposal, the only remaining dimensions belonging to flow would be action-awareness merging, concentration on task at hand, sense of control, loss of self-consciousness, transformation of time and possibly autotelic experience.

It would be of interest to carry out future research to find instruments with better psychometric properties in order to measure the BPN in Spanish sports people. Furthermore, for those who are familiar with the theoretical framework proposed by the SDT, it would be useful for future research to include the measure of a social variable, such as peer or trainer environment so as to see the effect it causes on satisfaction of BPN and self-determined motivation, where the effect of pre-competition self-confidence could also be confirmed as a trigger of *flow* state in judokas in national teams from other countries. Finally, we believe it appropriate for experimental studies to be carried out to demonstrate the positive effect of some of the strategies that have been suggested in order to promote the perception of competence or self-confidence.

CONCLUSIONS

the results are in line with the self-determination theory (SDT), and present pre-competition self-confidence as an important determiner for judokas to reach an optimum psychological state during the competition.

HIGHLIGHTS

In spite of its limitations, this study presents information which is relevant for sports professionals interested in finding out the keys that lead judokas to experience flow, reflecting the importance of their feeling confident in the face of competition. Besides, it provides new information about including pre-competition self-confidence as a motivational consequence in the context of high sports performance and within the framework that SDT provides.

COMPETING INTERESTS

Authors declare no conflicts of interest.

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