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Self-determined motivation and types of sportive cooperation among players on competitive teams

A Bayesian network analysis

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The aim of this study was to analyse the relationship between levels of self-determined motivation and the factors of sportive cooperation in young sports players. 270 athletes belonging to official competitive teams were studied, from the Balearic Islands, Spain (M = 14.6; Range = 11–18; SD = 1.53). To this end, we used the Behavioral Regulation in Sport Questionnaire and the Cuestionario de Cooperación Deportiva. The relationships of probabilistic dependence and independence of the six variables studied were established using a validated Bayesian network. Afterward, hypothetical probability values of the variables of cooperation were instantiated to observe changes in the probabilities in levels of self-determination. The results indicate that unconditional cooperation and extrinsic motivation are the most probabilistically independent variables, with intrinsic motivation being directly dependent on the other two. Conditional cooperation and amotivation have the lowest probability values in the athletes studied. The main conclusion is that cooperation and extrinsic motivation are the two roots of team dynamics, as unrelated variables. Coaches should take advice on that fact regarding their coaching style.

KEY WORDS: Self-determination, Cooperation, Bayesian Networks, Bayesian Probabilities, Youth Sports.

Introduction

Will a competitive sports team have greater willingness to engage in cooperation and prosocial conduct when their self-determined motivation is greater, or will it produce the opposite effect? This research question is

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becoming more relevant every day considering the inevitable tension between the individualistic behaviours of players and the obvious demands for teamwork that most coaches make on players during training and competition, including their self-determined motivation not addressed exclusively to the "win" or to obtain a certain performance by the team.

The conceptual framework of sportive cooperation is based on the concept of public goods (Deng & Chu, 2011; Deustch, 1949; Suri & Watts, 2011) and in the resolution of situations similar to those given in the Prisoner's Dilemma (Poundstone, 1995; Wu, Fu, & Wang, 2011). This construct, which is completely distinct from sportive cohesion (Carron, Colman, Wheeler & Stevens, 2002) is one of the tools to explain the internal dynamic of competitive sports teams (Olmedilla, Ortega, Almeida, Lameiras, Villalonga, Sousa, Torregrosa, Cruz, & García-Mas, 2011), based primarily in the seek for personal and/or team goals, for the production of sporting behaviors. Also, can be understood as a form of prosocial behaviour that reflects the player's individual decisions concerning the dedication of his or her efforts and technical skills to the team's objective (Vukov, Santos & Pacheco, 2011), and that in a certain manner also reflects his or her own interests (Caporael, Dawes, Orbell, & Van de Kragt, 1989; Liu, Chen, Zhang, Wang, & Perc, 2012). From this point of view, and through the use of the *Cuestionario de Cooperación Deportiva* (*Sportive Cooperation Questionnaire*, García-Mas, Olmedilla, Morilla, Rivas, García-Quinteiro, & Ortega, 2006), players can show unconditional cooperation, indicating their need to behave prosocially with their teammates and/or coach, as a stable tendency (Meglino & Korsgaard, 2004); conditional cooperation, based on the current or future obtainment of their objectives; and situational cooperation, based on the characteristics of the given sports situation.

Recently the lack of relations between unconditional and conditional cooperation has been demonstrated, since they are presented as two distinct factors, while situational cooperation acts as a modulating parameter of the other two (Olmedilla et al., 2011). Actually, the level and types of cooperation among team members helps explain sports behaviours such as the acceptance of the use of tricks and ruses in the game (Ponseti, Palou, Borras, Vidal, Cantallops, Ortega, Boixadós, Sousa, García-Calvo, & García-Mas, 2012), the existence of a particular level of cohesion in a team (Garcia-Mas, Olmedilla, Ortega, Almeida, Lameiras, Sousa, & Cruz, 2009; Olmedilla et al., 2011), the levels of collective effectiveness in relation to the performance of a team (Leo, Sánchez-Miguel, Sánchez-Oliva, Amado, & García-Calvo, 2011), the perceived team's leadership style (Almeida, Lameiras, & Garcia-Mas, in press) and the overall performance levels of sports teams (González & Ortín, 2010).

From both the theoretical framework and the empirical discoveries made until now, we may deduce that there should exist some more or less direct relationship between cooperation and the motivational aspects of sports conduct. However, thus far, only the relation between cooperation and motivation of achievement, that is, with the orientation to the ego or to the players' task, has been investigated (Lameiras, Almeida, & Garcia-Mas, 2014). Findings from these studies obtained show hierarchical relationships between dispositions towards goals and the other types of cooperation, without any direct relationship being given between the orientation to the players' tasks and the style of unconditional cooperation. The implications of the complex relationships that have been found between the disposition towards goals and the style of cooperation of the players indicates that they can be treated as two relatively independent psychological processes and that they deserve to be studied deeply.

Currently, however, the Theory of Self-Determined Motivation (Deci & Ryan, 2000; Vallerand, 1997) is crucial to understanding the behaviours of athletes, such as, for example, their cohesion in the team and their psychological well-being during the competition (Blanchard, Amiot, Perreault, Vallerand, & Provencher, 2009), as well as the concept of fair play (Chantal, Robin, Vernat, & Bernache-Asollant, 2005). Given that the level of self-determination in a sport is directly related to satisfaction, as are autonomy in decisions, the involvement in the sport and the perception of competence (Reinboth & Duda, 2006), there may theoretically exist relations with the concept of cooperation, understood as prosocial conduct expressed—in this case—in the competitive sports situation (Mitkidis, Sørensen, Nielbo, Andersen, & Lienard, 2013).

Indeed, after observe the relationships, but also if we observe the constants among amotivation, extrinsic motivation, and intrinsic motivation, that we can ask ourselves which of these motivational states is found in relation to willingness to cooperate prosocially in the team with teammates and with the coach. The intuitive suppositions that intrinsic—or internalized—motivation could determine the existence of unconditional cooperation, and that extrinsic motivation, or that governed by factors external to the athlete, could determine conditional cooperation, or even situational cooperation, must be put to the test in a more direct form.

To this end, in this study we have used probabilistic analysis using a Bayesian network (BN), primarily due to the isomorphism between the possible structure of the psychological variables studied, in addition to the form of probabilistic representation that BNs offer. BNs (Jensen & Nielsen, 2007; Pearl, 2000) constitute a powerful tool for modelling the

decision making process under a particular level of uncertainty. These networks can be considered at the intersection between artificial intelligence, statistics, and probability theory (Pearl, 2000), and seem to be a powerful tool in problems involving data mining (Heckerman, 1997). Bayesian networks are a kind of probabilistic graphical model (Larrañaga & Moral, 2011) that combines graph theory and probability theory to represent uncertainty among observed variables. In a probabilistic model of acyclic directed graphs, the nodes are the variables and the arcs the relations of dependence/independence between them, while the general structure may represent the causal relationships and the general aspects of all the probabilistic distributions of the factors considered (Glymour, 2003).

Bayesian networks can be used in the field of psychology as a tool to discover structure and date analysis from a data set (Lopez-Puga, Garcia, de la Fuente, & de la Fuente, 2007), they are codified as an expert system. This can be constructed directly from the data set, although it is also possible to add knowledge from prior expert knowledge during the learning process of the structure. In this field, they have been shown to be effective with regard to the Item Response Theory (Mislevy, 1986), in psychodiagnosis, and in forensic psychology, but above all in the analysis of decision making in organizational and consumer psychology, as well as in current so-called neuroeconomics (Lafuente & Romo, 2003), or the analysis of learning in conditions of uncertainty (Butz, Hua, Chen, & Yao, 2009). Recently, they have also begun to be applied in sports psychology (Fuster, Garcia-Mas, Ponseti, & Leo, 2015; Fuster, Garcia-Mas, Palou, Ponseti, & Cruz, 2013; Garcia-Mas, Fuster, Palou, Ponseti, & Cantallops, 2012). In all these cases, BNs allow the representation of the underlying structure to a data set, constructing a probabilistic graphical model starting from a data set that contains a set of observations about diverse variables. This makes them very useful for working on data obtained by means of psychometrical tests or direct observation (Lopez-Puga et al., 2007).

Objective of the study

As stated earlier, the objective of this study was to investigate the relationships that exist between self-determined motivation—as grouped in three general types of motivation with distinct characteristics, namely, amotivation, extrinsic motivation, and intrinsic motivation—and sportive cooperation (unconditional cooperation, conditional cooperation, and sit-

uational cooperation), in a large group of team sports players and through the probabilistic use of BNs. As a secondary objective, we intend to demonstrate the utility and statistical validation of the BNs to perform this type of analysis between empirically obtained diverse psychological variables.

Methods

Participants

This study's participants consisted of 270 athletes (244 boys and 26 girls) belonging to regular competitive teams affiliated to the Balearic Islands, of whom 165 played football, 83 basketball, and 22 handball. The average age was 14.67 years (Range = 11–18 years; *SD* = 1.53). Each participant signed an informed consent, ensuring confidentiality of data in the same way that met the principles of the Declaration of Helsinki and its subsequent revisions to human studies.

Measures

Self-determined motivation. In order to evaluate the level of self-determination in our participants, we used the Spanish adaptation (Viladrich, Torregrosa, & Cruz, 2011) of the *Behavioural Regulation in Sport Questionnaire* (BRSQ, by Lonsdale, Hodge & Rose, 2008). The Spanish version of the BRSQ consists of 24 items and has three subscales: intrinsic motivation, extrinsic motivation, and amotivation. Each item is graded on a 7-point Likert scale ranging from 1: "Completely false" to 7: "Completely true".

Sportive cooperation. For the evaluation of sportive cooperation, we used the *Cuestionario de Cooperación Deportiva* by Garcia-Mas, et al. (2006), which consists of 15 Likert-scale questions, where 1 signifies "Completely disagree" and 7 signifies "Completely agree". The questionnaire covers three factors: two dispositional factors, conditional cooperation and unconditional cooperation, which make reference to the type of personal tendency towards cooperating or not, and one situational factor, referring to the environmental stimuli to cooperate or not.

Procedure

After obtaining permission from the clubs and coaches of the selected teams, we obtained the consent of the parents of the athletes so that their children could participate in the study. The administration of the questionnaires was done in the middle of the season. The collection of the data lasted between 25 and 30 minutes. All the players studied participated voluntarily, and one of the researchers was always present during the administration to resolve possible issues regarding the questions and how to answer them.

Analysis Of The Data

To construct a BN, we used learning algorithms to generate a structure based on observed data (Antal, Fannes, Timmerman, Moreau, & De Moor, 2004; Cheng, Greiner, Kelly, Bell, & Liu, 2002; Lemeire, 2007). The structure was generated using Tetrad IV software (Glymour, Scheines, Spirtes, & Kelly, 1986; Scheines, Spirtes, Glymour, Meek, & Richardson, 1998), and we used the GES algorithm (*Greedy Search*, Chickering, 1996) integrated into Tetrad IV to obtain a possible graph with all the variables of the study. Tetrad IV obtains the structure using a chi square test that assumes that the maximum likelihood function of the measured variables has been maximized. The null hypothesis for the test is that the covariance matrix of the population on the measured variables is equal to the estimated covariance matrix of the measured variables written as a function of a free parameter model.

To obtain the parameters, we used Tetrad IV to make an estimation of a Bayesian model using a Dirichlet distribution for every variable. Using a pseudo-count, Tetrad IV determines a conditional probability distribution for every variable. In order to obtain a clear representation to see how inference flows in the whole set of variables, from the structure and parameters obtained in Tetrad IV the BN was implemented in Netica (Norsys Software Corporation, 2012). The program Netica carries out the computation and the representation of the prior probabilities of the variables, which are shown in percentages divided into three groups of probabilities: high (66-100%), moderate (33-66%) and low (0-33%). Once instantiated, by using Netica we can represent hypothetical values of the probabilities for any variable of the BN (Cobb & Shenoy, 2006).

Results

Validation Of The Bayesian Network

From the data set, the program Tetrad IV estimates the values of the variables in every case, which must be validated. First, the Receiving Operating Characteristics (ROCs, or graphic curves of sensitivity) are obtained, by plotting the fraction of true positives out of the actual positives versus the fraction of false positives out of the total actual negatives, at various threshold settings, using them as indicators of how well the BN fits. The value of the Area Under Curve ROC (AUC) is defined as the probability of correctly classifying a pair of cases (positive and negative) selected at random. In Table 1, you can see the AUC values associated with high, moderate, and low probabilities of every one of the variables studied, together with the percentage correctly classified (pcc). We observe that the probabilities have appropriate values, as well as pcc indicators that ensure that the BN obtained has an efficient system of predictions about the relationships of the variables studied.

TABLE I
Values Of The Aucs Obtained Through The Roc Curves And Percentage Correctly Classified (Pcc) Of The Variables Of The Bayesian Network.

	AUC Probability			
Variable	**Low**	**Moderate**	**High**	***pcc***
Intrinsic motivation (motint)	.82	.76	.85	79.26
Extrinsic motivation (motex)	.61	.61	.76	64.44
Amotivation (amot)	.90	.80	.79	87.04
Unconditional Cooperation (coopeuncond)	.73	.70	.77	65.92
Conditional cooperation (coopecond)	.62	.64	.72	76.30
Situational Cooperation (coopsitu)	.71	.69	.87	68.58

Note: Extrinsic motivation: motex; Intrinsic motivation: motint; Amotivation: amot; Unconditional cooperation: coopeuncond; Conditional cooperation: coopecond; Situational cooperation: coopsitu.

BAYESIAN NETWORK

The BN obtained, which can be observed in Figure 1, reveals that the variables that are probabilistically independent are unconditional cooperation and extrinsic motivation. The probability values obtained in the athletes analysed for these two variables are moderate in both cases, without extreme values.

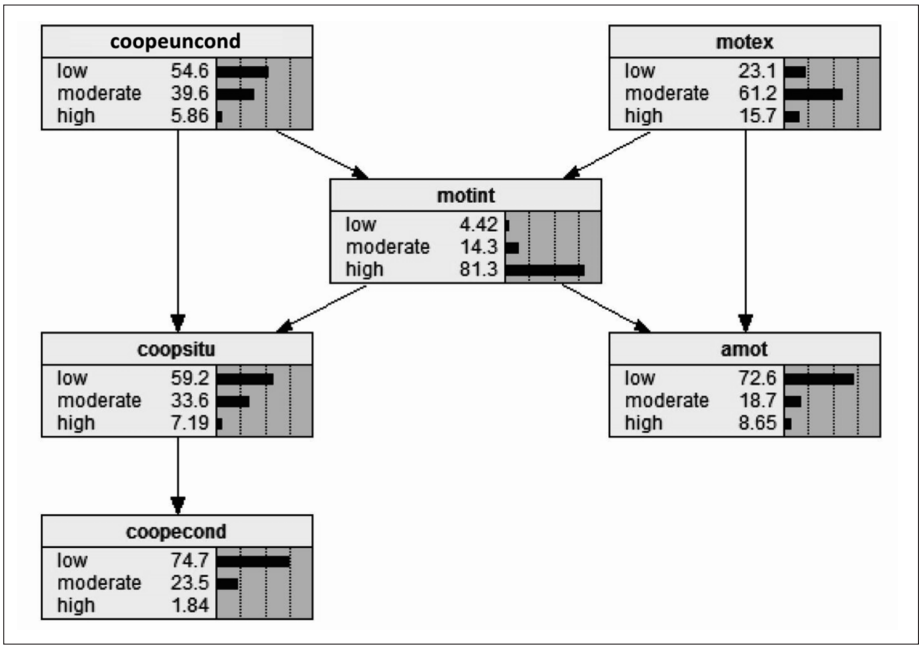

Fig. 1. - The obtained Bayesian network showing the probabilistic relations between self-determined motivation and sportive cooperation.

These two independent variables act on the rest in a distinct manner. Both participate equally in the probability of occurrence of intrinsic motivation, which is the motivational variable with higher values in the athletes studied. Moreover, intrinsic and extrinsic motivation have a shared influence over the probability of the occurrence of amotivation, with very low probability values in the population studied.

And finally, we can also see from Figure 1 how unconditional cooperation and intrinsic motivation have a shared influence over the probability of the occurrence of situational cooperation, with medium-low values in the data considered. This, in turn, has a direct individual impact on conditional cooperation, which is the variable with the greatest probabilistic dependency of all those studied, and which, in addition, is the one that shows real values below probability.

Instantiations

BNs can also be used to perform instantiations; that is, to search for the best explanation, and the most probable one, to explain either observed or hypothetical data. This allows us to study the occurrence of changes in the probabilistic dependencies/independencies by modifying the values of the effects instead of the causes. In our case, using the BN that appears in Figure 1, we have carried out three calculations with hypothetical data (see Table 2).

As can be seen in Table 2, each one of the calculations for the variables of sportive cooperation produces changes in the probabilities of occurrence of the three factors of self-determined motivation.

When we perform the first instantiation of a value below probability for unconditional cooperation, complemented with values of high probability for conditional and situational cooperation, hypothetical changes of relevance are produced. First, intrinsic motivation needs to change to a much lower probability, while it is necessary to increase the probabilities of extrinsic motivation and, to a greater extent, that of amotivation.

In the second instantiation (Table 2, second column) we hypothesize a high probability of unconditional cooperation (prosocial), and at the same time we instantiate low probability values for both conditional and situational cooperation. These changes produce hypothetical results in the variables of motivation in the opposite direction to the previous calculation, albeit in a more contrasted manner. The probability of intrinsic motivation does not increase (in fact, it is slightly reduced), but the probability of extrinsic motivation is reduced drastically, while that of amotivation is also reduced significantly.

TABLE II
Three instantiations of the Bayesian network (1: coopecond=low, coopeuncond=high, coopsitu=high; 2: coopecond=high, coopeuncond=low, coopsitu=low; 3: coopecond=high, coopeuncond=high, coopsitu=high), created with hypothetical data of sportive cooperation and its impact on self-determined motivation, expressed in probabilities.

			Instantiations		
			1	**2**	**3**
	Conditional Coop (coopecond)		low	high	high
	Unconditional Coop(coopeuncond)		high	low	high
	Situational Coop (coopsitu)		high	low	high
Intrinsic	Low:	4.41	9.87	16.60	16.60
Motivation	Moderate:	14.30	82.00	16.60	16.60
(motint)	High:	81.30	8.10	66.70	66.70
Extrinsic	Low:	23.10	12.10	100	100
Motivation	Moderate:	14.30	68.30	0	0
(motex)	High:	15.70	19.60	0	0
Amotivation	Low:	72.60	4.04	33.30	33.30
(amot)	Mod:	18.70	27.70	66.70	66.70
	High:	8.65	68.30	0	0

Note: For variables intrinsic motivation (motint), extrinsic motivation (motex), amotivation (amot) the first column shows the initial likelihood for low, moderate and high values once the BN has been compiled. The second column shows the likelihoods variations corresponding to instantiation 1. The third column shows the likelihoods variations corresponding to instantiation 2. The fourth column shows the likelihoods variations corresponding to instantiation 3.

Finally (as can be observed in the third column of Table 2), when values of high probability for the three types of cooperation are hypothesized at the same time (data never obtained in previous empirical studies), the results obtained for the variables of self-determined motivation are exactly the same as those obtained for the second of the calculations, when the probability of unconditional cooperation is the greatest and the probabilities of conditional and situational cooperation are the least.

Discussion

The results found in a group of players from affiliated teams should be discussed with different levels of explanation. First, if we observe the probabilistic values obtained using a BN, they are very similar to those obtained in similar teams using classical statistics, both in the case of sportive cooperation and its factors, and in the case of the three types of self-determined motivation.

Thus, the teams analysed are composed heterogeneously of a combination of players with the three possible forms of cooperation, namely, unconditional, situational, and conditional, and in proportions similar to other studies, although conditional cooperation—which implies tacit or explicit

negotiation between personal objectives and those of the team—had lower probability values than were found in studies conducted with semiprofessional or professional teams (Garcia-Mas et al., 2006; Lameiras et al., in review; Olmedilla et al, 2011). In this regard, Cratty & Hanin (1980) determined that the teams that obtain better performance are formed by a heterogeneous combination of personalities over other more homogeneous teams. Moreover, it is not bad news to find that there are important values of willingness to carry out prosocial behaviours within teams, not only related to issues such as fair play, but also to strictly sportive conduct related to the tactics proposed by the coaches (Ponseti et al., 2012).

The results with respect to the three factors of self-determination, analysed using their probability of occurrence, also offer results that in some respects replicate those found through traditional statistics. High values of intrinsic motivation, moderate values of extrinsic motivation, and low values of amotivation have been found. These findings are similar to those obtained in previous studies the same collective sport (Leo et al, 2011; Pelletier, Fortier, Vallerand, & Brière, 2001).

However, when we analyse the probabilistic relationships of causal dependence and independence that have been found through the Bayesian network between the two variables analysed, some results appear that do not exactly correspond to those previously found or predicted.

The two variables that have probabilistic independence are unconditional cooperation and extrinsic motivation. The two converge directly on the type of motivation that has higher values of occurrence: intrinsic motivation. Therefore, causally, we find ourselves facing a relatively stable dispositional factor (unconditional or prosocial cooperation), which is combined with a variable regulated by external stimuli (extrinsic motivation) and which, together, generate the occurrence of intrinsic motivation, repeatedly associated with better performance and psychological well-being during competition (Rivas, Romero, Pérez-Llantada, López de la Llave, Pourtau, Molina, González, & Garcia-Mas, 2012; Romero, Zapata, Letelier, López, & Garcia-Mas, 2013).

Additionally, we find that conditional cooperation and amotivation show complete probabilistic dependency, in a similar manner to the direct results of probability of occurrence that have been found. Similar data were obtained when comparing motivational climate with anxiety in young team players also using the BN methodology (Garcia-Mas, Fuster, Ponseti, Palou, Olmedilla, & Cruz, 2015).

In principle, this finding doesn't fit exactly with the hierarchical model of self-determined motivation (Standage, Duda, & Ntoumanis, 2003;

Vallerand, 1997), since amotivation appears as a causal result of other processes, and this fact is not readily apparent form the predictions of the theory (Deci & Ryan, 2000), although it could be understood as the establishment of a sports habit, within the behavioural repertoire of the athlete.

One of the benefits for to use BN is the possibility to instantiate hypothetical values, in other words, simulate changes in the real probabilistic values of the dependant variables to observe if there are changes in the independent, or "top" variables in the network. In this case, the instantiations we have made offers a simple but clear landscape: the probability for to have a high level of non-dispositional and state-dependant cooperation is directly related with the amount of occurrence of amotivation (high) and intrinsic motivation (low). The less internal motivated the athlete are, the more probability to cooperate for to obtain personal aims. Second, when we instantiated the maximum value of the prosocial and unconditional cooperation occurrence (as if the whole team is composed by highly cooperative players), the probability of the intrinsic motivation maintain its values, but extrinsic motivation and amotivation decreases almost to zero their probability to be present in the teamplayers. Thus, hypothetically, when we have to coach a quite homogeneous "prosocial" and cooperative team, should appear difficulties when the coaching style is more related to control and instructions.

From a practical point of view, these findings can be extrapolated towards the consideration of how extrinsic motivation (adjusted from the instructions of the coach, his style of communication, his system of use of reinforcement and punishment, e.g. Sousa, Cruz, Torregrosa, Vilches, & Viladrich, 2006) could help model or parametrize the willingness to cooperate in an unconditional manner. This would help to increase the probability that the motivation becomes internalized and that the players gain the perception of autonomy, as well as indicating how to promote the cooperative conduct most adequate at each moment and adequate in distinct scenarios or people present in the dynamic and changing sports situation (Mitkidis et al, 2013).

Likewise, the fact that conditional cooperation is found in the lowest stage from a probabilistic point of view should make us think that the concept of explicit negotiation and consciousness of objectives between player and coach, for example, is not an exceedingly common event in these players who, though competitive, are found at the pre-professional level. Or it can also happen that we find ourselves in the same situation that occurs with the internalizing of motivation, facing the dilemma of whether it must occur consciously or unconsciously. This is a topic still open to investigation (Levesque, Copeland, & Sutcliffe, 2008) that doubtlessly affects directly and

decisively how to psychologically outline the role of the coach in team sports, including their self-determined motivation not addressed exclusively to the "win" or to obtain a certain performance by the team.

On the other hand, and in regards to future investigations, we have to study the longitudinal development of the cooperation state-dependant styles, according to the season dynamics, and use for that the BN in combination with the multilevel system analysis (Wilson & Huzurbazar, 2006).

REFERENCES

Almeida, P., Lameiras, J., & Garcia-Mas, A. (in press). Coache's perceived leadership style and tendency to cooperate among athletes within competitive Teams. Kinesiology.

Antal, P., Fannes, G., Timmerman, D., Moreau, Y., & De Moor, B. (2004). Using literature and data to learn Bayesian networks as clinical models of ovarian tumors. *Artificial Intelligence in Medicine, 30*, 257-281.

Blanchard, C. M., Amiot, C. E., Perreault, S., Vallerand, R J., & Provencher, P. (2009). Cohesiveness, coach's interpersonal style and psychological needs: Their effects on self-determination and athletes' subjective well-being. *Psychology of Sport and Exercise, 10*, 545-551.

Butz, C. J., Hua, S., Chen, J., & Yao, H. (2009). A simple graphical approach for understanding probabilistic inference in Bayesian networks. *Information Sciences, 179*, 699-716.

Caporael, L. R., Dawes, R. M., Orbell, J. M., & Van de Kragt, A. J. C. (1989). Selfishness examined: Cooperation in the absence of egoistic incentives. *Behavioral and Brain Sciences, 4*, 683-698.

Carron, A. V., Colman, M. M., Wheeler, J., & Stevens, D. (2002). Cohesion and performance in sport: a meta analysis. *Journal of Sport and Exercise Psychology, 24*, 168-187.

Chantal Y., Robin P., Vernat J. P., & Bernache-Asollant, I. (2005). Motivation, sports personship, and athletic aggression: a mediational analysis. *Psychology Sport and Exercise, 6*, 233-249.

Cheng, J., Greiner, R., Kelly, J., Bell, D., & Liu, W. (2002). Learning Bayesian networks from data: an information-theory based approach. *Artificial Intelligence, 137*, 43-90.

Chickering, D. M. (1996). Learning Bayesian networks is NP-complete. In D. Fisher & H. Lenz (Eds.) *Learning from data: artificial intelligence and statistics* (pp. 121-130). Munich: Springer-Verlag.

Cobb, B. R., & Shenoy, P. P. (2006). Operation for inference in continuous Bayesian networks with linear deterministic variables. *International Journal of Approximative Reasoning 42*(1-2), 21-36.

Cratty, B. J., & Hanin, Y. L. (1980). *The athlete in the sport teams: social Psychology guidelines for coaches and athletes*. Denver, CO: Love Publishers.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self determination of behavior. *Psychological Inquiry, 11*, 227-268.

Deng, K., & Chu, T. (2011). Adaptative evolution of cooperation through darwinian dynamics in public goods games. *PLoS One, 6*(10). doi: e25496.

Deustch, M. (1949). A theory of cooperation and competition. *Human Relations, 2*, 129-152.

Fuster-Parra, P., Garcia-Mas, A., Ponseti, F. J., Palou, P., & Cruz, J. (2013). A Bayesian Net-

work to discover relationships between negative features in sport. A case study of teen players. *Quality and Quantity*, *48*, 1473-1491.doi: 10.1007/s11135-013-9848-y

Fuster-Parra, P., García-Mas, A., Ponseti, F. J., & Leo, F. M. (2015). Team performance and collective efficacy in the dynamic psychology of competitive team: A Bayesian network analysis. *Human Movement Science*, *40*, 98-118.

García-Mas, A., Olmedilla, A., Morilla, M., Rivas, C., García-Quinteiro, E., & Ortega, E. (2006). Un nuevo modelo de cooperación deportiva y su evaluación mediante un cuestionario [A new model of cooperation in sport and its evaluation by questionnaire]. *Psicothema*, 18(3), 425-432.

García-Mas, A., Olmedilla, A., Ortega, E., Almeida, P., Lameiras, J., Sousa, C., & Cruz, J. (2009). Cooperation and cohesion in competitive soccer teams. *International Journal of Hispanic Psychology, 2*(1), 689-696.

Garcia-Mas, A., Fuster, P., Palou, P., Ponseti, F. X., & Cantallops, J. (2012). Motivational Climate, Self-determination and Cooperation in Youth Basketball Players: and analysis with bayesian networks. In A. Antúnez & S. Jiménez (Coords.), *En el camino hacia la excelencia en el baloncesto* [On the way towards excellence in basketball] (pp. 117-136). Sevilla: Wanceulen.

Garcia-Mas, A, Fuster-Parra, P., Ponseti, F. J., Palou, P., Olmedilla, A., & Cruz, J (2015). A Bayesian Analysis of the motivation, motivational climate and anxiety in young competitive team players. *Anales de Psicología, 31*(1), 355-366. doi:10.6018/analesps.31.1.167531.

Glymour, C., Scheines, R., Spirtes, P., & Kelly, K. (1986). Discovering causal structure. *Technical report CMU-PHIL-1.*

Glymour, C. (2003). *The mind's arrows: Bayes nets and graphical causal models in psychology*. Nueva York: MIT Press.

González, J., & Ortín, F.J. (2010). Performance makers' and sportive cooperation. *Cuadernos de Psicología del Deporte, 10* (suppl.), 57-61.

Heckerman, D. (1997). Bayesian networks for data mining. *Data Mining Knowledge Discovery, 1*, 79-119.

Jensen, F. V., & Nielsen, T. D. (2007). *Bayesian networks and decision graphs (2nd edition). Information Science and Statistics*. Bruselas: Springer.

Lafuente, V., & Romo, R. (2003). Decisions arising from opposing views. *Nature Neuroscience, 6*, 792-793.

Lameiras, J., Almeida, P., & Garcia-Mas, A. (2014) Relationship between cooperation and goal orientation among professional team athletes. *Perceptual & Motor Skills*. *119*(3), 851-860.

Larrañaga, P., & Moral, S. (2011). Probabilistic graphical models in artificial intelligence. *Applied Soft Computing*, 1511-1528.

Lemeire, J. (2007). *Learning causal models of multivariate systems and the value of it for the performance modeling of computer programs* (Unpublished doctoral thesis). Vrije Universiteit, Bruselas.

Leo, F., Sánchez-Miguel, P., Sánchez-Oliva, D., Amado, D., & Garcia-Calvo, T. (2011). Incidence of cooperation, cohesion and self-efficacy on performance in football teams. *International Journal of Sport Science, VII*, 341-354.

Levesque, Ch., Copeland, K. J., & Sutcliffe, R. A. (2008). Conscious and Nonconscious Processes: Implications for Self- Determination Theory. *Canadian Psychology 49*(3), 218–224.

Liu, Y., Chen, X., Zhang, L., Wang, L., & Perc, M. (2012). Win-stay-lose-learn promotes cooperation in the spatial prisoner's dilemma. *PLoS One, 7*(2). doi: e30689.

Lonsdale, C., Hodge, K., & Rose, E. (2008). The Behavioral Regulation in Sport Questionnaire (BRSQ): Instrument Development and Initial Validity Evidence. *Journal of Sport and Exercise Psychology, 30*, 323-355.

Lopez-Puga, J., García, J., de la Fuente, L., & de la Fuente, E. I. (2007). Las Redes Bayesianas como herramientas de modelado en Psicología [Bayesian networks as modeling tools in Psychology]. *Anales de Psicología*, *23*(2), 307-316.

Meglino, B. M., & Korsgaard, A. (2004). Considering Rational Self-Interest as a Disposition: Organizational Implications of Other Orientation. *Journal of Applied Psychology, 89*, 946-959.

Mislevy, R. J. (1986). Bayes modal estimation in item response models. *Psychometrika, 51*(2), 177-195.

Mitkidis, P., Sørensen, J., Nielbo K. L., Andersen, M., & Lienard, P. (2013) Collective-Goal Ascription Increases Cooperation in Humans. *PLoS One, 8*(5). doi: e64776.

Norsys Software Corporation (2012). Netica is a trademarks of Norsys Software Coporation. Retrieved from http://www.norsys.com. Copyright 1995-2012. Accessed 2 Dec. 2012.

Olmedilla, A., Ortega, E., Almeida, P., Lameiras, J., Villalonga, T., Sousa, C., Torregrosa, M., Cruz, J., & Garcia-Mas, A. (2011). Cohesión y Cooperación en equipos deportivos [Cohesion and Cooperation in sports teams]. *Anales de Psicología, 27*(1), 323-238.

Pearl, J. (2000). *Causality. Models, reasoning and inference*. Cambridge: Cambridge University Press.

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Brière, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion, 25*, 279–306.

Ponseti, F. J., Palou, P., Borras, P., Vidal, J., Cantallops, J., Ortega, F., Boixadós, M., Sousa, C., García-Calvo, T., & García-Mas, A. (2012). El Cuestionario de Disposición al Engaño en el Deporte (CDED): su aplicación a jóvenes deportistas [Disposition to cheating in sport questionnaire (CDED): Its application to young athletes]. *Revista de Psicología del Deporte, 21*(1), 75-80.

Poundstone, W. (1995). *El Dilema del Prisionero* [Prisoners dilema]. Madrid: Alianza (Orig. 1992).

Reinboth, M., & Duda, J. L. (2006). Perceived Motivational Climate, need satisfaction and indices of well-being in team sports: a longitudinal perspective. *Psychology of Sport and Exercise, 7*(3), 269-286.

Rivas, C., Romero, A., Pérez-Llantada, M. C., López de la Llave, A., Pourtau, M., Molina, I., González, J., & Garcia-Mas, A. (2012). Bienestar Psicológico, salud General, Autonomía percibida y lesiones en futbolistas [Pshychological well being, general health, perceived autonomy and injuries in soccer players]. *Revista de Psicología del Deporte, 21*(2), 365-371.

Romero, A., Zapata, R., Letelier, A., López, I., & Garcia-Mas, A. (2013). Autonomy, Coping Stategies and Psychological Well-Being in Young Professional Tennis Players. *Spanish Journal of Psychology, 16*(e75), 1-11. DOI 10.1017/sjp.2013.70

Scheines, R., Spirtes, P., Glymour, C., Meek, C., & Richardson, T. (1998). The TETRAD project: constraint based aids to causal model specification. *Multivariate Behavioural Research, 33*, 65-117.

Sousa, C., Cruz, J, Torregrosa, M., Vilches, D., & Viladrich, C. (2006). Evaluación conductual y programa de asesoramiento personalizado a entrenadores (PAPE) de deportistas jóvenes [Behavioral assessment and individual counselling programme for coaches of young athletes]. *Revista de Psicología del Deporte, 15(*2), 263-278.

Standage, M., Duda, J. L., & Ntoumnais, N. (2003). Predicting motivational regulations in physical education: the interplay between dispositional goal orientations, motivational climate and perceived competence. *Journal of Sports Sciences, 21*(8), 631-647.

Suri, S., & Watts, D. J. (2011). Cooperation and contagion in web-based, networked public goods experiments. *PLoS One, 6*(3): doi: e16836.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 29, pp. 271-360). Nueva York: Academic Press.

Viladrich, C., Torregrossa, M., & Cruz, J. (2011). Calidad psicométrica de la adaptación española del Cuestionario de Regulación Conductual en el Deporte. *Psicothema, 23*(4), 788-794.

Vukov, J., Santos, F. C. & Pacheco, J. M. (2011). Incipient cognition solves the spatial reciprocity conundrum of cooperation. *PLoS One, 6*(3). doi: el7939.

Wilson, A. G. & Huzurbazar, A. V. (2006). Bayesian networks for multilevel system reliability. *Reliability Engineering and System Safety, 92*, 1413-1420.

Wu, T., Fu, T., & Wang, L. (2011). Moving away from nastyencounters enhances cooperation in ecological prisoner's dilemma game. *PLoS One, 6*(11). doi: e27669.

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