Investigating the complex relations among affective variables in the context of gambling

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Gambling disorder is a dramatic phenomenon that is spreading, in Italy as well as around the world, among younger and younger people every year. Activities in mathematics lessons at school can help pre-vent it, but it is necessary to know with which attitudes and beliefs students approach such mathematics lessons, as well as the role of the social environment. Thus, in this study, within a sample of secondary school students who experienced gambling at various levels of addiction (from none to high), we investigate the role of: mathematics-related beliefs, emotions, social relationships, attitudes towards gambling and behaviour, through a set of calibrated self-report multiple-choice questionnaires. This represents for us an opportunity to understand the complex relations among affective variables in mathematics educational activities aimed at preventing gambling disorder. For example, we found a positive correlation between mathematics-related beliefs and gambling frequency, and a negative correlation between emotional regulation and gambling frequency. Hence, we can say that affective variables such as emotions and beliefs have an effect on gambling behavior.

Keywords: affect as system, gambling disorder

ARTICLE DETAILS

LUMAT Special Issue
Vol 12 No 1 (2024), 64–79

Pages: 16
References: 14

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https://doi.org/10.31129/LUMAT.12.1.2148

1 Affect as a system

As, in the opening of his contribution to the Mathematical Views conference that took place in 2017, Liljedahl (2018) notes, affect-related research has known for a long time that affective variables influence each other. Hovewer, Peter Liljedahl interestingly argues also that "Research in the affective domain has often been restricted to focused attention on a single affective variable. This is ironic given that we know that affective variables tend to cluster. Perhaps the reason for this is that we lack theories for thinking about affective clusters" (Liljedahl, 2018, p. 21). Liljedahl's paper, thus, proposes to consider affect as a constellation of beliefs, attitudes, emotions, goals and efficacy. Each person holds their own affective system, which can be represented using a connected graph. Connections among the affective variables, which are the nodes of the graph, are established by the either quasi-logical (among beliefs and conceptions), or psychological (among the other variables) organisation the individual feels with respect to mathematics, its learning and its teaching. That is to say, an individual's

experience, as well as their affective reactions to experience, affect the way their affective system is organised.

In the very last years, some attempts have been made in order to understand affect as a system as a research *problematique* (see Liljedahl, 2018, and references therein). Our study, which consists in the analysis of statistical correlations among responses given to multiple choice questionnaires, previously calibrated, aims at contributing to this research goal by considering a number of affective variables, which we firstly outline separately in the next section and, in doing so, we also recall the theoretical foundations of the questionnaires used in order to conduct the research.

2 Affective variables

2.1 Beliefs and conceptions

According to Furinghetti and Pehkonen (2002), beliefs are the conclusions that an individual draws from their perceptions and experiences in the world around them. Beliefs can be understood as subjective knowledge: they are propositions about a certain topic that are regarded as true (Philipp, 2007). Being continuously subject to new experiences, beliefs can change, and new beliefs can be adopted (Furinghetti & Pehkonen, 2002). When a new belief emerges, it never comes in isolation from other beliefs, but becomes part of, what has been called, an individual's belief system. According to Green (1971), in fact, beliefs tend to form clusters, as they "come always in sets or groups, never in complete independence of one another" (Green, 1971, p. 41). These clusters form a system, which is organised according to the quasi-logical relations between the beliefs and the psychological strengths with which each belief is held (Green, 1971). Belief clusters are, thus, almost coherent families of beliefs across multiple contexts: for example, beliefs about the nature of mathematics and about its learning tend to cluster in a quite coherent way, for a student. This has probably led Furinghetti and Pehkonen (2002, p. 41) conclude that "an individual's conception of mathematics [is] a set of certain beliefs" namely to understand conceptions as clusters of beliefs.

The Gambling Belief Questionnaire (GBQ), developed by Steenbergh, Meyers, May & Whelan (2002), conceives beliefs and conceptions as rather synonymous. This is in line with Furinghetti and Pehkonen's (2002) understanding of the relation among the two. What is interesting for our own study is the characterisation of conceptions/beliefs according to the degree of intersubjective consensus and of

subjection to disputes, which distinguishes them from knowledge and which allow us to talk about mis-conceptions when subjective knowledge is in contrast with mathematical knowledge. We, thus, understand misconceptions as cluster of beliefs that are in contrast to mathematical knowledge. In the context of gambling, some important misconceptions play a crucial role, as they cause individuals to overestimate their level of control over the outcome of the game and diminish the role of chance (Philander, Gainsbury & Grattan, 2019). Research on gamblers' cognitive distortions suggests that they are an important component to understand both normative and disordered gambling behavior (Philander et al., 2019): evidence suggests that cognitive distortions lead to continued gambling despite significant financial loss and play a causal role in the maintenance and development of gambling disorders (Philander et al., 2019). Mathematical affect-related research has provided evidence that beliefs have observable behavioural consequences (e.g. Di Martino & Zan, 2011), and this can have dramatic consequences when students develop beliefs about mathematics that lead them to choose a career path that avoids it.

2.2 Attitudes

Di Martino and Zan's (2011) approach to attitudes in mathematics fits within the investigation about students' attitudes towards gambling (Ferris & Wynne, 2001). Di Martino & Zan, in fact, focus on the links among three dimensions that characterise their model of attitude, namely: (i) emotional disposition towards mathematics; (ii) vision of mathematics; and (iii) perceived competence in mathematics. Di Martino and Zan also argue that the relations among the three dimensions turn out to be "causal not in a logical sense but rather in a social, ethical and psychological one" (p. 480).

Within our study, we adopted the European School Survey Project on Alcohol and other Drugs (ESPAD). Interviewees are asked to rate their positive emotional disposition towards a list of betting games, as well as their adversity towards them, which can be understood in terms of emotional dispositions towards gambling. Moreover, the Canadian Problem Gambling Index (CPGI), whose development was associated to a rejection of a medicalised model of pathological gambling in favour of a view of problem gambling as a social issue (Ferris & Wynne, 2001), asks interviewees to state whether in the past 12 months it happened to them to bet more money than they wish, or to spend more time than they planned, on gambling. As beliefs about one own's ability to win betting games is assessed by GBQ, it is possible to investigate the relation

between an individual's misconceptions about gambling and its outcomes, their appreciation/

aversion towards betting games, their perceived competence on gambling and the problematic behaviour of gamblers. To note, the construct of attitude, in the way it is defined by DiMartino and Zan, includes self-efficacy, which is a central variable in the context of our research.

2.3 Emotions

In affect-related research, emotions are deemed as the most intense and unstable, as well as the least cognitive-related, dimension of affect (Hannula, 2012). Di Martino, Gómez-Chacón, Liljedhal, Morselli, Pantziara and Schukajlow (2015) annotate that emotions are recently gaining increasing attention, given the emerging acknowledgement of the role that emotions have in learning. With Goldin (2000), we maintain those emotions play an important role in human coping and adaptation. In Goldin's study, focused on problem solving, the solver experiences fluctuating affective states and they can exploit them during problem solving, in order to store and provide useful information, facilitate monitoring, and evoke heuristic processes.

This viewpoint is particularly relevant in the context of gambling, given the lack of emotional regulation that often characterises problematic gambling behaviour. According to Balzarotti, John & Gross (2010), in fact, emotion regulation is crucial not only in this context, but generally in various aspects of healthy adaptation, from affective functioning to social relations. In particular, two emotion regulation strategies have been paid attention to, namely: cognitive reappraisal, which consists of attempts to think about the situation so as to alter its meaning and emotional impact, and expressive suppression, which consists of attempts to inhibit or reduce ongoing emotion-expressive behaviour. Analysing how emotions unfold over time, and particularly interesting in the context of gambling, it has been argued that reappraisal and suppression have their primary impact at different points of the emotion-generative process (Balzarotti et al., 2010): while reappraisal is a strategy that is activated before the complete emotional response has taken place and is, thus, expected to modify the entire temporal course of it, suppression is a response-focused strategy that intervenes once an emotion is already under way and after emotional responses have already been fully generated. It thus might be expected to require repeated efforts to manage emotional responses as they continually arise, taxing the individual's resources (Balzarotti et al., 2010).

The Emotion Regulation Questionnaire by Balzarotti et al. (2010) measures such aspects of emotional regulation, which is theorised to have an impact on an individual actions by affecting behaviour, but also on an individual's reflexive interpretation of their own actions. In other words, emotional regulation is connected to an individual's interpretation of their experience, and thus to beliefs and attitudes.

2.4 Social relations (parents)

Within the MAVI community, it has been observed by Natascha Albersmann and Marc Bosse that "parental influences on their children's mathematical developments are especially notable in direct supportive situations, like homework situations, in which parents and their children get in contact with mathematics in an active way" (Albersmann & Bosse, 2016, p. 163). All in all, in any situation (even outside mathematics educational contexts), in which students and their parents enter in relationship, the latter tend to affect the way the former perceives and interprets what is going on —as a matter of fact. Thus, on one's side, parents' (mathematical yet pedagogical) knowledge turns out to be important in order to understand a child's attitude and beliefs towards it. On the other side, the kind of parental support a student receives can make a difference on the way they organise their belief system. For example, Albersmann and Bosse (2016, p.163) note:

> "Parents' involvement is particularly beneficial for children when it is, for example, autonomy supportive, focuses on the process of learning, and is accompanied by positive affect. However, it has negative repercussions for children if the involvement is controlling, performance focused, and accompanied by negative affect."

In the context of gambling, we explore if and how different kinds of parental support at emotional, relational and cognitive levels is related to students' attitudes and their mathematics-related beliefs towards gambling. This is investigated through the European School Survey Project on Alcohol and other Drugs (ESPAD).

2.5 A systemic view of affective variables

Inspired by the systemic approach to beliefs as tending to cluster, Liljedahl (2018) extends the metaphor of belief system to comprise the whole set of affective variables as a system. Namely, beliefs, attitudes, emotions form a system and are as well intertwined with experiences, needs, goals and personal relationships that frame an

individual's life. As Liljedahl (2018, p.24) exemplifies:

> "Consider, for example, a student who has low self-efficacy about doing mathematics. This student would also, likely, have high anxiety around writing mathematics tests. In this relationship we could say that the anxiety is a logical derivative of the primary affective variable of low self-efficacy (affect–affect causality). But both low self-efficacy and high anxiety may have actually arisen jointly from some negative experience involving poor performance on a test accompanied by some sort of negative consequence like being scolded by a parent or some form of public shaming (experience–affect causality). The reality is, however, that once established, whether it is derived from a negative test experience or directly from low self-efficacy, this student's anxiety will quickly become a robust affective variable on its own right. As such, within this framework, and for the purposes of the research presented here, affect–affect relationships are considered to not have a primary-derivative relationship [...]. However, environment–affect relationships are seen as causal [...]"

This model theorises the relations among the affective variables, but at the present, up to our knowledge, a systematic and quantitative analysis of the nature of the relations among them is missing within the research field. Our study aims at contributing to this goal. We, thus, draw on this model to both explore relationships among affective variables in the context of gambling, and contribute to describe the systemic nature of affect, by seeing how each variable influences the other and how the system as a whole is organised.

3 Methodology

We propose a systemic, interconnected approach to affective variables and we answer the following research questions: is there a correlation among different affective variables in the context of gambling? What is the nature of such a correlation?

3.1 Participants

For the research, 1218 students have been interviewed. They come from 4 secondary schools in the Northwest of Italy, which voluntarily adhered to the project: 328 of them are from the Lagrangia Higher Institute in Vercelli, 279 from the CNOS-FAP Rebaudengo, 321 from the Agnelli Higher Institute and 290 from the CNOS-FAP Valdocco. A diversity of mathematical achievement, socio-economic status and betting frequency among the students has been searched during the sampling phase. We underline that the sample under study was interesting not solely with regard to its numerosity. The students involved in the research come from neighbourhoods that are

peculiar: they live in truly multiethnic environments, with a variety of cultures, socio-economic statuses and conceptions that make it interesting to investigate, especially because no direct relations between differences in such dimensions and behaviour/beliefs with respect to gambling emerged. Participants include 788 males and 430 females, with an age range of 14-19 years (mean age 16.1 ± 1.3 years). Namely, these students attended grades from 9 to 12. They participated on a quasi-voluntary basis, that is to say that their teachers were contacted and, if they accepted, their respective classes were administered the questionnaires.

3.2 Data gathering

Questionnaires have been administered at school, on an online platform and anonymously. The following questionnaires have been proposed to students:

1. the Emotion Regulation Questionnaire (ERQ) (Balzarotti et al., 2010), a self-report questionnaire consisting of 10 items with responses on a 7-point Likert scale, ranging from 1 = "Strongly disagree" to 7 = "Strongly agree". It is composed of two scales that correspond to two different emotion regulation strategies: cognitive reappraisal and expressive suppression. The reliability was good for both the reappraisal scale (α = 0.84) and the suppression one (α = 0.72). Sample questions are: “When I feel bad, I try to look at things from a different perspective”, “When I face a difficult situation, I try to see it under a light that allows me to keep calm”. The Italian translation was developed for this project by the IUSTO psychological research area with a back-translation procedure.
2. Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001), a self-report tool that allows the researcher to identify any behaviour related to excessive or pathological gambling. It is made up of 9 items on a Likert scale from 0 = "Never" to 3 = "Almost always". The questionnaire has a good internal consistency (α = 0.87).
3. Gambling Belief Questionnaire (GBQ) (Steenbergh et al., 2002), a self-report questionnaire that measures cognitive distortions related to gambling, through 21 items with responses on a 7-point Likert scale, from 1 = "Strongly disagree" to 7 = "Strongly in agreement". In the GBQ questionnaire, we can single out two items that exemplify mathematical misconceptions in the context of gambling, that are: (A) “if I am gambling and I am losing, I have to

continue because I do not want to lose the opportunity to win" and (B) "I have a lucky strategy that I use when I gamble". Items labelled with A and B highlight two beliefs about gambling which conceal two misconceptions in probability, which regard the probabilistic independence of two events. The questionnaire has a really good internal consistency ($\alpha = 0.94$).

4. European School Survey Project on Alcohol and other Drugs (ESPAD), a self-report questionnaire that opens with a series of questions aimed at framing the interviewees' socio-cultural context and then investigates the consumption of legal substances such as tobacco, alcohol, psychotropic drugs, doping and other not-legal psychotropic substances, as well as betting games (which are not-legal for people younger than 18 years in Italy). Specifically, a distinction is made between the experiences of use of substances in general (within one own's life period), in the last 12 months and in the last 30 days. Attitudes of approval/disapproval with respect to the use of the various substances and the perception of the risks related to them are finally asked. In the ESPAD questionnaire, students were asked to rate their agreement with respect to statements like: (1) "My parents know the places where I go when I am not at home"; (2) "I feel welcomed by my parents"; (3) "I easily receive money from my parents when I ask".

Students took around 40 minutes to respond to the entire set of questionnaires.

3.3 Method of data analysis

In order to answer our questions about the existence and the nature of the correlation among different affective variables in the context of gambling, multivariate statistical analyses have been conducted. In particular, linear correlation reveals the extent to which variables are related to each other, in terms of how a variable increases (e.g. positive attitude) when another variable increases (e.g. enjoyment). Multiple linear correlation considers a set of (independent, labelled x_i) variables as linearly related to a (dependent, y) one. It is, thus, possible to compute different regression models and to estimate the correlation among the variables of interest. But it is also possible to combine linear regression models so as to investigate whether a variable explains a significant proportion of variance in the dependent variable (y), after accounting for all other variables. Hierarchical regression is the name of this technique.

In our study, we firstly compute the linear correlation among pairs of variables measured by the various questionnaires (e.g. correlation among perceived parental support and frequency of gambling). Then, when correlation was significant, hierarchical regression has been applied so as to check whether variables, for example related to social environment and emotional regulation, play a predictive role with respect to the gambling frequency and mathematics-related beliefs in gambling.

4 Results

We start with investigating the correlation between gambling frequency, measured by CPGI, and mathematics-related beliefs about gambling, measured by GBQ. Between the two, there is a rather strong positive correlation ($r=0.384$), which is statistically significant with a p-value lower than 0.001 ($p<0.001$ in the sequel). This means that, the more the misconceptions about gambling, the more the gambling frequency, and the probability to be wrong saying that there is a correlation of about 0.4 between the two is lower than 0.1 %. We can, thus, start representing the system of affective variables related to gambling and mathematics and weighting the link between the act of gambling and beliefs about it, as in Figure 1. Gambling frequency is strongly ($p<0.001$) and positively correlated with mathematics-related beliefs. A strong correlation is represented by a solid line, while a correlation with $p<0.05$ is represented by a dashed line and a weaker one ($p<0.10$) by a dotted line. Labels with 'positive' and 'negative' are attached to the connecting lines.

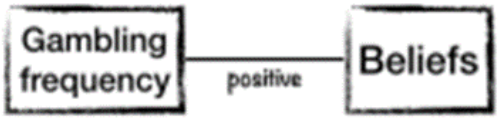

Figure 1. starting to characterise the affective system in the context of gambling, with a focus on mathematics related beliefs about it.

We now examine the systemic nature of the relations between mathematical beliefs/ misconceptions and family environment. Specifically, we explore how family factors (parents' education, student's satisfaction in the relationship with parents, and perceived parental support from ESPAD) were related to beliefs within gambling (from GBQ). Family factors show significant correlations between parents' schooling and mathematical beliefs related to gambling (Table 1). Specifically, there is a statistically significant correlation ($p=0.007$) between mother education and the total GBQ

score: r=-0.113 means that the higher the mother education level (from elementary to graduate), the lesser the misconceptions about gambling. There is also a significant (with a *p-value* at level of p=0.05) correlation between items A and/or B and parental support: weaker mathematics-related misconceptions about gambling are positively related to how much parents know the places frequented by the student (item 1 above) and how much a student feels welcomed (item 2). Gambling frequency increases when financial support provided by parents increases (item 3). To note, there is also another item that investigates financial support (i.e. "I receive a fixed amount of money by my parents on a monthly basis"), but the responses to this are correlated neither to gambling frequency nor to beliefs.

On the basis of these preliminary correlations, hierarchical regressions were performed to verify which family variables play a predictive role on the frequency of gambling activity and on beliefs. The results of the hierarchical regression analyses show that parental support explains 4.3 % of the variance of gambling frequency (daily, weekly or monthly). Conversely, parental education accounts only for 0.2 % of the variance in betting rate, and this is not statistically significant. Namely, regardless of the level of mother and/or father instruction, students tend to bet with higher or lower frequency. As regards mathematical beliefs about gambling (exemplified in items A and B), parental support explains 5.5 % of the variance and this effect is significant. In particular, the more strictly the rules the more the misconceptions (r=0.09 with p=0.05). The more the parents know about the places where students go, the lesser the misconceptions (r=-0.246 with p=0.001). The higher the financial support, the more the misconceptions (r=0,103 with p=0.05).

Table 1. Correlations among relationship with parents and gambling. Not statistically significant values are not reported.

	Mother education	Parents know places frequented by student	Student feels welcome by parents	Parents' economic support
Gambling frequency (ESPAD)	r = -0.133 (p = 0.007)			r = 0.103 p < 0.10
total GBQ score				
item A (GBQ)			r = -0.078 p < 0.10	

item B (GBQ)		r = -0.095 p < 0.05	r = -0.093 p < 0.10	

On the basis of this information, the affective system depicted in Figure 1 can be updated and Figure 2 can be drawn.

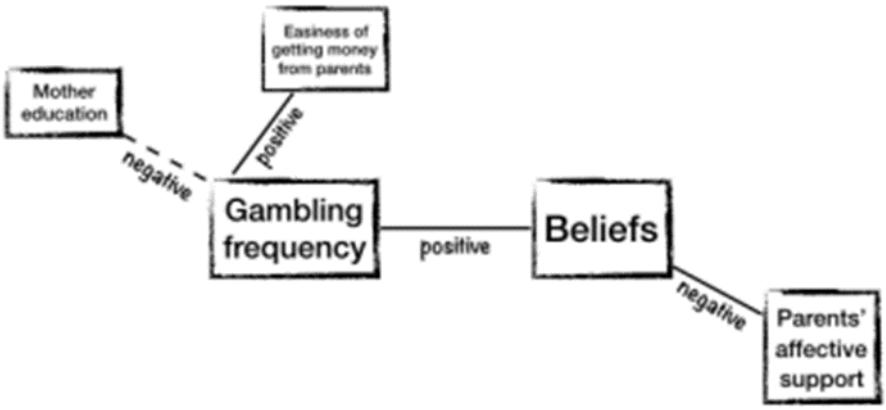

Figure 2. a refinement of the affective system, after the investigation about the role of parents' support with respect to gambling frequency and related beliefs.

We now focus on emotional regulation and mathematical-related beliefs about gambling (Table 2). Expressive suppression from ERQ questionnaire correlates significantly with both gambling frequency, the total score of GBQ questionnaire and items A and B. Correlation indexes in Table 2 mean that the more a student agrees with statements like "When I am happy, I try not to let people notice it", or "I try to control my emotions", the less they bet but the more they hold mathematical beliefs in contrast with probability knowledge. Moreover, cognitive reappraisal from ERQ questionnaire correlates statistically significantly with gambling frequency, as well as with the total score of GBQ questionnaire and item B. Similarly, to emotional suppression case, they are likely to bet less but to hold stronger misconceptions. Hierarchical regression further reveals that emotional regulation explains 7.5 % of the variance of the gambling-related mathematical beliefs, and this is statistically significant.

Table 2. Correlations among emotional regulation and gambling. There is a not-statistically significant value, which is not reported.

	Emotional expressive suppression	Cognitive reappraisal
Gambling frequency (ESPAD)	r = -0.153 p < 0.10	r = -0.1214 p < 0.001
total GBQ score	r = 0.246 p < 0.001	r = 0.168 p < 0.001
item A (GBQ)	r=0.189, p<0.001	
item B (GBQ)	r = 0.179 p < 0.001	r = 0.156 p < 0.001

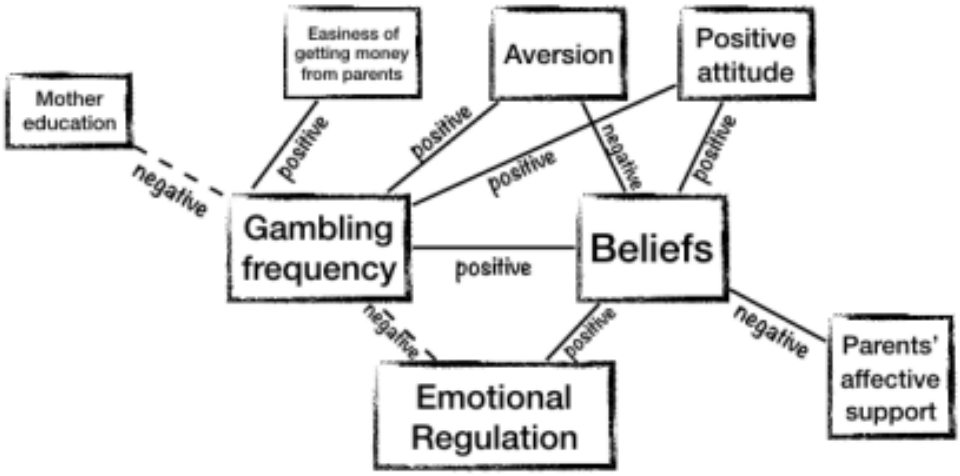

Figure 3. the final affective system in the context of gambling, as it emerges from our study.

Finally, we investigate the role of attitudes towards gambling, and in particular positive ones (i.e. how much a student "likes soccer sport bets", for example) and negative ones (i.e. how much does they think it is hazardous in terms of possible economic loss to bet on soccer plays, for example). As regards the former, both gambling frequency and mathematics-related beliefs increase as positive attitude of betting games increases, with significance $p<0.001$. As regards the latter, aversion towards risk increases with gambling frequency, but misconceptions decrease with it. In both cases, statistical significance is really good ($p<0.001$). The two attitudes are also related in an interesting way: negative attitudes towards gambling are higher both for those who like gambling the most, and for those who like it the least, whilst it is significantly

lower ($p<0.001$) for those who have intermediate attitudes. On the basis of this further information, the affective system can be featured as in Figure 3.

5 Discussion

In this paper, we investigate the correlations among affective variables with respect to students' views and habits about gambling and we focus on mathematics-related beliefs in this context, positive attitudes and aversion, emotional regulation, and family context. It emerges that, among a number of variables related to a student's relationship with their parents, mother's instruction level, parents' affective support and easiness of getting money (by just asking money to one's parents) play a significant role with respect to both gambling frequency and beliefs about gambling. As well, self-declared emotional regulation is correlated with both gambling frequency and beliefs. Also attitudes towards gambling are correlated with the two. Hence, we can give a positive answer to the question about the existence of a correlation among affective variables in the context of mathematics lessons aimed at preventing gambling, but we also recall that just a portion (10 %) of the interviewees use to gamble regularly: many of them had no to rare gambling experiences. This fact represents for us an element of strength of the research because findings do not apply only to (problematic) gamblers, but to a rather general population of secondary school students.

The context of gambling itself can be seen as either a limitation or a potentiality of the research. If we focus on its limiting character, we could say that it is possible that in other classroom settings, more tied to curricular mathematics, other kinds of relations among affective variables can emerge. However, we would like to say that the potentialities of this study reside in at least two of its features: (a) it focuses on an important social issue, about which schools can and want to play a part with respect to preventing gambling abuse, and about which mathematics teachers can play a significant role in teaching students how to understand betting games and their functioning (Andrà, Parolini & Verani, 2016); (b) it proposes a methodology that can be employed in order to investigate the relations among affective variables also in other contexts.

The methodology relies on multiple-choice and Likert-scale questionnaires, which have proved to be limited with respect to their ability to capture the complexity of affective issues and the psychological centrality of an individual's affective stances (Di Martino & Zan, 2011). We completely agree with Di Martino and Zan's (2011)

standpoint, but in this study, we adopted such a method of data collection because we needed tools that allow us to observe inter-relations among variables at a large scale. We did so by resorting to calibrated and (proved to be) consistent instruments, developed by experts in the field. A follow-up, qualitative approach to the issues raised in this study can further confirm, provide nuances and even contrast the findings of our research.

The numerosity of our sample allows us to not only conclude that some affective variables are related, but also to prove that they are related in a certain direction: for example, that mathematics-related (wrong) beliefs increase as parental affective support decreases. Our study confirms that there is a relation between beliefs and behaviour, in particular that there is a strong positive correlation between misconceptions and gambling frequency, and the context of gambling represents a rare opportunity to investigate the relations between attitudes and beliefs as, up to our knowledge, it had not yet been investigated by researchers. Positive attitudes towards betting games increase as misconceptions increase (and as gambling frequency increases), but the higher the aversion with respect to betting games, the lower the misconceptions. Highest aversion has been observed among those students who declared to like gambling the most and the least, while intermediate positions with respect to positive attitudes correspond to lower aversion. It could be interesting to investigate these relations also with respect to mathematics and to other specific mathematical topics, but at the same time we are well aware, to this respect, of the peculiarity of the context of gambling (Andrà et al., 2016), and of the potential limitations in trying to extend these results to different teaching contexts.

Literature on mathematics-related emotions connect them to both beliefs and attitudes, but in this study, we investigate how (self-declared) emotional regulation is related to both the actions of gambling (i.e. its frequency) and beliefs. We found out that both emotional expressive suppression and cognitive reappraisal, namely regulation of emotions on the flow and before action, are positively correlated with beliefs, namely the more the misconceptions the more the regulation, but negatively correlated with gambling frequency, namely the more the gambling the less the regulation. As a cautious note to the methodology employed in our study, we add that Hannula (2012) warns us against the limitations of using statistical tools with strong assumptions on the linearity of relations that seem to have a much more complex nature. However, acknowledging this as a limitation of our study, we take the statistically

significant correlations that emerge as an indicator that *also* these phenomena have features that can be captured by linear models.

6 Conclusions

We believe that our research, conducted at the boundary between Mathematics Education and Psychology, can have didactical consequences with respect to three main issues. Firstly, gambling and gambling abuse is spreading among young people all around the world and schools need to know not only the statistics about the phenomenon (e.g. how many 15-years-old pupils bet on a weekly basis), but also how their students' beliefs, attitudes and emotions, as well as the family context, contributes to either promote or discourage gambling practices so as to design and implement learning trajectories that truly help them develop awareness about the risks related to gambling abuse. Mathematics teaching plays a foreground role in this regard, as mathematical models allow one to understand the functioning of betting games, the probability of winning, their inequity and what happens in the long run.

Secondly, this study attempts to characterise the relations among different affective variables and to contribute to the understanding of mathematics-related affect as a system. It does so in a real-life setting, namely in a context where mathematical knowledge and misconceptions turn out to be significant for students' lives—not only for their mathematical understanding at school.

Thirdly, it does so by resorting to existing definitions of beliefs, conceptions, attitudes and emotions and by linking them to the methodological instruments chosen for the analysis. Results do not emerge from an experiment, but they are grounded in well-established theories of affect, which by themselves theorise existing relations between, for example, beliefs and behaviour, or emotions and beliefs, but fail to prove such claims with observations at a large scale. True, our study was exploratory in its nature. Follow-up ones are needed, so as to reveal further connections among affective variables and to allow us to know more about the systemic features of affect, which seems to be promising in allowing the researcher to grasp the interdependence among a variety of affective stances that emerge out of mathematics classrooms.

References

Albersmann, N., & Bosse, M. (2016). Towards inconsistencies in parents' beliefs about teaching and learning mathematics. In: C. Andrà, D. Brunetto, P. Liljedahl & E. Levenson (Eds.),

Teaching and learning in maths classrooms (pp.163-173). Springer International Publishing. https://www.doi.org/10.1007/978-3-319-49232-2

Andrà, C., Parolini, N., & Verani, M. (2016). *BetOnMath: Matematica e azzardo a scuola*. Springer Milano.

Balzarotti, S., John, O. P., & Gross, J. J. (2010). An Italian Adaptation of the Emotion Regulation Questionnaire. *European Journal of Psychological Assessment, 26*(1), 61–67. https://www.doi.org/10.1027/1015-5759/a000009

Di Martino, P., Gómez-Chacón, I. M., Liljedahl, P., Morselli, F., Pantziara, M., & Schukajlow, S. (2015). Introduction to the papers of TWG08: Affect and mathematical thinking. In: *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education* (pp. 1104-1107). ERME.

Di Martino, P., & Zan, R. (2011). Attitude towards mathematics: a bridge between beliefs and emotions. *ZDM 43*(4), 471–482. http://dx.doi.org/10.1007/s11858-011-0309-6

Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final report*. Canadian Centre on Substance Abuse.

Furinghetti, F., & Pehkonen, E. (2002). Rethinking characterisations of beliefs. In: G.C. Leder, E. Pehkonen & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education?* Kluwer Academic Publishers.

Goldin, G.A. (2000). Affective pathways and representation in mathematical problem solving. *Mathematical Thinking and Learning, 2*(3), 20919.

Green, T. F. (1971). *The activities of teaching*. McGraw-Hill.

Hannula, M. S. (2012). Exploring new dimensions of mathematics-related affect: Embodied and social theories. *Research in Mathematics Education*, *14*(2), 137–161. http://dx.doi.org/10.1080/14794802.2012.694281

Liljedahl, P. (2018). Affect as a system: The case of Sara. In B. Rott, G. Törner, J. Peters-Dasdemir, A. Möller, & Safrudiannur (Eds.), *Views and beliefs in mathematics education* (pp. 21-32). Springer. https://doi.org/10.1007/978-3-030-01273-1_3

Philander, K. S., Gainsbury, S. M., & Grattan, G. (2019). An assessment of the validity of the Gamblers Belief Questionnaire. *Addictive Behaviors, 97*, 104–110. https://doi.org/10.1016/j.addbeh.2019.05.029

Philipp, R. (2007). Mathematics teachers' beliefs and affect. In F. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 257–315). Charlotte, NC: Information Age.

Steenbergh, T. A., Meyers, A.W., May, R. K., & Whelan, J. P. (2002). Development and validation of the Gamblers' Beliefs Questionnaire. *Psychology of Addictive Behaviors, 16*(2), 143–149. https://doi.org/10.1037/0893-164X.16.2.143