Applying Social Network Indicators in the Analysis of Verbal Aggressiveness at the School

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Abstract

The purpose of this study is to detect structures of verbal aggressiveness using multiple indicators of social networks analysis (out- and in-degree, pagerank, Katz, authority, incremental and proportional behavior). Standardized questionnaires have been distributed to 151 students and 45 teachers at primary and secondary schools. We performed complete analysis of social networks and further processing by applying principal component analysis. According to the results, a complex structure of verbal aggressiveness occurred in the classes (networks) and the structure was necessary to be explored with several network indicators (Katz, pagerank, incremental and proportional behavior etc.). Prejudices about the role of the gender in the aggressiveness (e.g. that female are more peaceful than male) are deconstructed. As for the typology of the incremental and proportional behavior two types were proposed: 1) the "personal attack" that the verbal aggressor aims the victim's personality and 2) "social exclusion" that the strategy is to exclude the victim from the social surrounding.

Keywords

Verbal Aggressiveness, Network Analysis, Typology

1. Introduction

[1] has defined verbal aggressiveness as an attack in the perception of the individual to cause emotional pain to a person through communication process. Verbal aggressiveness is considered to be a destructive feature of communication [2]-[7] and acts as a catalyst for physical aggressiveness [8]. Research indicated that teachers' verbal aggressiveness is negatively correlated with students' attendance and participation in the learning process [7] [9], student motivation [10] [11] [12] [13] [14], interest [15], self-esteem [1] [16] [17], behaviour, thinking and motivation [18] [19] [20] [21], satisfaction, and learning outcome [7] [10]

[21]-[29], students' affective learning [30] [31] [32], teacher's reliability [33] and discipline reasons [34] [35]. Also, verbal aggressiveness affects student-teacher communication [11] [16] [36] [37], interpersonal attraction [38], students' fair play behaviours [39], Machiavelian tactics [40], bullying [41] and classroom climate [21] [42] [43]. Teachers with a high level of verbal aggressiveness present a high level of burnout [29] [44]. Verbal aggressiveness has also been examined through network analysis, and they have revealed hierarchical structures of aggressiveness behavior [20] [45] [46] [47] [48] [49].

Purpose of this study is to detect structures of verbal aggressiveness using multiple indicators of social networks analysis (out- and in-degree, pagerank, Katz, authority, incremental and proportional behavior). Especially, incremental and proportional behaviors are newly suggested indicators [47] which are expected to make deeper structures discernible.

The theoretical added value of this research consists in examples of detection and exploration of determinants of the verbal aggressiveness through multiple network indicators, the most newly suggested of which are the incremental and proportional behavior. Different network indicators depict different structures (relations) of behavior among the students and teaching staff. Thus, only e.g. indegree or Katz, cannot reveal any possible hierarchy of verbal aggressiveness. Incremental and proportional behaviors depict two types of over-extroversion (idiosyncratic and strategic, respectively, according to [47]), which here is first time applied at school classes. The practical added value consists in the using of the results for more accurate consulting and pedagogic action in the classes. In this way, possible prejudices can be deconstructed.

2. Method

2.1. Network Analysis

Complete network analysis investigates the interactions of participants through appropriate indicators depicting structures [50] [51]. Visone software has calculated the following indicators through network analysis:

1) In-degree (occasional hierarchy) is an indicator of centrality and defined as the percentage of relations which ends in a node. It shows a superficially targeted person.

2) Out-degree (occasional hierarchy, inversely to the in-degree) is an indicator of centrality and defined as the percentage of outgoing relations of a node. It shows a superficially aggressive person.

3) Katz status (accumulative hierarchy) calculated as power series through successive chains. It indicates passiveness more deep-rooted than in-degree.

4) Pagerank (distributive hierarchy) is based on the transferred value from one node to others. It is similar to Katz status, but it constrains outliers.

5) Authority indicates the nodes which are attracting most links from other nodes, among those who intensively seek to maintain relationships. In this case, it reveals a distinct tendency of being targeted.

All indicators above have repeatedly been used and interpreted in real empir-

ical context in many researches [46] [48] [52]-[57].

Additionally, two new indicators were proposed at recent research [47]. These two reveals over-extroversion, in contrast to the afore-mentioned indicators which do not take into account the relation between outgoing aggression (outdegree) and incoming aggression (indegree, katz, pagerank, authority). Namely, they consider the relation between targeting others and being targeted by others.

1) Incremental behavior (*IB*) indicates the pure aggressiveness and was computed by the following formula.

$$IB = (4 \times \text{outdegree}) - (\text{indegree} + \text{status} + \text{pagerank} + \text{authority})$$

2) Proportional behavior (*PB*) expresses rational strategy of adaptability

$$PB = \frac{4 \times \text{outdegree} + 1}{\text{indegree} + \text{status} + \text{pagerank} + \text{authority} + 1}$$

2.2. Sampling

Seven classes of public primary and secondary schools (Gymnasium and Lyceum) in Trikala have been surveyed as network samples. Cluster sampling has been used [58] and each class was examined as a network, where the students were the nodes, and the links among them were the perceived verbal aggressiveness to each other. The sample consisted of 196 individuals. The questionnaires were fluently completed within 30 - 45 minutes. The anonymity of the informants was emphasized and the participation was voluntary. At Tables 1-3, basic descriptive information about the sample is presented. In Table 1, a relatively balanced share of genders is observed while the relation of teachers to students is about 1/3.

Table 1. Distribution of sample by the gender.

Gender	Students	Teachers	Total
Famale	70	21	91
Male	81	24	105
Total	151	45	196

Table 2. Distribution of sample by the networks and gender.

Network		Gender		
	Type of school	Female	Male	Total
A	Primary school	13	12	25
B	Secondary school (Gymnasium)	14	16	30
C	Secondary school (Gymnasium)	9	20	29
D	Secondary school (Gymnasium)	19	10	29
E	Secondary school (Gymnasium)	10	19	29
F	Secondary school (Lyceum)	10	16	26
G	Secondary school (Lyceum)	16	12	28
Total		91	105	196

Table 3. Distribution of sample by the networks and ages.

Network	Students' Age	Range of teachers' age
A	11	54
B	14	45 - 55
C	14	45 - 55
D	14	45 - 56
E	13	45 - 55
F	17	46 - 63
G	17	46 - 63

In Table 2, though, the relation between female and male at the network from C to G is not so balanced. This produces the advantage of a gender-based dynamics which may intensify the network effect.

In Table 3, a smooth increase of the students' age is observed through the networks, from A to G. This assures the research advantage of covering a wide range of age. This also happens in the case of teachers, whose age classes are also smoothly increasing.

2.3. Questionnaire

The participants answered a questionnaire consisted of two parts: 1) non-network variables (e.g. gender, age, economic situation, etc.), and 2) network variables based on the Greek version of Verbal Aggressiveness Scale [59] which consisted of eight items (e.g., "threats students" "makes negative judgments of ability"). Preliminary examination [59] supported the psychometric properties of the instrument. In particular, Confirmatory Factor Analysis indicated satisfactory fit indices (CFI: 0.97, SRMR: 0.02), and internal consistency of the scale ($\alpha = 0.96$).

2.4. Statistical Analysis

Visone (version 2.17) was used for the computation of several indicators (indegree, status, pagerank, authority, density, avg network degree). Also, the structure of the networks was depicted by Visone software. Both network and non-network data were entered into Statistical Package for Social Sciences (SPSS 21.0). The Spearman correlation coefficient was used to measure the correlation between the network non-network variables. Principal Component Analysis was implemented to formulate typology for the Incremental and Proportional behavior. The level of statistical significance was set at 0.05.

3. Results and Discussion

3.1. Examples of Structures in Verbal Aggressiveness

In Figure 1 the seven networks of verbal aggressiveness are depicted and classified by density. All graphs visualize the katz hierarchy of the networks. The red nodes represent female and the blue ones male. The shape of circle at a node
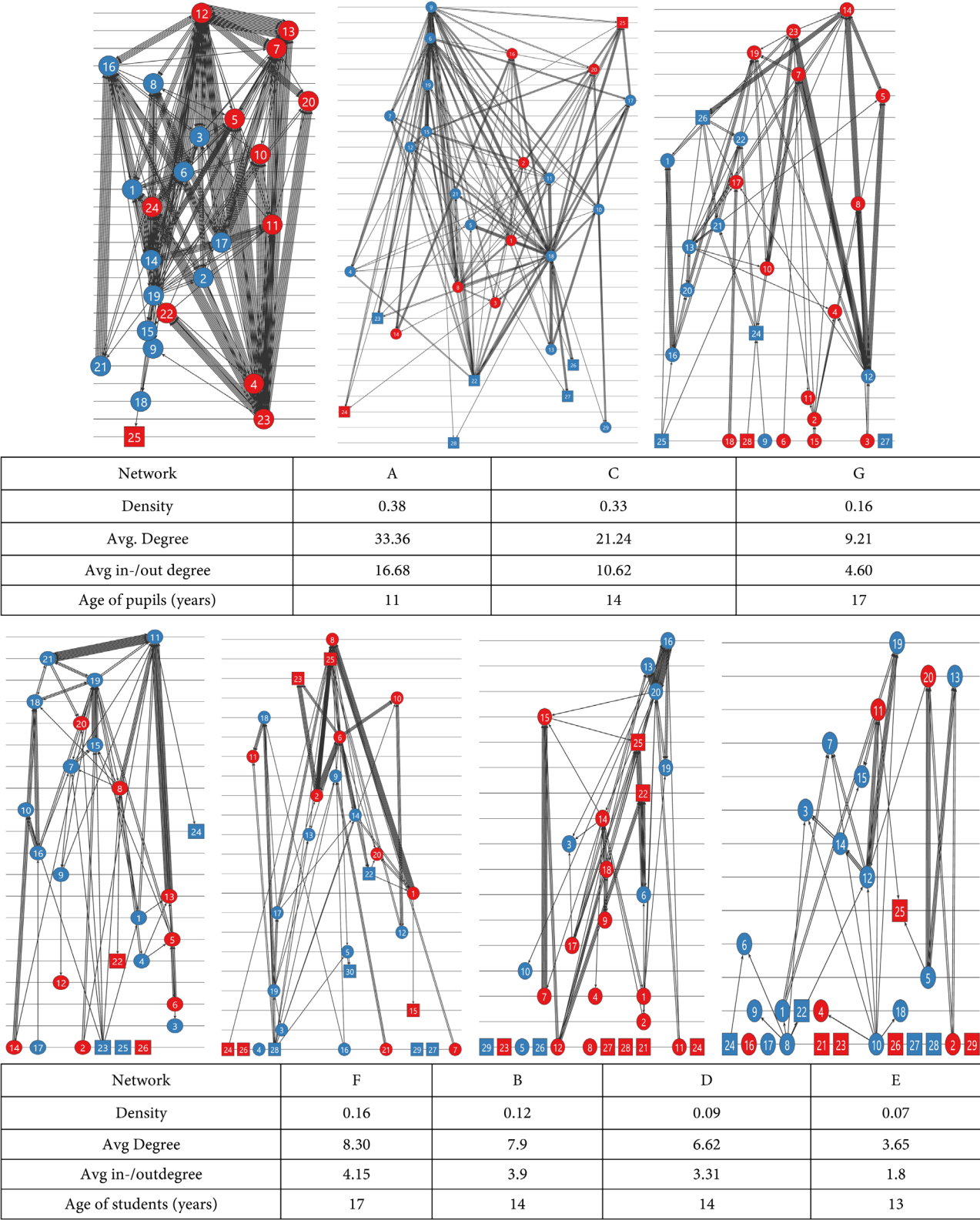
Network	A	C	G
Density	0.38	0.33	0.16
Avg. Degree	33.36	21.24	9.21
Avg in-/out degree	16.68	10.62	4.60
Age of pupils (years)	11	14	17

Network	F	B	D	E
Density	0.16	0.12	0.09	0.07
Avg Degree	8.30	7.9	6.62	3.65
Avg in-/outdegree	4.15	3.9	3.31	1.8
Age of students (years)	17	14	14	13

Figure 1. Verbal aggressiveness hierarchy in different networks according to Katz indicator.

implies that the participant is student and the rectangle that is teaching staff.

At the top of the status hierarchy there can be either male or female nodes.

This is a rough evidence that verbal aggressiveness is not strongly affected by the gender.

Also, the density varies among networks and seems to be correlated with the average degree of the network and with the ratio of in-degree to out-degree.

In **Figure 2** a network is analyzed and visualized by different indicators. The structure of the networks does not seem to alter at least at the peak while at the bottom, there is a slight differentiation.

3.2. Relationship between Verbal Aggressiveness

In **Table 4** the correlations among different indicators of underestimating of intelligence (item of verbal aggressiveness, selected as an example), age and gender are presented. The gender, as showed above on the basis of rough visual evidence mentioned above in **Figure 1**, does not play any role in verbal aggressiveness while the higher age conctitute someone a target of aggressiveness in contrast to previous research results referring to Hgiher Education students [46] [48]. However, the age plays also no role idiosyncratically (IB) or strategically (PB).

In **Table 5**, correlations between total verbal aggressiveness, age and gender. Once again, gender does not seem to have any significant correlation with any of the indicators. Age seems to be correlated with most of the indicators (depitcting either incoming and outgoing ones), however, once again not with IB and PB.
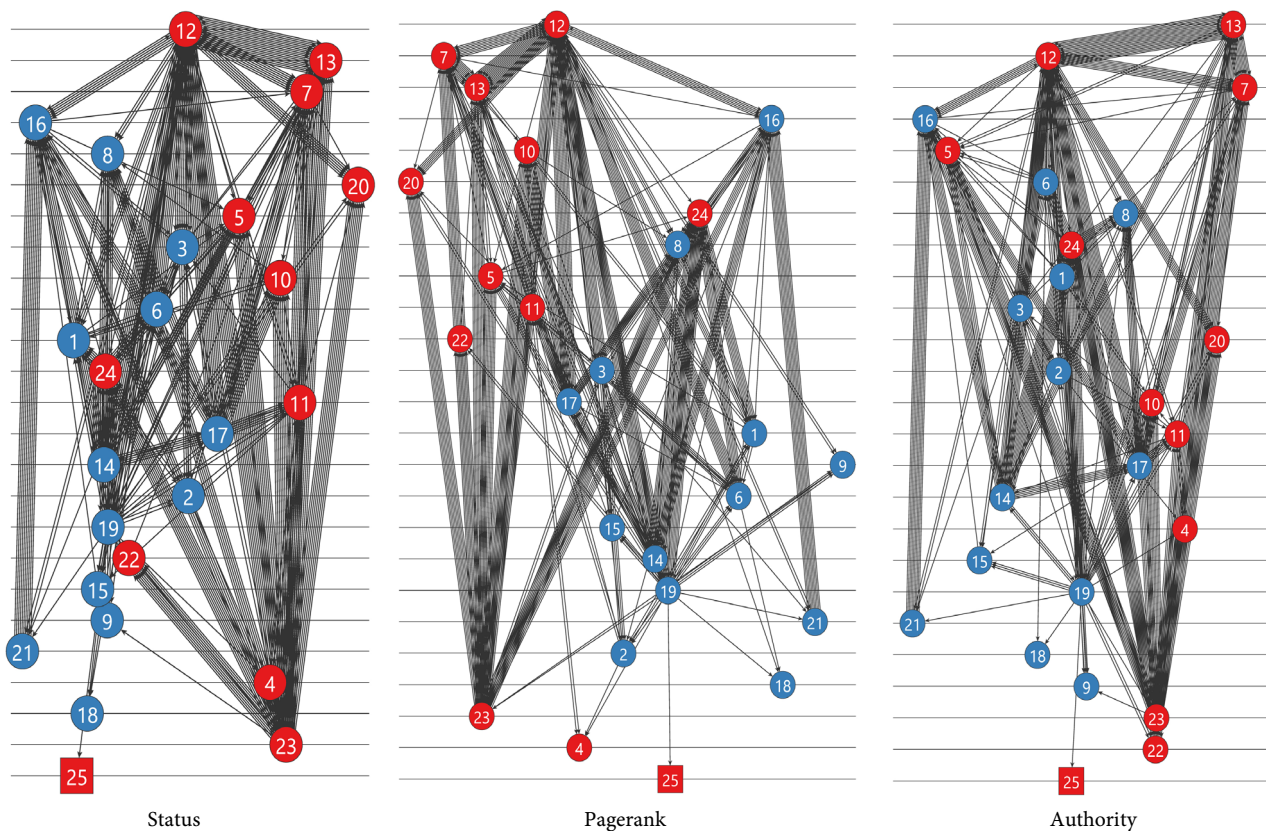

Figure 2. Verbal aggressiveness hierarchy in network A according to different indicators.

Table 4. Spearman correlations of verbal aggressiveness (underestimating of intelligence).

Spearman's rho	Status	Pagerank	Indegree	Authoriy	Outdegree	IB	PB
Gender	0.050	0.115	0.039	0.064	−0.020	−0.098	−0.037
	0.487	0.107	0.589	0.376	0.784	0.171	0.610
Age	0.140	**0.230****	0.139	**0.164***	0.116	−0.086	−0.058
	0.063	**0.002**	0.066	**0.030**	0.125	0.256	0.444

**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed).

Table 5. Spearman correletions of verbal aggresiveness (total).

Spearman's rho	Gender	Age	Status	Pagerank	Indegree	Authoriy	Outdegree	IB	PB
Gender	1.000	0.025	0.085	0.094	0.079	0.025	0.048	0.019	−0.011
	.	0.739	0.237	0.192	0.269	0.727	0.505	0.794	0.880
Age	0.025	1.000	**0.268****	**0.262****	**0.277****	**0.398****	**0.150***	−0.070	−0.059
	0.739	.	**0.000**	**0.000**	**0.000**	**0.000**	**0.047**	0.353	0.439

**Correlation is significant at the 0.01 level (2-tailed) *Correlation is significant at the 0.05 level (2-tailed).

3.3. Typology of Verbal Aggressiveness Based on Incremental and Proportional Indicators

In Table 6, a principal component analysis (PCA) is presented which was conducted on the nine items verbal aggressiveness (incremental behavior). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.69, and all KMO values for individual items were lower than 0.55, which is above the acceptable limit of 0.5 [60]. Bartlett's test of sphericity χ^2 (45) = 293.2, p < 0.001, indicated that correlations between items were sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Two components had eigenvalues over Kaiser's criterion of 1 and in combination explained 81.92% of the variance. Table 6 shows the factor loadings. The items that cluster on the same components suggest that component 1 represents a "Personal attack", component 2 "social exclusion".

In Table 7, a principal component analysis (PCA) on the nine items verbal aggressiveness (Proportional behavior) is presented. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.75, and all KMO values for individual items were above 0.70, which is well above the acceptable limit of 0.5 [60]. Bartlett's test of sphericity χ^2 (45) = 496.18, p < 0.001, indicated that correlations between items were sufficiently large for PCA. An initial analysis was run to obtain eigenvalues for each component in the data. Two components had eigenvalues over Kaiser's criterion of 1 and in combination explained 92.31% of the variance. Table 7 shows the factor loadings. The items that cluster on the same components suggest that component 1 represents a "Personal attack", component 2 "social exclusion".

Both indicators compare the outgoing with ingoing verbal aggressiveness.

Table 6. Typology of verbal aggressiveness (Incremental behavior).

Component Matrix[a] Incremental behavior (IB)	Component	
	Personal attack	Social exclusion
Verbal aggressiveness (insulting behavior)	**0.855**	−0.156
Verbal aggressiveness (underestimating of intelligence)	**0.731**	**0.498**
Verbal aggressiveness (underestimated attitude)	**0.939**	0.111
Verbal aggressiveness (ironic comments)	**0.904**	0.047
Verbal aggressiveness (rude behavior)	**0.784**	0.179
Verbal aggressiveness (lessening behavior)	**0.892**	−0.341
Verbal aggressiveness (causing bad feelings)	**0.885**	0.031
Verbal aggressiveness (mocking behavior)	**0.907**	−0.226
Verbal aggressiveness (threating behaviour)	**0.831**	−0.282
Verbal aggressiveness (rejection from social surroundings)	0.209	**0.955**

Extraction method: Principal component analysis.

Table 7. Typology of verbal aggressiveness (Proportional behavior).

Component Matrix[a] Proportional behavior (PB)	Component	
	Personal attack	Social exclusion
Verbal aggressiveness (insulting behavior)	**0.985**	−0.100
Verbal aggressiveness (underestimating of intelligence)	**0.709**	**0.662**
Verbal aggressiveness (underestimated attitude)	**0.929**	−0.019
Verbal aggressiveness (ironic comments)	**0.974**	−0.048
Verbal aggressiveness (rude behavior)	**0.907**	0.102
Verbal aggressiveness (lessening behavior)	**0.936**	−0.167
Verbal aggressiveness (causing bad feelings)	**0.975**	−0.063
Verbal aggressiveness (mocking behavior)	**0.939**	−0.122
Verbal aggressiveness (threating behavior)	**0.951**	−0.133
Verbal aggressiveness (rejection from social surroundings)	0.060	**0.992**

Extraction method: Principal component analysis.

They indicate pure aggressiveness [47]. So the typology can reveal the strategies of a verbal aggressor. A verbal aggressor either attack to the victim's personality with a different pattern or simple try to exclude him from social surrounding. Such typologies have also been proposed in previous research [41] [61].

4. Conclusions

Verbal aggressiveness is presented in all classes, but the structural features are differentiated. Regarding network structures density is an appropriate indicator for depicting the perceived verbal aggressiveness, so it is useful to apply several indicators (katz, pagerank, etc.). All indicators seem to be correlated with certain non-network variables, but different indicators reveal different properties and

meanings. The social meaning of five tested indicators (katz, pagerank, authority, indegree, outdegree) seems to converge in the present study. Also, the new indicators (incremental and proportional behavior), appear to express the pure aggressiveness. Using a wide range of network metrics (indegree, katz, pagerank, authority) discloses a respectively conscientious range of types depicting distinct structures and behaviors. As for the typology of the incremental and proportional behavior two types were proposed: a) the "personal attack" that the verbal aggressor aims the victims' personality and b) social exclusion that the strategy is to exclude the victim from the social surrounding.

Especially typologies seem to be practically useful for classifying or recognizing particular types of students more precisely and clearly. Such discrete types can thus be criteria for pedagogic planning and orientation of the teaching staff while the irrelevance of gender can help deconstruct prejudices (e.g. about the peacefulness of female students or the distinct aggressiveness of the male ones). Thus, the application of such mathematical application in the analysis of class relations using the particular indicators seems to create the expected added value.

Certain challenges for future research are to propose more elaborated network indicators for depicting more deep-rooted structures. Extensive focus groups and in-depth interviews with students and teaching staff can enable a deeper understanding of the quantitative results. A larger sample from more regions or other countries would also be conducive to a comparable analysis.

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