When language leads to delinquency
Relationships between social aspects and vandalism on stop signs

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Abstract: The present paper studies the average level of vandalism on stop signs in seven districts of Montreal and tries to define its causes. By inserting frequency of vandalism levels in a chi-square test, it is suggested that the distribution of this form of vandalism is not random. A range of social factors concerning age, education, employment, marital status, familial status and means of transportation are correlated with the vandalism average in order to define which social factors has the most impact on vandalism production. The results are pointing towards age and means of transportation as influential in vandalism.

Introduction

Vandalism is a destructive act performed by an individual on a public or private object. Being part of delinquency, vandalism has been studied by sociologists and psychologists in order to define its causes and incentives. Based on criminal records or direct surveys, scholars have examined the average age and the familial environment of vandals (Richards, 1979; Steffensmeier and all, 1989; Steinberg, 1987). The results of those studies seem to indicate that young individuals are more susceptible to fall into delinquency than older ones. Ploeger (1997) looked at correlations between employment and vandalism, observing an increase of vandalism in the employed population, situation that contradicted the general opinion that young adults become more responsible when they start working.

The present paper is different from these earlier ones because it focuses on vandalism on stop signs found in Montreal's districts. By correlating levels of vandalism with social aspects of Montreal's society, the goal of this project is to find which factor has the most influence on vandalism. Depending on the results obtained, this study could help refute certain of the stereotypes that are affecting our society. However, it could also create new ones.

Methods

At first, social data on areas covered in the survey were collected via Statistics Canada's 2006 Census. Due to time constraints, aspects judged to have none or little impact on vandalism production were not taken into consideration. Examples of those aspects are types of dwelling, language spoken at home, mobility status and field of study. **Table 1** shows the list of chosen social aspects for this study.

Population	Marital status	Language
Total population	Single	Mother tongue English
Density	Common-law couples	Mother tongue French
Population 0-9 years old	Married	Mother tongue both
Population 10-19 years old	Married and separated	Mother tongue other
Population 20-29 years old	Divorced	Known English
Population 30-39 years old	Widow	Known French
Population 40-49 years old		Known both
Population 50-59 years old	**Families**	Known none
Population 60-69 years old	Total families	
Population 70-79 years old	Married families	**Transport to work**
Population over 80 years old	Lone parent families	Total working population
	Lone mother families	Car as driver
Work	Common-law families	Car as passenger
Population over 15 years old		Public transport
Employed	**Education**	Walk/Bicycle
Non-employed	No diploma	Other
Not in search of work	High school diploma	
Employment rate in %	Apprenticeship diploma	
Unemployment rate in %	Non-University diploma	
	University diploma	

Table 1. Data collected for each districts listed by categories.

For the municipalities of Westmount, Côte-St-Luc and Hampstead, census data was available on the website: http://www12.statcan.ca/english/census06/data/profiles/community/Index.cfm?Lang=E, however, as the districts of Notre-Dame de Grâce (NDG), Côte-des-Neiges (CDN), Plateau Mont-Royal and Ville-Marie are merged into the city of Montreal, census tracts (CT) in those boroughs were studied separately and added up. The information on CTs was available on the website: http://www12.statcan.ca/english/census06/data/profiles/ct/Index.cfm?Lang=E. Only the CTs covered by the students' survey have been included. For more precision, the districts of CDN and NDG needed to be separated. The border for this division has been established following The Boulevard due to the importance and position of that street. The same principle of division has been applied to Ville-Marie and Plateau Mont-Royal, but with the roads Sherbrooke and Bleury as south and west borders respectively.

In each social category studied, raw numbers of social aspects were collected. Those numbers were then divided by the total population of the category to get a percentage (**Appendix A**). Both numbers for all social aspects were necessary as they both served for different tests.

Concerning the stop signs, a wide range of data were collected by small teams of undergraduate students at McGill University in predefined zones of Montreal. In each zone, all stop signs were registered and their attributes were given predetermined values. In total, 2816 stop signs distributed in 31 zones were evaluated. For each stop sign, a number of attributes were recorded, but the present paper only looks at two of them, namely the level of vandalism on front and back of signs. The codes for vandalism are as follows:

V 0= no visible writing or stickers
V 1= one sticker or one word covering less than 20% of the surface
V 2= two or more stickers/words or one sticker/word covering 20-50% of the surface
V 3= three or more stickers/words or more than 50% of surface covered

Figure 1. Examples of each level of stop sign vandalism.
Back vandalism from left to right (sign codes): V1 → 15-11-7, V2 → 31-21-5, V3 → 7-18-2
Front vandalism from left to right (sign codes): V0 → 15-14-6, V1 →27-4-3, V2 → 27-13-1, V3 → 9-6-c

After dividing the main stop sign database by districts, a frequency of each level of vandalism (front and back together) was calculated for each district using Excel. Those frequencies were then put into a chi-square test in order to see if they could be the results of random distribution (**Table 3**).

With the same database, means of vandalism on front (VF) and vandalism on back (VB) were calculated. Those means were then inserted into scatter-plots in relation with all percentages of social aspects registered. For each scatter-plot, linear regression and its respective Pearson's R coefficient were calculated (see Appendix A for results). However, those computations considered the front and back faces separately, a situation which could lead to errors of interpretations. In order to get correlations that group both sides, an index of vandalism level was created. Beginning with the assumption that front vandalism is more visible, thus more prominent, VF codes were given twice the value of VB (see **Table 2** for new values). In this situation, as the code 0 represented the absence of vandalism, it was attributed a value of 0 for both sides.

Vandalism on back	Vandalism on front
0=**0**	0=**0**
1=**1**	1=**2**
2=**2**	2=**4**
3=**3**	3=**6**

Table 2. Values given to each vandalism code. The new values are represented in bold.

For each district, frequencies of each level of vandalism were multiplied by their new value. The results obtained for VF and VB were then added up and divided by the total number of stop signs in the district. This new average mean was then integrated into scatter-plots that related to the same percentage of social aspects used earlier. It is important to note that only the scatter-plots obtained with the index of vandalism are analysed in the present paper. This is due to time constraints, but also to a lack of significant difference between the index and the VF/VB results.

Results

The resulting p-value from the chi-square in **Table 3** is 1,09412E-63. This shows that the distribution of vandalism in the districts cannot be random. There are thus factors influencing the production of vandalism on stop signs, but those factors need to be identified using different tests.

	Vandalism 0	Vandalism 1	Vandalism 2	Vandalism 3	Total
VM	447	79	48	25	599
CDN	817	63	13	13	906
CSL	660	30	23	8	721
Hampstead	636	26	2	0	664
NDG	1008	168	54	14	1244
Plateau	287	85	38	28	438
Westmount	725	149	51	26	951
Total	4580	600	229	114	5523

degrees of freedom	18
P-value	1,09412E-63

Table 3. Chi-square of vandalism levels by districts.

In the course of the present research, more than 140 scatter-plots were produced. In order to avoid making the text too heavy, only the most relevant ones are displayed, however the R^2s of all correlations are available in **Appendix A**. The distribution of age groups percentages versus vandalism index are displayed in **Figures 2** to **6**.

% of 0-9 years-old/Index V

$$y = -0,1504x + 2,2213$$
$$R^2 = 0,7858$$

% of 0-9 years-
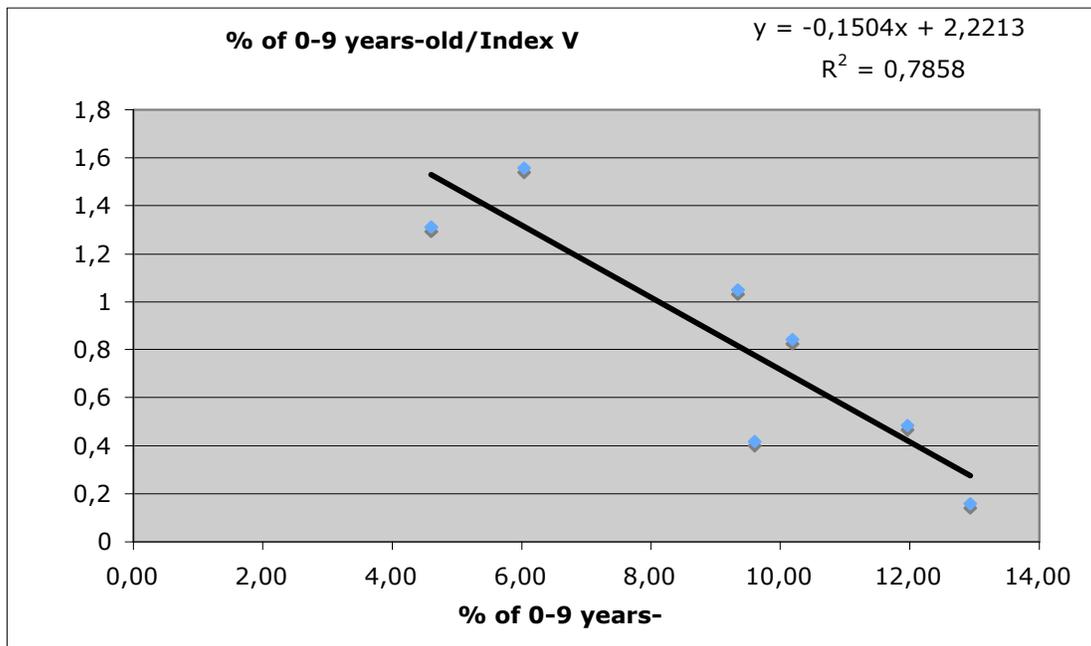
Figure 2. Correlation between the percentage of 0 to 9 years old in all districts and the vandalism mean with calculated regression

% of 10-19 years-old/Index V

$$y = -0,1299x + 2,1735$$
$$R^2 = 0,6745$$
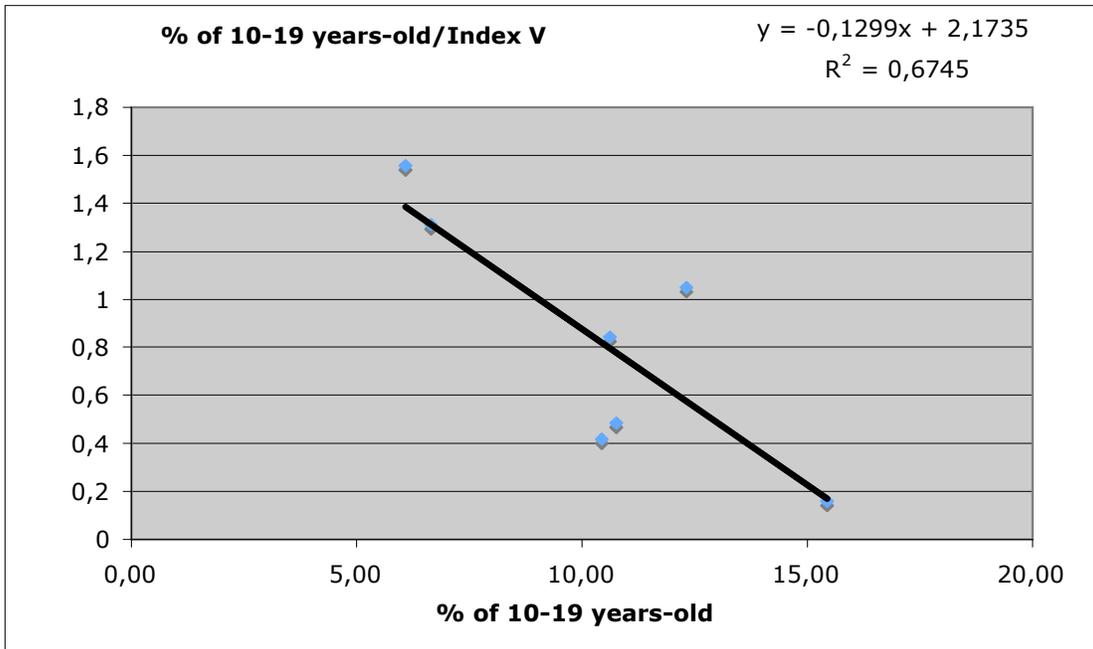
Figure 3. Correlation between the percentage of 10 to 19 years old in all districts and the vandalism mean with calculated regression

% of 20-29 years-old/Index V

$$y = 0,0502x - 0,0356$$
$$R^2 = 0,6492$$
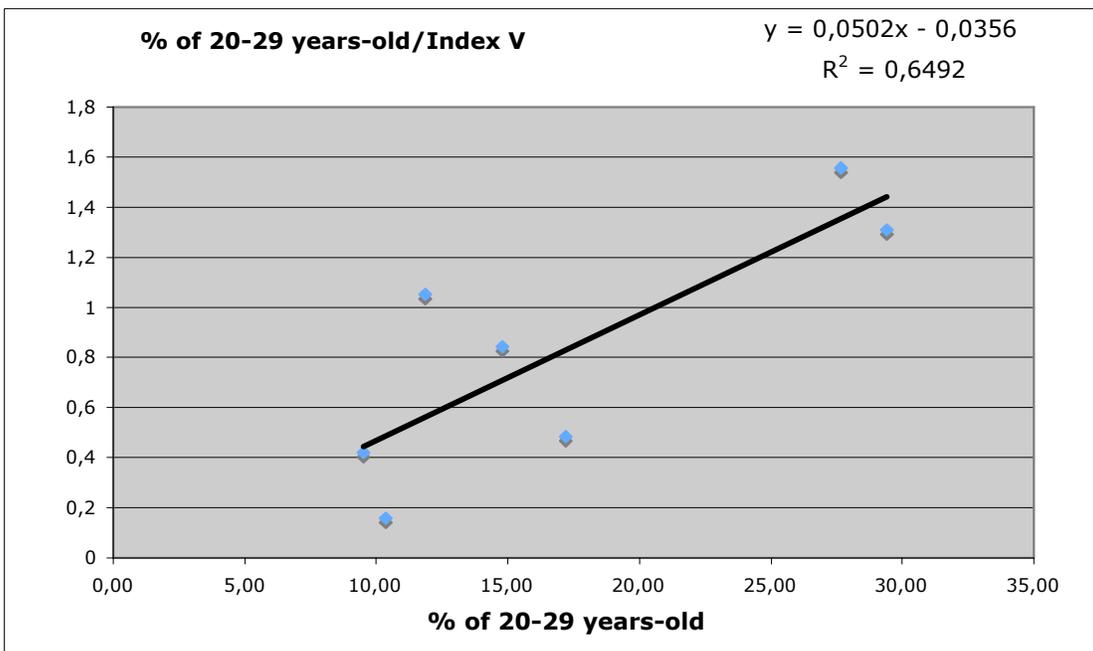
Figure 4. Correlation between the percentage of 20 to 29 years old in all districts and the vandalism mean with the calculated regression

% of 30-39 years old/Index V

$y = 0{,}0707x - 0{,}1849$

$R^2 = 0{,}3384$
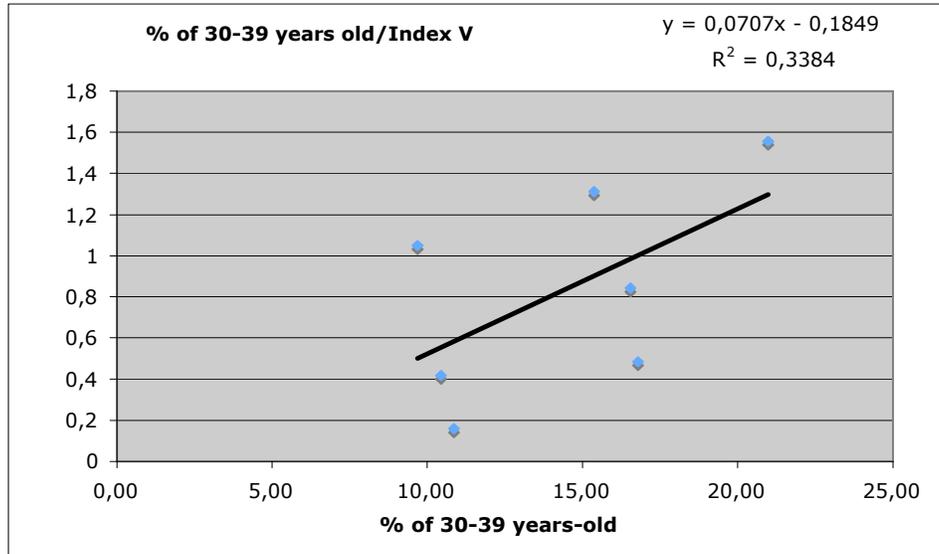
Figure 5. Correlation between the percentage of 30 to 39 years old in all districts and the vandalism mean with the calculated regression

% of 40-49 years-old/Index V

$y = -0{,}0713x + 1{,}7794$

$R^2 = 0{,}0797$
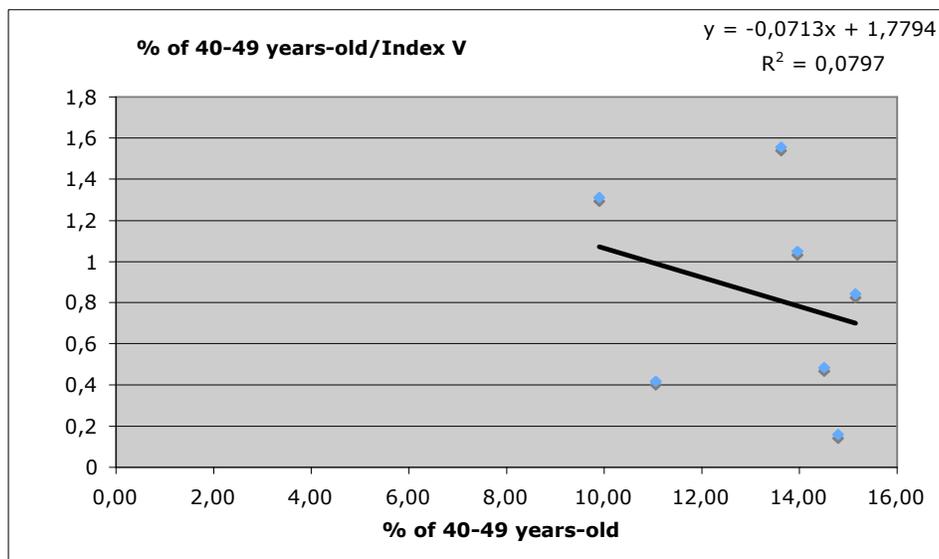
Figure 6. Correlation between the percentage of 40 to 49 years old and the vandalism mean with the calculated regression

The R^2s for the distribution of the 0-9, 10-19 and 20-29 years old are strong. This shows a significant correlation between age and vandalism levels. In the case of **Figures 5** and **6**, even if their R^2 is not significant, the direction of the regression line shows that production of vandalism tends to decrease after 40 years old. It is important to note here that those groups are fairly large. For further research, it would be important to look at data for each slice of 5 years instead of 10, as there are many biological and psychological changes that occur around 15 years old. In fact, as major sociological changes happen between 15 and 40, a 5 year measure would provide a better sense of the evolution of vandalism in a population.

In **Figure 7**, the R^2 is 0,8647, showing a strong relationship between the percentage of people who walk or drive a bicycle to go to work and the production of vandalism. Based on the direction of the regression line, vandalism tends to increase in districts with a higher percentage of people using those

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means of transportation. On the other hand, **Figure 8** suggests that a higher percentage of people driving to go to work will correlate with less vandalism.

Walk/bicycle to go to work

$y = 0,0301x + 0,2957$

$R^2 = 0,8647$

% of people walking or using bicycle
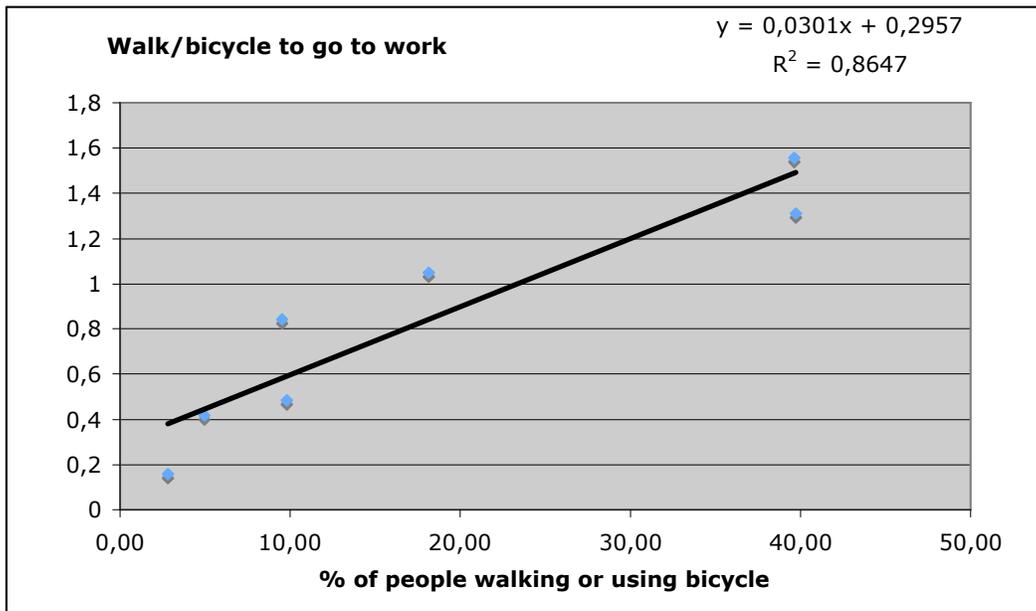
Figure 7. Correlation between the percentage of people walking or using a bicycle to go to work and the vandalism index with the calculated regression

People driving to go to work and vandalism

$y = -0,0188x + 1,7315$

$R^2 = 0,6451$

% of individuals driving to go to work
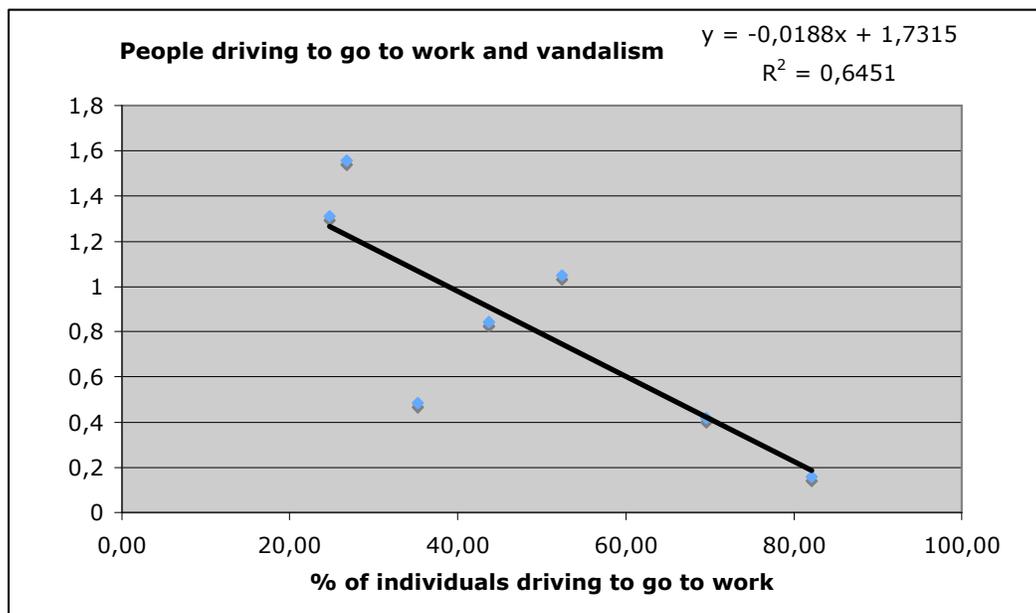
Figure 8. Correlation between the percentage of individuals driving to work and the vandalism index with the calculated regression

The category of marital status and types of families are displayed in **Figures 9** to **13**. All the scatter-plots have strong R^2s. According to the equations of each regression line, the amount of vandalism increases in districts with higher percentages of single individuals and common-law couples/families, but it decreases when percentages of married couples/families are higher.

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Common-law families and vandalism

$y = 0,0346x + 0,2533$

$R^2 = 0,8157$
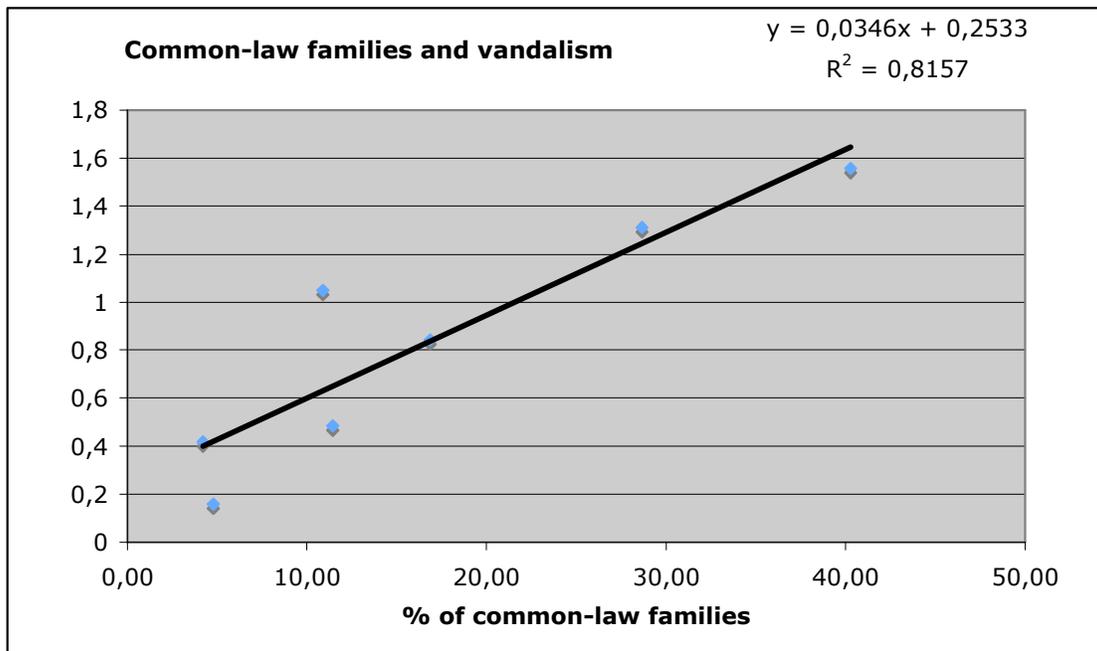
Figure 9. Correlation between the percentage of common-law families and the vandalism index with the calculated regression

Married couples and vandalism

$y = -0,0325x + 2,1604$

$R^2 = 0,7847$
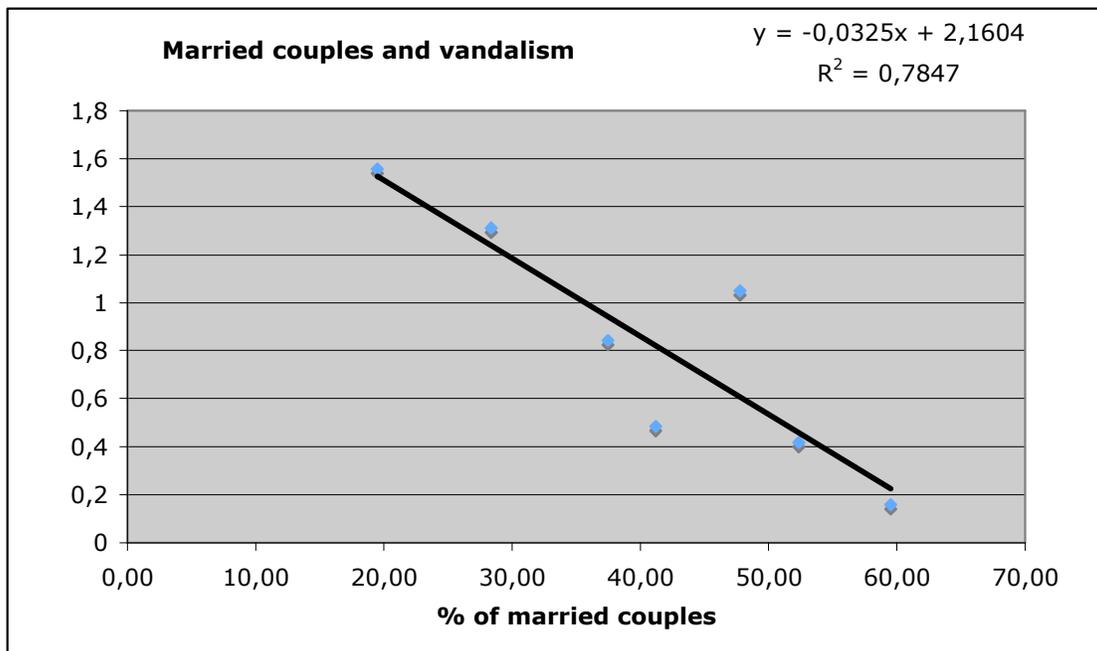
Figure 10. Correlation between the percentage of married couple and the vandalism index with the calculated regression

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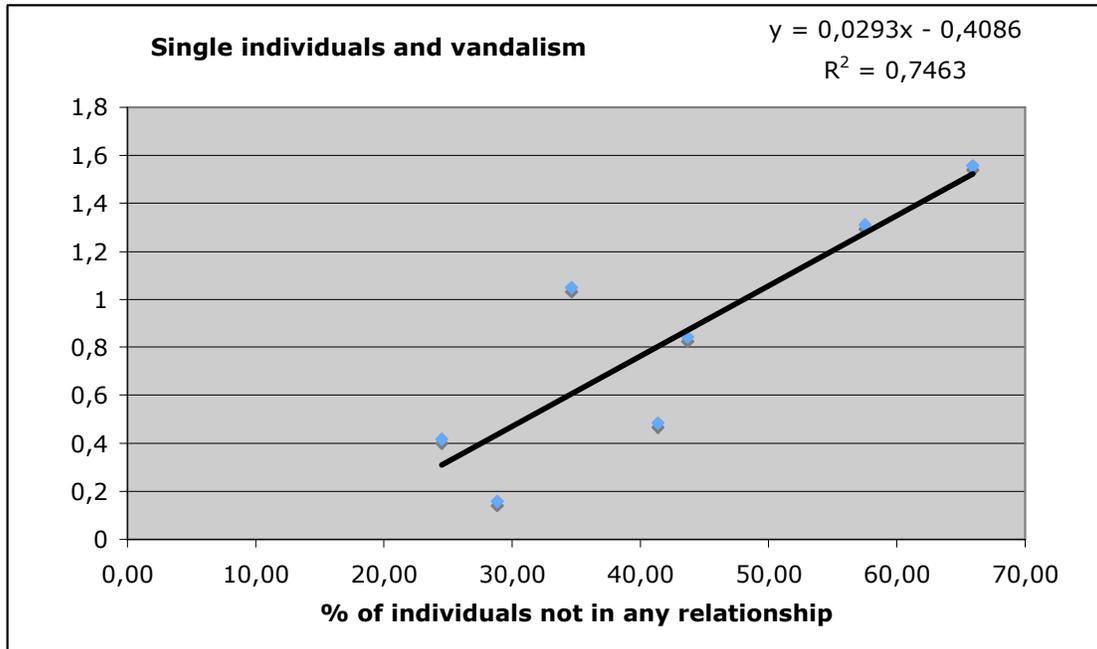
Figure 11. Correlation between the percentage of single individuals and the vandalism index with the calculated regression
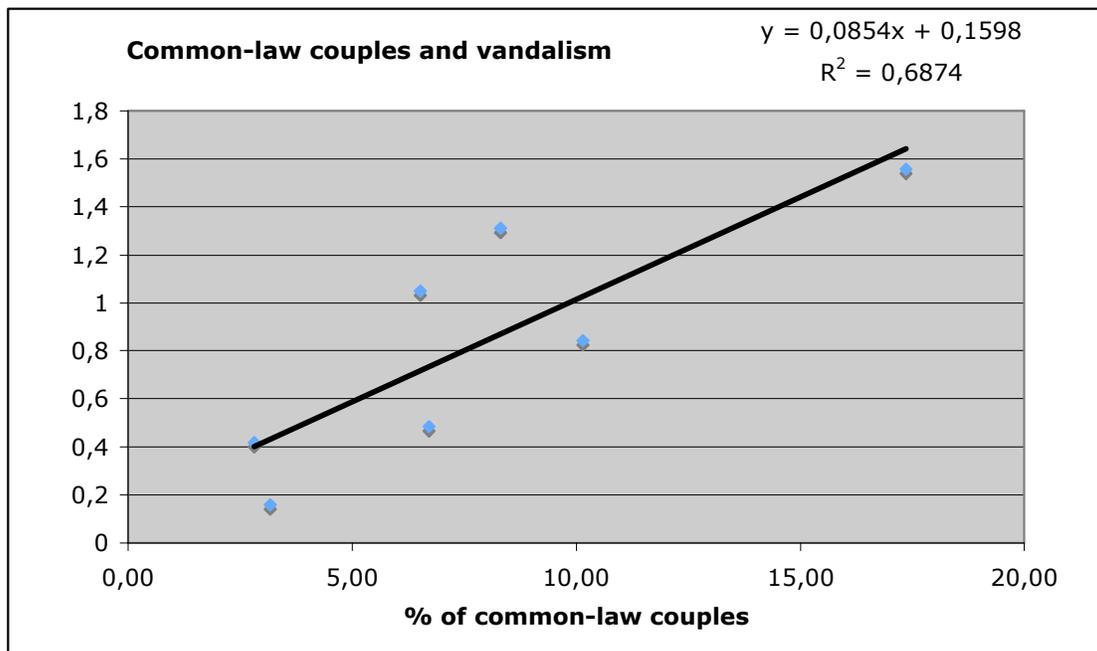
Figure 12. Correlation between the percentage of common-law couples and the vandalism index with the calculated regression
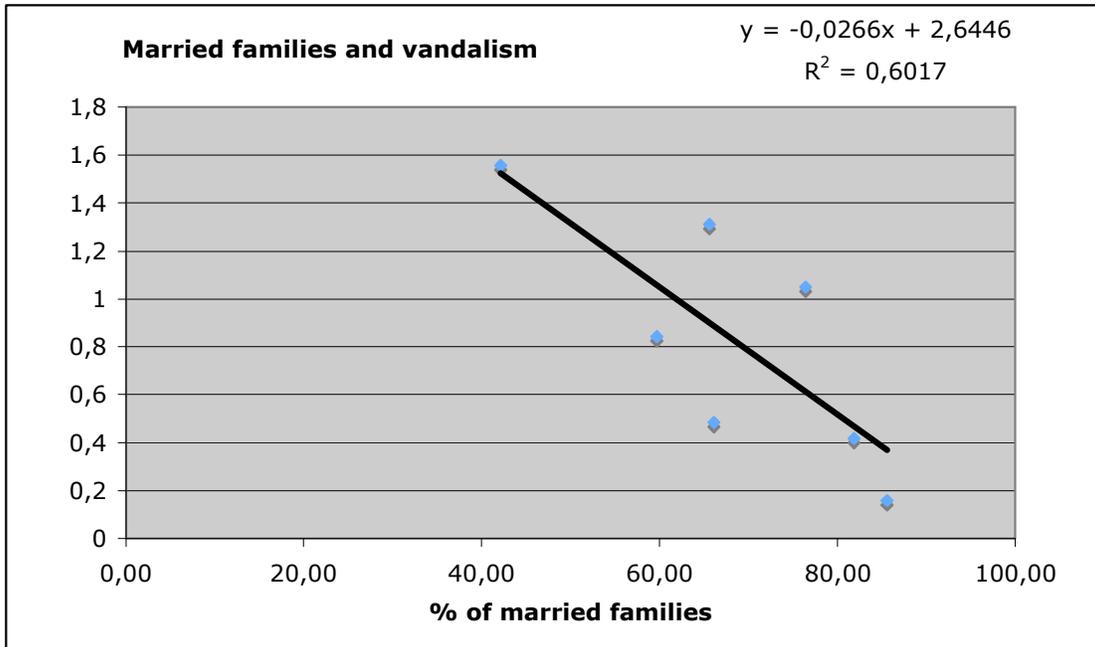
Figure 13. Correlation between the percentage of married families and the vandalism index with the calculated regression

As shown in **Figure 14**, there is a strong correlation between the percentage of individuals that have French as their mother tongue and the amount of vandalism. It seems that there is significantly more vandalism in French speaking areas.
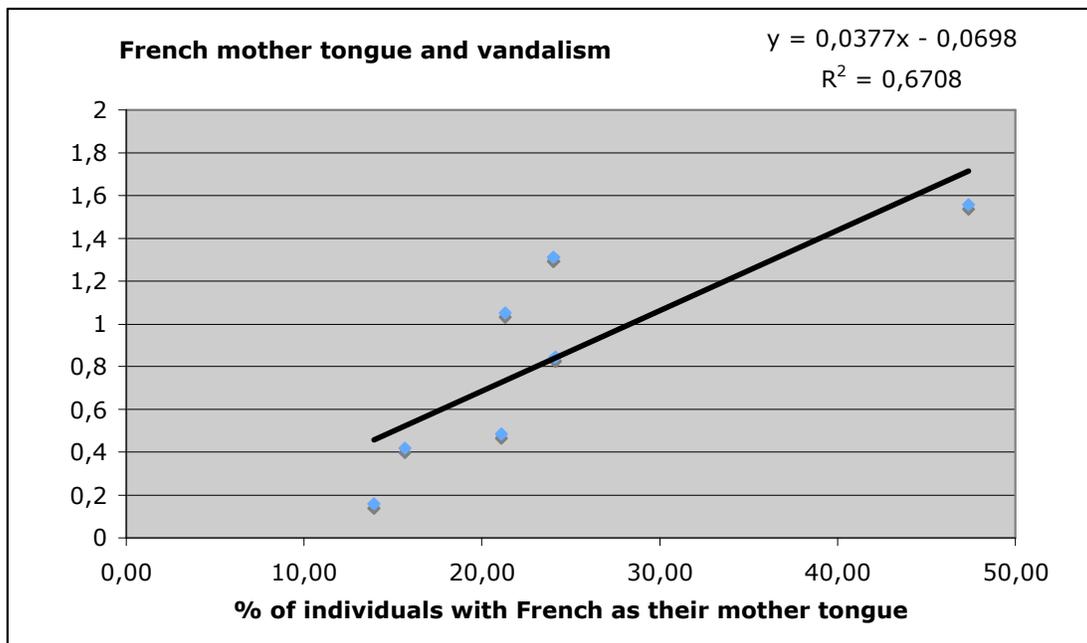
Figure 14. Correlation between the percentage of individuals with French as their mother tongue and the vandalism index with the calculated regression
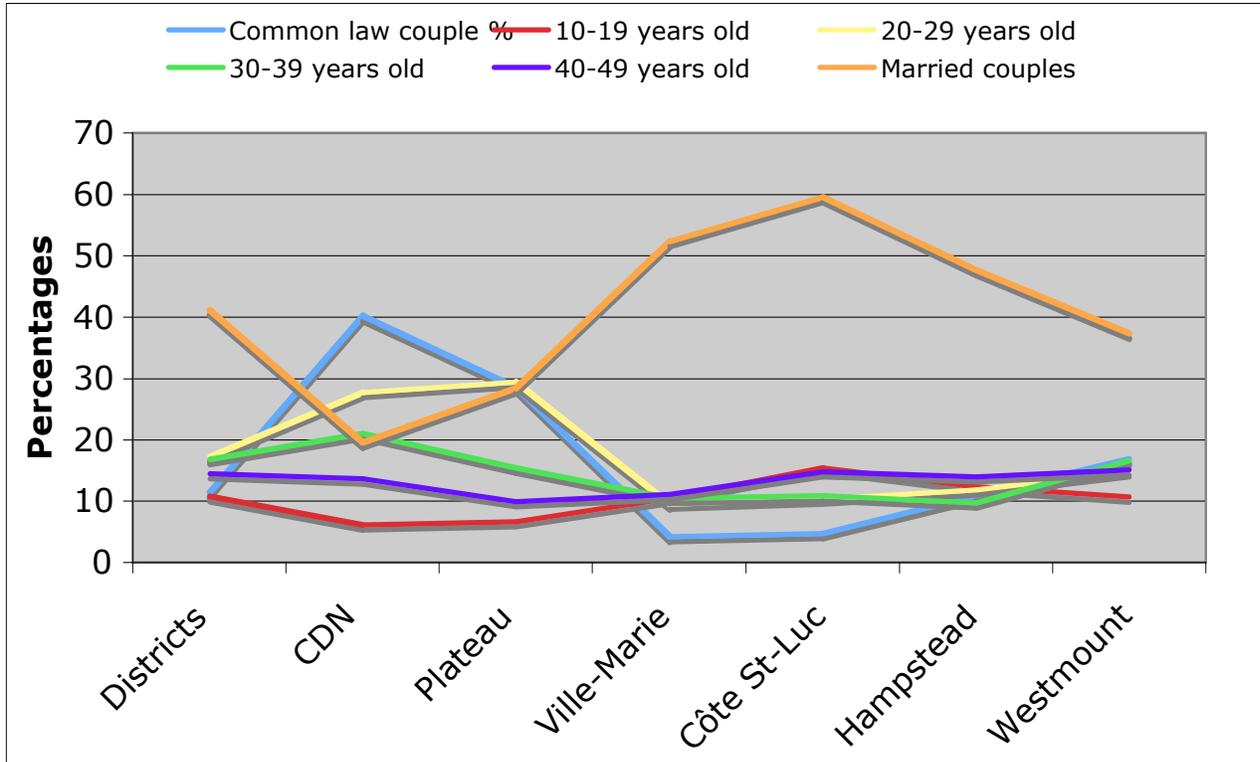
Figure 15. Linear distribution of 6 social aspects
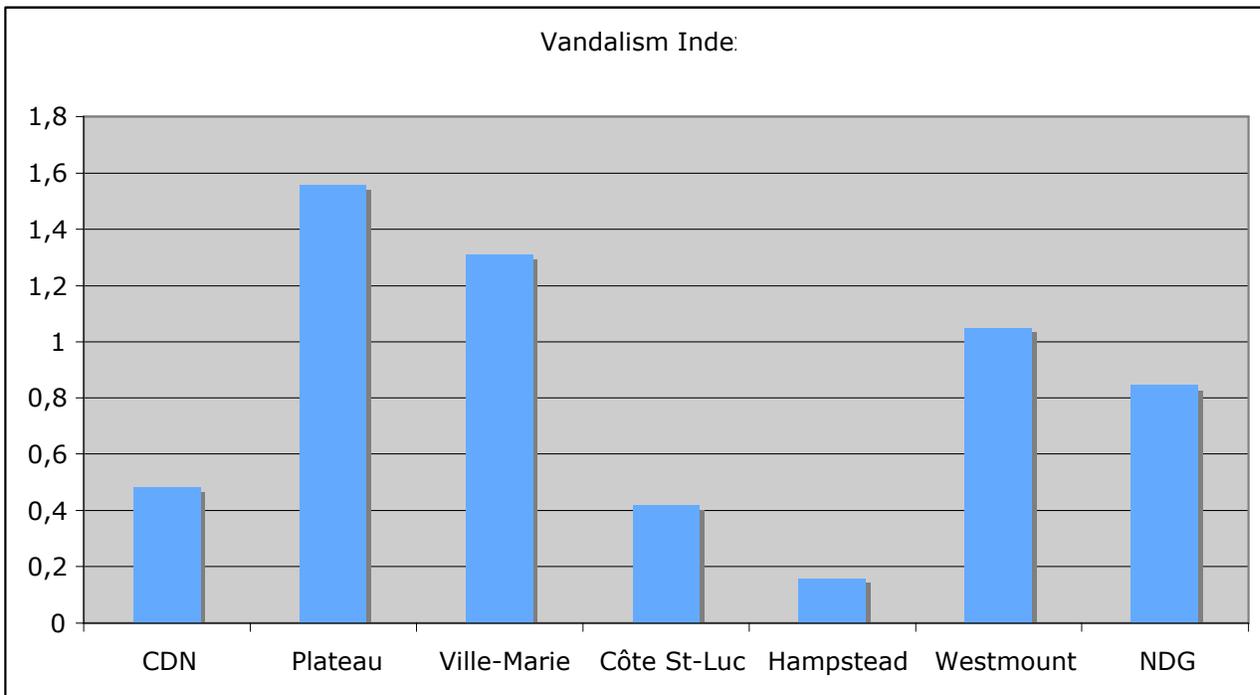
Figure 16. Vandalism Index by districts.

Discussion

At first glance, one could conclude that there are many social factors influencing the production of vandalism, however some of those can probably be explained due to additional factors. For example, **Figures 12** and **13** suggest that there is a difference between common-law and married couples. If we follow this assumption, individuals living in common-law couples/families are more likely to vandalise stop signs than people living in married couples/families. This result is surprising because, except for legal concerns, there is no notable difference between those two types of relationships. However, when we compare the distribution of certain age groups with the distribution of those marital statuses (**Figure 15**), we see that the distribution of common-law couples follows mostly the distribution of 20-29 and 30-39 years old, groups that were strongly associated with vandalism. On the other hand, the distribution of married couples follows more closely the older group, in which no trend for vandalism was discovered. Of course, this is only one explanation and it could be turned the other way around. It would not be sensible, however, to say that individuals younger than 20 and older than 40 years old are less inclined to vandalise because they are not in common-law relationships.

Looking at age groups, it seems clear that districts with higher percentages of young children have less vandalism. A social approach to this result would say that family-occupied neighbourhoods are usually secured by the presence of parents looking after their children's safety. This omnipresence of parents can dissuade vandals from acting in the neighbourhood. Starting from 20 years old, the situation changes. As shown in **Figures 4** to **6**, vandalism production is more frequent in populations with a high percentage of 20-40 years old. There are many explanations possible for those results, however the extent of the present research does not enable me to affirm anything. There are many factors that influence and change the behaviour of 20 to 40 year old individuals and more research needs to be done on this subject to pin-point what is most relevant. The only conclusion I can venture in this paper is that there seems to be a clear correlation between age and vandalism, but the causes for it are still undefined.

It is interesting to see that there seems to be no strong correlation between employment and vandalism (R^2s lower than 0,01). This contradicts the popular belief which dictates that employment leads to maturity and responsible behaviours. On the other hand, this result is not strong enough to support Ploeger's assumption saying that there is more delinquency in employed individuals than in unemployed ones (Ploeger 1997). In order to have more precise results on this question, we need to look at the age of employed/unemployed individuals, as a person that has been working for 40 years might be more responsible than one that started working a month ago.

The means of transportation seems to have a great impact on stop signs' vandalism. This is logical, as drivers do not usually stop in their route to vandalise stop signs. Walking individuals have many more opportunities to commit vandalism than drivers. If the trend seems clear for walking or driving, the question of public transportation causes problems. A logical assumption would be to expect an increase in vandalism in districts where the public transportation use is higher. This is true for the majority of districts, but it is the other way around in the two districts with the highest percentage of public transportation use (NDG and CDN) (**Appendix B**). This is a very strange result, for which I do not have an explanation yet.

Finally, there is the very interesting correlation suggesting that vandalism is higher in districts with a high percentage of French speaking population. Before creating controversy by saying that French speaking people are more inclined to vandalise stop signs, I have looked at the Vandalism Index by districts (**Figure 16**). The highest index value comes from Plateau Mont-Royal, which is a primarily French neighbourhood. However, if a majority of French individuals live there, it is not the same situation when we consider the nocturnal life of this district. The area covered in the Plateau includes the streets St-Laurent, St-Denis and Mont-Royal, three lively streets that are visited day and night by non-residents of the area. In particular, the bars of St-Laurent welcome daily many non-French individuals. As vandalism is usually performed at night, when the chances of being caught are smaller, we have to take

into consideration the fact that vandalism in the Plateau district might not have been done by residents, but by drunken bar hoppers from other districts. Moreover, it is important to note that the Plateau is the only French district included in the survey performed by the students. This is very likely to be a sample bias in which the only French area cannot be representative of all French districts. However, this is only an assumption, and it might be influenced by my personal biases towards French and English speakers. In order to see if there is actually more vandalism in French over English districts, the survey areas would need to be opened up to residential areas in the eastern parts of Montreal.

Due to time constraints, the present paper only gives an overview of the different social aspects that can influence the degree of vandalism produced in Montreal districts. In the need for more research precision, one should consider census data at a smaller scale. The same tests should be done looking at Census Tracts instead of districts to secure the correlations and enable a more precise analysis of the outliers. Moreover, as said earlier, the survey sample should be extended to French residential areas in order to have an equal distribution of both populations. Finally, one could look at the social aspects neglected in the present study, as there is always a possibility that they could tell us something about what incites individuals to vandalise stop signs.

References

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Appendix A: R^2 of linear regressions in correlations of social aspects and VF, VB and Index

Social aspects	VF R^2	trend	VB R^2	trend	Index R^2	trend	Equation (Index)
% Walk/Bicycle	**0,7027**	up	**0,7791**	up	**0,8647**	up	y = 0,0301x + 0,2957
% Common-law families	**0,5439**	up	**0,8637**	up	**0,8157**	up	y = 0,0346x + 0,2533
% 0-9 years old	**0,6609**	down	**0,6692**	down	**0,7858**	down	y = -0,1504x + 2,2213
% Married couples	**0,5676**	down	**0,7419**	down	**0,7847**	down	y = -0,0325x + 2,1604
% Single individuals	**0,5307**	up	**0,7182**	up	**0,7463**	up	y = 0,0293x - 0,4086
% Transportation other	**0,6403**	up	**0,5656**	up	**0,7212**	up	y = 0,6306x - 0,152
% Common law couples	**0,4307**	up	**0,7905**	up	**0,6874**	up	y = 0,0854x + 0,1598
% 10-19 years old	**0,4654**	down	**0,6614**	down	**0,6745**	down	y = -0,1299x + 2,1735
% Mother tongue French	0,3699	up	**0,8848**	up	**0,6708**	up	y = 0,0377x - 0,0698
% 20-29 years old	**0,471**	up	**0,5926**	up	**0,6492**	up	y = 0,0502x - 0,0356
% Car as driver	**0,5964**	down	**0,4485**	down	**0,6451**	down	y = -0,0188x + 1,7315
% Married families	0,3692	up	**0,6675**	down	**0,6017**	down	y = -0,0266x + 2,6446
% High school diploma	**0,6021**	down	0,2727	down	**0,4621**	down	y = -0,1363x + 3,4552
% Known French	0,0335	up	0,0699	up	0,3724	up	y = 0,0449x + 0,4187
% Car as passenger	0,2118	down	0,4139	down	0,3618	down	y = -0,1879x + 1,604
% 30-39 years old	0,1504	up	0,43	up	0,3384	up	y = 0,0707x - 0,1849
% Divorced	0,3469	up	0,1614	up	0,3168	up	y = 0,206x - 0,8112
% Mother tongue English	0,1817	down	0,3137	down	0,3118	down	y = -0,0183x + 1,5379
% Mother tongue both	0,4034	up	0,07	up	0,2723	up	y = 0,238x + 0,4835
% 60-69 years old	0,1324	down	0,2749	down	0,2552	down	y = -0,1225x + 1,9719
% Known English	0,0013	down	0,0963	down	0,2233	down	y = -0,0364x + 1,6892
Density per Km2	0,0838	up	0,3435	up	0,2214	up	y = 7E-05x + 0,3412
% Lone mother families	0,1423	up	0,1436	up	0,1838	up	y = 0,2788x + 0,1376
% Widow	0,1462	down	0,1439	down	0,1834	down	y = -0,061x + 1,2399
% University diploma	0,2886	up	0,0717	up	0,1687	up	y = 0,0253x - 0,2725
% 80+ years old	0,1095	down	0,1026	down	0,1371	down	y = -0,0514x + 1,1385
% 70-79 years old	0,0621	down	0,1438	down	0,1293	down	y = -0,081x + 1,3972
% Employment rate	0,019	up	0,2307	up	0,0931	up	y = 0,0258x - 0,6757
% 50-59 years old	0,0197	down	0,1229	down	0,0907	down	y = -0,1013x + 2,108
% Not in work search	0,0119	down	0,2247	down	0,086	down	y = -0,0244x + 1,7306
% 40-49 years old	0,0722	down	0,0529	down	0,0797	down	y = -0,0713x + 1,7794
% Employed	0,007	up	0,2072	up	0,0654	up	y = 0,0215x - 0,4128
% Public Transport	0,086	up	0,0083	up	0,0616	up	y = 0,0097x + 0,5525
% Non-employed	0,0191	up	0,0297	up	0,0471	up	y = 0,0716x + 0,4494
% No diploma	0,1544	down	0,001	down	0,0469	down	y = -0,0279x + 1,1569
% Known nor French nor Eng.	0,0183	up	0,01	up	0,0301	up	y = 0,0767x + 0,6724
% Lone parent families	0,0215	up	0,0064	up	0,0252	up	y = 0,016x + 0,5732
% Known French and English	0,0028	down	0,0196	down	0,0208	down	y = -0,0088x + 1,4052
Population working outside	0,029	up	1E-05		0,0191	up	y = 8E-06x + 0,7153
Population 15+ years old	0,0382	up	0,0026	down	0,0175	up	y = 4E-06x + 0,7155
% Unemployment rate	0,0172	down	1E-08		0,017	up	y = 0,0261x + 0,6119
% Married separated couples	0,0159	up	0,0016	up	0,0159	up	y = 0,1096x + 0,6018
% Lone father families	0,0141	up	0,0015	up	0,0152	up	y = 0,0144x + 0,6365
% Non-University diploma	0,0144	down	0,0223	down	0,0126	down	y = -0,0422x + 1,3992
% Apprenticeship diploma	0,0506	down	9E-05		0,0097	down	y = -0,0316x + 0,9875
% Mother tongue other	0,0006	down	0,052	down	0,0078	down	y = -0,0039x + 0,973
Families number	1E-06		0,054	down	0,0061	down	y = -7E-06x + 0,8942
Population	0,0218	up	0,0106	down	0,0018	up	y = 1E-06x + 0,7959

Appendix B: Correlation between percentage of individuals using public transport and vandalism index.

Public transport and vandalism
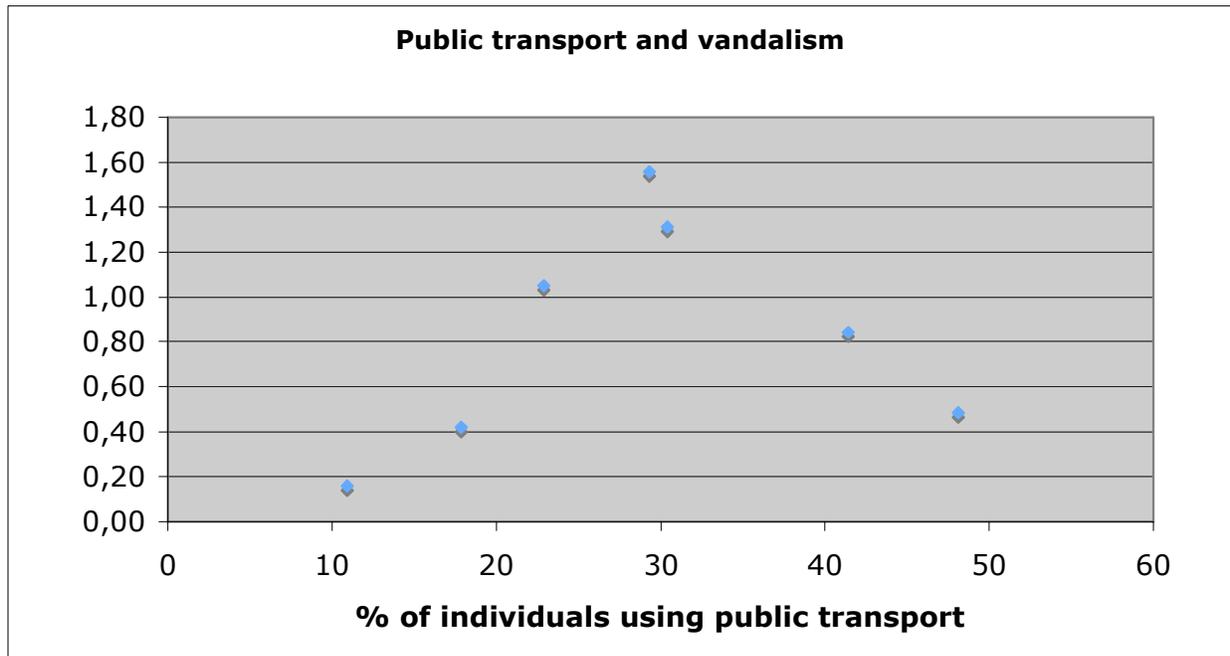
Appendix C: Means values for VF, VB and Index

	Mean VF	Mean VB	Index
CDN	0,20568928	0,07572383	0,483660131
Plateau	0,43835616	0,6803653	1,557077626
VM	0,48666667	0,34782609	1,311258278
CSL	0,1456044	0,13165266	0,418032787
Hamstead	0,07228916	0,01807229	0,158357771
WM	0,4573991	0,24752475	1,051282051
NDG	0,331189171	0,18006431	0,84244373

Appendix D: Frequencies of each level of vandalism classified by districts

Districts	Vandalism value	Frequency VF	Frequency VB	Sum FB
Plateau	0	154	133	287
	1	42	43	85
	2	15	23	38
	3	8	20	28
NDG	0	471	537	1008
	1	106	62	168
	2	35	19	54
	3	10	4	14
Hampstead	0	310	326	636
	1	20	6	26
	2	2	0	2
	3	0	0	0
Côte-St-Luc	0	334	326	660
	1	15	15	30
	2	7	16	23
	3	8	0	8
CDN	0	398	419	817
	1	37	26	63
	2	9	4	13
	3	13	0	13
Ville-Marie	0	210	237	447
	1	48	31	79
	2	28	20	48
	3	14	11	25
Westmount	0	311	414	725
	1	83	66	149
	2	35	16	51
	3	17	9	26