Journal of
Neurology, Neurosurgery
& Psychiatry

Profiling acquired pedophilia: retrospective analysis of 66 Italian forensic cases of pedophilia

Journal:	*Journal of Neurology, Neurosurgery, and Psychiatry*
Manuscript ID	Draft
Article Type:	Research paper
Date Submitted by the Author:	n/a
Complete List of Authors:	Ciani, andrea s.; University of Padova Scarpazza, Cristina; spedali civili of brescia, ; Cristina Scarpazza, Covelli, Valeria; University of Padova , FISPPA Battaglia, Umberto; University of Padova , FISPPA
Note: The following files were submitted by the author for peer review, but cannot be converted to PDF. You must view these files (e.g. movies) online.	
Supplem Material B_Database Pedofilia 13 December 2018.sav	

Profiling acquired pedophilia: retrospective analysis of 66 Italian forensic cases of pedophilia

Camperio Ciani AS[1*], Scarpazza C[2*], Covelli V[2], Battaglia U[2]

[1] Department of Philosophy, Sociology, Education and Applied Psychology, University of Padova, Padova, Italy

[2] Departiment of General Psychology, University of Padova, Padova, Italy

Corresponding author:

Prof. Andrea Camperio Ciani,

Department of Philosophy, Sociology, Education and Applied Psychology, Via Venezia 8, 35131 Padova, Italy

andrea.camperio@unipd.it

Dr. Cristina Scarpazza

Department of General Psychology, Via Venezia 8, 35131 Padova, Italy

cristina.scarpazza@unipd.it

Manuscript word count: 1633 words

Abstract:

Objective: Neurological disorders can be mis-diagnosed as psychiatric ones when the psychiatric symptoms are the predominant. This is often the case of pedophilia emerging as a symptom of brain insult (i.e. acquired pedophilia). The aim of this research is to identify a behavioral profile that might help clinicians and psychiatric consultants to identify defendants whose pedophilia is more likely to be the consequence of a neurological disorder.

Methods: Cluster hierarchical analysis on variables identified through a systematic review of the literature on cases of acquired pedophilia was applied to a new dataset including 66 italian closed cases of pedophilia. Stepwise regression analyses were carried out to further analyze the differences between the clusters identified in the cluster analysis.

Results: The sample was partitioned into two large clusters. Individuals with ascertained acquired pedophilia were grouped together. The two clusters widely differed for the prevalence of red flags (2.14±0.79 vs 4.96±0.93, $p<0.001$). Regression analysis provided a robust model that included the three most significant red flags that, together, explain over 64.5% of the variance (absence of masking, spontaneous confession and offenders older age).

Conclusions: An organic origin for pedophilia should be suspected if the red flags are present in a defendant charged with pedophilia: an in depth trans-disciplinary neuroscientific investigation is advocated. The behavioral profile identified might help to provide a proper assessment of defendants and might help judges to reach an informed decision on the defendant *mens rea,* reducing controversies and avoiding to punish people who need medical treatment.

Keywords: Pedophilic behavior, sexual preferences, child sexual offender, profiling, acquired pedophilia, cluster analysis, criminal justice.

"*If I were to order a general to fly from one flower to another like a butterfly, or to write a tragedy, or to change himself into a sea-bird, and if the general did not carry out the order, which one of us would be at fault?*"
The Little Prince

Introduction

Despite it is now widely known that neurological disorders are commonly associated with psychiatric symptoms, it is more difficult to accept that a number of neurological disorders, because of their predominantly behavioral and sometimes bizarre presentation, are often mistakenly diagnosed as psychiatric(1, 2). This is often the case of acquired pedophilia, a medical condition known by many years(3) that recently gained a lot of attention for its medical and legal consequences(4-7).

Acquired pedophilia differs from developmental pedophilic disorder in many aspects: etiology, underlying neural correlates, possible therapies, *modus operandi* and legal consequences.

While developmental pedophilic disorder is considered to be a psychiatric disorder included within the paraphilias in the DSM 5(8), present throughout the individual's life and without a clear etiology, acquired pedophilia emerges later in life as a consequence of a neurological condition with clear etiology (e.g. frontotemporal dementia(9), brain tumor(10), clivus chordoma(5), surgical lesions(11), hippocampal sclerosis(12)), thereby causing a "*behavioral fracture*" in the overt behavior manifested prior and after the brain disease insurgence (6, 13).

The neural basis of the two forms of pedophilic disorders are different as well. Developmental pedophilia is characterized by brain functional alterations without evident structural correlates(14). These alterations seem to be congenital or to emerge very early during life, encompassing brain regions involved in sexual arousal(15), such as the amygdale and the hypothalamus. On the contrary, evident structural brain alterations emerging later in life are pivotal for the diagnosis of acquired pedophilia. The neural network involved in the onset of this pathological behavior is still not fully understood, as it includes the right orbitofrontal cortex(10, 16), the right amygdale(11), the right globlus pallidus(12), the hypothalamus(3, 5, 17), the hippocampus bilaterally(12, 18), the basal ganglia bilaterally(12). These regions seems to be associated with a network involved in diminished behavioral control(14).

Regarding possible treatments, there is no evidence to suggest that developmental pedophilia can be changed. Instead, interventions are designed to increase voluntary control over sexual arousal, reduce sex drive, or teach self-management skills to individuals who are motivated to avoid acting upon their sexual interests(19). Contrarily, acquired pedophilia can theoretically be treated by treating the underlying medical condition. For instance, pedophilia can recede after surgical resection of the tumor causing it(5, 10).

Furthermore, the *modus operandi* widely differs between developmental and acquired pedophilia. While individuals suffering with developmental pedophilia try to mask their sexually abusing behavior, enforcing victim's silence and using psychological and physical violence(20, 21), individuals with acquired pedophilia usually do not attempt to disguise their criminal behavior(5, 6, 10, 12, 13). Another critical differences between the two is that developmental pedophiles actively search for victims, organize their action and, if caught, might deny their behavior(20, 22). Contrarily, individuals with acquired pedophilia usually lack of premeditation (5, 7). These behavioral differences probably reflect the impulse dis-control that characterize patients with acquired pedophilia(14).

Crucially, both the ability to understand the moral and social value of one's own action and the ability to exert control over impulses are pivotal to the capacity for self-determination. As individual with acquired pedophilia usually lack of these abilities, insanity becomes a relevant issue in these cases. For these reasons, individuals with acquired pedophilia are usually considered not fully liable for their pedophilic behavior, contrarily to developmental pedophilic individuals, whose legal consequences are severe.

Although the distinction between developmental and acquired pedophilic behavior seems to be easy basing on the description provided so far, the identification of an underlying medical or iatrogenic cause in a defendant presenting with pedophilia can be diagnostically challenging, thereby the importance of a trans-disciplinary approach has been advocated(13). Indeed, the neurological impairment causing pedophilia may pass unobserved without a neurological examination, as pedophilia might be the first overt symptom of a serious disease (e.g.(5, 10, 23)).

The aim of the current research is thus to identify a behavioral profile that might help clinicians and psychiatric consultants to identify defendants whose pedophilia is more likely to be the consequence of a neurological insult. In the cases identified as possible acquired pedophiles, an in-depth neuroscientific investigation, for instance including a brain magnetic resonance images (MRI), is advocated. To this aim, we systematically review the literature on acquired pedophilia in order to identify possible behavioral predictors of acquired pedophilia with the aim to create an *a priori* hypothesis on acquired pedophilia profiling. Using a falsificationist approach, the profile will be tested through additional analysis conducted using unsupervised methods on a new dataset of individuals convicted for pedophilia.

Methods

***Systematic Review*:** A systematic review of cases of acquired pedophilia was conducted with the aim to identify possible behavioral, clinical and demographic red flags of acquired pedophilia. The systematic review was conducted in accordance with the PRISMA guidelines(24). Papers were included in the subsequent analysis if they described new cases of late onset pedophilia emerging as a symptom of a neurological condition. The papers screening procedure is reported in the PRISMA flow chart available within the Supplementary Materials (A).

For each case of pedophilia identified in the literature, data regarding the demographic information, the clinical status, the modus operandi and the victimology have been extracted from the source literature. In particular, the demographic characteristics of the offender are recorded: gender, age, education, marital status, profession in contact with children. Regarding the clinical status, the presence of previous psychiatric symptoms (excluding the paraphilia) and the underlying neurological disorder responsible for acquired pedophilia have been recorded. Regarding the modus operandi, we included the following information: premeditation, attempt of masking, sense of guild, confession, previous criminal sex offense, severity of the abuse, length of the abuse, place of the abuse. Finally, regarding the victimology, the number and gender of the victims and the relationship between the offender and the victim were recorded. The variables that emerged as consistently reported in the literature are hereafter referred as "red flags", as our *a priori* hypothesis is that these variables will help in discriminating acquired from developmental pedophilia.

New Subjects: This study involves a retrospective cross-sectional study based on the re-analysis of closed criminal cases of pedophilia. As in Italy there is no archive for crimes and criminals such as the Violent Crime Linkage Analysis System (http://www.rcmp-grc.gc.ca/to-ot/cpcmec-ccpede/bs-sc/viclas-salvac-eng.htm), the authors asked the authorities the access to

access the criminal registry of four regional court archives in the North of Italy (i.e. Verona, Ferrara, Reggio Emilia and Padova). The access was granted to examine the court documentation related to closed cased of pedophilia. The authors signed a declaration agreeing to respect the privacy of the defendants and to not disclose any individual personal data. This research is conform with the Declaration of Helsinki and its later amendments, and was approved by the Ethical Committee of the Department of General Psychology, Padova, Italy.

Documentation regarding 76 closed cases of pedophilia occurred between 2005 and 2015 were collected. Five cases were subsequently excluded as the information available were not complete enough. Five additional cases were excluded as the offense was disconfirmed and the defendants were not charged with pedophilia. The final database thus included 66 cases of pedophilia involving a sexual offense against at least one victim aging 13 or younger, according with the most restrictive definition of pedophilia(15, 25). All the offenders were pursued by the law and convicted for pedophilia. For all the cases included, the same information regarding the demographic variables, clinical status, modus operandi and victimology collected for the systematic review were recorded as well and stored in a centralized dataset, available within the Supplementary Material (B).

Statistical analyses: In order to investigate whether acquired pedophilia can be identified basing on the data included in the centralized dataset, a hierarchical cluster analysis was performed using all the 17 variables listed in the "systematic review" paragraph. Cluster analysis is an unsupervised way of classification that requires no predefined classes and that is used to find hidden patters within the data. Cluster analysis generates classes basing on the correlation of relevant variables and it is considered to be the most adequate bottom-up method to find similarities between cases. Using cluster analysis, squared Euclidian distances were obtained using the Ward method(26). These Euclidian distances are subsequently used to identify relevant clusters based on minimal Euclidean distances between the selected variables.

In order to investigate possible between cluster differences in the red flags and variables prevalence, chi squared tests have been performed for each variable, using Cluster (1 or 2) as independent variable. Furthermore, correlation analyses for dichotomous variables were performed using the phi coefficient to investigate the association between all ref flags and variables that significantly differs between the two clusters. Correlations were considered significant if they survived the Bonferroni multiple comparison correction.

Finally, to further explore the differences between the two resulting clusters, a multiple regression analysis (stepwise method) was performed using the 17 variables. Because the model involves a step-by-step method, only the variables or predictors that increase variance explanation are included in the final model, and highly correlated variables are ignored.

Results

***Systematic Review*:** The systematic review identified 15 papers reporting original cases of acquired pedophilia(3, 5, 10-13, 16-18, 23, 27-31), including a total of 22 cases from 1972 to 2018. The cases included are summarized in the table available within the Supplementary Information (C).

All the offenders suffering with acquired pedophilia reported in the literature are men. They are >50 age in 17 out of 22 cases (77.27%), reflecting the insurgence of the neurological disorder during the senescence. The other demographic information are not completely reported, but 6 out of 9 (66.66%) patients have >8 years of education and 11 out of 14 (78%) are married. Interestingly, only 2 out of 9 (22.2%) have a profession that put them in contact with children.

Regarding the clinical status, 13 out of 16 (81.2%) of them have a negative history for previous psychiatric conditions, while 3 out of 16 previously suffered with major depression. Tautologically, all of them presented with a neurological condition that account for the insurgence of pedophilia (n=8 neoplasm; n=4 behavioral variant of the frontotemporal dementia; n=2 traumatic brain injury; n=1 bilateral hippocampal sclerosis; n=1 multiple sclerosis involving the orbitofrontal cortex; n=3 Parkinson's disease; n=1 frontal variant of Alzheimer's disorder; n=1 vascular dementia involving the globus pallidus; n=1 Huntington's disease).

Critically, the *modus operandi* is characterized by the absence of premeditation in all cases (10 out of 10), by the absence of tentative to mask the sexual assault (11 out of 12, 91.6%), by an immediate confession upon arrest (8 out of 8), by the presence of sense of guilt (6 out of 8, 75%) and by the absence of previous criminal sex offense (18 out of 18). The severity of the abuse ranged from no abuse at all (only pornography) to severe abuse with a complete sexual intercourse. The places where the sexual assault took place were heterogeneous as well as they ranges from the offender's house to open spaces.

The victimology is highly inconsistent between different cases as the number of victims range from 0 (pornography only) to many; the gender of the victim varies across cases. Finally, the sexual offenders could be relatives or stranger to the victims (n=9 strangers, n=8 relatives, n=1 neighbour; n=1 pediatrician).

Thus, the systematic review of the literature suggest a profile of acquired pedophilia characterized by old age, absence of previous psychiatric disorders and sex related crimes, absence of premeditation and masking, presence of spontaneous confession and sense of guilt. These seven out of 17 variables are hereafter referred as "red flags". We do not consider the presence of a neurological disorder as a way to profile acquired pedophilia because it would have been a circular reasoning.

New Subjects. Although we included cases of pedophilia involving a sexual offense against at least one victim aging 13 or younger, six of the individuals included in the study offended also pubescent victims aging 14 to 17 years.

Critically, out of 66 cases included in the new analysis, 7 refers to cases of ascertained acquired pedophilia and the juridical documentation was complete enough to identify the underlying neurological disorder and to assess the causal link between the neurological disorder and the pedophilia onset. These brain disorders included: 2 cases of behavioral variant of fronto-temporal dementia; 1 case of fronto-parietal meningioma; 1 case of neoplasm of the notochord; 1 case of ischemic stroke involving the left temporal lobe; 1 case of advanced dementia and 1 case of right temporal lobe atrophy. The neurological origin of pedophilia was recognized during the trial in these cases. For these 7 cases, the variable "presence of a neurological disorder" was positive, while for all the other cases included in the database (n=59), the same variable was negative as these offenders never received a neurological diagnosis because they were never tested for that.

Clusters analysis: The cluster analysis partitioned the sample in two large clusters, graphically represented in *Figure 1*, including a bigger cluster of 41 subjects (Cluster 1) and a smaller cluster of 25 subjects (Cluster 2). Notably, the seven offenders with ascertained acquired pedophilia clustered together in Cluster 2. Even more interestingly, the same seven offenders are not grouped together in a small, distinguishable cluster, but are homogeneously widespread across Cluster 2.

A t-test on the number of red flag in each cluster reveled that the two cluster widely differs for the number of red flags: Cluster 1 mean number of red flags = 2.14 (dev standard 0.79); Cluster 2 = 4.96 ± 0.93, two independent sample t-test=13.06, $p<0.001$.

Between Cluster differences: *Table 1* reported the prevalence of each variable in each cluster. The mean age in the two cluster is 40.7±10.6 and 55.3±13.8 for Cluster 1 and 2, respectively (two independent sample t-test= -4.92, p<0.001). Of note, six out of seven of the red flags identified throughout the systematic review were statistically more represented in the smaller cluster compared to the largest one. The only red flag whose prevalence did not differ between the two cluster relates to the absence of previous psychiatric disorders. This is likely to be due to the low prevalence of psychiatric disorders in the general population. Unexpectedly, a higher percentage of individuals classified in the second cluster rather than the first cluster is married. This is likely due to the lower prevalence of married individuals within the developmental group, reflecting their inherent paraphilia(15).

Correlations between variables and red flags: Correlation analyses were conducted between 7 red flags and one variable (being married). Thus, 28 correlations were performed setting the new statistical threshold to p=0.0017 (0.05/28). The results are reported in *Table 2*. Three correlations only resulted statistically significant: older defendant are characterized by lower premeditation (p=0.001); defendant who lack of premeditation are those who did not try to disguise their own acts (p=0.001); defendant who spontaneously confess their criminal acts are those who feel guilty (p<0.001).

Regression analysis: The multiple regression output presents a final model including the three most significant red flags and explaining 64.5% of the variance in the case distribution between Clusters 1 and 2. The first and most significant red flag is the Absence of masking, which explains 42.3% of the variance in the case cluster distribution. The second predictor is spontaneous confession, which explains the 13.1% of the variance. The last significant predictor in the model is age older than 50, which contributes to 9.1% of the variance. Results are reported in *Table 3*. The regression analysis did not include premeditation and sense of guilt. These red flags are however highly correlated with absence of masking and spontaneous confession, respectively, as reported in *Table 2*. The final interpretative model is represented in *Figure 2*.

Discussion

Results from the systematic review on acquired pedophilia cases led to suggest that individuals whose paraphilia emerged as a results of neurological disorders behave differently from individuals with developmental pedophilia. These observations are supported by the main analysis on a dataset of 66 juridical cases of pedophilia. Using an innovative combination of statistical methodologies, we have been able to draw a profile of individuals with acquired pedophilia based on information derived from previous medical evidences, offender's history and *modus operandi*. In particular, we identified six red flags of acquired pedophilia that can be summarized as follow: i) no evidence of masking or ii) no premeditation, and iii) no previous sexual criminal records, iv) spontaneous confession and a v) sense of guilt with an vi) age older than 50.

The following results are of particular relevance: first, the cluster analysis classified the offenders into two big clusters that widely differs in the number of red flags for each offenders; second, the offenders with ascertained acquired pedophilia are homogeneously widespread across the smaller cluster and no difference is evident between offenders included in this cluster besides the presence of a neurological disorder in offenders with acquired pedophilia and the absence of neurological disorder in offenders classified in the same cluster, who were never tested for the

presence of neurological disorders. This let us to speculate that those offenders had an unrecognized acquired origin for their pedophilic behavior.

Furthermore, the regression analysis provides a robust model that included the three most significant red flags that, together, explain over 64% of the variance (absence of masking, offenders older age > 50 and spontaneous confession). Finally, the correlation analysis highlights that different red flags are strongly correlated with the three main red flags emerged by the regression analysis. For instance, premeditation strongly correlates with absence of masking, both of which are the behavioral expression of impulse control disorder(7). In addition, Spontaneous confession strongly correlates with sense of guilt, as both of them pertain to the moral aspect of behavior and reflect a preserved moral judgment(7).

Expanding the functional meaning of the six red flags, two out of the six red flags are indicative of the acquired nature of the altered sexual interests: older age, absence of previous criminal sex offence. Older age, which is considered one of the most significant predictors, reflects the relative high prevalence of patients with late onset dementia in the acquired pedophilia group. Age is also an high risk factor for other neurological disorders, as brain tumors(32) and stroke(33). On the contrary, developmental pedophilia is characterized by an early onset(8, 34) and by a significant criminal comorbidities(34, 35).

Two out of the six red flags reflects the impulse discontrol that characterized acquired pedophiles(3, 5, 10, 11, 13): absence of premeditation and of tentative to disguise the criminal behavior. This explains their strong correlation. Indeed, if a behaviors is driven by the *hic and nunc* sexual impulse, it should appear dis-organized. For instance, these offenders assault the victim at hand in open spaces, occasionally even in front of possible witnesses. In contrast, the *modus operandi* of developmental pedophiles is usually characterized by a predatory, fully organized and premeditated behavior, for instance they lure the victim out of sight of parental control. In addition, a lot of effort is put on tentative to mask the sexual abuses enforcing victim's silence and using psychological and physical violence(20, 21).

The last two predictors, confession and sense of guilt, are slightly more difficult to interpret. Both of them might be explained by a spared moral judgment that would make the pedophilic behavior ego-dystonic(10, 11, 17, 31). In contrast, in developmental pedophilic disorder, the sexual attraction to children is perceived as ego-syntonic(36). However, at least in some cases, the juridical "ability to understand" is impaired as well(5, 13, 18, 29) and the defendants are not able to understand what is morally wrong. In this case they tend to easily confess their crime as they cannot see anything wrong in them, but the sense of guilt is absent. In one peculiar case(5, 6) upon arrest the defendant was completely incapable to understand the moral disvalue of his acts, but a strong sense of guilt emerged after the surgical resection of the tumor.

It is here important to underline that the presence of these red flags cannot lead to a clinical diagnosis of acquired pedophilia. Rather, their presence should prompt a rapid neuro-scientific evaluation including at least a brain imaging scan and a comprehensive neurological examination(6, 13). The adoption of this behavioral red flags as a way to profile acquired pedophilia might be extremely useful to better inform sentencing and to reduce controversies in forensic setting.

Study limitations

Despite the innovative approach adopted, this study is not devoid of drawbacks, first of all its cross-sectional retrospective nature due to the restrictions to data access that prevents the inclusion of the follow up data in the analysis. Thus, it is not possible to ensure whether the offenders classified in the same cluster as the acquired pedophilic individuals received a neurological diagnosis or not. Interestingly, these cases shared the same red flags of acquired

pedophilia, suggesting that their impulse control brain network is somehow disrupted. Despite the absence of follow up data is an insurmountable limitation, this makes the aim of the current paper even more important as it suggest that the prevalence of acquired pedophilia might be higher than expected. Future longitudinal studies should use the profile of acquired pedophilia described in this study to gradually improve knowledge on acquired pedophilia and integrate defendant's assessment and evaluation.

Conclusion

Identification of an underlying medical or iatrogenic cause in a defendant presenting with pedophilia can be diagnostically challenging(1). In the current paper we identified six red flags that could suggest an organic origin of pedophilia in a sexual offender. We therefore here suggest that any pedophilic cases presenting with i) no evidence of masking or ii) no premeditation, and iii) no previous sexual criminal records, iv) showing a confession and a v) sense of guilt with an vi) age older than 50, should receive further neurological investigation to assess the acquired rather than developmental nature of pedophilia. Four of these profiling elements are related to the crime (i.e. premeditation, absence of masking, sense of guilt and confession), one is demographic (i.e. offender's age over 50) and one is clinical (i.e. absence of previous sex offenses). As the current study is based on 66 cases, including only 7 cases of confirmed acquired pedophilia, the results should not be considered as conclusive. Clinical vigilance, meticulous observations of clinical progression and legally irrelevant symptoms (6) are of utmost importance for the diagnosis, management and legal implication of acquired pedophilia.

Authors Contributions: Prof. Andrea Camperio Ciani have full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design*: Andrea Camperio Ciani, Umberto Battaglia. *Acquisition, analysis, or interpretation of data*: All the authors. *Drafting of the manuscript*: Andrea Camperio Ciani, Cristina Scarpazza. *Critical revision of the manuscript for important intellectual content*: Umberto Battaglia, Valeria Covelli. *Statistical analysis*: All the authors. *Final approval of the version to be published:* All the authors.

Competing Interests: The authors declare to have no competing interests.

Funding/Support: This research was supported by DOR2016 and BIRD2017 funding from the University of Padova, Italy, awarded to Andrea Camperio Ciani.

Figures Caption:

Figure 1. Cluster Analysis results. The image represent the results of the cluster analysis: subjects were partitioned into two large clusters.

The higher row on the x axis denotes each case identification number. The numbers (ranging from 1 to 6) on the lower row on the x axis refers to the number of red flags that are present for each offender. Asterisk (*) denotes a offender's with confirmed acquired pedophilia as evidence of a neurological disorder was provided and a causal link between the neurological disorder and the pedophilic behavior has been assessed in each of them.

Figure 2. Final Interpretative Model. Diagram showing the link between the functional domains affected in acquired pedophilia and the red flags suggesting the suspect acquired pedophile profile.

On the middle column, the three predictors emerged from the stepwise multiple regression are represented; number denotes the percentage of individual contribution to regression variance. On the left side column the functional meaning of these red flags is highlighted. On the right side column, the red flags significantly correlated (after Bonferroni correction) with the three main ones are reported. On the horizontal lines the Phi correlation coefficients between the main red flags and the other one is reported.

Variable	Cluster1 n=41	Cluster2 n=25	Chi squared	p
Demographic features				
Older age (> 50 years)	8 (19.51%)	16 (64%)	13.28	<0.001
Low Educational level (<8 years)	39 (35.1%)	23 (92%)	0.226	0.606
Marital Status (Married)	13 (31.7%)	22 (88%)	19.75	<0.001
Profession in contact with children (yes)	5 (12.19%)	3 (12%)	0.002	0.981
Clinical Status				
Absence of previous psychiatric disorders	39 (95.12%)	24 (96%)	0.028	0.868
Ascertained neurological disorder	0	7 (28%)	13.28	<0.001
Modus Operandi				
Premeditation (no)	12 (29.26%)	20 (80%)	16.003	<0.001
Masking (no)	7 (17.07%)	21 (84%)	28.47	<0.001
Spontaneous Confession (yes)	1 (2.43%)	10 (40%)	15.77	<0.001
Sense of Guilt (yes)	0	8 (32%)	14.93	<0.001
Previous Criminal sex offenses (no)	21 (51.21%)	25 (100%)	17.49	<0.001
Abuse mild (yes)	14 (34.14%)	5 (20%)	1.51	0.218
Repeated Abuse (no)	24 (58.53%)	14 (56%)	0.41	0.840
Place of the abuses (public spaces)	11	9	0.618	0.432
Victimology				
Number of victims (>1)	12 (29.26%)	10 (40%)	0.805	0.370
Sex of the victims (assault to both genders)	10 (24.39%)	6 (24%)	0.001	0.971
Relationship with the victims (stranger)	5 (12.19)	5 (20%)	0.736	0.391

Table 1. Between Clusters Differences. Numbers represent the raw number (percentages). Red Flags (i.e. variables emerged from the systematic review of the literature as potentially useful to discriminate developmental from acquired pedophilic) are highlighted in grey.

	Older age	Marital Status	Absence of previous psychiatric disorders	Premeditation	Masking	Confession	Sense of Guilt	Previous Criminal sex offenses
Older age	1							
Marital Status	0.234	1						
Absence of previous psychiatric disorders	-0.014	-0.086	1					
Premeditation	-0.401	-0.245	-0.225	1				
Masking	0.013	0.316	0.254	-0.394	1			
Confession	0.085	0.258	0.098	-0.217	0.192	1		
Sense of Guilt	0.105	0.257	-0.081	-0.197	0.245	0.457	1	
Previous Criminal sex offenses	0.019	-0.172	0.144	0.310	-0.366	-0.206	-0.245	1

Table 2. Correlation analyses. Number denotes phi coefficient for dichotomous correlations. The colors denote the following: Blue = Correlation not statistically significant; Light red = statistically significant correlation at $p<0.05$; Dark Red = statistically significant correlation after multiple comparison correction.

Independent Variable	B	R^2 adj.	B stand.	t	Sig.
Masking Absent	.490	.423	.499	6.394	<0.001
Confession	.478	.554	.367	4.875	<0.001
Age	.233	.645	.318	4.140	<0.001

Table 3. Stepwise multiple regression analysis, final model, dependent variable *Cluster* , n. cases 66, 17 variables and predictors entered and removed from the resulting final model.

References:

1. Butler C, Zeman AZ. Neurological syndromes which can be mistaken for psychiatric conditions. J Neurol Neurosurg Psychiatry. 2005;76 Suppl 1:i31-8.
2. Keshavan MS, Kaneko Y. Secondary psychoses: an update. World Psychiatry. 2013;12(1):4-15.
3. Miller BL, Cummings JL, McIntyre H, Ebers G, Grode M. Hypersexuality or altered sexual preference following brain injury. J Neurol Neurosurg Psychiatry. 1986;49(8):867-73.
4. Farisco M, Petrini C. On the stand. Another episode of neuroscience and law discussion from Italy. Neuroethics-Neth. 2014;7:243-5.
5. Sartori G, Scarpazza C, Codognotto S, Pietrini P. An unusual case of acquired pedophilic behavior following compression of orbitofrontal cortex and hypothalamus by a Clivus Chordoma. J Neurol. 2016;263(7):1454-5.
6. Scarpazza C, Pellegrini S, Pietrini P, Sartori G. The Role of Neuroscience in the Evaluation of Mental Insanity: on the Controversies in Italy. Neuroethics-Neth. 2018;11(1):83-95.
7. Gilbert F, Focquaert F. Rethinking responsibility in offenders with acquired paedophilia: punishment or treatment? Int J Law Psychiatry. 2015;38:51-60.
8. Beech AR, Miner MH, Thornton D. Paraphilias in the DSM-5. Annu Rev Clin Psychol. 2016;12:383-406.
9. Mendez MF. The Unique Predisposition to Criminal Violations in Frontotemporal Dementia. J Am Acad Psychiatry. 2010;38(3):318-23.
10. Burns JM, Swerdlow RH. Right orbitofrontal tumor with pedophilia symptom and constructional apraxia sign. Arch Neurol. 2003;60(3):437-40.
11. Devinsky J, Sacks O, Devinsky O. Kluver-Bucy syndrome, hypersexuality, and the law. Neurocase. 2010;16(2):140-5.
12. Mendez M, Shapira JS. Pedophilic Behavior from Brain Disease. J Sex Med. 2011;8(4):1092-100.
13. Scarpazza C, Pennati A, Sartori G. Mental Insanity Assessment of Pedophilia: The Importance of the Trans-Disciplinary Approach. Reflections on Two Cases. Front Neurosci. 2018;12:335.
14. Mohnke S, Muller S, Amelung T, Kruger TH, Ponseti J, Schiffer B, et al. Brain alterations in paedophilia: a critical review. Prog Neurobiol. 2014;122:1-23.
15. Tenbergen G, Wittfoth M, Frieling H, Ponseti J, Walter M, Walter H, et al. The Neurobiology and Psychology of Pedophilia: Recent Advances and Challenges. Front Hum Neurosci. 2015;9:344.
16. Fumagalli M, Pravettoni G, Priori A. Pedophilia 30 years after a traumatic brain injury. Neurol Sci. 2015;36(3):481-2.
17. Frohman EM, Frohman TC, Moreault AM. Acquired sexual paraphilia in patients with multiple sclerosis. Arch Neurol. 2002;59(6):1006-10.
18. Mendez MF, Chow T, Ringman J, Twitchell G, Hinkin CH. Pedophilia and temporal lobe disturbances. J Neuropsychiatry Clin Neurosci. 2000;12(1):71-6.
19. Seto MC. Pedophilia. Annu Rev Clin Psychol. 2009;5:391-407.
20. Hall RC, Hall RC. A profile of pedophilia: definition, characteristics of offenders, recidivism, treatment outcomes, and forensic issues. Mayo Clin Proc. 2007;82(4):457-71.
21. Miranda AO, Corcoran CL. Comparison of perpetration characteristics between male juvenile and adult sexual offenders: preliminary results. Sex Abuse. 2000;12(3):179-88.
22. Fagan PJ, Wise TN, Schmidt CW, Jr., Berlin FS. Pedophilia. JAMA. 2002;288(19):2458-65.
23. Rainero I, Rubino E, Negro E, Gallone S, Galimberti D, Gentile S, et al. Heterosexual pedophilia in a frontotemporal dementia patient with a mutation in the progranulin gene. Biol Psychiatry. 2011;70(9):e43-4.
24. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339:b2535.
25. Frances A, First MB. Hebephilia is not a mental disorder in DSM-IV-TR and should not become one in DSM-5. J Am Acad Psychiatry Law. 2011;39(1):78-85.
26. Ward JH. Hierarchical Grouping to optimize an objective function. Journal of American Statistical Association. 1963;58:236-44.

27. Alnemari AM, Mansour TR, Buehler M, Gaudin D. Neural basis of pedophilia: Altered sexual preference following traumatic brain injury. Int J Surg Case Rep. 2016;25:221-4.
28. Gilbert F, Vranic A. Paedophilia, Invasive Brain Surgery, and Punishment. J Bioeth Inq. 2015;12(3):521-6.
29. Lesniak R, Szymusik A, Chrzanowski R. Case report: Multidirectional disorders of sexual drive in a case of brain tumour. Forensic Sci. 1972;1(3):333-8.
30. Regestein QR, Reich P. Pedophilia occurring after onset of cognitive impairment. J Nerv Ment Dis. 1978;166(11):794-8.
31. Solla P, Floris G, Tacconi P, Cannas A. Paraphilic behaviours in a parkinsonian patient with hedonistic homeostatic dysregulation. Int J Neuropsychopharmacol. 2006;9(6):767-8.
32. MacDonald BK, Cockerell OC, Sander JW, Shorvon SD. The incidence and lifetime prevalence of neurological disorders in a prospective community-based study in the UK. Brain. 2000;123 (Pt 4):665-76.
33. Bonita R. Epidemiology of stroke. Lancet. 1992;339(8789):342-4.
34. Hanson RK, Morton-Bourgon KE. The characteristics of persistent sexual offenders: a meta-analysis of recidivism studies. J Consult Clin Psychol. 2005;73(6):1154-63.
35. Stone TH, Winslade WJ, Klugman CM. Sex offenders, sentencing laws and pharmaceutical treatment: A prescription for failure. Behav Sci Law. 2000;18(1):83-110.
36. MacMartin C, Wood LA. Sexual motives and sentencing - Judicial discourse in cases of child sexual abuse. J Lang Soc Psychol. 2005;24(2):139-59.

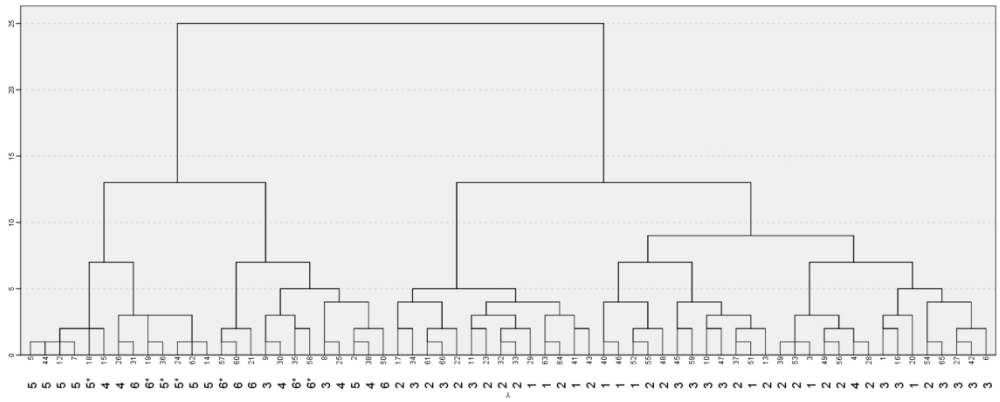


Figure 1. Cluster Analysis results. The image represent the results of the cluster analysis: subjects were partitioned into two large clusters.
The higher row on the x axis denotes each case identification number. The numbers (ranging from 1 to 6) on the lower row on the x axis refers to the number of red flags that are present for each offender. Asterisk (*) denotes a offender's with confirmed acquired pedophilia as evidence of a neurological disorder was provided and a causal link between the neurological disorder and the pedophilic behavior has been assessed in each of them.

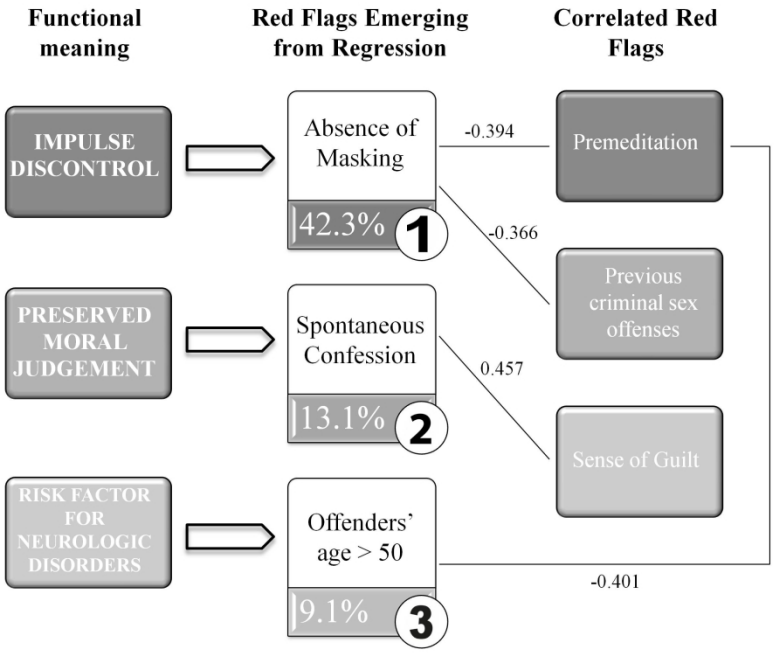
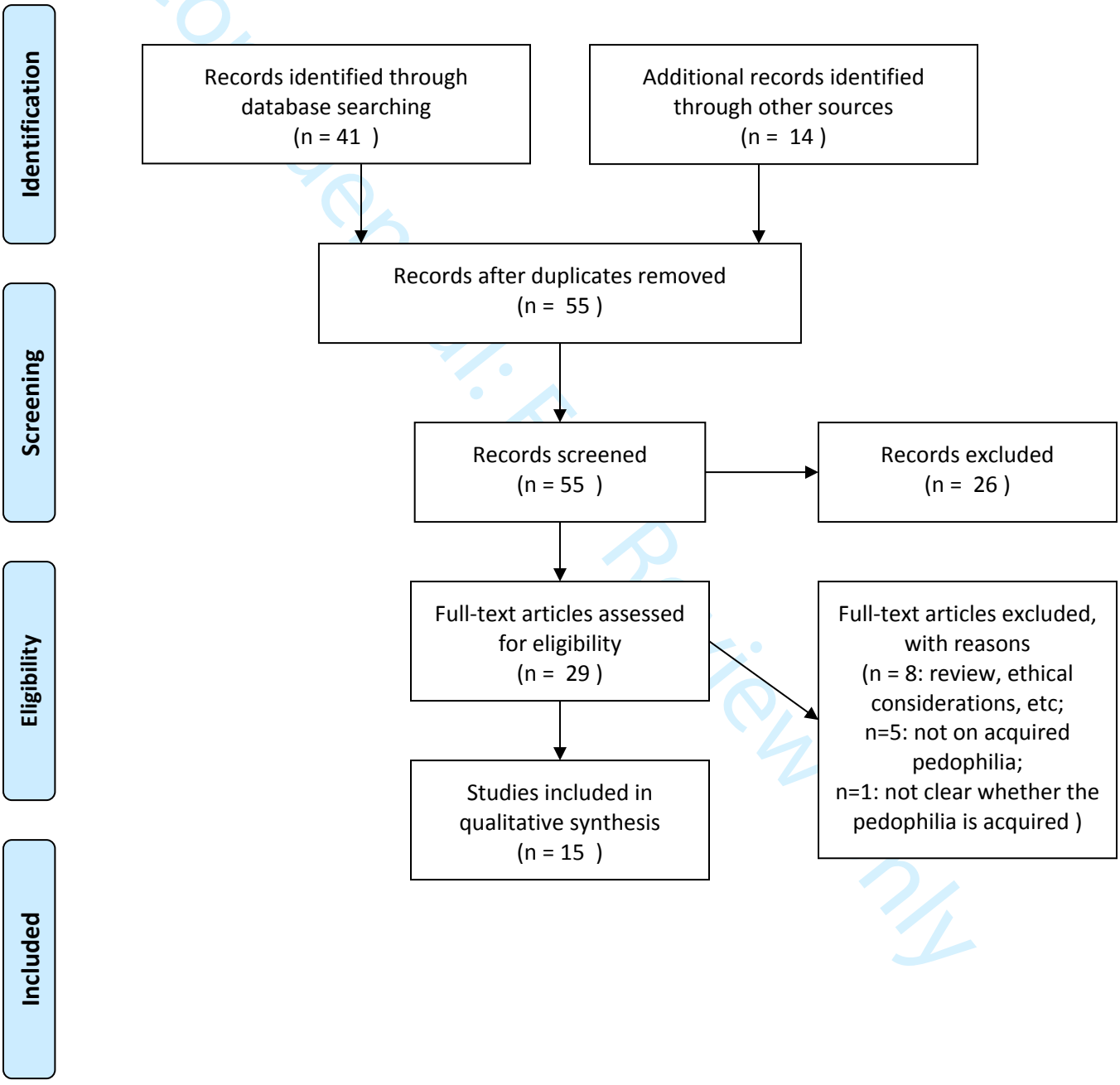


Figure 2. Final Interpretative Model. Diagram showing the link between the functional domains affected in acquired pedophilia and the red flags suggesting the suspect acquired pedophile profile. On the middle column, the three predictors emerged from the stepwise multiple regression are represented; number denotes the percentage of individual contribution to regression variance. On the left side column the functional meaning of these red flags is highlighted. On the right side column, the red flags significantly correlated (after Bonferroni correction) with the three main ones are reported. On the horizontal lines the Phi correlation coefficients between the main red flags and the other one is reported.

254x190mm (300 x 300 DPI)

PRISMA 2009 Flow Diagram
Profiling acquired pedophilia: retrospective analysis of 66 Italian forensic cases of pedophilia



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

SUPPLEMENTARY MATERIAL

Profiling acquired pedophilia: retrospective analysis of 66 Italian forensic cases of pedophilia

Table 1. The table summarizes the demographic and the clinical data of the acquired pedophiles described in the literature, their modus operandi and victimology.

MS = Multiple Sclerosis; FTD = Fronto-Temporal Dementia; TBI = Traumatic Brain Injury; OFC = Orbitofrontal Cortex; n/a = not available.

In light grey are highlighted the variables that we included in our profile of acquired pedophilia. In dark grey are highlighted deviations from the profile. Despite highly consistent across subjects, we did not include some variables in the profile for the following reason:

- Gender: all pedophiles are male. Thus, gender is not predictive of acquired pedophilia;
- Education: there is a slight prevalence of individuals with high education within the cases described. However, education is not causally linked with neurological disorders, thus we exclude any functional meaning of education;
- Marital Status: the majority of the cases described are married. As the majority of middle age/senescent man are married, being married could not be considered as predictive of acquired pedophilia;
- Ascertained neurological disorder: tautologically, all the patients included have an ascertained neurological disorder. Including this variable in our profile would have made the analysis circular, and would have been useless as we aimed to create a profile of acquired pedophilia to be useful when a neurological disorder has not been suspected yet.

Notes:

- Two cases out of eight described in Miller et al. 1986(1) were excluded as the patients presented with sexual alterations other than pedophilia;
- Three cases described in Regeistein et al. 1978(2) were excluded as the etiology of the pedophilia is not clear;
- Cases 1 and 8 described in Mendez & Shapira, 2011(3) are the same already reported in Mendez et al. 2000(4);
- the case described in Mendez et al. 2010 (5) was already described in Mendez et al. 2000(4).

	Miller et al. 1986(1)	Mendez et al. 2000 case 1(4);	Mendez et al. 2000 case 2(4)	Frohman et al. 2002(6)	Burns & Swerdlow, 2003(7)	Solla et al. 2006(8)	Devinsky et al. 2010(9)	Rainero et al. 2011(10)	Fumagalli et al. 2014(11)	Alnemari et al. 2016(12)	Sartori et al. 2016(13)	Scarpazza et al. 2018 case 1(14)	Scarpazza et al. 2018 case 2(14)
Demographic features													
Gender	Male	Male	Male	Male	Male	Male	Male	Male	Male	Male	Male	Male	Male
Age of the offender	50	60	67	36	40	62	51	49	63	Early 20	64	70+	60+
Education	n/a	>8	n/a	>8	>8	n/a	>8	n/a	n/a	n/a	>8 Medical degree	<8 years	<8 years
Marital Status	Married	Divorced	n/a	Unmarried	Married	Widower	Married	Married	n/a	n/a	Married	Married	Married
Profession in contact with children	n/a	No (college professor)	No (artist)	n/a	Yes (Schoolteacher)	n/a	No (pharmaceutical researcher)	n/a	n/a	n/a	Yes (pediatrician)	No (tradesman)	No (unemployed)
Clinical Status													
Previous psychiatric disorders	No	n/a	Yes: major depression; drug abuse	n/a	No	n/a	No	No	n/a	n/a	No	No	Yes: major depression
Ascertained neurological disorder	Neoplasm involving the pons, hypothalamus and thalamus	Behavioral variant FTD	Bilateral Hippocampal sclerosis	MS involving OFC	Right OFC tumor	Parkinson's disease	Gangoglioma; amygdalotomy for surgical removal	Behavioral variant FTD	Ventromedial frontal TBI	Temporal TBI	Clivus Chordoma	FTD	Brain Tumor
Modus Operandi													
Premeditation	No	No	n/a	n/a	No	No	No	n/a	n/a	n/a	No	No	No
Masking	No	No	n/a	No	Yes	No	No	n/a	n/a	n/a	No	No	No
Confession	n/a	Yes	n/a	n/a	Yes	Yes	Yes	n/a	n/a	n/a	Yes	Yes	Yes
Sense of Guilt	n/a	No	n/a	Yes	Yes	Yes	Yes	n/a	n/a	n/a	No	Yes	No
Previous criminal sex offense	No	n/a	n/a	No	No	No	No	n/a	n/a	n/a	No	No	No
Severity of the abuse	Mild	Mild	Moderate	n/a	n/a	Mild	Mild	n/a	n/a	n/a	Mild	Mild	Mild
Length of the abuse	Not prolongued	Last 18 months	Last 24 months	Not prolongued	n/a	Not prolongued	n/a	n/a	n/a	n/a	Not prolongued	Not prolongued	Not prolongued
Place of the abuse	Open space	Open spaces	n/a	Movie theater	n/a	n/a	n/a	n/a	n/a	n/a	School	Movie theater	Open space
Victimology													
Number of victims	>2	>2	2	2	n/a	1	n/a	1	2	n/a	7	2	>2
Sex of the victims	female	Both genders	Males	female	n/a	Female	n/a	Female	Males	n/a	Females	Males	Both genders
Relationship with the victims	Familiar and stranger	Familiar and stranger	Stranger	Stranger	Familiar	Granddaughter	n/a	Father	n/a	n/a	Professional	Stranger	Stranger
Notes	n/a	n/a	n/a	n/a	Pedophilia receded after surgical removal	Side effect of drugs to treat Parkinson's	n/a	n/a	n/a	Increased sexual interest with NO acts	Pedophilia receded after surgical removal	n/a	n/a

	Lesniak et al. 1972(15)	Regestein et al. 1978 Case 1(2)	Mendez & Shapira, 2011 Case 2(3)	Mendez & Shapira, 2011 Case 3(3)	Mendez & Shapira, 2011 Case 4(3)	Mendez & Shapira, 2011 Case 5(3)	Mendez & Shapira, 2011 Case 6(3)	Mendez & Shapira, 2011 Case 7(3)	Gilbert & Vranic, 2015(16)
Demographic features									
Gender	Male	Male	Male	Male	Male	Male	Male	Male	Male
Age of the offender	60	56	67	76	82	59	32	59	48
Education	3 years	>8	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Marital Status	Married	Married	Married	n/a	n/a	n/a	n/a	Married	n/a
Profession in contact with children	No (farmer)	No (musician)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Clinical Status									
Previous psychiatric disorders	No	No	No	No	No	Yes: depression	No	No	No
Ascertained neurological disorder	Neoplasm in the right OFC	Meningioma involving the right frontal lobe	Behavioral variant of FTD	Frontal variant of Alzheimer's	Vascular Dementia involving the globus pallidus	Parkinson's disease (addition of pramipaxole)	Huntington's disease (atrophy of the striatum)	Pallidotomy for Parkinson's disease	Tumor in the left frontal lobe
Modus Operandi									
Premeditation	n/a	n/a	n/a	No	n/a	n/a	No	n/a	n/a
Masking	No	n/a	n/a	No	n/a	n/a	No	n/a	n/a
Confession	No	n/a	n/a	n/a	n/a	Yes	n/a	n/a	n/a
Sense of Guilt	No	n/a	n/a	n/a	n/a	Yes	n/a	Yes	n/a
Previous criminal sex offense	No	No	No	No	No	No	No	No	n/a
Severity of the abuse	Severe (complete sexual intercourse)	Not Clear	Mild (sexual advances)	Mild (touching; inappropriate comments)	n/a	Mild (only pornography)	Mild (inappropriate touch)	Mild (inappropriate touch)	n/a
Length of the abuse	n/a	n/a	n/a	n/a	n/a	n/a	Not prolonged	Not prolonged	n/a
Place of the abuse	n/a	n/a	n/a	Open spaces	n/a	n/a	House	n/a	n/a
Victimology									
Number of victims	>2	>2	>1	>2	n/a	noone	1	1	1
Sex of the victims	Both genders	Both genders	Females	Both genders	n/a	n/a	Female	Female	Female
Relationship with the victims	Father and stranger	Familiar and stranger	Grandfather	Neighbors	Grandfather	n/a	Stranger	Granpdphather	Stepfather
Notes	n/a	n/a	n/a	n/a	n/a	Pedophilia resolved after discontinuation of pramipaxole	n/a	n/a	Pedophilia receded after surgical removal

References

1. Miller BL, Cummings JL, McIntyre H, Ebers G, Grode M. Hypersexuality or altered sexual preference following brain injury. J Neurol Neurosurg Psychiatry. 1986;49(8):867-73.
2. Regestein QR, Reich P. Pedophilia occurring after onset of cognitive impairment. J Nerv Ment Dis. 1978;166(11):794-8.
3. Mendez M, Shapira JS. Pedophilic Behavior from Brain Disease. J Sex Med. 2011;8(4):1092-100.
4. Mendez MF, Chow T, Ringman J, Twitchell G, Hinkin CH. Pedophilia and temporal lobe disturbances. J Neuropsychiatry Clin Neurosci. 2000;12(1):71-6.
5. Mendez MF. The Unique Predisposition to Criminal Violations in Frontotemporal Dementia. J Am Acad Psychiatry. 2010;38(3):318-23.
6. Frohman EM, Frohman TC, Moreault AM. Acquired sexual paraphilia in patients with multiple sclerosis. Arch Neurol. 2002;59(6):1006-10.
7. Burns JM, Swerdlow RH. Right orbitofrontal tumor with pedophilia symptom and constructional apraxia sign. Arch Neurol. 2003;60(3):437-40.
8. Solla P, Floris G, Tacconi P, Cannas A. Paraphilic behaviours in a parkinsonian patient with hedonistic homeostatic dysregulation. Int J Neuropsychopharmacol. 2006;9(6):767-8.
9. Devinsky J, Sacks O, Devinsky O. Kluver-Bucy syndrome, hypersexuality, and the law. Neurocase. 2010;16(2):140-5.
10. Rainero I, Rubino E, Negro E, Gallone S, Galimberti D, Gentile S, et al. Heterosexual pedophilia in a frontotemporal dementia patient with a mutation in the progranulin gene. Biol Psychiatry. 2011;70(9):e43-4.
11. Fumagalli M, Pravettoni G, Priori A. Pedophilia 30 years after a traumatic brain injury. Neurol Sci. 2015;36(3):481-2.
12. Alnemari AM, Mansour TR, Buehler M, Gaudin D. Neural basis of pedophilia: Altered sexual preference following traumatic brain injury. Int J Surg Case Rep. 2016;25:221-4.
13. Sartori G, Scarpazza C, Codognotto S, Pietrini P. An unusual case of acquired pedophilic behavior following compression of orbitofrontal cortex and hypothalamus by a Clivus Chordoma. J Neurol. 2016;263(7):1454-5.
14. Scarpazza C, Pennati A, Sartori G. Mental Insanity Assessment of Pedophilia: The Importance of the Trans-Disciplinary Approach. Reflections on Two Cases. Front Neurosci. 2018;12:335.
15. Lesniak R, Szymusik A, Chrzanowski R. Case report: Multidirectional disorders of sexual drive in a case of brain tumour. Forensic Sci. 1972;1(3):333-8.
16. Gilbert F, Vranic A. Paedophilia, Invasive Brain Surgery, and Punishment. J Bioeth Inq. 2015;12(3):521-6.