

12th June 2006

Dear Sir,

I am a Forensic Document Examiner completing a Masters in Forensic Science with the University of Western Australia. My thesis deals with a number of issues relating to graffiti tags. Tags are a representation or an artistic version of an individuals name or pseudonym.

My thesis aims to create a nexus between traditional handwriting examinations and graffiti tags by providing empirical data on the similarity of the spatial properties of tags compared to handwriting. Matrix Analysis, a software package developed specifically for Forensic Document Examinations, calculates a number of spatial measurements allowing the grouping of tags. When an offender is apprehended these tags can be compared and other offences linked to an individual. The research also aims to validate the evidential value of expert testimony given by Forensic Document Examiners. This will be achieved by a number of examiners from Australian and New Zealand government laboratories taking part in a barrage trial in which they are required to determine the authorship and process by which a tag was competed.

Graffiti taggers produce multiple images of their stylised signature on both public and private property causing an estimated \$300 million dollars worth of damage per year in Australia. As the behaviour results in criminal damage there is world wide interest in the mechanism by which traditional handwriting techniques may be applied to the images for the purpose of identifying the individual responsible.

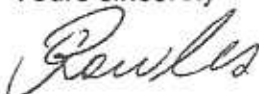
Rapid removal and other widely used techniques used to deter graffitists only have a limited effectiveness. Latest research shows that some graffitists are grateful for the rapid removal of graffiti at hot spots as it provides them with a 'clean canvas' to work on. Close circuit televisions installed on buses and trains are apparently sought as they add to notoriety.

By creating and providing techniques, which will maximise the effects of new legislation and tougher penalties, there is an opportunity to reduce the effects of graffiti in our community.

As a resident of the Shire of Joondalup I would be proud to have the research continued here and for the benefits of this study to flow directly into our community.

Thank you for your time and consideration of the attached proposal.

Yours sincerely



Genevieve Rowles

Research Proposal
Graffiti Tagging Behaviour and It's Forensic Identification

Applicant Organization and Contact Details

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Amount Requested and Grant Term

2 years

Background of Forensic Document and Handwriting Examinations

The discipline of Forensic Document Examination (FDE) involves the comparison and or examination of documents and handwriting. It is undertaken for the purpose of determining whether any evidence exists that may assist the judicial process in the determination of the methods by which questioned documents have been manufactured, altered or authored. (Osborn, 1929; Harrison 1958; Conway, 1959; Hilton, 1982; Ellen, 1989; Huber & Headrick, 1999).

Handwriting is a complex, well organised, over learnt, goal directed behaviour. Motor programs are created and updated with sensory feedback during the learning process through repetition and practice. Therefore handwriting features once learnt tend to remain constant within an individual. The complex movements required to produce a word or letter trace are differentially transferable between muscle sets not normally associated with writing tasks.

Due to the complexities of a cognitive method in dealing with behavioural evidence, there is a need to provide empirical data regarding all possibilities of authorship and process. Determination of whether handwriting was completed naturally or was simulated or copied is part of an FDE's examination. Even if an author cannot be determined in a signature examination the process can be.

Preliminary investigations into the styles of graffiti have reiterated the desire by artists to be recognized within the graffiti subculture. This desire to be

recognized creates competition between writers to develop their own individual style. If there are enough distinguishing features between different tags it may be possible to link different tags completed by the same graffitist. However until research is undertaken to make these determinations it will remain unknown.

Past research into graffiti purports no desire by graffitists to forge another's tag as the main purpose behind tagging is for an individual to become known. There is no doubt that under current penalties and if penalties are increased, defense counsel acting on behalf of graffitists will deny other incidents of graffiti. By providing a research base, this aspect could be refuted. The evidence would also provide validation to the expertise used to link tagging offences.

There is also the question as to whether a graffitist should be penalized if someone has forged their tag to get them into trouble. Graffiti research to date has been quite repetitive, focusing on crime prevention or juvenile justice / youth issues. Recent research has highlighted changes in the subculture "Graffiti crews, for most parts, are more sophisticated than ordinary gangs as there exists a strong hierarchical structure and these members are becoming much more organized encompassing politics, technology (Internet), the railways and media" (Hintz & Pybus, 2003, p.5). The subculture is constantly adapting to advances in technology and policing, they have access to an array of information on how to tag without getting caught. It is imperative that scientific research into graffiti tagging is conducted thoroughly. All alternative hypothesis need to be disproved before one is accepted. To link tags forensically the possible explanation that a tag has been simulated needs to be disproved.

Research to provide scientific evidence and in some cases databases to support the underlying principles of variation, frequency and individuality have been undertaken and commented upon (Welch, 1999; Sita & Rogers, 2002; Sita, Rogers & Found, 2002; Srihari, 2002).

This research is cutting edge as nobody has done any research into validating a graffiti tag database. Here we have opportunity not only to build a database but to test it as well using the following experiments.

Aims of Research

- To determine whether a Forensic Document Examiner can identify a tag as genuine or simulated
- To determine if Forensic Document Examiner's can link multiple tags to an individual or identify the author
- To create a database of tags

Questions of Research

1. Can non professionals determine genuine and non genuine tags with the same expertise as FDE's?
2. Can graffiti tags be compared to handwriting?
3. Can acid glass etchings be compared to tags and/or handwriting?

Research Methodology

Experiment One

Five graffitist volunteers will write ten repetitions of their tag on seven different sized pieces of paper. The smaller tags will be written in ballpoint pen, the medium sizes will be written with a marker pen and the larger sized tags will be spray painted.

Two of these tags will be chosen to be copied. One of the tags chosen will represent a more complex or skilled tag and the other tag will be a simple or less skilled tag. Three of the original graffitists and eight lay people will be asked to copy each of the chosen two tags ten times each. This will be repeated on two different sized pieces of paper, one with a marker and one with spray paint

A handwriting examination, conducted following an accepted methodology, will be undertaken on the genuine tags. The construction features of each tag, at each of the different sizes will be recorded.

Matrix Analysis is a computer software package which calculates spatial consistency in and between samples. After a set of predetermined points are selected in the tag the software will automatically perform calculations. The program generates the line length ratios in a two step process. In the first step it calculates a set of line lengths from the points. In the second step it calculates a set of ratios from the line lengths.

Both steps are effectively generating the set of paired combinations (not permutations as repetitions of length or ratios are unwanted) for the population. Computationally the program does this by starting at point 1, pairing this with each subsequent number, stepping to point 2 and pairing this with each subsequent number and so on until it runs out of numbers to pair. Between 25000 and 50000 calculations are performed and approximately 18000 ratios are determined. Matrix Analysis also calculates natural variation between each repetition of each tag at each size.

The copies made by both the taggers and lay people will be analyzed as above. The results from the software concerning the spatial consistency of these copies will be compared between taggers and lay people, to determine whether taggers ability affects the copying process.

Using genuine and copied tags a validation trial will be constructed. This trial will contain a number of sample genuine tags to be compared to a mixture of fifty genuine and copied tags. Fifteen FDE's and fifteen lay people will be asked to complete the validation trial. They will be asked to comment on the authorship and the process they believe were used to complete each tag in the trial. It is anticipated that this will aid in the determination of expertise in the forensic identification of tags and both FDE's and researchers will benefit from this means of assessing individual and collective expertise and performance.

Experiment Two

The photographing of tags before removal is necessary as it will facilitate in the examination of handwriting and the image can also be analyzed using the Matrix Analysis computer software. The researchers are willing to be involved in the forensic training of graffiti removalists so that optimum information is gained from photographic evidence taken and to ensure its admissibility as evidence if required for court.

The first aim of this research is to use the experimental data collected in experiment one and to utilize it to create a maintainable database of graffiti tags. Once the database is established, tags found and photographed in Perth City would be added initially with tags from the rest of the metropolitan area added once the system is fine tuned. This database will create a centralized storage facility for all graffiti tags from all interested members of the community including the police, local councils, businesses and private property owners.

With the apprehension of offenders there may be the opportunity to conduct comparisons between normal handwriting and tags. This has applications with sketch books and with the use of multiple tags for prosecution purposes as research purports most graffitists have a sketch book in which they practice their tag and store photographic evidence of their work.

Significance: Degree to which proposal will add to understanding of crime prevention

Conducting the above research will provide empirical data on the spatial properties of graffiti tags. Current research in this area is scant. The accumulated research base, including a data base will contribute to the weight of evidence given to Forensic Document Examiners (FDE) evidence in graffiti related prosecutions. This database, the forensic handwriting examination and the computer software analysis of any given number of tags will allow different offences to be cross linked.

It is believed that the dissemination of this research coupled with the new legislation in Western Australia plus a zero tolerance attitude towards repeat offenders will reduce offences. Furthermore through community and education awareness programs the knowledge base being established by the government, police and forensic specialists will help identify and prosecute offenders and will deter current and future taggers from this expensive form of vandalism.

Glass etching involves the use of a hard substance such as rocks, keys, knives, sandpaper, screwdrivers etc to scratch glass, perspex or metal. Acid etching involves the use of a craft etching acid to degrade or 'eat into' glass. Etching has recently become an alternative form of tagging largely due to efficient clean up of mainstream graffiti. (Upano, 2005; Vandalwatch, 2005; McGuire, 2004). Nonetheless, with glass etching if there is handwriting trace that is comparable to tags and or handwriting, it would not be a quantum leap to include these etchings on the tag database. As with paint the skill of the writer will be indicated, allowing tags and etchings to be grouped together.

Expected Benefits

The creation of a database will act not only as an aid in the prosecution of offenders by offering forensic evidence as to the authorship of any given tag, it is hoped it will act as a deterrent to graffitiists and future graffitiists. Furthermore, the capability of the database will facilitate in the analysis of the spatial consistencies between any number of samples of a given tag. This will result in different offences being linked together or discarded with a high degree of certainty.

Graffitiists are part of a subculture which is hierarchal in nature and where the rules are strict and enforced by other members. These rules seem to remain relatively constant across the world. It is hoped that the database and its capability to aid in prosecutions plus an associated media awareness campaign will contribute to deterring graffiti offenders.

The database and the images on it will not be available for viewing by the general public. Graffitiists, until charged, would be unaware of how many times if any, their tag appears in the database. A media campaign directed at the Western Australian community informing them about the technological advances in identifying graffitiists could be undertaken. The dissemination of information to the media and community would have to be carefully constructed, focusing more on the technological advances, including CCTV.

The validation trials proposed will be a world first by Forensic Document Examiners in determining authorship of graffiti. This knowledge base will certainly become the mainstay of any opinion evidence delivered in a court of law.

Ethical Issues: Including risks associated and plans to minimize risks

Using graffiti taggers from Perth raises some ethical issues which need to be addressed. The University of Western Australia Human Ethics Committee demands a high level of ethical behaviour from researchers which requires all information gathered and used in the trials to remain unidentifiable. Any personal information collected in relation to this research will remain confidential and will be destroyed upon completion of the project.

The University of Western Australia's Human Research Ethics Committee has already given ethical approval. The researcher is not a prosecutor and ethics requires confidentiality and participants sign an information and consent form.

It is an accepted university practice to pay volunteers involved in research. There are opportunities in Perth to use graffitiists involved in developing legal walls with local councils, there are 'retired' graffitiists who could be approached as well as current graffitiists

As stated earlier, research into handwriting consolidates that handwriting is a learnt motor skill which is difficult to reproduce. Individuals find it difficult to simulate (copy) the handwriting characteristics of others accurately. By asking the graffitiists to produce ten repetitions of their tag at each size, it would be difficult to confuse the findings or to disguise their handwriting characteristics on extended writing samples.

Initially the tag database will be created using the experimental data collected from this research. A second data base will be established whereby graffiti tags photographed in the City of Perth will be entered. The initial database will be destroyed upon establishment of the second.

One other issue is the use of spray paint. The experiments need to be conducted indoors to reduce the affect of any environmental factors. When conducting a scientific experiment all variables need to remain constant. Collecting data indoors will not affect or distort results as research purports graffitiists plan all aspects of their 'hits' and factoring in the weather is important. Spray paint contains many chemicals and there is the potential of a health problem to graffitiists. To minimize any health risks to graffitiists, lay people and experimenters facial dust masks will be available and recommended for use by all participants.

Strategies for Dissemination of Results: During and after the research

As stated this research has not been conducted elsewhere. Forensic document examiners both nationally and internationally have expressed interest in these trials. The results of this research will be disseminated by attending and presenting the results of this work at forensic science meetings and other relevant conferences. This research will also be published in forensic science journals as well as the more popular and mainstream magazines. It is imperative that this research and the significant advances being made available to the public.

On a more global scale some of the preliminary work was presented at the American Academy of Forensic Sciences meeting in Seattle, Washington in February 2006. This will be followed by two presentations at the Australian and New Zealand Forensic Science Society symposium in Fremantle, Perth in April 2006.

Awareness by the community in general and education of school children is paramount to the success of any program of this nature. Mainstream media is an effective means of disseminating information to the general public and it is proposed that the media become involved in this project through the OCP. The researchers are willing to be involved with the development of the media releases and community and school awareness programs to advise on the advances of graffiti tagging identification.

Project Budget over Two Years (option 1)

ITEM	COST
Camera Equipment/Tripod/Memory Cards	\$1000
Consultancy Victoria and New Zealand	\$5000
Digital Camera	\$1500
Digital Video Camera	\$1800
Payment for Lay Persons (\$50 each x 8)	\$400
Payment for Taggers (\$100 each x 5)	\$500
Purchase of Matrix Software	\$500
Research Assistant Salary (2 years+o/heads)	\$118040
Consumables (SprayPaint/Paper/ Tarpaulins/Dust Masks)	\$3500
Total	\$132,740

Justification of Budget

A full time Research Assistant is required to achieve the goals of this research. However, this is still an inexpensive option compared with the \$500 average cost for a FDE to provide a cursory examination of a document or handwriting. Furthermore, the standard analysis of a single tag is \$1000, plus court time.

Databases are expensive to initiate. Matrix Analysis has been in development for ten years. The use of Matrix Analysis comes without any of the research and development costs and is only available at such a reasonable price because it is being used for research. The original database containing experimental data will remain the property of the researchers, for ethical reasons this database will be destroyed on completion of the project. The database created with 'real' tags will be owned by the Office of Crime Prevention and at the completion of the research term the onus will rest with them regarding maintenance.

The purchase of digital camera equipment is necessary for experimental data collection. It is the researchers understanding that graffiti removed from public assets is routinely photographed. Therefore the costs of this equipment will not increase. Generally, with research of this kind, equipment such as this would become University property at the end of the research term.

Project Budget over Two Years (option 2)

A scholarship is a very inexpensive way to achieve the goals of this research.

ITEM	COST
Camera Equipment/Tripod/Memory Cards	\$1000
Consultancy Victoria and New Zealand	\$5000
Digital Camera	\$1500
Digital Video Camera	\$1800
Payment for Lay Persons (\$50 each x 8)	\$400
Payment for Taggers (\$100 each x 5)	\$500
Purchase of Matrix Software	\$500
Scholarship – (2 years)	\$49300
Consumables (SprayPaint/Paper/ Tarpaulins/Dust Masks)	\$3500
Total	\$64,000

Timeline

The first year of research involves the data collection of the experimental samples of tags and the analysis of the samples. Each individual tag will be examined according to approved handwriting methodology, this process alone will take six months. The software program is an additional tool used in handwriting examinations, it in no way replaces the analysis completed by a FDE. Matrix provides statistical data to mathematically consolidate the analysis.

The second year of the project will be dedicated to a graffiti tag validation trial to be distributed to approximately half of the FDE's working in Australia and New Zealand. These results will be compared to those given by a group of lay people. The analysis of these results will take at least three months. The creation of the database will begin at this time. The final period of tenure would be used to collect data and research into acid etching. The use of an acid in a marker or shoe polish container should leave a handwriting trace, which may be comparable to handwriting and/or tags. This is the final data collection, which again would need up to six months to analyse.

Glossary

Baseline alignment: Position of handwriting trace in relation to a visible or imaginary line beneath the writing

Class characteristics: Features of handwriting adopted by a group of people – derived from the style of handwriting taught in school

Closed loop control: A motor memory which is executed without feedback

Differences: Features which are inconsistent within a sample or samples of writing

Feature detection: Analysis undertaken to determine similarities and differences

FDE: Forensic Document Examination

FDE's: Forensic Document Examiners

Forensic: Relevant to the law and courts of law

Formation variation: Differences noted in the construction of a writing

Frequency: The occurrence of specific letter or number styles

Graffiti: A style of writing or art

Graffitiist: A person who engages in graffiti

Hip hop: A style of music derived from rap and break dancing

Individual characteristics: Features which are considered unique to one person

Individuality: The sum of all unique features contributed to one person. The chance match of all these characteristics being replicated naturally in another persons handwriting is extremely low

Inter-writer variation: The differences between individuals handwriting

Intra-writer variation: The natural or subconscious differences within one individuals handwriting

Matrix Analysis: A computer software program which calculates spatial consistency in and between samples

Natural variation: The differences which may be noted across samples may be due to many contributing factors. Subconscious or environmental factors may slightly affect the handwritten artefact

Open loop control: Motor memory programs which are executed with the aid of sensory feedback

PEAT: Pattern Evidence Analysis Toolbox – A software program from which Matrix was developed

Rapid removal: Cleaning off graffiti as quickly as possible also known as rapid response

Skilled writing: Handwriting completed at between 4-5Hz – or 8 strokes per second (2 letters), duration is 100 – 150 ms per stroke

Similarities: Features which are closely related

Simulation: The act of copying handwriting

Spacing: The area between letters and the area used by the word, line or entire text

Tag: A stylized signature or nickname

Text structure: The format of a handwritten document

Vandalism: Destruction of public or private property

Writer: A person who engages in graffiti

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1.1 Graffiti Management (05-019-03-0002/SFP)

City of Belmont Delegate to move:

MOTION

That the Western Australian Local Government Association lobby the State Government to address the issue of graffiti by:

- a) ensuring a State-wide approach is taken to graffiti;
- b) making graffiti a criminal damage offence;
- c) developing alternatives to current penalties;
- d) making penalties for Juvenile Justice Team agreements that are not honoured (imposing mandatory sentences if agreements not honoured);
- e) setting up a central reporting point through the Western Australian Police Service;
- f) allowing sufficient resources to the Western Australian Police Service so they can properly record and investigate graffiti offences;
- g) giving the Western Australian Police Service the ability to shut down websites specifically used for displaying illegal graffiti tags; and
- h) changing legislation to make it easier to convict offenders, especially for multiple offences.

IN BRIEF

- Graffiti continues to be a significant cost to Local Government across the State.
- Seeking for the Association to work in partnership with the State Government to develop policies and mechanisms to appropriately target graffiti.

MEMBER COMMENT

The problem of graffiti for the City of Belmont is a major one and is costing more and more each year. The incidence of graffiti has nearly quadrupled over the last three years. It can be generally attributed to the better reporting of instances and the improved manner in which the City of Belmont deals with graffiti.

Reasons given for graffiti are:

- lack of social support - high cost of joining clubs etc;
- feeling of value - belonging etc;
- loss of identity - lack of esteem;
- parents - lack of support, parents powerless;
- disconnection from community - don't fit in, only way of being heard; and
- boredom - no outlet for artistic needs

There are currently a number of legislative issues that arise that could assist in the reduction of graffiti for the City of Belmont. Some of these are.

- the high cost of conviction of offenders;
- difficulty in enforcing current legislation;
- graffiti seen as a minor offence;
- no penalties; and
- no alternative to penalties.

To overcome some of the current legislation issues it may be possible to consider the following changes to legislation requirements:

- increasing penalties;
- changing community perception of offence by characterising graffiti as criminal damage;
- making a penalty for Juvenile Justice Team agreements not being honoured – impose mandatory sentences if agreements not honoured; and
- changing legislation to make it easier to convict offenders especially for multiple offences.

Other issues required to fully combat graffiti may be along the following lines:

- police need to record offences - police at the moment are not recording offences or occurrences and have not done so for the past four years;
- there needs to be a central reporting point for graffiti offences;
- ability to link offences from other districts and prosecute as one offence - ie if tag is copied, original tagger can also be prosecuted; and
- ability to shut down websites specifically used for displaying illegal graffiti tags.

To help overcome the issue of graffiti there needs to be a State-wide approach through a graffiti taskforce. It has been said that graffiti is costing Local Government around \$25 million per annum to combat and remove graffiti.

SECRETARIAT COMMENT

The Association continues to recognise the significant cost worn by Local Government in graffiti management. Recent initiatives taken by WALGA include:

- Ongoing representation by WALGA staff and Local Government representatives on the Graffiti State Working Party established by the Office of Crime Prevention.
- 2006 submission to the designing out crime draft statement by the Office of Crime Prevention.
- Lobbying the Department of Local Government and Regional Development to alter the Local Government Act Sections 3.21 and 3.22 to allow Local Government officers or contractors to access private property to remove graffiti without fear of liability for any damages incurred as a result of this work.
- Attendance at the State Graffiti Forum (2005).

Graffiti management is a significant issue for Local Governments and their communities. Graffiti costs the community in significant ways through damage to civic pride, encouraging further criminal activity, devaluing property, intimidating residents and generating fear and anger throughout communities. Residents look to Local Government to manage this issue.

It is difficult to ascertain the true cost of graffiti to Local Government as different reporting mechanisms used by Local Governments do not allow easy comparison or correlation of costs. The Association has approached the Office of Crime Prevention to develop research parameters and policy methodology to allow the true cost of graffiti to Local Government to be ascertained and to develop consistent cost reporting mechanisms.

Research consistently demonstrates that prompt graffiti removal plays a key role in reducing graffiti levels because it diminishes the level of recognition and reward achieved by offenders. Many Local Governments therefore have a 48 hour removal policy, with offensive or racist graffiti removed within 24 hours of reporting. The State Government has recently circulated graffiti vandalism removal standards that mirror those set by Local Governments.

The State Government has a range of policies and programs that target graffiti issues including their Designing out Crime policy, the Repay WA program and the continuing work of the Police Department and the Office of Crime Prevention through its Designing Safer Communities (Graffiti) Program. The role of the police in graffiti management continues to be raised by Local Government as a concern.

The Designing Safer Communities (Graffiti) Program, developed in response to concerns by Local Government, assists Councils combat graffiti and the increasing cost of addressing graffiti issues. Grants of up to \$10,000 were made available to Local Government.

The Department of Corrective Services through 'Repay WA', has expanded its community work order program by boosting the number of low-risk and first time offenders working to benefit of the community and giving more community organisations a chance to take part. This includes both adult and juvenile offenders on a range of projects which includes graffiti clean up crews. Local Government has access to these crews and can develop contract parameters with the Repay WA Manager.

Community work is considered an important part of the sentencing process and many more offenders are now doing community work, including low risk offenders who might otherwise go to prison. Such initiatives allow offenders to repay their debt to WA for the crime they have committed, develop new skills to help them better reintegrate into society and it saves taxpayers money. Increasing penalties and mandatory sentencing are considered last resorts by legislators in addressing significant community and social issues as it further marginalizes community members who are already considered to be unengaged citizens.

As such it not recommended that the Association pursue tougher sentencing parameters for acts of graffiti. It is recommended that the Association continues to lobby the State Government to address the issue of graffiti by:

- ensuring a State-wide approach is taken to graffiti;
- setting up a central reporting point through the Western Australian Police Service;
- working with State Government to develop policy guidelines for the collection and reporting of incidences of graffiti;
- working with State Government to research and develop mechanisms to ascertaining the true cost of graffiti across the State;
- allowing sufficient resources to the Western Australian Police Service so they can properly record and investigate graffiti offences; and
- giving the Western Australian Police Service the ability to shut down websites specifically used for displaying illegal graffiti tags.