

## Prevocative

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# Search Visualizer

Connecting the dots.

Executive Briefing, 3/8/2010

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# Wired: Scientific Method Man

**Gordon Rugg cracked the 400-year-old mystery of the Voynich manuscript. Next up: everything from Alzheimer's to the origins of the universe.**

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Summary of copyrighted article appearing in Wired Magazine, September 2004 by Joseph D'Agnese; <http://www.wired.com/wired/archive/12.09/rugg.html>

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Two years ago, an Englishman named Gordon Rugg slipped back in time. He spread his papers on the kitchen table and, working with a steel-nibbed calligraphic pen, he scribbled a vaguely medieval script. Transliterated into the Roman alphabet, some of the words read: "qopchedy qokedydy qokoloky qokeedy qokedy shedy." He struggled to understand the person who had first scrawled this incomprehensible text some 400 years ago.

He was researching one of the world's great oddities: the Voynich manuscript, a hand-lettered book written in an unknown code that has frustrated cryptographers since its discovery in an Italian villa in 1912.

In three months, he cooked up the most persuasive explanation yet for the 234-page text: Sorry, folks, there is no code – it's a hoax!

Rugg cracked the Voynich not because he was smarter, but because he focused on what everyone else had missed. In 1996, he and his colleagues developed a rigorous method for peering over the shoulders of experts – doctors, software engineers, pilots, physicists – watching how they work and think, testing their logic, and uncovering ways to help them solve problems.

If Rugg gets his way, verifiers will revolutionize the scientific method and help solve other seemingly unsolvable mysteries, such as the origins of the universe or the cause of Alzheimer's disease.

As he read about the Voynich and began applying his method – amassing knowledge about a problem and assessing the kinds of expertise applied so far are steps one and two – he saw that no one had seriously explored the idea that the book was a grand hoax. As Philip Neal, one of the world's leading Voynichologists, says, "It has been argued – I used to argue myself – that the phonetic structure was beyond the powers of a 16th-century forger to create, so that the text must be a real language or an unknown type of cipher."

But as specialists get further from their core expertise, the possible solutions – what's been tried, what hasn't, what was never properly examined, what ought to be tried again – get even more elusive.

So here's Rugg, studying the Voynich on his own and asking himself: If I were living in the 16th century and wanted to make a book that looked mysterious but was really gibberish, how could I do it cheaply and easily?

The time and effort would definitely be worth it: In the Elizabethan era, Rudolph II, the Holy Roman emperor, became fascinated with the beautifully wrought manuscript (he believed it was the work of 13th-century philosopher Roger Bacon) and paid 600 gold ducats for it – about \$30,000 today.

Sometime in 1996, while having lunch with colleague Joanne Hyde, it occurred to Rugg that he could pull together all the tools psychologists use – elicitation techniques, the vast literature on human

error, decisionmaking models, formal logic and reasoning – to create a novel form of problem-solving: a scientific method to verify the methods of science.

The verifier method boils down to seven steps: 1) amass knowledge of a discipline through interviews and reading; 2) determine whether critical expertise has yet to be applied in the field; 3) look for bias and mistakenly held assumptions in the research; 4) analyze jargon to uncover differing definitions of key terms; 5) check for classic mistakes using human-error tools; 6) follow the errors as they ripple through underlying assumptions; 7) suggest new avenues for research that emerge from steps one through six.

Following Rugg's success with the manuscript, potential collaborators surface daily. Astrophysicists at Keele want to work on sorting out seemingly incompatible theories in modern physics. A biochemist at UC San Diego wants to untangle questions in exobiology, the study of the chemical origins of life. University of Warwick wants to apply the verifier method to attention deficit-hyperactivity disorder. Rensselaer Polytechnic Institute thinks Rugg can help resolve mysteries about ancient Greco-Roman settlements.

Gordon Rugg will need a bigger kitchen table.

# Introduction

It's a knowledge economy, but there's until now there has been no integrated framework for handling knowledge . The Search Visualizer is a tool which makes handling knowledge simpler, faster and more efficient. It is based on an integrated framework for handling knowledge, developed by our partners in this collaboration, Dr Gordon Rugg and Ed de Quincey. The same framework forms the basis for a range of software and services which complement the Search Visualizer.

This framework covers four main issues involving knowledge:

- Getting knowledge out of people: e.g. market research, interviewing, knowledge elicitation, requirements engineering
- Choosing the best way to represent that knowledge: e.g. PR, public understanding of science, knowledge representation, mathematical formalisms
- Testing knowledge for completeness and correctness: e.g. formal logic, human error, judgment/decision-making
- Getting knowledge into people: e.g. education, training, coaching

This framework also looks at how each of these areas interacts and overlaps with each of the others: for example, using concepts from the “representation” part to improve handling of the “getting knowledge out” process. At each stage, the conclusions have been tested against real-world problems, and benchmarked for quality via peer-reviewed publication. For getting knowledge out of people, the framework uses about a dozen different types of knowledge. Each of these is derived from the relevant literature, and where possible we have mapped each type back onto the underlying neurophysiology. Each knowledge type has then been mapped onto the appropriate methods for getting at that particular knowledge type—some are only accessible via one or two routes.

Parts of that framework feature within the section on how to represent knowledge. The search visualizer is an example of software based on the framework's guidance about how to represent knowledge.

Testing knowledge has involved integrating several literatures to provide the required toolkit – it's a large one. People make much the same types of mistake regardless of their level of expertise, and of the field in which they are working. If you know what those types of mistakes are, and how to look for them, then you've got a good chance of finding errors that everyone else has missed. One outcome from this work is the Verifier approach, for re-examining difficult unsolved problems. Dr Rugg and his team have applied this approach to two very different problems – the Voynich Manuscript and autism. In both cases, they have produced significant new insights, which have passed peer review in the top relevant journals.

Finally, the part of the framework relating to education and training, re-uses the same categorization of knowledge types, and maps each type onto the appropriate delivery method. This includes topics which people usually find difficult to put into words, like hunches, gut feel and “the flow”.

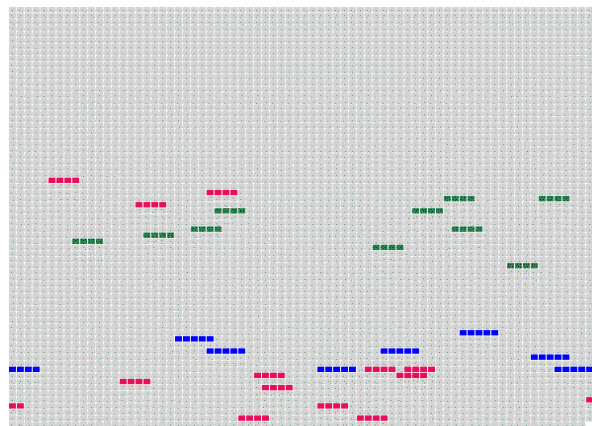
# Search Visualizer Overview

Online searches via standard search engines are very good at finding potentially relevant documents, and providing a few key facts about each of those documents. However, when it comes to assessing whether they actually are relevant, then things start to slow down. At present, the user assesses the documents for relevance by reading the document summary and then reading the document itself if the summary looks promising. This is a slow, inefficient process, constrained by human reading speed, and by the limited information in the summary. A much faster and more efficient way is to present results so that the user can assess their relevance using visual scanning, as shown below. That's what the Search Visualizer is for.

<http://www.prevocative.net/sharedrive/Intro.mov>

The search visualizer software fits onto any of the major search engines. The user types in search terms in the usual way. When the search engine returns hits, the search visualizer shows each of the files, which the search engine has found, usually ten at a time, with each file looking like a column containing small squares. Each square represents a character in the file; the keywords for the search are shown as colored squares, while the other words in the file are shown as grey dots.

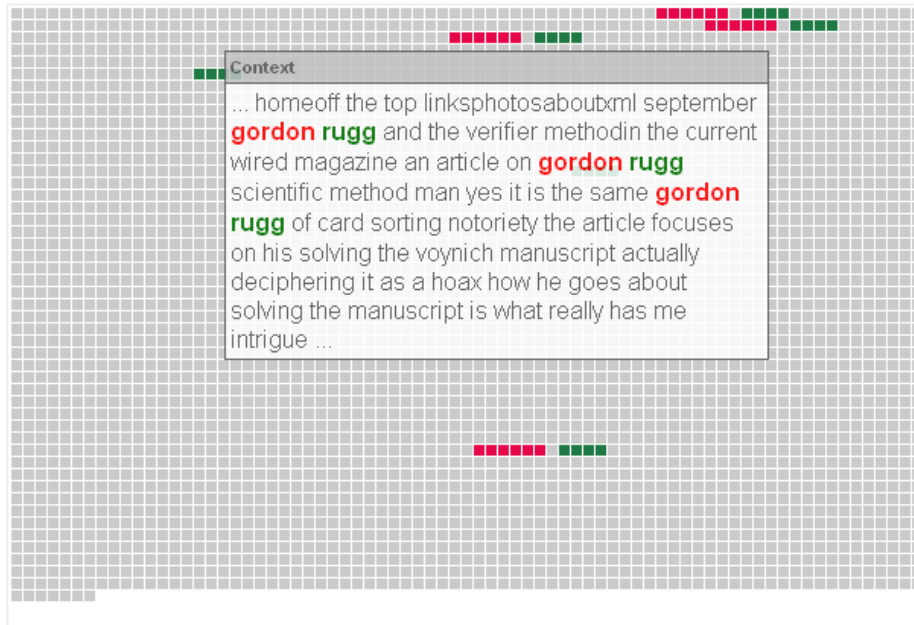
The example below shows a hit from a search on wind wave solar by a user looking for information about types of alternative energy. It's a short file, which we can tell by the length of the column, but it has numerous occurrences of each key word, so it's likely to be relevant. The key words also occur as separate bands, implying that they are in a structured list, with the further implication that the area between the green layer and the blue layer might contain a list item about a different type of alternative energy.



This visualization allows users to assess the relevance of a file much more quickly than by reading the text summary, and also allows users to spot features such as the presence of a list. This makes it possible to do types of search, which are difficult or impossible on standard search engines, as well as the standard types of search. This approach has obvious advantages for people doing online search from mobile devices, as well as people with sophisticated search needs.

# Search Visualizer Functional Capabilities (Beta)

**Functional Capability 1:** the magnifier function, applied to a search for “gordon rugg”. This is from a real search, which has found the “Wired” article. The magnifier has been used over a section of the column with numerous green and red bars (“gordon” and “rugg” respectively).



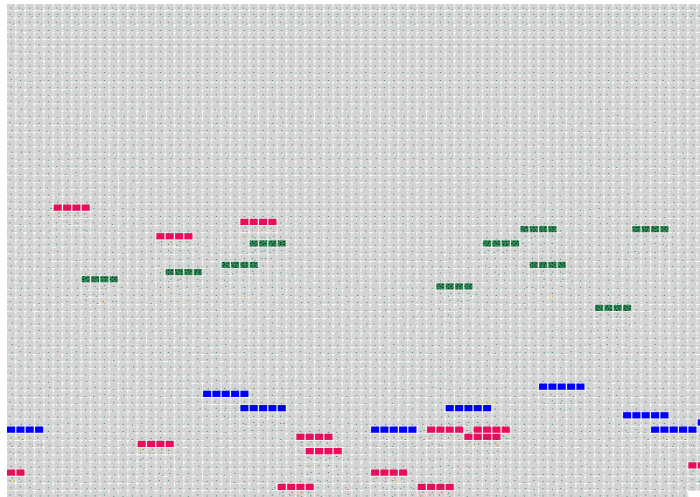
(<http://www.wired.com/wired/archive/12.09/rugg.html>)

## Functional Capability 2: spotting a list in a record

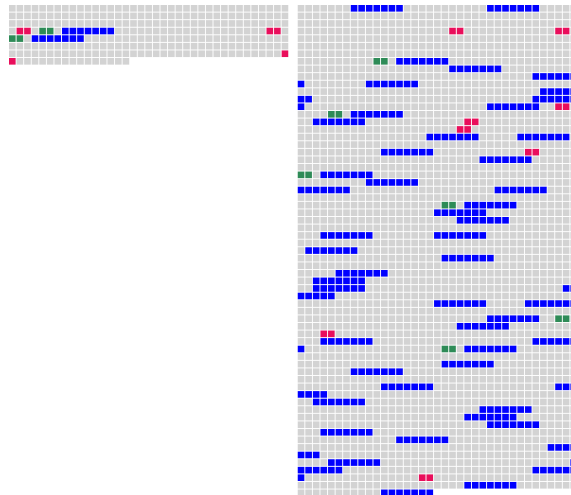
This is a search for “wind” “wave” and “solar”. The horizontal banding of colors corresponds to paragraphs in the document; the gap between the green band and the blue band corresponds to a paragraph about a different energy source.

A police-related example might be: “How could we set about identifying a John Doe body apart from dental records, facial reconstruction and skeletal abnormalities”?

(<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/ocean.html>)



**Functional Capability 3:** This is a simple search for “ed de quincey” to show how the core concept works. The first column is a short file, which is a true positive; the second contains “ed”, “de” and “quincey” but in widely separated places, and a false positive. Both of these results are from (the first ten returned) the MSN search engine.



left: <http://moodle.teach.cs.keele.ac.uk/user/view.php?id=390&course=1>  
 right: <http://home.aol.com/chtbhegavp/quincey.htm>

## Example 1: Hitler Rommel getroffen

This example demonstrates how the Search Visualizer can be used to identify relevant documents in a language, which the user doesn't speak. We will use the scenario of an Allied intelligence station in WWII.

The station has received a report of a meeting between Rommel and Hitler. It's not known whether this meeting has already happened, or is about to happen. The Allies are keen to prevent the meeting if possible, and urgently need to know whether or not the meeting has already taken place. The station has a lot of German intercepts, but hasn't translated all of them yet because of a shortage of translators. It does, however, have plenty of security-cleared staff who don't speak German, and copies of the Search Visualizer. So, what does the station commander do?

### Hitler Rommel getroffen



**Mission: identify occasions when  
Hitler and Rommel met,  
occurring in German language documents**

<http://www.prevocative.net/sharedrive/Hitler-Rommel-Getroffen.mov>

We will focus on a team, which is searching for any documents saying that the meeting has already happened.

Each operator types in the words: Hitler Rommel getroffen. This is a first-pass search; there are other terms, which can be tried if these draw a blank.

The Search Visualizer now runs the search. What you see in this example is a real-life Internet search on those keywords. The search finds records in batches of ten, in just the same way as a standard Google search. The left hand side of the screen shows basic information about each of the records currently being displayed. Each column in the body of the screen shows a visualization of one of those ten records.

The grey squares in each column correspond to words in the record, starting at the top left, and ending at the bottom right. The colored squares in each column correspond to the search terms. The top left of the screen shows which color corresponds with which search term. The clerks are told to look for places where two or more different colors occur close to each other. One of the columns contains all three colors close to each other. The clerk summons the translator, who selects the magnifier function

This shows the selected record at higher magnification. The translator moves to the relevant part of the record, and hovers the mouse over one of the keywords. The search visualizer shows the original text corresponding to that part of the visualization. The translator translates the text, which says that Hitler has met Rommel.

This demonstrates success despite factors which would scupper a Google search – e.g. intervening adverbs between key words, several possible permutations of the key words, huge numbers of false positives, etc.

## Example 2: Midway Island Desalination World War II

This example works through the core features of the search visualizer. We have used the WWII example of the Midway desalination plant message. For this demonstration, we're doing an English language search on the Internet, to show the underlying principles.

### **Desalination Plant on Midway Island**



### **WWII Military Intelligence helps defeat Japan in the Battle of Midway**

<http://www.prevocative.net/sharedrive/Midway.mov>

The user enters the keywords in exactly the same way as in standard search engines. The search visualizer sits on top of the user's search engine, and acts as an interface for it. This allows the user to use the search visualizer in combination with advanced search features from the user's own search engine.

Each keyword is represented here in a different color. It's also possible to represent keywords in other ways, such as patterns or textures. The search finds records in the usual way. Each record is shown on the left of the screen as a numbered url, and in the body of the screen as a column.

The search visualizer can also represent records as one square per word, or one square per sentence or paragraph and so forth, which is useful for very long documents. For most searches, the setting of one square per letter is most effective. The setting of one square per letter is also useful for some features in languages such as Arabic. Because the visualization corresponds directly to the underlying text, the user can tell a lot about what's in the columns using their existing knowledge.

For example, the length of the column corresponds to the length of the underlying text, so the user can see immediately whether they're dealing with a short document or a long one. Similarly, the user can see whether the document contains many mentions of the keywords, or only a few. The key point is that the user just needs to look for places where the keywords are close to each other.

The visualization grays out all the irrelevant detail, so that the user can get straight to the essentials. Using visualization in this way makes it easy to do standard searches swiftly and efficiently. It also makes it easy to do types of search, which are complex or cumbersome using traditional search engines, such as proximity-based searches, which are liable to numerous well-recognized problems.

This representation also maps directly onto skills, which the user already has, making it fast and simple to learn. It can also be customised to the specific needs of a particular field.

## Example 3: Visualizing a Hunch

Article: [http://www.securityworldmag.com/tech/tech\\_view.asp?idx=399&part\\_code=040250112&page=2](http://www.securityworldmag.com/tech/tech_view.asp?idx=399&part_code=040250112&page=2)

A recurrent theme in security work is the hunch: when you're sure that there's something wrong, even if you can't say quite what it is or why you're so sure. If you're a store detective, for instance, you might have a gut feel that there's something not quite right about the harmless-looking pensioner who is a popular figure at the local supermarket. So you follow the hunch, and you keep a close eye on the pensioner, and you discover that he's a systematic shoplifter. Once you started watching him, the evidence was easy enough to find, but what was it that made you start looking in the first place? That's one of the questions that G4S wanted to answer, as part of developing their training process. To find those answers, they turned to someone who specialises in types of knowledge that are hard to put into words, Dr Gordon Rugg.

There are numerous different types of knowledge which are hard to put into words. Some of these, like "the flow" in sport, have acquired a semi-mystical status. In fact, the underlying processes for most of them are now fairly well understood, but the detailed explanations involve a significant amount of neurophysiology, so this issue is not widely known, or widely considered in terms of practical issues such as design of recruitment criteria or training programme design. It is only recently that it has started to receive attention outside a few specialist groups.

G4S were well aware of the importance of "gut feel" in store detection. They already had a good training programme which covered the core skills, but there were a lot of other "gut feel" skills which the best store detectives had, and which nobody was able to articulate in a way that could be used in training. Instead, it was accepted that these skills would have to be picked up the hard way, via experience on the job. The problem was that this method was time-consuming and unreliable – some people picked up these skills without difficulty, but others never seemed to acquire them properly despite years of experience.

Investigating skills of this sort requires specialised techniques – you have to leave interviews and questionnaires behind when you go into this territory. Interviews and questionnaires are fine if you're dealing with knowledge that people can easily put into words (explicit knowledge) and especially good with knowledge that the person has already organised (codified knowledge). They're of little or no use when dealing with other types of knowledge.

This distinction became apparent as the project progressed. The expert who trained the store detectives had extensive and well-organised knowledge which she could easily put into words. The store detectives, in contrast, often had extensive knowledge and were highly skilled, but were unable to put most of their knowledge into words. It was very similar to the difference between a sports coach and a sports player. There were, however, many areas of expertise where even the trainer wasn't able to put things into words, which took the project into the areas of tacit and semi-tacit knowledge.

Tacit knowledge, in the strict sense, involves skills which we can perform without having any understanding of how we are doing them. Often we don't even notice that we're doing them. A classic example is the skilled driver, who can manoeuvre and change gear without having to think about it. Tacit skills are extremely valuable in most fields because they are very fast and very efficient; they are fast and efficient because they don't require conscious mental processing, and are performed "automatically" – the equivalent of an organisation

performing a task at branch level, rather than having to go via head office. In the case of driving, novice drivers have to process all their actions consciously, which is slow and liable to error. Interestingly, if you force an expert to think about what they are doing, this can interfere with tacit skills, and cause the expert's behaviour to deteriorate drastically.

Because tacit skills don't involve conscious reasoning, they can't be accessed via interviews, which can only reach knowledge to which we have conscious access. Experts often think that they know what they are doing in their tacit skills, but these accounts often bear little or no relation to reality, however strongly the expert might believe them. To get at knowledge of this sort is notoriously difficult, but if you know what you're looking for, and watch the expert performing the right set of tasks, you can get a lot of useful insights.

In the case of the store detectives, the tasks involved viewing video clips of store interiors, which included some episodes of shoplifting. The most striking result from this was the speed with which the store detectives could reliably spot a shoplifter before the crime had taken place – less than a second, for skilled store detectives watching some clips.

The store detectives were asked to explain what was happening in each clip, and their explanations fell into two main categories. The first involved things which the store detectives could articulate, even if they didn't have specific names for some of them – for example, using a legitimately bought item to conceal another item which was being stolen, such as a newspaper to conceal a magazine inside it. The second involved things which they couldn't articulate, such as someone walking in a suspicious manner – they knew that the manner was suspicious, but they couldn't explain why.

Interestingly, the store detectives differed in terms of what they were able to put into words, so some of the “give-away” signs can be taught explicitly as part of the training course. An example is a behaviour which is hardly ever used by shoppers but which is used by many shoplifters, and which one store detective called “shark's eyes”. This involves looking for CCTV cameras, to identify blind spots which the cameras don't cover. Most people, if they want to look up, will turn their whole head upwards, which is easily visible on CCTV. Some shoplifters attempt to get round this by keeping their head still, but looking upwards with their eyes, rather like a shark at the moment when it strikes its prey and rolls its eyes upwards. Once you know the specific actions, it's easy to identify this give-away; if you haven't had them explained to you explicitly, you'll probably notice that there's something odd about the person's behaviour, but not be able to say exactly what it was, especially for such a fleeting activity.

What about the give-aways that nobody could put into words? There are various ways of handling these. The quickest solution in the short term is to teach them via what is known as implicit learning – show numerous video clips, until the trainees learn to identify the give-aways, even if they still can't say precisely what the give-aways are. In the longer term, it's usually possible to unpack the specific details via carefully structured studies, using methods such as systematically concealing different parts of an image to identify the key feature.

The project also identified various types of semi-tacit knowledge – knowledge which will sometimes be articulated, and sometimes not, depending on the situation. For example, when the store detectives were commenting on the video clips they mentioned numerous things which they clearly considered to be general knowledge, and which they would probably not have bothered to mention in an interview, such as “doing a freeze” – putting out an alert to store security personnel over the store public announcement system, so that a shoplifter would know they had been spotted, and would abandon the attempt to shoplift.

This type of “taken for granted” knowledge is a familiar feature in many fields; it is easily picked up via tasks such as the video clip task, but is usually missed by interviews.

By the end of this project, G4S had put the hunches of skilled store detectives onto a more systematic footing, in a form which could be incorporated into their training programme. The project also identified other areas worth investigating, such as how experts mentally organised space – for instance, various zones within a store, to identify patterns of behaviour which might otherwise be missed. Will that find anything which changes how security providers think about problems? They can’t be sure yet, but they have a hunch...

# Verifier

The core concept of Verifier is simple. People make predictable types of mistakes; they make the same types of mistakes regardless of how much expertise they have, and regardless of their area of expertise. Once you know what those types of mistake are, then you can go hunting for them, with a better chance of finding mistakes that other people have missed. Verifier is a toolkit of methods for finding those mistakes. At that level, it's easy to describe. It also looks very obvious. So why didn't anyone try it before?

The answer is that finding mistakes is simple if you're dealing with small problems: the equivalent of changing the spark plug on an automobile. If you're dealing with big problems, like seeing whether previous researchers into autism have all made the same faulty assumption, that's more like removing the engine from an eighteen wheel truck. You need a much bigger toolkit, and you need to be ready for some seriously hard work.

The Verifier approach was invented by Dr Gordon Rugg and his colleague Dr Joanne Hyde. They knew right from the start that it had enormous potential, but to convince anyone that it could deliver the goods, they needed to show that it worked. For that, they needed an unsolved problem; the more difficult, the better. The Voynich Manuscript was a perfect fit.

It's been described as the most mysterious book in the world. Discovered in 1912 by antiquarian bookseller Wilfried Voynich, it's also been described as looking like a perfectly ordinary book which happens to have come to Earth from a parallel universe. It has over two hundred handwritten pages, most of them richly illustrated; its text is in a unique script. It's never been deciphered, despite over ninety years of increasingly determined effort by some of the world's greatest codebreakers. One obvious explanation – that it was an ordinary text written in an unidentified language – runs aground on the unique structures within the text: if it's a language, it's the strangest language in the world. The only other plausible explanation – that it was a meaningless hoax consisting only of meaningless gibberish – hit the problem that the text showed numerous subtle regularities, far beyond the complexity that anyone thought possible for a mediaeval hoax.

Gordon Rugg applied the Verifier approach to the problem. Within four months, he had found a plausible solution. It was possible to replicate the complex, unusual features of the manuscript using simple, ancient technology – nothing more complex than a table of meaningless syllables, and a piece of card with a few holes cut in it. He also demonstrated that the entire manuscript could have been produced by one person within four months – the same time it had taken to find this solution.

Subsequent statistical analysis by Austrian nuclear physicist Dr Andreas Schinner strengthened the case: he concluded that the text was most likely to contain meaningless gibberish produced using Rugg's method. Recent examination of the manuscript by a team of Austrian researchers found that there was no evidence of corrections within the text of the manuscript – again, most consistent with a hoax, probably produced for sale to a rich collector, in an age when mysterious manuscripts were a valuable commodity.

Rugg's team went on to tackle another difficult long-standing problem: autism. Sue Gerrard applied the Verifier method to the literature on autism, and identified some key assumptions which were founded on unsound reasoning and assumptions. Her conclusions? First, that there may well be several completely separate conditions being lumped together under the name "autism," leading to confusion. Second, that one of the established models, the neuroconstructivist model, offered a good explanation of one version of autism, but was missing a key component, which she added. Her paper describing these findings was published in the leading peer-reviewed autism journal in 2009.

## Conclusion and future developments

The framework for handling knowledge produced by Dr Rugg and his team, combined with the industry experience and capability of the Prevocative team, provide a powerful combination of insights and applications.

The Search Visualizer is one example of how this approach can be used to solve real world problems via swift, efficient, powerful solutions.

Because of the unified underlying framework, the Search Visualizer can be easily integrated with other products from the same stable, all of which share the same features of tackling long-standing, difficult problems, and eliminating those problems via powerful, simple new solutions.

The architecture of Search Visualizer is comprised of industry-standard tools, programming languages, interfaces and protocols. This allows SV to intelligently query virtually any modern data source, including leading online search engines, email folders, textbooks and manuals, corporate and public sector databases.

Additional features, such as left-right and non-Roman languages for Chinese or Arabic capability, or split-screen viewing and comparison of selected documents, can also be added with relative ease. SV is fully scalable in size, speed and across enterprises.

## Appendix A: Additional Applications Of Search Visualizer (Partial List)

Law Enforcement

Law

Literary Studies

Law

Foreign Language

Healthcare

Applications (Partial List)	Notes
Law enforcement, e.g searching the text of witness statements for particular topics	Looking for other cases which include the same features, particularly when these features are only mentioned in the text files of the witness statements, rather than in a database field. Stylometrics, showing distinctive phrasings which act as “phrasing fingerprints” for a specific individual
Technical manuals, large online manuals, e.g. aircraft maintenance	Harold Thimbleby’s formal analysis of aircraft flight manuals, which found that there were numerous states that the plane could be in, but which weren’t covered in the manual
Literary studies, e.g. visualizing the distributions of specified words in a text	Applying the SearchVisualizer to the poem Beowulf (with the keywords Grendel and dracan) shows how it’s actually two poems bolted together, without cross-references between its two sections. Stylometrics, showing distinctive phrasing in genuine documents versus fakes
Law, e.g. finding relevant precedents in case law	The first British case where a doctor’s black bag (and the drugs in it) was stolen from a locked car: what were the relevant precedents?
Foreign language documents, e.g. scientific literature in Russian, or historical documents in Arabic	Checking the Russian technical literature for technological innovations – e.g. the Shkval super-cavitation torpedo
Healthcare/Medical, e.g. searching medical records for combinations of symptoms	Checking for sensory problems in children diagnosed with autism

## Appendix B: Chief Scientist – Dr. Gordon Rugg

Dr Gordon Rugg is head of the Knowledge Modelling Group at Keele University, UK, and a Senior Visiting Research Fellow at the Open University, UK. He is on the editorial board of Expert Systems: the Journal of Knowledge Engineering and a member of the Editorial Review Board for the International Journal of Information and Operations Management Education (IJIOME). He is co-author of three books: The Unwritten Rules of PhD Research (Open University Press, 2004), A Gentle Guide to Research Methods (Open University Press/McGraw-Hill, 2006) , and The Stress-Free Guide to Studying at University (Sage, 2008) and sole author of a fourth: Using Statistics: A Gentle Introduction (Open University Press/McGraw-Hill, 2007).

Much of his work involves ways of handling knowledge, such as how to elicit knowledge that people are unable to put into words; how to represent information and knowledge so that it is easy for people to understand; and how to check for errors in expert reasoning. This work has included case studies in a range of disciplines, including biochemistry, podiatry and autism research.

Dr Rugg is co-developer of the Verifier method for detecting errors in expert reasoning about difficult problems. His first case study involved a cryptographic problem which had been unsolved for over ninety years, despite concerted study by some of the world's best cryptographers – the Voynich Manuscript. Previous researchers had concluded that the text in the manuscript was too complex to be a meaningless hoax; within a few months, Dr Rugg demonstrated that this conclusion was based on faulty reasoning, and demonstrated a way of producing very similar text to that in the manuscript using low technology methods. This study was published in the leading peer-reviewed journal of historical cryptography, Cryptologia and in Scientific American. A subsequent paper in the same journal by Austrian researcher Dr Andreas Schinner applied sophisticated statistical analysis to the manuscript, and concluded that the manuscript's text was probably meaningless gibberish produced in a similar way to the one described by Dr Rugg.

The second case study applied the Verifier method to the literature on autism, in a study by Sue Gerrard and Dr Rugg. This resulted in an article in the leading peer-reviewed journal in the field, the Journal of Autism and Developmental Disorders (JADD), which has just been published. The article identifies several key assumptions in the autism literature which are based on faulty reasoning or use of evidence; it also outlines a model of autism which integrates much previous work in the field into a new framework.

### Selected bibliography:

1. Gerrard, S. & Rugg, G. (2009); Sensory Impairments and Autism: A Re-Examination of Causal Modelling; Journal of Autism and Developmental Disorders, 39(10) October, 2009
2. Beardmore, J., Rugg, G. & Exley, C. (2007). A systems biology approach to the blood-aluminium problem: The application and testing of a computational model. Journal of Inorganic Biochemistry 101, pp.1187-1191.
3. Curran, M.J., Rugg, G. & Campbell, J. (2006). Would podiatrists benefit from an expert system for clinical reasoning and diagnosis? The Foot, 16, pp71-75
4. Rugg, G. (2004). The Mystery of the Voynich Manuscript. Scientific American, July 2004, pp. 104-109.
5. Rugg, G. (2004). An elegant hoax? A possible solution to the Voynich manuscript. Cryptologia, XXVIII(1), January 2004, pp. 31-46

## Consultancy background

Dr Rugg is a director of several companies, and his consultancy experience includes work for G4S, one of the largest private security providers in the UK. His work with them featured in several leading trade venues, including Security World magazine and the British Retail Consortium Yearbook.

## Twitter Example

He and his colleagues use a range of methods, including proprietary software developed by them, to tackle problems. For example, his colleague Ed de Quincey recently featured in the media because of his software for using text analysis of Twitter messages to trace the spread of flu: <http://www.telegraph.co.uk/health/swine-flu/6193551/Twitter-could-help-health-official-track-swine-flu.html>

## On the Web:

[http://www.scm.keele.ac.uk/research/knowledge\\_modelling/km/people/gordon\\_rugg/](http://www.scm.keele.ac.uk/research/knowledge_modelling/km/people/gordon_rugg/)

[http://en.wikipedia.org/wiki/Gordon\\_Rugg](http://en.wikipedia.org/wiki/Gordon_Rugg)

Autism:

<http://www.springerlink.com/content/j75v5146620k120q/>

## Appendix C: Software Architect – Ed de Quincey

<http://www.eddequincey.com>

Mr. de Quincey is currently a Senior Lecturer at the University of Greenwich, London (School of Computing and Mathematics), previously a Research Fellow at the City eHealth Research Centre (CeRC) at City University, London and a visiting researcher at the Knowledge Modelling Research Group in the School of Computing and Mathematics at Keele University. And he is working on a PhD in Computer Science under the supervision of Gordon Rugg at Keele University.

He has worked in the area of online human behaviour for 7 years, looking into the usability and impact of websites as well as uses of the information that they collect. This has involved investigations into the following areas: People's perceptions of corporate and academic websites for organisations such as Securicor, Keele University and the Open University. One particular study led to a 50% increase in student numbers in under a year.

Mr. de Quincey led and been involved in a number of studies into visualisation; the process of visually representing large amounts of data or code in order to identify trends and patterns. This has resulted in the production of software to visualise the data that is collected in web server logs to identify trends in online user behaviour and search. It has been successfully used to identify trends in searches for diseases on a healthcare digital library website.

Most recently, he led research that has investigated the potential of Twitter to detect disease outbreaks such as Swine Flu. By collecting messages on Twitter that contained the word "flu" we were able to demonstrate the potential that social networking sites have in monitoring epidemics and are now looking at how they can be used to direct appropriate information to the general public. Mr. de Quincey is also using the same approach to investigate the impact of the 2012 Olympic Games in London.

### Press

- ❖ The Daily Telegraph: "Twitter could help health official track swine flu"  
<http://www.telegraph.co.uk/health/swine-flu/6193551/Twitter-could-help-health-official-track-swine-flu.html>
- ❖ The Times of India: "Twitter could help track swine flu spread"  
<http://timesofindia.indiatimes.com/life-style/health-fitness/health/Twitter-could-help-track-swine-flu-spread/articleshow/5018126.cms>
- ❖ The Health Protection Agency (HPA): "Social networking sites could detect flu outbreaks faster"  
[http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb\\_C/1252660057427?p=1231252394302](http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1252660057427?p=1231252394302)

### Awards

- ❖ Apple's "Featured Web App" (April 2nd, 2008) and an Apple "Staff Pick" for "WebClipr" web application
- ❖ Bizcom 2008 Winner and National Finalist – Business Idea Competition

## Selected Publications

- ❖ de Quincey, E and Kostkova, P. (2010). Early Warning and Outbreak Detection Using Social Networking Websites: The Potential of Twitter. In: Electronic Healthcare. Berlin Heidelberg: Springer . p21–24.
- ❖ de Quincey, E , Kostkova, P and Farrell, D. (2009) Visualising web server logs for a Web 1.0 audience using Web 2.0 technologies: eliciting attributes for recommendation and profiling systems. Workshop on Adaptation and Personalization for Web 2.0 in connection with UMAP 2009, June 22–26, 2009, Trento, Italy
- ❖ H Oliver, G Diallo, E de Quincey, P Kostkova, G Jawaheer, D Alexopoulou, B Habermann, R Stevens, S Jupp, K Khelif, M Schroeder, G Madle. (2009) A User-Centered Evaluation Framework for the Sealife Semantic Web Browsers. BMC Bioinformatics, Semantic Web Applications and Tools for Life Sciences, 2008, BMC Bioinformatics 2009, 10(Suppl 10):S14, doi:10.1186/1471-2105-10-S10-S1
- ❖ Ed de Quincey, Helen Oliver, Patty Kostkova, Gawesh Jawaheer, Gemma Madle, Gayo Diallo, Dimitra Alexopoulou, Michael Schroeder, Bianca Habermann, Khaled Khelif, Simon Jupp, Robert Stevens. (2009) Mining for Patterns of Semantic Link Usage: Do Domain Users Actually Like Semantic Browsing? wi-iat, vol. 3, pp.50–53, 2009 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology, 2009
- ❖ de Quincey, E, Hawksley, C (2009) Collaborative learning inside and outside of a Wiki Environment In Novel Approaches to Promoting Student Engagement. HEA Subject Centre for Information & Computer Sciences
- ❖ Petre, M, de Quincey, E. (2006) A gentle overview of software visualisation Computer Society of India Communications. August, 6–11. ISSN 0970-647X
- ❖ Full list available at: [http://www.eddequincey.com/?page\\_id=8#publications](http://www.eddequincey.com/?page_id=8#publications)

## Grants and Funded Projects

- ❖ Co-Investigator on NIH Grant to investigate the impact of healthcare websites on antibiotic prescription. Currently under review (\$275,000)
- ❖ City Commercialisation Grant to fund an MBA student Summer Internship (£1,000)
- ❖ Funding for development of online games to teach differential equations in U.S. Universities (\$1,000)
- ❖ Mercia Spinner Grant (£7,000) for research into the potential uses of elicitation methodologies including software developed as part of my PhD
- ❖ Collaborator on “Software Visualisation” project with researchers at the Open University (£1,000)
- ❖ Management of TE3 grant funded (£10,000) “Multimedia Marketing Resource Kit” project
- ❖ Developer of online resources as part of the TE3 grant funded (£1,000) “Virtual interviews with micro business entrepreneurs” project

## Appendix D: Prevocative, LLC

<http://www.Prevocative.net>

- ❖ Prevocative provides top technical expertise and thoughtful business analysis to growing companies.
- ❖ Our objective is to identify the maximum points of leverage where people, technology and finance intersect. This creates successful businesses, which contribute to a safer, more secure, more just and compassionate society, worldwide.

**Principal: Michael North**

### Applied Technology and Market Development

<http://www.mediasense.com>

Michael North is the President and co-founder of [Greenstar Corporation](#), a technology company that focuses on solar power, wireless communications and media development.

Through Greenstar's "digital culture" programs in the developing world, solar-powered community centers are installed in remote, rural off-the-grid villages. A Greenstar system includes health, education, employment, telecommunications, agriculture and ecommerce services.

Greenstar co-operates with the US Department of Energy, US Agency for International Development, National Renewable Energy Laboratory, Sandia National Labs, the United Nations Development Programme, the International Telecommunications Union, the World Bank, the World Resources Institute, Capital Missions, Rotary Clubs International, Motorola, Hewlett-Packard, the Technology Empowerment Network and other international organizations. Interviews with Michael North about Greenstar can be read here at the [Center for Digital Government](#) and at [Interactivist](#).

Previously, Michael served for 20 years as the founder and CEO of North Communications, which was responsible for many innovations in touchscreen networks. In partnership with IBM, SAIC, Xerox and others, North Communications won a major federal procurement for Info/USA, awarded through the U.S. Postal Service.

Other major clients included the Social Security Administration, Veterans Administration, the State of California, the City of New York, the Congressional Printing Office, the State of Texas, the cities of Singapore and Brisbane. The company designed and supported a fully-integrated network management system, including hardware, systems and application software, media production, installation and maintenance, telecomm and transaction processing. Its key investor was billionaire John Kluge of Metromedia. In 1999 the company was acquired by IBM and Diebold.

In 2010, he formed Prevocative with colleague Clyde Musgrave, to provide business development services to growing technology companies.

## **Principal: Clyde Musgrave**

### **Strategic Technology and Business Development**

<http://www.DrClydeM.com>

Clyde Musgrave is a business executive, technologist, engineering leader, communicator and entrepreneur.

He holds a Masters of Business Administration from the University of Texas, a Masters in Electrical Engineering from the Naval Postgraduate School, and a Ph.D from LaSalle. For the United States Navy, his focus was satellite and wireless communications. He did graduate work with Richard Hamming of "Hamming Code" fame, as well as Jack Wozencraft, a seminal expert in telecommunications. His undergraduate degree in Electrical Engineering at University of Nebraska focused on digital design.

Clyde's MBA work explored entrepreneurship and commercializing technology. This unusual combination of expert technical capability and business analysis helps him bring his skills to bear in practical forms in the corporate world.

Dr. Musgrave has shared responsibility for advances into radical new technologies by many government agencies, including National Security Agency, Central Intelligence Agency, National Institute of Standards and Technology, National Reconnaissance Office, Defense Intelligence Agency, Defense Mapping Agency, Advanced Research Projects Agency, and National Information & Display Laboratory.

Since 1973, he has held Top Secret – TS//SI//TK/plus others based on full background investigations and full lifestyle polygraphs, and holds Dept. of Homeland Security access.

Dr. Musgrave served the Navy in classified engineering and line capacities, including the Navy Milstar Program and the Naval Electronic Systems Command, among many others. He conducted the Technical Evaluation and Operational Evaluation of the first ship-borne SigInt/ComInt program for NSA as well as many others.

In his corporate career, Clyde served on the Strategic Development Staff at GTE (now Verizon). He held the post of Chief Technology Officer for Efficient Networks (now part of Siemens). He worked as Director of Corporate Development for Sarnoff Labs, helping one of Sarnoff's biometric spinoffs, IriScan, achieve early commercialization of practical iris identification. Clyde also served as Director of Systems Engineering at General Electric.

At Efficient Networks, a pioneer in xDSL for business and residential broadband communications, he helped position the company for its acquisition by Siemens for \$1.2 billion. He was Vice President and General Manager of a software business and had P&L responsibility for 50+ people, and annual revenues of \$25 million per year.

A highlight of Clyde's public sector career was his service with Vint Cerf and others on the ARPANET Executive Committee in the late 1970's, when the standards for the Internet Protocol (IP) were being defined. He is a Registered Professional Engineer in three states, and was twice awarded the Defense Meritorious Service Medal, which is bestowed on members of the U.S. Armed Forces who have distinguished themselves by meritorious service or achievement while assigned to a joint activity.

Dr. Clyde holds eleven U.S. patents in the fields of secure electronic transactions, digital watermarking in video/images, digital certificates, and biometrics and has patents pending in the areas of xDSL, a transaction model for telecom services, electric power utilities, non-traditional financial services, passport/visa fraud protection, and others.

He has done private consulting with government and commercial partners and served in several start-ups through the present. One of his recent business development vehicles is Prevocative, formed in 2010 in partnership with Michael North.

## Appendix E: Voynich, Midway, Getroffen, Briefing Videos

“Scientific Method Man”; Wired Magazine

<http://www.wired.com/wired/archive/12.09/rugg.html>

“The Mystery of the Voynich Manuscript”; Scientific American

<http://alturl.com/9fto>

“Ambush the Ambushers” – Midway, Desalination, example

<http://worldwar2history.info/Midway/ambush.html>

Executive Briefing Overview (QuickTime Video):

<http://www.prevocative.net/sharedrive/Intro.mov>

Case Study: Midway Island Desalination and Search Visualizer (QuickTime Video):

<http://www.prevocative.net/sharedrive/Midway.mov>

Case Study: Hitler Rommel Getroffen and Search Visualizer (QuickTime Video):

<http://www.prevocative.net/sharedrive/Hitler-Rommel-Getroffen.mov>



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Web: [prevocative.net](http://prevocative.net)