Legal knowledge-based systems: new directions in system design

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Abstract

'Legal Knowledge-Based Systems: New Directions in System Design'

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This thesis examines and critiques the concept of 'legal knowledge-based' systems. Work on legal knowledge-based systems is dominated by work in 'artificial intelligence and law'. It seeks to *automate* the application of law and to automate the solution of legal problems. Automation however, has proved elusive. In contrast to such automation, this thesis proposes the creation of legal knowledge-based systems based on the concept of *augmentation* of legal work. Focusing on systems that augment legal work opens new possibilities for system creation and use.

To inform how systems might augment legal work, this thesis examines philosophy, psychology and legal theory for information they provide on how processes of legal reasoning operate. It is argued that, in contrast to conceptions of law adopted in artificial intelligence and law, 'sensemaking' provides a useful perspective with which to create systems. It is argued that visualisation, and particularly diagrams, are an important and under considered element of reasoning and that producing systems that support diagramming of processes of legal reasoning would provide useful support for legal work.

This thesis reviews techniques for diagramming aspects of sensemaking. In particular this thesis examines standard methods for diagramming arguments and methods for diagramming reasoning. These techniques are applied in the diagramming of legal judgments. A review is conducted of systems that have been constructed to support the construction of diagrams of argument and reasoning. Drawing upon these examinations, this thesis highlights the necessity of appropriate representations for supporting reasoning. The literature examining diagramming for reasoning support provides little discussion of appropriate representations. This thesis examines theories of representation for insight they can provide into the design of appropriate representations. It is concluded that while the theories of representation that are examined do not determine what amounts to a good representation, guidelines for the design and choice of representations can be distilled. These guidelines cannot map the class of legal knowledge-based systems that augment legal sensemaking, they can however, be used to explore this class and to inform construction of systems.

Legal Knowledge-Based Systems: New Directions in System Design

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None of the material contained in this thesis has previously been submitted for a degree in this or any other university. This thesis is entirely the author's own work.

Doing a PhD sounded like a good idea at the time, it has not been a bad idea, though it feels like a long time. During the course of my research I have relied upon the help of many people to whom I would like to express my sincere thanks. To my research supervisors, Robin Widdison and Tom Allen, go my thanks for the constant encouragement they have provided during the course of this work. Their enthusiasm and their willingness to discuss the ideas that arose during the course of this research have made this better than it otherwise would have been. No liability is assigned to either however, for errors or omissions which remain! To Robin I would also like to express particular thanks for being such an understanding 'boss' during my time working for the Centre for Law and Computing in Durham. To the Department of Law at the University of Durham I express my gratitude for the financial support, office space, and encouragement it has provided during my years in Durham.

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"If you'd argue with me, it would help me decide."

1 Introduction

There ain't no rules around here! We're trying to accomplish something!
Thomas Edison

Imagine a scenario – it is 19:00 and the young associate hunched over her computer has just been handed a file concerning the biggest client of the firm for which she works. She has a memorandum to prepare for an 08:30 meeting the following morning and two hours until the last available train connection. Unfortunately, the file concerns an unsettled area of law. The pressure to quickly, clearly, concisely and forcefully clarify the client's position is countered by the apprehension of sleeping on the office couch.

Fortunately, she has been trained to use the firm's knowledge tools. Approaching her computer with its flat, dormant screen, she traces her finger across the touch pad on her keyboard. The screen wakes. Faced with an empty canvas, she is free to begin sketching the arguments that will save her client. Placing the central issue in the case at the centre of the screen, she frames and re-colours it in order to highlight its importance. Dragging boxes with the touch pad and then linking them to the issue with a few finger taps, she enlarges upon the central issue and begins to decompose it into constituent sub-issues and to note questions and concerns raised by each. As they arise, she outlines arguments that resolve the issue in her clients favour and, anticipating objections, to each of these she links those counter arguments she thinks likely from the opposing party. Rocking back in her chair, she contemplates the network of issues, questions and arguments glowing on the screen. The only annoyance is that her client is clearly in the right and she is being forced to spend valuable evening hours proving the obvious. If only she can make the judge and opposition see things from the same perspective! Leaning forward she drags several more boxes onto the screen, linking them to those already there. Linking them to indicate how the client's argument is supported and anticipating how the opposition might respond. Slowly, a network of detailed arguments builds up. The main issue becomes surrounded by those sub-issues that are implicated by it. These sub-issues in turn become embedded in a network of arguments for and against her client. Each of these arguments is itself slowly decomposed until it is clear how each piece of evidence in the dispute fits into the scenario she has constructed. Scrolling back and forth, zooming in and out of the argument network, expanding and contracting branches, selectively displaying and hiding certain types of branches, a solid argument emerges. Indeed, the opposing arguments begin to look feeble. Pleased, she commands her desk workstation to save the work. Instantly, the argument network is saved on the firms central storage located several floors below.

The following morning and the team gathered to fight the case assembles for a joint briefing. Those in the office wander away from the coffee and seat themselves around the conferencing table. The faces of those on the opposite coast and in other countries flash on screen. Commencing with a short discussion of her work the previous evening, the associate recalls the argument map she constructed. The firms conferencing system immediately projects the map on the 3 by 4 metre screen that occupies the wall behind the podium on which she stands. Simultaneously, the map appears on the screen that is in front of each team member present in the conference room and on the screen in front of each participant at their various global locations. Mentally reprimanding herself, our associate notes that she has not found any authorities for the arguments in the argument map. The participant in Singapore who mumbles a complaint quickly notes this, a complaint immediately echoed by the partner in charge of the matter. However, before she has a chance to respond, the young solicitor drafted in to gain experience in corporate litigation objects to the structure of the argument supporting the third issue, and begins to drag and rearrange the arguments on his personal screen. The changes simultaneously appear on the screen behind our associate and on the screens of all other participants. After a minute the young solicitor stops, apparently satisfied with his work. However, the partner is now dissatisfied and begins to rearrange the argument map. Another minute of activity follows. Now however, one of the American associates thinks he has spotted a weakness in the rearranged arguments - viewed as a whole he objects that the arguments supporting the first and fourth issues weigh in opposite directions. A murmur of agreement flows through the rest of the participants.

Fearing major dissent, the associate opens a second window on her personal screen. This opens the firms information retrieval engine, which she commands to retrieve material relating to the same issues. After a seconds delay, a summary of another memorandum appears on screen as well as a short letter of advice drafted a year previously. It is the second that she retrieves in full. Another moment and her personal screen divides into two halves. On the left remains the argument map under consideration. On the right appears the text of the letter of advice. The letter is ten pages long. Never having seen it before, the associate glances at the title to verify that she been given what was requested. Satisfied, she types a command and the text of the letter disappears and is replaced by the argument map underlying the letter. Dragging, scrolling and zooming, she locates the section that covers issues one and four. It is apparent from the letter that its author viewed the law in the same way as she originally had. The letter's argument map and the argument map she originally drafted have the same structure. Relieved, she projects onto the main screen and onto the screens of each team member, the structure of the argument map from the letter. After a few moments spent digesting its contents, murmurs of satisfaction replace the previous murmurs of discontent. Incontrovertible proof that the argument as originally structured was sound. For the argument map in the letter of advice was constructed by none other than the firm's legendary expert on such matters. Fifty such cases prepared for trial and not one lost. Unfortunately, this expert chose to leave and establish his own practice. However, thanks to the firms computer systems some of this expertise remains. After another hour spent rearranging the argument and retrieving past work, cases, legislation and articles, the participants agree that their jointly constructed argument is a winning one, close down their screens, farewell the overseas participants, and file out of the conference room.

Unfortunately, a computer system of the type envisaged above and facilitating the type of interactions envisaged remains unrealised. However, such as system would be of immense benefit - allowing individuals to more efficiently and more comprehensively solve problems, to more efficiently explore their own ideas and to more clearly construct and comprehend arguments. Moreover, it would allow more efficient cooperation and communication during group work. Indeed, the benefit of such systems extends beyond the immediate improvement of individual and group work. The ongoing use of such systems would drive the capturing of an organisation's knowledge and the construction of an organisational memory, cushioning the organisation from staff turnover and facilitating ongoing staff education.

Given the value of such systems how they might be constructed is a major question. Providing tools for improving legal knowledge work is vitally important. At least since Loevinger inaugurated 'jurimetrics', the use of computers in law has been the subject of concerted research.[1] Lawyers employ a diverse range of computer applications - from the humble word processor to complex client relationship management packages. The growth of the internet has spawned an array of new applications of computers in law and prompted the formation of a diverse range of companies that seek to sell computer products to the legal market. Computers are being used in law in more and more diverse ways. This work explores legal knowledge-based systems - the ways in which computers can be used to improve legal work and to manage the increasing complexity of the environment in which legal work occurs.

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[1] Loevinger coined the term 'jurimetrics' to 'signify the scientific investigation of legal problems, especially by the use of electronic computers and by symbolic logic.'; Lord Lloyd of Hampstead, Introduction to Jurisprudence (3rd edition) (1972) Stevens & Sons, 415-7.

1.1 Underlying thesis

Amongst the most interesting use of computers in law is the creation of 'knowledge-based' systems – systems that seek to manipulate legal knowledge. However, legal knowledge-based tools have largely focused on the application of artificial intelligence. This has proved difficult and limited. The application of artificial intelligence is based on a particular conception of the way computers should be integrated with human work processes. It is based on a conception of computers automating these processes. As currently conceived, legal knowledge-based systems seek to automate legal work – to automatically perform the complex problem solving that lawyers engage in. Automating the reasoning that lawyers perform, however, has proved highly problematic.

In contrast to this focus on automation, this work examines an alternative conception for the use of computers in law - motivated by the conviction that there remain numerous unexplored uses of computers in law. In particular, the concept of legal knowledge-based systems remains underdeveloped. In contrast to the currently prevalent concept of legal knowledge-based systems based on the concept of 'automation', this work proposes a wider concept of legal knowledge-based system – a concept based on the notion of 'augmentation'.

Through examining legal theory this work explores the construction of jusrisprudentially sound legal knowledge-based systems. In particular, this work is concerned with how the diagrammatic presentation of legal information can improve legal knowledge work. Work in psychology and cognitive science indicates that visualisation of information is extremely beneficial. This work suggests that visualisations of legal knowledge, as opposed to the traditional 'textual' presentation of legal information, can benefit legal knowledge work. This work examines how computer systems that support the manipulation of diagrammatic representations of legal knowledge can be built to augment legal knowledge work. To date, this use of computers in law remains largely unexplored in the literature discussing legal knowledge-based systems.

As discussed throughout this work, all legal knowledge-based systems are based on 'representations' - including representations of how computers should be used in law, and how the law and legal reasoning operate. This work examines the concept of representations in detail. Legal knowledge-based systems are constructed on representations of legal work and legal knowledge and this work examines the nature of such representations in detail. In particular, this work examines whether there is any systematic way to construct representations that could underlie legal knowledge-based systems. Although concluding that theory cannot currently determinately specify representations, representational guidelines are available. This work explores and discusses such guidelines.

1.2 Methodology and Scope

Examining legal knowledge-based systems necessarily involves drawing from diverse sources. The two primary fields informing this examination are legal theory and the relatively young field of 'artificial intelligence and law'. Descriptive legal theory is examined for information it can provide on how legal reasoning operates and hence how computers might be used to augment legal reasoning. The field of artificial intelligence and law is the primary field which explores the creation of legal knowledge-based systems and research in artificial intelligence and law is examined for the light it casts on the construction of legal knowledge-based systems. In addition, this work draws on research in philosophy, psychology and cognitive science for insight these disciplines can provide into processes of reasoning. In particular, these disciplines are examined for insight they can provide on the use of diagrammatic representations in support of reasoning and problem solving. Finally, this work examines research in computer science, and particularly work on hypertext, where research on knowledge support tools is comparatively advanced.

However, while this work is interdisciplinary and examines each of these fields, this work is not specifically situated within any of these fields. This work is not presented as a contribution to legal theory or the field of artificial intelligence and law. Nor does this work propose contributions to research in philosophy, psychology or cognitive science. Each of these fields is examined solely for contributions they can make to the construction of augmentation tools for legal knowledge work. It is difficult to pin a precise label to the field to which this work belongs. Although it is a work examining the use of computers in law, it is not a 'black letter' examination of the substantive law involved in the resolution of problems thrown up by computer technology, as is usually conjured up by the phrase 'computer law'. The field of artificial intelligence and law, with its concern with legal knowledge-based systems, is perhaps closest to this work. However, this work differs in its rejection of the automation paradigm. As far as is necessary, it is perhaps most accurate to conceive of this work as an examination of legal knowledge-based systems in a broad sense.

While an examination of legal knowledge-based systems however, this work does not report the construction of a new legal knowledge-based system. Nor does this work report on the use of any particular legal knowledge-based system. Rather, this work is a theoretical examination of the foundations of legal knowledge-based systems. This work reports the attempt to clarify and expand the concept of legal knowledge-based system and the attempt to clarify the key issue involved in the construction of legal knowledge-based systems – the construction of representations to augment legal knowledge work.

This work makes four main contributions o the study and understanding of legal knowledge-based systems. First, this work provides a new conception for legal knowledge-based systems. This conception argues for a wider understanding of what constitutes a legal knowledge-based system than is typically adopted. Secondly, this work highlights the potential benefits in the use of visualisation for the creation of legal knowledge-based systems. Thirdly, this work reveals the importance of understanding the theoretical underpinnings on which the representations underlying legal knowledge-based systems are based. Finally, this work distils guidelines from the diverse disciplines upon which it draws for the creation of the representations that underlie legal knowledge-based systems.

This work is but a first step in an ongoing process of exploratory construction and testing of legal knowledge-based systems. It is hoped that subsequent work will explore in more depth and clarify the ideas discussed here and commence to build and test systems based on these ideas. As such, this work is aimed at lawyers interested in the use of computers to improve legal work, it is hoped that the alternative vision of the role of computers in supporting legal knowledge work presented here will motivate the support of research in this area. Moreover, this work is aimed at those interested in the actual construction of computer systems to support legal work, by providing a broad outline of the types of systems that would benefit working lawyers.

1.3 Organisation

This work is organised into seven chapters. Following this introduction, chapter two examines research on computer support for legal work, in particular focusing on research in the field of artificial intelligence and law. Work in artificial intelligence and law is particularly interesting because it investigates in depth the intersection between legal knowledge work and computing. In order to understand the potential benefits that computing provides in law, it is necessary to understand current limitations of work on the use of computers in law. The examination in chapter two provides an overview of work in artificial intelligence and law. It examines three main methods by which researchers attempt to automate processes of legal reasoning and highlights some of the limitations of this work. In particular, this chapter focuses on the limitations of the paradigm of automation on which work in artificial intelligence and law is based. Chapter two proposes an alternative paradigm for the use of computers in law – a use of computers based on the augmentation of legal work.

Chapter three concerns legal reasoning. This chapter examines perspectives on law and legal reasoning provided in the jurisprudential literature. In particular, this chapter focuses on descriptive legal theory and how such theory has informed the creation of computer systems in law based on the use of artificial intelligence. This legal theory is founded on an 'objectification' of law. This chapter argues that theories of law and legal reasoning which underlie the application of artificial intelligence in law are inadequate to found systems to augment legal knowledge work. In contrast, chapter three examines an alternative perspective of law and legal work, a perspective which places the legal thinker at the centre of legal problems solving and in which legal problem solving becomes a process of 'sensemaking'. It is argued that when a sensemaking perspective is adopted, new issues and questions arise concerning legal problem solving. In particular, it is argued that problem representations are of central importance and that problem visualisation is an invaluable mechanism in problem solving.

Chapter four builds on the examination of legal theory undertaken in chapter three. Chapter four examines methods that have been developed for diagramming, for visualising, the structures of argument and reasoning. This chapter attempts to apply these methods for diagramming argument and reasoning to diagramming legal judgments. Through this attempt to diagram legal judgments, chapter four argues that all methods to diagram argument and reasoning are necessarily selective and that of critical importance is finding a representation, or representations, appropriate to support of legal work.

Chapter five reviews computer systems that have been built to support the construction of diagrams to aid argument and reasoning. This chapter highlights the diversity of systems that have been constructed to support the diagramming of reasoning. The computer systems reviewed in this chapter have been built to support a wide range of tasks, both inside and outside the law. Constructed to support a diverse range of tasks, the systems surveyed in chapter five are themselves based upon a diverse range of representations. In addition to highlighting the diverse uses to which systems can be put and thereby the scope of potential benefit of such systems, chapter five emphasises the need for a theoretical underpinning to the choice of representation underlying any particular representation.

Chapter six examines theories of representation. Throughout this work, the centrality of representations in problem solving is emphasised. All computer systems designed to augment legal knowledge work must be based on a representation of law and legal knowledge work. The choice of representation is centrally important to the use and operation of the system. However, the diversity is striking amongst representations used in problem solving and computer systems to support problem solving. This chapter examines theories of representation for clarification they might provide on how to create useful representations to support legal work. Chapter six concludes that theories of representation do not provide determinative criteria for the creation of representations in support of legal knowledge work or the choice amongst representations in support of legal knowledge work. Further, while providing visualisations is considered important, chapter six argues that theory does not currently indicate what visualisation should be chosen for a representation. Whilst theories of representation and visualisation provide guidelines which can inform the creation of and choice amongst representations, and the visual presentation of such representations, a large element of art remains. Despite this lack of determinacy however, chapter six argues that there exists a largely unexplored class of computer systems in law, a class of systems based on the use of visualisations of problem solving to support legal knowledge work. As examples of computer systems in this class that could be constructed this chapter discusses two potential computer applications to support legal knowledge work.

The final chapter in this work, chapter seven, summarises the conclusions reached during the course of this work and suggests avenues for future research.

2 Computer support for legal work

If a little knowledge is dangerous, where is a man who has so much as to be out of danger?

Thomas Henry Huxley

2.1 Introduction

This chapter investigates legal knowledge work and the use of computers to support legal knowledge work. Much has been written about the use of computers in law and about 'knowledge-based' systems in law. Work on legal knowledge-based systems is currently dominated by attempts to apply techniques from artificial intelligence in law. Indeed, as currently conceived, legal knowledge-based systems have come to be synonymous with the application of methods from artificial intelligence. This has given rise to the specialised field of research unsurprisingly labelled 'artificial intelligence and law'. Research in artificial intelligence and law is simultaneously intriguing, tantalizing and frustrating. This research is intriguing because the ultimate aim – to create computer systems that can automatically reason with the law and solve legal problems – forces intimate examination of what law is and what it means to 'think like a lawyer'. Such examination displays in stark contrast the many gaps in our knowledge about what law is and what legal reasoning involves. This research is tantalizing because it promises a world in which access to legal knowledge and legal expertise is fundamentally changed and democratised. This research can display numerous constructed computer systems seemingly able to engage in surprisingly complex legal reasoning. However, this work is frustrating because the goal of creating a computer system that can truly 'reason like a lawyer' seems continually just out of reach.

This chapter outlines an additional use of computers in law to that conceived in artificial intelligence and law – a use of computers to *augment* legal knowledge work. This use of computers in law is also concerned with legal knowledge and legal knowledge work. However, unlike work in artificial intelligence and law, this use of computers does not seek to *automate* legal knowledge work. This requires reconception and a widening of what legal 'knowledge-based systems' are understood to encompass.

Following this introduction, the next three subsections outline causes of the need for knowledge processing tools. This is followed by an examination of work in artificial intelligence and law in subsection five. After discussing the benefits and drawbacks of this work, subsection six outlines an alternative use of computers in law. This is a use of computers based on the augmentation, rather than the automation, of legal knowledge work.

2.2 The information explosion

For over 50 years Drucker has chronicled changes in the United States and world economies. According to Drucker while in 1900 the majority and largest single group of Americans earned their living from agriculture, by 1940 the largest single group was industrial workers. By 1960 the largest single group was professional, managerial, and technical - that is, knowledge workers. Drucker predicted that by 1975-80 this group would embrace the majority of Americans.[2] According to Drucker it is knowledge, not land, raw materials, or capital, that has become the central factor in production. This idea, that the very basis of economies worldwide is changing - moving from a base of physical production to a focus on knowledge - is echoed by numerous commentators.[3] It is widely accepted that knowledge and work with knowledge is a key to future success and competitive advantage.[4] In its 1998 competitiveness white paper,

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[2] Drucker, P.F., The Effective Executive (1967) Harper and Row.

[3] E.g. Tapscott, D., The Digital Economy: Promise and Peril In The Age of Networked Intelligence (1997) McGraw-Hill.

[4] E.g. Stewart, T.A., Intellectual Capital: The New Wealth of Organizations (1997) Nicholas Brealey.

the government of the United Kingdom attempted to outline a regulatory framework in which the 'knowledge driven economy' could flourish.[5]

With the increased importance of knowledge has come a new type of worker. While the exact terms used to describe this change vary, the ideas are essentially similar. For example, while Drucker talks about the 'knowledge worker', Reich argues that the 'symbolic analyst' has emerged in society. According to Reich:

> Symbolic analysts solve, identify, and broker problems by manipulating symbols. They simplify reality into abstract images that can be rearranged, juggled, experimented with, communicated to other specialists, and then, eventually, transformed back into reality. The manipulations are done with analytic tools, sharpened by experience. The tools may be mathematical algorithms, legal arguments, financial gimmicks, scientific principles, psychological insights about how to persuade or amuse, systems of induction or deduction, or any other set of techniques for doing conceptual puzzles.[6]

Whether we call such workers 'knowledge workers' or 'symbolic analysts', commentators argue that with this new worker has come a new type of organisation, the 'knowledge organisation'.[7] In such organisations, cultivating the creation of knowledge and subsequent 'knowledge management' are central activities.[8] Not only does the nature and role of individual workers change, so

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[5] Department of Trade and Industry, 'Competitiveness White Paper: Building the Knowledge Driven Economy' (1998). Available at: http://www.dti.gov.uk/comp/competitive/ (accessed 18/2/2001).

[6] Reich, R.B., The work of nations: preparing ourselves for 21st-century capitalism (1991) Alfred A. Knopf, 178.

[7] Tapscott characterises this change as encompassing five aspects: the effective individual; the high performance team; the integrated enterprise; the extended enterprise; and the internetworked business: Tapscott, above n. 3, ch. 3.

[8] For a discussion of changes to education and their relation to work and organisations, see: ibid. ch 8.

do organisations themselves. Knowledge organisations must themselves cultivate an 'organisational memory' and promote 'organisational learning'.

Whether or not all claims about the knowledge driven economy are correct and whether or not all predicted changes materialise, in any move towards knowledge-based work new tools are required by workers in this economy. Workers in the knowledge driven economy are subject to new pressures. For example, it appears that many workers are under pressure to deal with increasing amounts of information. Workers are encountering increasing levels of stress as they face the need to deal with increasing amounts of information in decreasing amounts of time. This has lead to a phenomenon that has been called 'information overload'.[9] While it has been claimed that computers will eventually take over many of the jobs that people perform, even in knowledge-based areas,[10] at present the explosion in information technology has actually increased the information processing load that workers are subject to.

This is no less the case in legal work. Not only is the workplace in general filled with more and more information, but legal workers are faced with more and more legal information. We are also subject to ever increasing legal regulation. We live in what Susskind has characterised as a 'hyper regulated society'. According to Susskind:

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[9] As Rheingold states:

> The problem with the information age, especially for students and knowledge workers who spend their time immersed in the info flow, is that there is too *much* information available and few effective filters for sifting the key data that are useful and interesting to us as individuals. (Rheingold, H., The Virtual Community: Finding Connection in a Computerized World (1994) Secker & Warburg, ch. 2.)

[10] E.g.: Kurzweil, R., The Age of Spiritual Machines : When Computers Exceed Human Intelligence (2000) Penguin; Moravec, H.P., Robot: Mere Machine to Transcendent Mind (2000) Oxford University Press.

> We are all subject, in our social and working lives, to a body of legal rules and principles that is so vast, diverse, and complicated that no one can understand their full applicability and impact.[11]

New tools are needed to help those who work with the law cope with the increasing amount and complexity of legal information.[12]

2.3 The knowledge processing lag

When examining computer applications in law it is customary to contrast 'back office' applications with 'front office applications' or with 'practice support systems.'[13] Back office systems are:

> generally the preserve of support staff. The primary purpose is to enhance the productivity of secretarial and clerical employees; perhaps also of paralegals and legal executives.[14]

Time and billing software, and accounting packages are typical examples of such back office systems.

In contrast, front office applications or practice support systems are said to be systems which:

> *directly* assist the substantive practice of law; which assist the lawyer in providing a better service, in a more efficient manner.[15]

Such systems might include applications such as word processing packages, legal research databases, case management systems and document management systems.[16]

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[11] Susskind, R.E., The Future of Law. Facing the Challenges of Information Technology (1996) Oxford University Press, 13, hereafter Susskind "The Future of Law".

[12] Ibid. 2.3; Susskind, R., Transforming the Law (2000) Oxford University Press, 21-6, hereafter Susskind "Transforming the Law".

[13] Susskind "The Future of Law", above n. 11, 72; Mital, V., Johnson, L., Advanced Information Systems for Lawyers (1992) Chapman & Hall, 2.

[14] Mital and Johnson, above n. 13.

[15] Ibid., footnote omitted.

However, the distinction between back office systems and front office systems can be misleading. The image of a clear separation is difficult to maintain. The distinction between back office systems and front office systems suggests a separation based on the way a particular legal practice is structured rather than on a function of the applications themselves.[17]

It is nevertheless useful to focus on the substantive practice of law and on computer applications that support the substantive practice of law. According to Mital and Johnson, this covers an extremely diverse range of applications – from word processing systems to legal research databases to expert systems. To this could be added applications such as: automated document generation systems; real time transcription systems; evidence management systems; computerised training aids; and legislative drafting aids to name but a few. The notion of applications that support the substantive practice of law is thus very wide. However, it usefully focuses on the kind of work being performed – rather than who performs the work. It indicates a distinction between administrative work on the one hand and substantive work, or knowledge work, on the other.

This distinction between legal knowledge work and other legal work is a distinction highlighted by Susskind. Susskind argues that computer applications in law are characterised by a 'knowledge processing lag' – while techniques exist to process legal information, techniques to process legal knowledge are highly

[16] Ibid.

[17] For example, it is not uncommon for lawyers to run time-keeping packages on their own computers, at least partly taking this out of the preserve of support staff. Similarly, it is not uncommon, although perhaps decreasingly so, for lawyers to pass documents to support staff for typing, layout and printing, or to pass research requests to in-house librarians. In both situations, 'practice support applications' are being directly used by back office support staff. Further, other computer applications straddle both uses. For example, email and video mail could be used both as administrative tools and in the substantive practice of law. The distinction thus blurs depending on how a package is used in a particular situation.

underdeveloped.[18] Addressing this legal knowledge processing lag is crucial to tackling information overload and hyper regulation. However, knowledge work itself involves many aspects and to support the knowledge work that lawyers perform it is necessary to have a better idea of what knowledge work involves.

2.4 Knowledge work

Surprisingly for a term that has achieved such wide usage and that is applied to so many aspects of work, the precise content of knowledge work is difficult, if not impossible to pinpoint. Drucker outlines the wide-ranging effects that transition to a knowledge driven economy will have and the myriad diversity of knowledge workers in this economy – however, apart from the possession of specialised knowledge he does not indicate what characterises knowledge workers.[19]

According to the US Army Corps of Engineers, a knowledge worker is someone:

> who gathers data/information from any source; adds value to the information; and distributes value-added products to others.[20]

Reich's conception of knowledge work is slightly narrower, it involves identifying problems and solving problems through the abstraction of information, organizing information in new ways, making sense of information, seeing information as a whole, ordering information, and communicating it.[21] Reich leaves out the finding of information. Tapscott provides a broad view of knowledge work, stating it is 'leveraged intellect'.[22] While conceptions vary, at a very broad level knowledge work can be said to encompass

- Finding knowledge

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[18] Susskind "The Future of Law", above n. 11, 2.3.

[19] Drucker, P.F., Post-Capitalist Society (1993) Harper Collins.

[20] http://www.cecer.army.mil/kws/kwp.htm (accessed 15/12/2000)

[21] Reich, above n. 6, 225-233.

[22] Tapscott, above n. 3, 44.

- Creating knowledge
- Communicating knowledge[23]

It is knowledge that is found, created and communicated, it is knowledge that is important – but this leaves unanalysed precisely what 'knowledge' actually is. As the background to the DTI Competitiveness White paper states:

> The information available in a book or on the Internet becomes knowledge only when it has been read and understood.[24]

Terrett emphasises this, stating:

> There are three fundamental information management concepts that require definition: data, information and knowledge. The firsts is simple – data is raw facts and figures. Information can be defined as 'data process into meaningful patterns.' .... The concept of knowledge implies a body of information that is of higher value or calibre, that offers meaning or insight ... 'knowledge is a personal subjective process emerging from previous experiences and current events, while information is objective data about the environment.'[25]

Regardless of any epistemological considerations, for practical purposes central to all knowledge work is thus coming to an understanding of information. According to Terrett, five elements are central to knowledge work: contextualisation; categorisation; calculation; correction; and condensation.[26] Knowledge work involves placing information in a context such as to provide meaning. Before information can be regarded as knowledge, sense must be made of the information in order to gain some deeper understanding.

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[23] Susskind expands on these in the legal context when examining legal knowledge management: Susskind "Transforming the Law", above n. 12, 22-4.

[24] Department of Trade and Industry, above n. 5, 1.6 Analytical Report. Note that this is different to the concept of 'knowledge' discussed in philosophy in epistemology. Such latter conceptions of knowledge will not be discussed here.

[25] Terrett, A., The Internet: Business Strategies for Law Firms (2000) Law Society Publishing, 87 citations omitted.

[26] Ibid. 87.

A refinement can thus be provided on the need for knowledge processing tools symbolised by the technology lag. Addressing the technology lag requires providing support for making sense from information and legal knowledge workers require support in making sense from the mass of legal information.

Supporting the making of sense in legal knowledge work remains somewhat vague. For example, providing the information out of which sense is made could itself be argued to support the making of sense. However, just as the making of sense must be distinguished from the tasks that surround it and interact with it, so must support for the making of sense be distinguished from support for those tasks that surround and interact with it. This distinction will be clarified in subsequent chapters. At present it is stressed that this discussion will not focus on the 'administrative applications' of computers in law - on those applications of computers in law that, though they support knowledge work, do not directly support the substantive aspects of legal knowledge work. Although such distinctions between knowledge work and other work and between elements of knowledge work are necessarily fuzzy, this distinction serves to focus the field of enquiry.

2.5 Automated meaning making

The uses of computers in law have been actively investigated for more than 50 years and have focused on diverse applications. However, perhaps the most tantalising work occurs in the field of 'artificial intelligence and law.' Since the advent of computers the possibility of creating intelligent machines has enthralled countless researchers. This research is intimately concerned with using computers to manage legal knowledge, as opposed to legal information.[27]

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[27] Oskamp discusses the crossover between the fields of artificial intelligence and law and knowledge management: Oskamp, A., Tragter, M. and Lodder, A.R., 'Mutual benefits for

Indeed the use of computers to manage legal knowledge, to make sense in law, has come to be dominated by applications of artificial intelligence.

The field of artificial intelligence is enormous with a huge diversity of research and applications in numerous areas.[28] Although researchers differ on the goal of the field, the essential idea is that with 'intelligent' computers the work of knowledge workers could be automated – the computer could itself identify and solve problems through the abstraction and reorganization of information. The computer would make sense out of the mass of information. The possibility of automatically reasoning about legal problems and automating the application of law is a tantalising one and has motivated much work. Indeed, Berman and Hafner state that artificial intelligence, and the automatic solution of legal problems, has the capacity to solve a crisis in the legal system.[29] Since 1987 the field of 'artificial intelligence and law' has had its own biennial conference[30] and since 1992 its own journal.[31] Unfortunately, however, the present prospect of fully automating legal knowledge work appears limited. Essentially, artificial intelligence faces considerable difficulty in representing legal knowledge in a form appropriate for automated reasoning.

It is obvious to observe that knowledge is a prerequisite for any kind of automated, knowledge-based, intelligent activity. However, this does emphasise that to build an intelligent computer some approach must be adopted to decompose the vast pool of human knowledge in such a way that it can be

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AI law and knowledge management' p. 126, in Proceedings of the Seventh International Conference on Artificial Intelligence and Law (1999) ACM Press.

[28] See the different opinions on what AI is trying to achieve in: Baumgartner, P., Payr, S., (eds.) Speaking minds: interviews with twenty eminent cognitive scientists (1995) Princeton University Press.

[29] Berman, D.H., Hafner, C.D., 'The potential of artificial intelligence to help solve the crisis in our legal system' (1989) 32(8) Communications of the ACM 928.

[30] The International Conference on Artificial Intelligence and Law.

[31] The International Journal of Artificial Intelligence and Law.

formalised and then manipulated by a computer. Knowledge must be represented in a form that a computer can manipulate. As Brachman and Levesque explain:

> The notion of *representation of knowledge* is at heart an easy one to understand. It simply has to do with writing down, in some language or communicative medium, descriptions of the world in such a way that an intelligent machine can come to a new conclusion about its environment by formally manipulating these descriptions.[32]

Knowledge representation is central to artificial intelligence. Central to the application of artificial intelligence in law is writing down a description of the legal world in such a way that an intelligent machine can come to new conclusions about the law.

Importantly, Brachman and Levesque's description of knowledge representation covers two distinct though subtly related issues. First is the description of the world being reasoned about. Second is the expression of that description in some language that a computer can manipulate. Artificial intelligence depends on developing both an appropriate description of the world being reasoned about and an appropriate computer manipulatable expression of that description.

The concept of representations, their nature and use, is central to this thesis. Representations are discussed in more detail throughout this thesis and a more detailed discussion of representations is provided in subsequent chapters. To clarify discussion for the moment however, it is important to keep in mind the above distinction. To emphasise this distinction and clarify discussion, when representations in the sense of descriptions of the world are being discussed, the term 'representation of' will be used. That is, if a representation of the world is being discussed, it will be called a representation of the world. If a representation of law is being discussed, it will be called a representation of law,

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[32] Brachman, Levesque, Readings in Knowledge Representation (1985) Morgan Kaufman, xiii.

and so forth. When discussing a representation of something as implemented in a language that a computer can manipulate, the term 'formal representation' will be used. If discussing issues relevant to both representation of things in the world and formal representations, the general term 'representation' will be used.

To better understand the prospects and limitations of research in artificial intelligence and law – and hence the prospect of automated knowledge processing – it is necessary to examine in more detail the uses of artificial intelligence in law. In artificial intelligence various major approaches to simulating legal intelligence are evident. Three important approaches involve: viewing law as composed of rules; viewing law as composed of cases; and viewing law as composed of arguments. These approaches are founded on representations of law and representations of legal reasoning loosely adopted from legal theory. The formal representations used to describe these representations of the legal world are adopted from the wider field of artificial intelligence. Each of these approaches is discussed in turn.

2.5.1 Logic and rules as knowledge and reasoning

A highly influential representation of law and legal reasoning - a representation of law and legal reasoning discussed and criticised in more detail in the following chapter - views law as composed of rules and sees legal reasoning as the application of legal rules. The application of law is regarded as solely involving the application of legal rules. This representation of law and legal reasoning has been widely adopted in the domain of artificial intelligence and law[33] – perhaps partly because it presents an apparently 'neat' representation of law and legal reasoning, partly because it builds on traditions in law itself,[34] and

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[33] Though not without criticism, for example Peczenik is sceptical of the ability of logic to capture all of legal reasoning: Peczenik, A., 'Jumps and Logic in the Law' (1996) 4 Artificial Intelligence and Law 297.

[34] See discussion at 3.2.1.

also because it resonates with formal representations used in artificial intelligence.

When law is represented as composed of rules and when legal reasoning is represented as the application of those rules, the formal representations typically applied are logic and production rules. Zeleznikow and Hunter illustrate this with an example from a hypothetical drink-driving law. Given the hypothetical rule:

If you drive while drunk they you will lose your licence.

this could be translated into a formal representation as:

drink & drive → licence_loss[35]

Here that English language rule has been 'translated' into 'propositional calculus'.[36] Reasoning is then a matter of determining whether the conditions in the representation are met.[37] If these conditions are met then the specified consequences follow.

Such formal representations of law can undoubtedly be useful.[38] However, as representations of legal knowledge and as representations of legal problem solving these representations are problematic. First, the representation of law and the representation of legal reasoning on which these approaches are based is itself limiting. This representation of law suggests that law is solely composed of rules. This representation of legal reasoning suggests that all legal reasoning is a matter of applying rules in solving problems. However, research indicates that rather than reasoning from rules whenever they solve problems, people

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[35] Zeleznikow, J., Hunter, D., Building intelligent legal information systems: representation and reasoning in law (1994) Kluwer, 97-9.

[36] Ibid. 102-4.

[37] Ibid.

[38] Such representations are used as the basis of automated checklists and legal document drafting systems. Such representations also have notable application in governmental administration, Softlaw (www.softlaw.com.au) is a successful company producing systems for public administration based on this approach.

rely on their experience.[39] People use knowledge of how they solved problems in previous similar situations to guide them in how they should approach a problem in a present situation. This is discussed in more detail in the following subsection and the following chapter.

Secondly, as means to express legal knowledge the formal representations, the logics and rules, are themselves problematic. These formalisms have limitations.[40] The very applicability of different logics for representing legal concepts is itself a lively area of debate and research. This will not be discussed further here.[41] For, apart from the theoretical possibility of using any particular formal representation to express a concept, it can nevertheless be difficult practically to express legal knowledge in these formalisms. It is perhaps most straightforward to formalise legislation and regulations in this way but it is less clear how precedents should be incorporated. When law is regarded as solely composed of rules, some means is necessary to 'transform' precedents into collections of rules. While approaches have been proposed for such transformation, these approaches are problematic.[42]

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[39] The role of precedents in legal problem solving is discussed in the following chapter.

[40] For example, 'propositional calculus', in which the above example is written, has no existential qualifier or universal qualifier. Other logics, such as 'first order predicate calculus' for example address this, see: Zeleznikow and Hunter, above n. 35, 104-9. Notably, the representation of law as rules predates computer applications in law and indeed has been a motivator for computer applications.

[41] In pursuit of this goal ever more complex systems of logic have been developed e.g. modal logics, temporal logics and deontic logics. For a brief introduction to the different types of logic used in legally oriented computer applications, see: Zeleznikow and Hunter, above n. 35. While each logic has its own characteristics, strengths and weaknesses, the observations made here apply to each such logic.

[42] 'Deep structure' is one approach, for a discussion of deep structure see: Smith, J.C., Deedman, C., 'The Application of Expert Systems Technology to Case-Based Law' p. 84, in The First International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1987) ACM Press N; Kowalski, A., 'Case-Based Reasoning and the Deep Structure Approach to Knowledge Representation' p. 21, in The Third International

The most problematic aspect of formal representations discussed here however, arises from an aspect inherent in such formal representations. Formal representations require all knowledge to be made explicit - and to be explicitly expressed within the formal representation. Although systems can draw inferences, this is restricted by the amount of knowledge available to the system. For example, with the above hypothetical drink-drive rule, *prima facie*, questions arise whether the rule applies both to someone driving a car after drinking a glass of water and to someone obviously drunk but riding a skateboard on a public road. In the first situation applicability of the rule depends on knowing more about what type of drinking the rule is intended to cover. In the second situation applicability of the rule depends on knowing whether riding a skateboard is regarded as 'driving' within the scope of the rule. In each situation it is necessary to know more about what kind of situations the rule is supposed to cover. Rules such as the above are obviously not meant to apply in every situation apparently covered by them. The difficulty is

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Conference on Artificial Intelligence and Law: Proceedings of the Conference (1991) ACM Press. Attempting to represent the *ratio decidendi* of cases as rules is another approach, see e.g.: Weiner, S.S., 'CACE: Computer-Assisted Case Evaluation in the Brooklyn District' p. 215, in The Second International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1989) ACM Press; Yoshino, H., Haraguchi, M., Sakurai, S. and Kagayama, S., 'Towards a Legal Analogical Reasoning System: Knowledge Representation and Reasoning Methods' p. 110, in The Fourth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1993) ACM Press; Nitta, K., Shibasaki, M., Sakata, T., Yamaji, T., Xianchang, W., Ohsaki, H., Tojo, S., Kokubo, I. and Suzuki, T., 'New HELIC-II: A Software Tool for Legal Reasoning' p. 287, in The Fifth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1995) ACM Press. For numerous decades however, jurists such as Stone have emphasised the difficulty in determining the *ratio* of precedents. Stone argues that precedents have multiple, perhaps conflicting *rationes*, rendering impossible the identification and representation of *a ratio*: Stone, J., Legal System and Lawyer's Reasonings (1964) Stevens & Sons Limited.

determining in which situations the rule should and should not apply.[43] Theoretically, addressing such problems might 'simply' be a matter of providing an ever larger number of ever more explicit rules. Regardless of any practical considerations however, modelling legal knowledge and legal reasoning as collections of rules is beset by the problem of 'semantic flexibility', which the following subsection examines.

2.5.2 Legal precedents

Problems with logic and rule-based representations have motivated research into the role of legal precedents in legal problem solving. In response to perceived inabilities of logic and rule-based representations to capture all that is involved in human reasoning, researchers in artificial intelligence generally, and in artificial intelligence and law in particular, have investigated 'case-based reasoning' systems.[44] In legal problem solving, problems are resolved by

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[43] The difficulty in determining the extent of application of rules is of course not unique to artificial intelligence and has been discussed by numerous legal theorists, see the discussion in the following chapter. In artificial intelligence this general limitation is variously called the 'frame-problem' the 'background knowledge problem' and the 'common-sense knowledge' problem and is widely regarded as one of the major hurdles facing AI, see: Baumgartner, above n. 28. The CYC project is an interesting and ambitious attempt to address the common-sense knowledge problem. For perhaps the best source of information about the CYC project see: www.cyc.com.

[44] For a general discussion of case-based reasoning and the closely related field of computational analogy see: Riesbeck, C.K., Schank, R.C., Inside case-based reasoning (1989) Lawrence Erlbaum Associates, Inc; and Kolodner, J., Case-Based Reasoning (1993) Morgan Kaufmann. Note that in law the very term 'case-based reasoning' is laden with meaning. Legal cases are vital in the common law and lawyers use legal cases when reasoning about legal problems. However, when used in artificial intelligence the term 'case' has much wider meaning than that of a legal case. The term 'case' refers generally to any experience. As such, case-based reasoning is not generally concerned with reasoning with legal precedents but with the use of past experiences in reasoning. In addition to case based reasoning an influential approach to reasoning with legal precedents is based on the use of 'neural networks', see 'Special Issue on Neural Networks' (1999) 7(2-3) Artificial Intelligence

reference to how similar problems have been solved in previous, similar circumstances. Precedents are used as guides.

Numerous case-based reasoning systems have been built in law.[45] Case-based reasoning systems can offer undoubted benefits compared to logic and rule-based systems. For example, HYPO is one of the most famous case-based reasoning systems in law and compares and contrasts over 30 precedents when responding to problems in US taxation law. Nevertheless, systems such as HYPO have several shortcomings as a means to simulate legal reasoning. The problems experienced mirror those affecting logic and rule-based approaches to automating legal problem solving. First, the representation of law and the representation of legal reasoning underlying this approach is itself problematic. While legal reasoning unarguably makes use of precedents it is an open question as to what role precedents actually play in legal reasoning an in how precedents are used. The following chapter discusses in more depth legal theory examining the role precedents play in legal reasoning.

Secondly, there are problems with the formal representations themselves. Many formal representations have been developed in case-based reasoning. As with logic and rule-based formalisms, the individual characteristics of these formal representations will not be discussed here.[46] Rather, a more general aspect of the formal representation of precedents and legal reasoning with precedents

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and Law. To avoid discussing the technical similarities and differences between case-based reasoning systems and neural networks, which are not important for present purposes, this discussion will use the term 'case-based reasoning' as referring to both approaches.

[45] E.g.: Ashley, K.D., Modelling Legal Argument: reasoning with cases and hypotheticals (1990) MIT Press; Popple, J., A pragmatic legal expert system (1996) Dartmouth. For a detailed discussion of simulations of legal precedential reasoning and legal analogising, see: Aikenhead, M., 'Legal analogical reasoning - the interplay between legal theory and artificial intelligence' (1997) Master of Jurisprudence, Department of Law, University of Durham, England, ch. 6.

[46] See: Riesbeck and Schank, above n. 44; Kolodner, above n. 44.

will be examined. As with rule-based reasoning systems, case-based reasoning systems can only reason with knowledge that designers have explicitly provided, or more specifically, that has been explicitly provided using a formal representation. In an important way, logic and rule-based systems, and case-based reasoning systems are very similar. Case-based reasoning systems rely on the same formalisms for representing legal knowledge as do logic and rule-based systems.[47] This sameness is the cause of common problems with knowledge representation that affect both approaches. As with logic and rule based systems, the legal knowledge represented in case-based reasoning systems is limited. Case-based reasoning systems have limited knowledge and the knowledge they do have is brittle. This results in problems with 'semantic flexibility'.

It is easy, but fallacious, to assume that a computer has access to information that we would presume when reasoning about a problem. Whatever domain a system is operating within, knowledge about that domain must be converted into a formal representation. This is problematic however, as it is extremely difficult to represent the full complexity, richness and flexibility of human knowledge in a computer manipulatable form.[48] The practical problem is that making human knowledge amenable to computer manipulation is extremely time consuming. In a case-based reasoning system, for efficiency it is desirable to include only those cases and only those aspects of cases, which are useful to the system. However, it can be extremely difficult to separate knowledge that might be useful from knowledge that might not be useful. Designers must make fundamental choices about what cases to include in a system and what

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[47] Case-based reasoning systems differ however, in the 'level' of knowledge represented. While rule-based systems represent general rules, case based reasoning systems represent individual experiences. These two types of system can thus have very different practical characteristics and practical application. However, as theoretical approaches to artificial intelligence, they are beset by very similar problems.

[48] For an attempt to achieve this, see: the CYC project, above n. 43.

knowledge to include in those cases.[49] Systems necessarily involve a trade-off between the amount of knowledge represented and between the amount of work needed to create and maintain the system. Even the most sophisticated systems operate with shallow representations of knowledge.[50]

The extent of this shallowness is best illustrated with an example. In the approach to simulating precedential argument pioneered in HYPO, a domain of law is first analysed to determine what 'dimensions' are important for predicting the outcome of disputes within the domain.[51] It is for an expert in the field to decide what dimensions are important in determining the outcome of cases. Dimensions do not specify the necessary and sufficient conditions for a classification but instead represent considerations that are relevant to constructing arguments for and against a classification.[52] According to Ashley, dimensions:

> are a conceptual link between various clusters of operative facts ... and the legal conclusions that they support or undermine.[53]

For example, United States trade secrets law can be broken down into various factors such as: 'common-employee-paid-to-change-employers'; 'exists-express-non-competition-agreement' and 'security-measures-adopted'.[54] Figure 1 indicates a precedent analysed according to the dimensions it exemplifies. The

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[49] Kolodner, above n. 44, 14, 160.

[50] Case-based reasoning systems are sometimes referred to as 'deep' or 'shallow' in the case-based reasoning literature. 'Deep' systems are systems that have some representation of general knowledge apart from the actual knowledge contained in cases. However, 'deep' and 'shallow' are relative terms and even in 'deep' case-based reasoning systems, the depth of knowledge is far less than typically available to a person.

[51] To be precise, Ashley's theory of argument is based on the use of 'factors'. When factors are implemented in a computer program they are approximated using dimensions: Ashley, above n. 45, 37-8. However, for simplicity it is sufficient to here refer solely to dimensions.

[52] Ibid. 112-3.

[53] Ibid. 38.

[54] For a complete list of dimensions used by the HYPO program see: ibid. Appendix F.

dimensions that were thought important in the precedent are indicated in the 'Dimensions List'.

Case: USM Corp. v. Marson Fastener Corp.
SHORT TITLE: "USM v. Marson"
CITATION: 379 Mass. 90
DATE: August 29, 1979
PARTIES:
Plaintiff Corporate-Party: USM
Defendant Corporate-Party: Marson
DECISION FOR: Plaintiff Corporate-Party: USM
CLAIMS DECIDED: Type-of-Claim: Trade-Secrets-Misappropriation
Won by: Plaintiff Corporate-Party: USM
DIMENSIONS LIST:
Competitive-Advantage-Gained
Security-Measures-Adopted
CASES CITED:
Eastern Marble v. Roman Marble
Healy v. Murphy

Figure 1: A top-level HYPO precedent frame[55]

It is these dimensions around which matching revolves. Systems have no deeper representation of the concepts referred to in the dimensions list. There is no representation of the concept of what it means to gain a competitive advantage or to adopt security measures. The only information that systems have is that which is explicitly provided.

The problem with such shallow representations of concepts is that, as Gentner notes, the representational decisions made when encoding knowledge:

> are crucial to the operation of the algorithm. Differences in the way things are construed can cause two situations to fail to match even if they are informationally equivalent.[56]

Thus for example, although invoking the same meaning for readers, asserting

- DIMENSIONS_LIST(COMPETETIVE-ADVANTAGE-GAINED,

[55] Ibid. 90. Note that this is only the top most frame which is actually used to represent this precedent.

[56] Gentner, D., 'The mechanisms of analogical learning' p. 199, in Ortony, A. and Vosniadou, S. (eds.) Similarity and Analogical Reasoning (1989) Cambridge University Press, 210.

SECURITY-MEASURES-ADOPTED)

and

- DIMENSIONS_LIST(GAINED-COMPETETIVE-ADVANTAGE, ADOPTED-SECURITY-MEASURES)

would prevent a match in the system. Though the two assertions may convey the same information to a reader, their formal representations are completely different. Programs require uniform and unambiguous definitions of the concepts being reasoned about. As Hoffman notes:

> formal schemes ... will be limited by (at least) the depth, breadth, flexibility, and dynamics of the world knowledge that they can represent.[57]

Programs represent very minimal knowledge, which is in turn shallow and inflexible.

As Hofstadter cautions, when examining reasoning systems great care must be taken to avoid reading:

> far more understanding than is warranted into strings of symbols - especially words - strung together by computers.[58]

For example, in the above example, it makes no difference to a computer if instead of referring to 'COMPETETIVE-ADVANTAGE-GAINED', some other reference is used. This could just as well have been referred to as 'X'. Similarly, 'SECURITY-MEASURES-ADOPTED' could have been referred to as 'Y', 'GAINED-COMPETETIVE-ADVANTAGE' referred to as 'M' and 'ADOPTED-SECURITY-MEASURES' referred to as 'N'. This would give:

- DIMENSIONS_LIST(X, Y)
- DIMENSIONS_LIST(M, N)

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[57] Hoffman, R.R., 'Monster analogies' (1995) 16(3) AI Magazine 11, 27.

[58] Hofstadter calls this the 'ELIZA' effect after the famous program, 'ELIZA', developed by Joseph Wizenbaum and to which many people spuriously attributed immense powers of perception an understanding: Hofstadter, D., The Fluid Analogies Research Group, Fluid

In the same vein, 'DIMENSIONS_LIST' has no particular importance to a computer and 'A' could be substituted instead. This would give:

- A(X, Y)
- A(M, N)

It is interesting how this dramatically reduces the inherent feeling that 'X' and 'M', and 'Y' and 'N' are similar. To state matters starkly, formal representations are based on the assignment of labels to objects and concepts, and reasoning depends on being able to match those labels.

At first glance, addressing shallowness and inflexibility might appear simply a matter of adding more and more knowledge to a system. Apart from the previously mentioned practical difficulties though, there is a philosophical difficulty with this. Simply, it is not known how to exhaustively describe objects or concepts. Objects and concepts can be described in seemingly innumerable ways. Objects and concepts are 'semantically flexible'.[59]

A humorous illustration of this is provided by Hofstadter who poses the question - 'Who is the First Lady of England?'[60] At first glance several answers might be proposed: Queen Elizabeth or Anitta Rodick for example. Each of these is a prominent lady. Out of these however, the Queen is perhaps the most eminent and so might be regarded as the First Lady. However, the term 'First Lady' is widely used in the United States of America to refer to the wife of the president. Who then is the First Lady of England? Tony Blair plays a role in the United Kingdom that is in many ways similar to the role played by the president of the United States of America. Should the First Lady of England thus be regarded as Cherie Blair? Choosing the most prominent woman in the country implies choosing Queen Elizabeth. Choosing the spouse of the national

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Concepts and Creative Analogies: Computer Models of the Fundamental Mechanisms of Thought (1995) Basic Books, 157.

[59] Hoffman, above n. 57, 19.

[60] Hofstadter, above n 58, 196.

political leader implies choosing Cherie Blair. However, in another sense Queen Elizabeth also plays a role in some ways reminiscent of the presidential role. Should her spouse be chosen? Could Prince Philip be regarded as the First Lady of England? While this has some nice similarities between the positions of the people involved, the term 'First Lady' strongly implies that a woman should be chosen.[61] Several competing pressures can be observed here: the pressure induced by the phrase 'First Lady' to find a woman to play this role; the pressure to choose the spouse of the most powerful political figure; the feeling that the 'First Lady' should be just that, the most powerful or popular lady in the country. According to Hofstadter, the person who is eventually chosen is determined by the result of the interplay between these pressures and what is felt to be involved in the concept of 'First Lady'. With foreseeable stretching, the concept could be allowed to slip and cover Prince Philip as being England's First Lady. Rather than being a well-defined, static concept, the concept of 'First Lady' is fluid and semantically flexible.[62]

It is difficult to see how pre-defined static representations of knowledge can capture the fluidity, illustrated above, that characterises semantic flexibility. Notably, addressing this problem is not a matter of the mere addition of a greater amount of ever more detailed knowledge about the objects represented in the system.[63] While this may appear to help, there is no way to stop semantic

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[61] For a subtle twist on this example see Hofstadter: ibid.

[62] While Hoffman speaks of 'semantic flexibility', Hofstadter discussed the 'fluidity' evident in human thought. Hoffman and Hofstadter appear to have a similar concept in mind. As Hofstadter states:

> ['fluidity'] exudes quite a clear image of flexibility, mutability, nonrigidity, adaptability, subtlety, pliancy, continuousness, smoothness, slipperiness, suppleness ...' (Hofstadter ibid.)

[63] Hofstadter, D., French, R., 'Tabletop, BattleOp, Ob-Platte, Patelbat, Belpatto, Platobet' p. 323, in Hofstadter, D. and Fluid Analogies Research Group (Eds) Fluid Concepts and Creative Analogies: Computer models of the Fundamental Mechanisms of Thought (1995) Basic Books.

flexibility recursively affecting the knowledge that is added.[64] For example, HYPO's ability to match precedents is limited to situations in which matching revolves around locating shared dimensions. HYPO can retrieve precedents that share the dimension 'competitive-advantage-gained'. However, HYPO's matching ability is restricted by limited knowledge of the concept 'competitive-advantage-gained'. HYPO cannot reason about the presence or absence of dimensions themselves. While addressing this problem might appear to be a matter of analysing the dimensions used with 'sub-dimensions', there is seemingly no way to prevent the same difficulty recurring with the 'sub-dimensions' themselves. A system relying on sub-dimensions would not be able to reason about the applicability, the presence or absence of those sub-dimensions, without resorting to analysis using sub-sub-dimensions, apparently *ad infinitum.*[65] Semantic flexibility arises whenever it is attempted to match real-world situations with the concepts used in a reasoning system. The model of precedential reasoning embodied in HYPO is thought-provoking and is more sophisticated than anything implemented in previous programs. Numerous subsequent systems adopt a dimension based approach. However, dimensional analysis is itself subject to several limitations.[66]

Semantic flexibility affects both rule based reasoning systems and systems that attempt to reason with precedents in essentially the same way. For rule based systems the problem is to determine whether the preconditions of a rule are met. Semantic flexibility complicates the determination of whether preconditions of the rule have been met. For systems that reason with precedents the problem is to determine whether two situations are similar. Semantic flexibility in the concepts being compared complicates this assessment

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[64] Hoffman, above n 57, 21.

[65] Mendelson argues that dimensional analysis is only useful in some areas of law: Mendelson, S., 'An Attempted Dimensional Analysis of the Law Governing Government Appeals in Criminal Cases' p. 128, in The Second International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1989) ACM Press.

[66] See further discussion in: Aikenhead, above n. 45, ch 8.

of similarity. Systems lack access to all the real world, common sense and other knowledge that we use both in the flexible perception of concepts and in resolving tensions caused by this flexible perception. The difficulty in representing the richness and flexibility of human knowledge in computer manipulatable form, and hence the difficulty in addressing semantic flexibility, restricts the kind of reasoning that systems can perform.[67]

Researchers have attempted to address semantic flexibility in various ways. Indeed, focusing on the role played by legal precedents in legal problem solving is itself an attempt to address problems of semantic flexibility encountered in rule-based approaches to reasoning. Researchers have attempted to address the semantic flexibility evident in reasoning, amongst other things, by utilising legal principles and policies and by trying to develop 'strong' theories of law. Suffice to say that all of these approaches fail to eliminate semantic flexibility or the problems to which it gives rise.[68]

2.5.3 Argumentation

The third strand of work in artificial intelligence and law examined here focuses on legal reasoning as a process of argument. Law is clearly an argumentative endeavour and controversies surrounding the application of rules and the similarity or dissimilarity between precedents are addressed through argument. Whether or not the preconditions of a rule are actually met and whether or not two situations are actually similar, it would be useful to be able to simulate the processes of argument through which the controversies generated by semantic flexibility are addressed. Indeed it will subsequently be

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[67] This affects all systems that seek to simulate legal analogical reasoning: ibid. ch.s 5,6.

[68] For an in depth discussion of attempts in artificial intelligence and law to incorporate reasoning with legal precedents see: ibid. ch 6. For a discussion of attempts by researchers in artificial intelligence and law to develop 'strong' theories of law, see the discussion of the Language for Legal Discourse: ibid. s.6.3.3.

asserted in this thesis that argument plays a central role in legal reasoning. Nevertheless, simulations of argument have numerous shortcomings.

For the moment little will be said about the representation of legal reasoning as a process of argument – except to note that although argument appears inherent in legal reasoning, argument does not appear to comprise legal reasoning. The relation between argument and legal reasoning is explored in more depth in the following chapter. The examination here focuses on formal representations of argument.

According to Bench-Capon, two distinct approaches are observable in computer-based models of legal argument.[69] The first of these approaches uses types of logic to model legal argument. The second of these approaches models argument as a process of comparing and contrasting precedents. These are examined in turn. Prakken has provided a useful structure through which to view logic based representations of argument. Prakken asserts that logic based models of argument are concerned with three main things: (a) the logic to be used; (b) an argument framework; and (c) dialectical protocols.[70] Within this perspective, the logic is concerned with 'defining a relation of necessary consequence between sets of premises and conclusions'.[71] For example, this could be syllogistic logic. The argument framework itself has four concerns:(i) defining what amounts to an argument; (ii) defining when arguments are in conflict and types of conflict; (iii) defining an ordering for conflicting arguments; and (iv) definitions for the ultimate status of arguments. Dialectical protocols are concerned with the way in which argument occurs as an

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[69] Bench-Capon, T., 'Argument in Artificial Intelligence and Law' (1997) 5(4) Artificial Intelligence and Law 249.

[70] Prakken, H., 'From Logic to Dialectics in Legal Argument' p. 165, in The Fifth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1995) ACM Press.

[71] Ibid. 166

interaction between two parties and define the rules through which the parties can interact.[72]

However, while Prakken's framework is useful, it should not mask the difficulties underlying the application of logics, argument frameworks and dialectical protocols. Regardless of the strengths, weaknesses and idiosyncrasies of any particular logic, argumentation framework or protocol, these all depend on matching formal descriptions of objects and concepts as discussed in the previous subsection. In a logic for example, as Bench-Capon indicates, work is concerned with modelling *soundness* of arguments.[73] An example formula in predicate calculus is:

$(\exists x)fx$

This can be read as 'There exists at least one *x*, such that it is *f*.'[74] Similarly:

$(\forall x)fx)$

is read as 'For all *x*, *x* is *f*.'[75] The difficulty however is in determining whether the actual situation under consideration is an '*x*', as opposed to a 'y' or 'z', or something else. Similarly, for example, in the ordering of arguments specified in the argument framework, with a hypothetical ordering that 'A takes precedence over B' in every situation it is necessary to unequivocally determine whether arguments 'A' and 'B' are present - as opposed to other arguments. In essence, this aspect of work on legal argument is very similar to work examined above that seeks to represent law as composed of legal rules and represents

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[72] Similarly, Feteris classifies research on legal argumentation according to whether it investigates logical, rhetorical, or dialogical aspects of argument: Feteris, E.T., 'A survey of 25 years of research on legal argumentation' (1997) 11(3) Argumentation 355.

[73] Bench-Capon, above n. 69.

[74] The '∃' symbol is read as meaning 'there exists', in predicate calculus this is called the 'existential qualifier': Mitchell, D., An Introduction to Logic (2nd edition) (1964) Hutchinson & Co, 95.

[75] The '∀' symbol is read as meaning 'for all', in predicate calculus this is called the 'universal qualifier': ibid. Note that although Mitchell uses a different symbol for the universal qualifier, '∀' is widely used and has the same meaning.

legal reasoning as the application of those rules. Although the objects of focus are different – rules in one case and arguments in the other – the underlying approach is analogous. It is certainly not that this work is without value, only that it does not escape problems of semantic flexibility.

The second distinct approach in computer-based models of legal argument mentioned by Bench-Capon is based on comparing and contrasting precedents. Ashley's work with HYPO is a paradigmatic example of this work. The central aim of this work is to simulate how precedents can be used to construct and support arguments about how a problem should be resolved. This mirrors the way that legal practitioners use precedents to construct and support arguments for particular propositions and the way in which alternative precedents are cited in order to undermine these arguments. As discussed in the previous subsection, HYPO revolves around 'dimensional analysis'. HYPO bases the arguments it constructs around these dimensions. In a dispute, the presence of certain dimensions and the absence of others will strengthen the plaintiff's case while the presence and absence of other dimensions will strengthen the defendant's case. A dispute will involve competing dimensions and since there is no 'deductive or mathematical process' by which to resolve the conflicts between dimensions, precedents are used to support arguments about how to resolve conflicting dimensions in a problem.[76] By focusing on dimensions, arguments can be constructed and precedents that have shared dimensions can be cited in these arguments as support.

This is a distinctly different approach to argumentation than that adopted in logical approaches. While these differences are interesting, for present purposes it is sufficient to observe that this approach is restricted by an inability to address semantic flexibility. HYPO's limitations in this respect have been discussed in the previous subsection.

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[76] Ashley, above n. 45, 28.

Regardless of the approach adopted to modelling legal argument, in reviewing this work on argument in artificial intelligence and law, two goals seem apparent. The first seeks to develop systems that in some way conduct an automated argument with an opponent. That is, systems which seek to refute statements made by an opponent and which propose their own counter arguments. For present purposes it suffices to observe that, apart from other obstacles, such systems are limited by the amount of knowledge formally represented in them. Without detailed formalised knowledge about the subject being argued about, an automated argument system can only make limited refutations and counter arguments.

The second goal of this work does not seek to automatically generate arguments or to perform inferences over arguments in a system. This work does not seek to determine what arguments support or refute each other. This is not to say that these things aren't useful – they would certainly be useful if possible. In contrast to systems that seek to conduct automated argument, the second goal of work on computer-based legal argument seeks to provide systems that impose a formal framework which regulates an argument occurring between opponents. For example, if argument 'A' is labelled as 'supporting' argument 'B' and argument 'B' is labelled as 'supporting' argument 'C' then the system can indicate that argument 'A' also 'supports' argument 'C'. By tracing which arguments are unchallenged and which unchallenged arguments have the most support, some indication can be provided of which argument is 'winning'. Nothing will be said about the representations of argument embodied in these systems – each system embodies a potentially different representation of argument. Nor will the characteristics of the formal representations be discussed – these too vary from system to system. However, it is important to note that in this approach to argument, semantic flexibility is less of a problem as the system is merely 'tracing' relationships which the user determines to be existent or non-existent. The user inherently resolves issues of semantic flexibility in labelling arguments as 'supporting' or 'attacking' or any of the other relationships supported by a particular system.

It is important to note how different this second approach to computer-based argument is to attempts to have a computer automatically propose or refute arguments or itself determine which arguments are complimentary or contradictory. The latter is severely limited by our inability to formally represent knowledge. The former merely relies on a computer's ability to keep track of the many relationships that can exist between arguments. This approach to computer-based argument is unproblematic to the extent that it relies on the user to label arguments – and not on the system to automatically propose arguments or to determine argument relationships.

2.5.4 Artificial intelligence?

Disappointingly, research in the field of AI and law has resulted in notably few applications.[77] One reason for this is perhaps the aim underlying the endeavour. According to Minsky, artificial intelligence is the science of making machines do things that would require intelligence if done by people.[78] Artificial intelligence and law would thereby seek to build systems to perform tasks that would require intelligence if performed by a lawyer. Even if the focus of artificial intelligence and law is not regarded as the creation of machines that could 'truly' be regarded as intelligent, the simulation of intelligence remains a central concern. The field is intimately concerned with investigating how legal knowledge can be expressed in computer manipulatable formalisms and how the processes of legal reasoning can be simulated on computer. Within this approach it is argued, once the precise operation of legal reasoning is understood and once it is understood how to formally represent legal knowledge, it will then be possible to automatically perform legal reasoning

[77] A notable exception being SoftLaw: above n. 38.

[78] Minsky, M.L., (ed.) Semantic information processing (1968) MIT Press, v.

and automatically solve legal problems. As discussed above though, formalising legal knowledge is extremely difficult. As we will see in the following chapter, a precise description of legal reasoning remains elusive. So far this difficulty has made simulations of legal reasoning of any degree of complexity impossible. None of the above means that the goal of artificial intelligence and law is fundamentally impossible, only that so far it has proved elusive.

The construction of computer systems that could independently reason with the law and automatically solve legal problems would be of undoubted benefit for the legal knowledge worker. Such systems could independently process some of the masses of information that workers are presented with, reducing it, refining it and distilling it into a more valuable and manageable essence. However, if this goal is currently largely out of reach then the practical benefit of artificial intelligence as a path to legal knowledge processing is limited.

2.6 Augmenting knowledge work – computer support for sensemaking

The concept of knowledge-based systems in law, systems that help manipulate knowledge rather than just information, has come to be synonymous with the application of artificial intelligence. If this goal is currently unattainable then this apparently limits the possibility of legal knowledge processing. If the prospects for artificial intelligence in law are currently limited, the hope of addressing the knowledge processing lag appear remote.

The application of artificial intelligence in law is based on a specific vision of the relationship between computers and people. It is based on a vision of computers that replace many of the intelligent tasks people perform. In contrast to this automation paradigm, more than 25 years ago the idea of tools to aid the knowledge worker – and not to replace her - was prominent in the thinking of researchers such as Engelbart:

> But the very great importance of aspects other than the new tools ... makes us prefer the "augmentation" term that hopefully can remain

> "whole-scope." We want to keep tools in proper perspective within the total system that augments native human capacities toward effective action.[79]

The notion of *augmenting* knowledge work, rather than automating it, is a powerful one. If we cannot build tools to automate legal knowledge work can we nevertheless augment that work?

The concept of augmentation is suggestive and has been adopted by various researchers in computing. For example, Brown examines the idea of 'cognitive ergonomics'.[80] Suthers refers to mental 'scaffolding'[81] when discussing human-computer systems. Although Brown and Suthers refer to uses in different contexts, the commonality is the use of computers to improve the knowledge work people perform.

The concept of augmentation has informed numerous strands of research in computing. For example, 'computer supported cooperative work', which investigates means of using computers to promote teamwork and the communication and transfer of knowledge within teams, is predicated on the use of technology to augment the sharing of information and improvement of group interaction. The concept of augmentation has also informed work in fields such as 'decision support systems,' 'group decision support systems',

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[79] Engelbart, D.C., Watson, R.W. and Norton, J.C., 'The Augmented Knowledge Workshop' p. 9, in AFIPS Conference Proceedings, National Computer Conference (1973). See also: Engelbart, D.C., 'Augmenting Human Intellect: A Conceptual Framework' (1962) Report AFOSR-3223, SRI Project 3578, Stanford Research Institute, Menlo Park, Ca.

[80] Brown, J.S., 'From cognitive ergonomics to social ergonomics and beyond' p. 457, in Norman, D.A. and Draper, S.W. (eds.) User centred system design (1986) Lawrence Erlbaum Associates.

[81] Suthers, D., 'Representations for Scaffolding Collaborative Inquiry on Ill-Structured Problems' (1998) Presented at the 1998 conference of the American Educational Research Association, April 1998, San Diego. Available at: http://lilt.ics.hawaii.edu/lilt/papers/aera98.pdf (accessed 15/12/2001).

'negotiation support systems' and hybrid versions of such systems. Negotiation and decision-making are vital in legal problem solving. Such systems might thus provide a valuable means with which to augment legal knowledge work. However, work on decision-support systems and related systems has predominantly focused on 'quantitative' decision support. For example, Bayesian belief networks and decision trees (both of which allow the diagramming of decisions) focus on facilitating the performance of calculations in a form of inference. Quantitative decision analysis is based on the existence of consensus as to what the possible options and choices are in any problem and where the only uncertainty is how to best choose between the enumerated options. In contrast, this thesis investigates the possibility of 'qualitative' decision support.[82] Decision-support systems encounter difficulty where it is unclear what the available options are and where it is difficult to quantify the available options. In this respect work in 'decision support systems' is not designed to support the 'ill-structured'[83] nature characteristic of many problems.[84] Qualitative decision support has a wider remit, also exploring how

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[82] This is a distinction drawn by Lee: Lee, J., 'SIBYL: A qualitative decision management system' p. 105, in Winston, P. and Shellard, S. (eds.) Artificial intelligence at MIT: Expanding frontiers (1990) MIT Press hereafter 'Lee 1990a'. Similarly, Sutherland distinguishes on the one hand between Group Decision Support Systems and Group Decision and Negotiation Support Systems, and on the other hand, support for 'judgment based decision making': Sutherland, J.W., 'Extending the reach of collective decision support systems: Provisions for disciplining judgment-driven exercises' (2000) 48 Theory and Decision 1. Sutherland argues the existence of:

> a family of collective decision support facilities not as yet well represented in either GDSS or GDNSS designs, i.e., facilities to assist a collectivity is [sic] arriving at a *rational* resolution to decision exercises that are too technically intractable to allow an algorithm-driven decision choice, but not so ill-structured as to rule out anything but a subjectively-engined outcome. (Sutherland, 6.)

Notably though, Sutherland does not examine any of the Toulmin, IBIS, QOC, and other systems which are discussed below.

[83] The nature of such problems is discussed in more detail in the following chapter.

[84] Sutherland, above n. 82, 3.

options are generated, how options evolve and how choices and decisions can be made in situations where quantification is impractical. To this end, a new class of 'argumentation decision support systems' has been proposed.[85]

2.7 Discussion

Lawyers would appear to be paradigmatic knowledge workers. It is typical to regard lawyers as the paradigm of professions and the practice of law as requiring much education, understanding, skill and intelligence. The application of artificial intelligence in law has promised legal workers radical new tools to enhance their work and promised to reduce the legal knowledge processing lag. However, applications of artificial intelligence in law founder on various troublesome aspects of law – legal concepts are fluid, they are semantically flexible and their content is determined not only during their application, but changes over time. This flexibility confounds logic based approaches to simulating legal reasoning, automated determinations of similarity and automated argumentation on which legal problem solving seems to depend.

An alternative approach to creating legal knowledge-based systems and to addressing the knowledge processing lag is to use computers to augment legal knowledge work. In contrast to the automation of legal knowledge work, augmentation investigates how computers, jointly regarded with their users as knowledge processing systems, can best be built to support knowledge work. While the apparent cost of such an approach is loss of the power to perform automated reasoning, given the currently limited practical scope for this, this is not be a big loss compared with the potential gains from focusing on augmentation. Certainly, augmentation does not exclude automation in

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[85] Hua, G.H., Kimbrough, S.O., 'On hypermedia-based argumentation decision support systems' (1998) 22 Decision support systems. 259.

support of reasoning, only acceptance that practical applications must acknowledge the limitations of automated reasoning.

There are potentially many ways to augment legal knowledge work. Knowledge workers perform a variety of tasks and each could potentially be provided with computer support. To a degree, supporting each task augments knowledge work. The focus here is narrower. As discussed above, making sense of information is central to knowledge work. Support for making sense would thus be beneficial. In this respect, augmenting legal knowledge work requires more understanding of what making sense in law involves. The following chapter examines theories of law, legal reasoning and legal problem solving. This chapter proposes a representation of law and a representation of legal reasoning on which systems to augment legal knowledge work could be based. This examination forms the basis for subsequent chapters which examine systems to augment legal work.

3 Wicked legal problems

While I am writing, I'm far away;
and when I come back, I've gone.
I would like to know if others
go through the same things that I do,
have as many selves as I have,
and see themselves similarly;
and when I've exhausted this problem,
I'm going to study so hard
that when I explain myself,
I'll be talking geography.
Pablo Neruda

3.1 Introduction

The previous chapter examined the use of computers, and particularly knowledge-based systems, to support legal work. It was argued that work on knowledge-based systems has focused on the use of artificial intelligence. Artificial intelligence seeks to automate legal knowledge work. In contrast to automating legal work, it was argued that augmentation of legal knowledge work would be beneficial.

Computer applications necessarily embody a theory of law and a theory of legal reasoning.[86] Computer applications in law necessarily embody a representation

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[86] For work explicitly discussing the role of legal theory in the creation of computer tools for use in law, see e.g.: Susskind, R.E., Expert systems in law (1987) Clarendon; Zeleznikow and Hunter, above n. 35; Valente, A., Legal Knowledge Engineering: A modelling approach (1995) IOS Press, Ohmsha; Visser, P.R.S., Knowledge Specification for Multiple Legal Tasks: A Case Study of the Interaction Problem in the Legal Domain (1995) Kluwer Law International.

of law and a representation of legal reasoning. Program designers consciously or unconsciously create the representation of law embodied in a computer program.[87] This is whether the computer application seeks to itself automate legal reasoning or to support lawyers in their work. However, whether consciously or unconsciously embodied, these representations must reflect the way lawyers work within the law. Work in artificial intelligence and law is based on particular representations of law and representations of legal reasoning – representations that this chapter argues are potentially misleading. This chapter examines theories of law and theories of legal reasoning in order to better understand the limitations of automation and to clarify how augmentation might occur.

The law and legal reasoning can be examined from numerous perspectives. The development of law through history can be examined. The social and political influences on and effects of the law and legal structures can be scrutinized. According to Kelly, one tension running through theories of law is a conception of the relationship between the individual and the law - the relation between individual identity and freedom and the constraints imposed by the legal order.[88] The relationship between the individual decision maker and the law is of central importance for the creation of computer systems that augment legal knowledge work. This chapter examines the descriptive elements of various theories of law and legal reasoning in light of this relationship.[89] This chapter concludes with the presentation of a perspective on law and legal reasoning – a representation of legal reasoning as a process of 'sensemaking' - that is of particular importance for work on computer tools to augment legal knowledge work.

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[87] This observation is what motivates the work on ontologies of law in artificial intelligence and law, e.g.: Valente, above n. 86 and Visser, above n. 86.

[88] Kelly, J.M., A Short History of Western Legal Theory (1992) Clarendon Press.

[89] Normative aspects are not examined as this thesis is concerned with supporting the processes of legal reasoning, not specifying how they should operate.

Following this introduction, the next subsection examines several descriptive theories of law that underpin work in artificial intelligence and law. This subsection argues that these theories of law present an unbalanced representation of legal reasoning. The third subsection briefly examines a theory of law, which while not having been adopted in artificial intelligence in law, is a useful complement to the preceding examination. Subsection four presents a representation of law as a process of 'sensemaking'. This subsection explores what sensemaking in law involves and how it relates to the previously examined theories of legal reasoning. The fifth and final subsection in this chapter examines aspects of sensemaking that are particularly relevant for the creation of computer tools to augment legal knowledge work. It is argued that central to sensemaking are processes of argumentation. Moreover, this subsection argues that visualisation is a process that can be extremely beneficial in sensemaking. Hence, it is proposed that visualisations of processes of sensemaking and in particular, visualisation of processes of argumentation, can be highly beneficial for legal sensemaking.

The examination of law and legal reasoning undertaken in this chapter, and the perspective on legal reasoning as a process of sensemaking proposed here, form the basis for subsequent chapters which examine computer tools that might augment legal sensemaking.

3.2 Law as an object

It is a commonplace to talk about 'the law' and to discuss 'legal reasoning' acting on that law.[90] It is common to speak of 'the law' – as something separate from other things – and of 'legal reasoning' – as a specialised tool that is used

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[90] In many ways talking about 'legal reasoning' is inherently vague. As discussed in subsection 3.5, it is highly doubtful that there is only one type of reasoning that is used when thinking

to examine the law in order to solve problems.[91] Viewing law in this way is linked to deep-rooted views about the purpose of law in society. Central to these is the view that the law is an objective, rational means to order society and regulate human relationships. Law is perceived as the means of restraining excesses of official use of power, of regulating the behaviour of individuals, and hence balancing the needs and desires of the population in a just way.

3.2.1 Law as rules

This conception of law and of the 'rule of law' is embedded in Western legal thought. According to Kelly, although the notion of the rule of law is not abstractly expressed in classical Greek writings, the general feeling of a sovereignty of law was a source of Greek pride.[92] Thus Plato states that:

> For wherever in a state the law is subservient and impotent, over that state I see ruin impending; but wherever the law is lord over the magistrates, and the magistrates are servants to the law, there I descry salvation ...[93]

Similarly, Aristotle says that 'we do not permit a man to rule, but the law.'[94]

Corresponding sentiments are evident in Roman legal theory. Cicero wrote that:

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about the law and legal problems. Nevertheless, unless circumstances require it, this discussion will continue to examine 'legal reasoning' as a generic whole.

[91] A further difficulty when discussing legal reasoning is simply the overwhelming number of theories of legal reasoning that exist. In a non minimal sense any discussion about the law inherently implicates a theory of what the law is and is not, as MacCormick has said, every 'theory of legal reasoning requires and is required by a theory of law': MacCormick, N., Legal Reasoning and Legal Theory (1978) Oxford University Press, 229. There are thus differences in the conception of legal reasoning proposed by different legal theorists, such differences being inherently tied to the nature of law proposed by the theorist.

[92] Kelly, above n. 88, 25.

[93] Plato cited in Kelly, above n. 88, 25.

[94] Aristotle cited in Kelly, above n. 88, 25

> True law is right reason in agreement with nature, diffused among all men; constant and unchanging, it should call men to their duties by its precepts, and deter them from wrongdoing by its prohibitions ... To curtail this law is unholy, to amend it illicit, to repeal it impossible; nor can we be dispensed from it by the order either of senate or of popular assembly; nor need we look for anyone to clarify or interpret it; nor will it be one law at Rome and a different one at Athens, nor otherwise tomorrow than it is today; but one and the same Law, eternal and unchangeable, will bind all peoples and all ages; and God, its designer, expounder and enacter, will be as it were the sole and universal ruler ...[95]

As expressed by Cicero, this conception of law is one of a higher, divinely inspired, natural order.[96] As divinely inspired, law is not merely a means to order the common good for society as a whole, it also commands and prohibits, it controls the actions of individuals. As St Thomas Aquinas wrote in the middle ages, law is a:

> rule or measure of action in virtue of which one is led to perform certain actions and restrained from the performance of others'[97]

Though rejecting the natural and divine as the source of law - instead placing man himself at the centre of a legal order for regulating his own affairs - early positivists maintained a conception of law as a defined framework itself controlling behaviour and ordering society. Thus, Bentham expounded the notion of 'complete law':

> To have the effect of a complete law it should be made to appear such in the eyes of those who are concerned in it: to the citizen who is to take it, ... for the measure of his conduct; to the judge who is to take it for the measure of his decision: and to the legislator, who ... should be able to

[95] Cicero cited in Kelly, above n. 88, 58-9

[96] Kelly, above n. 88, 19-21

[97] St Thomas Aquinas cited in Kelly, above n. 88, 135.

> see at a moment's glance what it is he hath done. It ought accordingly to be consigned to paper, and that in such a form that anyone who opens a volume of the code may lay his finger upon it and say this is one law: and this is another: here the first begins, and there ends: here are all the parts, and these together are what makes the whole of it.[98]

As Austin, a student of Bentham, made clear, the law commands obedience – indeed the law is a set of commands from superiors to inferiors:

> The matter of jurisprudence is positive law: law, simply and strictly so called: or law set by political superiors to political inferiors.[99]

Again, these commands prescribe the behaviour of individuals:

> A law, ... may be said to be a rule laid down for the guidance of an intelligent being by an intelligent being having power over him.[100]

Just as early theorists expounded an all encompassing unchanging law, Benthem and Austin promoted the notion of the complete, well defined and comprehensive law. The conception remains of a legal order in which solving problems is simply a matter of referring to the law itself and hence from which human caprice is removed.

This conception of law has continued to be highly influential in nineteenth and twentieth century legal theory. Indeed, from being defined and complete, Langdell went so far as to call law a 'science'. According to Langdell it is:

> indispensable to establish at least two things; first that law is a science; secondly, that all the available materials of that science are contained in printed books .... the library is the proper workshop of professors and students alike; that it is to us all that the laboratories of the university are

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[98] Quoted in Lloyd, above n. 1, 207.

[99] Quoted in Lloyd, ibid.

[100] Ibid. 208.

> to the chemists and physicists, all that the museum of natural history is to the zoologist, all that the botanical garden is to the botanist.[101]

As Twining argues, the central idea conjured up by this analogy is the idea of order.[102] In this vein, law consists solely of doctrines and principles to order behaviour.[103]

Given the importance of rules in what have been labelled 'formalist' theories of law, it is tempting to follow Frank's lead and criticise formalists for an adherence to 'mechanical justice'.[104] A mechanical justice that operates with hierarchies of ever more abstract rules; rules which apply without regard to the merits or demerits of the situation and which apply to every instant case to determine a legal result. However, it is more difficult to find conceptions of law that conform to this extreme. While the writings of Benthem, Austin and Langdell might border on this, other jurists who emphasise the importance of rules nevertheless acknowledge an element of human agency in rule application.

For example, while in Kelsen's 'pure theory of law' all laws can trace their validity back to an overarching 'basic norm', Kelsen also viewed law making as a dynamic even 'political' process.[105] Kelsen did not regard the basic norm as prescribing particular norms and thus particular results in every situation – he acknowledged that the content of norms is simply developed based on higher norms, and that this development was a dynamic process.[106] Kelsen states that if:

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[101] Quoted in Twining, W., Karl Llewellyn and the Realist Movement (1973) Weidenfeld and Nicholson, 11-12.

[102] Ibid. 12.

[103] Ibid. 13.

[104] Frank, J., Law and the Modern Mind (1949) Stevens & Sons Limited, ch XIII.

[105] Kelsen, H., Pure theory of law (1967) University of California Press, 198.

[106] Ibid.

> law is to be applied by a legal organ, he must determine the meaning of the norms to be applied: he must "interpret" these norms. Interpretation, therefore, is an intellectual activity, which accompanies the process of law application in its advance from a higher to a lower level.[107]

Interpretation:

> need not necessarily lead to a single decision as the only correct one, but possibly to several, which are all of equal value ....[108]

Similarly, Hart did not regard either primary or secondary rules as determinate. Hart discussed the 'open texture' of rules arguing that rules have a 'core' of settled meaning and that only the 'penumbra' suffers from vagueness or ambiguity. Hart thought that there is inherent indeterminacy in legal rules and precedents, stating it:

> is impossible in framing general rules to anticipate and provide for every possible combination of circumstances which the future may bring.[109]

In cases of indeterminacy, Hart talks of the opposing values and reasons and of courts:

> forced to balance or weigh them and to determine priorities among them.[110]

Hart clearly acknowledges the role of the individual in judgment.

Nevertheless, Kelsen's goal was a 'pure theory of law' which sought to 'eliminate from the object of description everything that is not strictly 'law'[111] - such as moral judgments and political biases. Although Kelsen acknowledged that such factors might influence the interpretation of norms,[112] he regarded this as

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[107] Ibid. 348.

[108] Ibid. 351.

[109] Quoted in Lloyd, above n. 1, 794.

[110] Ibid. 797.

[111] Kelsen, above n. 105, 1.

[112] Ibid. 353.

outside the field of positive law. Similarly, while Hart acknowledged the need to 'weigh' the results of the application of legal rules, he was not concerned with the actual operation of the process that this mechanistic metaphor conjures up. Certainly, by arguing that only the rules of law need be examined, Kelsen and Hart endorse a rule oriented view of law.

This notion of an authoritative law, controlling and ordering society is a hallmark of Western legal thought.[113] The conception of law as composed of rules governing human interaction, evident in both natural law and positivistic theories of law, is striking not so much for arguments about where the power of law derives but rather the nature of law as a collection of controlling rules that is thus conceived. This is a conception of law that has been highly influential in artificial intelligence and law – it has underpinned work on rule-based systems.[114] This is also a conception of law that has come under sustained criticism. Such criticisms are numerous and varied. For present purposes it is sufficient to highlight the semantic flexibility to which the terms of legal rules are subject.[115]

3.2.2 Experience and legal precedents

This overwhelming concern with the rules of law, and the difficulty in determining the scope of rules, was criticised by Justice Holmes who in an often quoted passage stated:

> The life of the law has not been logic: it has been experience. The felt necessities of the time, the prevalent moral and political theories, intuitions of public policy, avowed or unconscious, even the prejudices which judges share with their fellow-men, have had a good deal more to do than the syllogism in determining the rules.[116]

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[113] Kelly, above n. 88, 183.

[114] See 2.5.1 for an examination of this work.

[115] See: 2.5.1.

[116] Holmes, O.W., <u>The common law</u> (c1881) Little, Brown, 1.

The inadequacy of rules for determining legal problems was a theme adopted by the American Realists.[117] This scepticism about rules as determinants of decisions and this concern with the law's 'experience' prompted Levi to emphasise the importance of precedent in Anglo-American law. Thus according to Levi, it:

> is important that the mechanism of legal reasoning should not be concealed by its pretense. The pretense is that the law is a system of known rules applied by a judge; the pretense has long been under attack.[118]

In contrast according to Levi:

> The basic pattern of legal reasoning is reasoning by example. It is reasoning from case to case.[119]

This occurs in a three step process:

1. similarity is seen between cases,
2. the rule of law inherent in the first case is announced; and
3. the rule of law is made applicable to the second case.[120]

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[117] However, as Frank points out, this label masks a multitude of views and in that respect is problematic: Frank, above n. 104, preface to the 6th printing vi-viii. According to Frank, sceptics could be divided into two groups: 'rule sceptics'; and 'fact sceptics'. Rule sceptics argue that the rules – the 'paper rules' – expressed in court are unreliable guides to the prediction of decisions and that instead 'real rules' can be found based on regularities in actual judicial behaviour; Frank viii. Fact sceptics, amongst whom Frank places himself, agree that paper rules do not predict decisions but further argue that the elusiveness of the facts on which decisions turn make it impossible to predict decisions in most disputes; Frank, ix.

[118] Levi, E.H., An Introduction to Legal Reasoning (1949) University of Chicago Press, 1 footnote omitted. Notably in this footnote, Levi states 'The controlling book is Frank, Law and the Modern Mind (1936)'.

[119] Ibid. 2.

[120] Ibid. 1. Burton, S.J., An introduction to law and legal reasoning (1985) Little, Brown & Co, 26-39 gives a similar taxonomy. Levi's view has been criticised by Murray, J.R., 'The Role of Analogy in Legal Reasoning' (1982) 29(4) UCLA Law Review 833, 848-50 and also by Sunstein, C.R., 'On Analogical Reasoning' (1993) 106 Harvard Law Review 741, footnote

Reflecting its premier position in the process, Levi states that the 'finding of similarity or difference is the key step in the legal reasoning process.'[121] Far from being deterministic however, this finding of similarity is for the individual judge.[122]

Levi's emphasis on the role of cases in shaping law and legal decisions forms the basis for much jurisprudence examining and emphasising the role of case law and analogical reasoning in Anglo-American jurisprudence.[123] Indeed Cross has stated that analogising is central to legal reasoning since there is a formal principle of justice that requires 'treating like cases alike'.[124] Similarly, MacCormick and Summer argue that the use of precedents in decision making is a critical element of rationality.[125]

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63 and Cross, R., Precedent in English Law (3rd edition) (1977) Clarendon Press, 182 footnote 2. The substance of these criticisms differ. This discussion is in accord with these criticisms in arguing that Levi's examination of analogy leaves many questions unaddressed. Levi's examination is nevertheless commendable for its clarity.

[121] Levi, above n. 118, 2.

[122] Ibid. When discussing the doctrine of *stare decisis*, Cross states that the discovery of the *ratio decidendi* of the previous case is 'primarily a psychological problem': Cross, above n. 120, 187. Justice Keeton says interpretation should be consistent with 'common sense': Keeton, R.E., 'Statutory analogy, purpose and policy in legal reasoning: live lobsters and a tiger cub in the park' (1993) 52 Maryland Law Review 1192, 1204. This of course leaves open however, the thorny question of what amounts to common sense and how is it made. MacCormick is content to state that acts 'are not determined by logic, they are determined by the choices of agents, and by whatever, if anything, that determined those choices.': MacCormick, above n. 91, 33.

[123] E.g.: Burton, above n. 120; Brewer, S., 'Exemplary reasoning - semantics, pragmatics, and the rational force of legal argument by analogy' (1996) 109(5) Harvard Law Review 923; Golding, M.P., Legal reasoning (1984) Alfred Knopf; Sunstein, above n. 120.

[124] Cross, above n 120.

[125] MacCormick, D.N., Summers, R.S., (eds.) Interpreting Precedents: a comparative study (1997) Dartmouth, 5-6.

However, while accepting that cases play an important role in legal problem solving, maintaining laws determinacy is nevertheless of paramount concern. The fear, as voiced by Unger, is that if cases - which can be similar and dissimilar in innumerable ways - are used to justify decisions then they can consequently be used to justify innumerable decisions.[126] The doctrine of *stare decisis* and the troublesome search for the *ratio decidendi*[127] within a case are expressions of this desire to restrict capricious analogising. Indeed Brewer has gone so far as to argue that judges should be interpreted as structuring analogies with deductive 'analogy warranting rules'. According to Brewer this is necessary to satisfy 'rule of law' ideals which in turn explain why analogies are justified.[128] With such analogy warranting rules, the 'rational force' of analogising is preserved.[129]

Thus, under this conception of precedent, even if the rules by themselves do not determine decisions, rules used with reference to cases do determine decisions.[130] The irony is that reasoning with cases comes to be conceived within a deductive mould and the problem of determining the scope of any rules then re-emerges – the very problem Levi originally sought to address.

If a deductive model of precedents is rejected, the difficulty re-arises of determining when cases are alike. Any set of circumstances will resemble each other in some ways and differ in others. As Levi wrote:

> The problem for the law is: When will it be just to treat different cases as though they were the same? A working legal system must therefore be

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[126] Unger, R.M., 'The Critical Legal Studies Movement' (1983) 96 Harvard Law Review 561, 571.

[127] Stone, above n. 42.

[128] Brewer, above n. 123, 992. See also: Golding, above n. 123, ch 3.

[129] Brewer, above n 123, 928.

[130] For example the work of Brewer, ibid. and Golding, above n. 123 provide near mechanical models of the operation of analogising in law.

> willing to pick out key similarities and to reason from them to the justice of applying a common classification.[131]

3.2.3 Legal principles

According to Levi, the perception of cases as similar or different is a process of classification within ever moving legal categories.[132] However, Levi only hints at what drives this classification, when at the end of his examination he mentions the role of 'legal theory.'[133] Levi does not discuss in depth what such legal theory involves. However, the idea that 'higher' evaluative standards control analogising is an influential one in legal theory. For example, MacCormick argues at length that it is legal principles that determine situations being regarded as similar.[134] According to MacCormick, the finding of similarity is dependent on the overall purposes that the legal system is trying to achieve, which are in turn expressed in the principles that the law recognises and in the balance that is achieved amongst those principles.[135] Sunstein reaches similar conclusions.[136]

For present purposes, the comparative details of these theories are not important. The interesting aspect of this work emphasising legal principles is the concern to relocate a constraint for legal decision-making. Rather than decision-making driven on an *ad hoc* case-by-case basis, the use of legal principles provides a general, principled, strategy for decision-making. Indeed,

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[131] Levi, above n. 118, 3.

[132] Ibid. 8.

[133] Ibid. 103.

[134] MacCormick states: 'Analogies only make sense if there are reasons of principle underlying them.': MacCormick, above n. 91, 186. Similar positions are expressed by Golding, above n. 123 and Sunstein, above n. 120.

[135] MacCormick, above n 91, ch. 5 et seq.

[136] Sunstein, above n. 120. It is ironic how in some of this work, analogising is cast in a deductive mould e.g.: Brewer, above n. 123 and Golding, above n. 123

legal principles come to be seen as not only constraining the use of precedents but as ultimately driving and constraining the application of legal rules. Thus according to MacCormick:

> The decision whether to interpret a statute restrictively or extensively, or the decision whether to explain and distinguish or follow by extending a case-law rule is ... in part at least based on arguments from legal principles ...[137]

Legal principles come to be seen as the ultimate constraint in legal reasoning.

This picture of an empire of rules and principles is perhaps most sweepingly expressed in Dworkin's work. According to Dworkin, principles not only guide decision-making but also control to the extent that the vast majority of disputes in law have right answers.[138] Dworkin argues that solving legal disputes involves construction of:

> a scheme of abstract and concrete principles that provides a coherent justification for all common law precedents and, so far as these are to be justified on principle, constitutional and statutory provision as well.[139]

Within this framework, the ultimate constraint is achieved. Dworkin states that:

> It remains the judge's duty, even in hard cases, to discover what the rights of the parties are, not to invent new rights retrospectively.[140]

Through the application and interaction of rules of law, precedents and legal principles, the law achieves its aim of restraining individual discretion. By focusing on the law, and solely on the law, disputes can be resolved.

Despite the desire to constrain reasoning through the application of legal principles, highlighting the importance of legal principles does not fully illuminate how legal reasoning occurs. A reasoner may adhere to particular

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[137] MacCormick, above n. 91, 231, see generally ch.s VII and VIII.

[138] Dworkin, R., Taking Rights Seriously (1977) Gerald Duckworth & Co.

[139] Ibid. 116-7.

[140] Ibid. 81.

legal principles and given adherence to these legal principles, particular cases might be regarded as similar and a particular rule as applicable. In this sense, focusing on principles, cases and rules tells us a lot about what legal reasoning involves. However, why a reasoner adheres to particular principles rather than others, and how these principles are given content and related to other principles is itself left unclear. As Sunstein observes when discussing the use of precedents, although we may adhere to a principle or set of principles, the consequences of this may be unclear – for the application of the principles we adhere to:

> is an important part of the development of those principles. .... We cannot know what it is that we think until we explore a range of cases. Principles are thus both generated and tested through confrontation with particular cases.[141]

The application of principles itself changes the conception of those principles. However, if principles themselves change during use then it is questionable how principles can fully constrain legal reasoning.

Regardless of the precise kind and degree of constraint that legal rules, legal precedents and legal principles have on decision-making, it is notable that in focusing solely on these, legal reasoning is largely divorced from the individual who is purportedly engaged in that reasoning. In the drive to constrain individual decision-making, reasoning comes to be regarded as disembodied. All that is important here are the legal objects which direct problem solving. This is a an 'Objectivist' conception of law.

However, reasoning is always performed by someone.[142] It is individuals who think about and apply the law. Legal objects may be regarded as relevant to a given dispute but if they are not self-applying, who is it that does this

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[141] Sunstein, above n. 120, 775. Levi noted this early on stating that the 'rules change as the rules are applied': Levi, above n. 1183-4. See also MacCormick, above n. 91.

[142] At least perhaps until the field of artificial intelligence and law fulfils it promises.

regarding? It cannot be anyone other than the individual considering the resolution of the dispute. It is up to this individual to conclude how the dispute should be resolved. Unsurprisingly, this representation of law and legal reasoning - as a process involving the objective application of determinative, formal laws that control decision-making and determine legal outcomes - has come under sustained criticism.

3.3 The radically free thinker

The vision of law as objectively and impassively controlling decisions has been called one of the central ideas of modern legal thought.[143] It is also an image of law that has been subject to sustained criticism by the American Realists, and more recently by the Critical Legal Studies (CLS) movement.[144] In this light, CLS scholars criticise the invocation of rules, cases:

> impersonal purposes, policies, and principles as an indispensable component of legal reasoning.[145]

In contrast to the control imposed by these, according to Unger:

> legal reasoning seems condemned to a game of easy analogies. It will always be possible to find, retrospectively, more or less convincing ways to make a set of distinctions, or failures to distinguish, look credible. ... Because everything can be defended, nothing can.[146]

In stark contrast to the constraint conjured up by Dworkin, Unger sees an 'incorrigible indeterminacy.'[147]

Focusing on the rules, cases and principles of law directs problem solving into a search for means to satisfy the requirements of those legal objects - a search for the components of the legal rule or a search for the elements which will make a

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[143] Unger, above n. 126, 563.

[144] For a characterisation of this movement by a participant see: Unger, above n. 126.

[145] Ibid. 564.

[146] Ibid. 570.

[147] Ibid. 579.

precedent similar. A search for the constituents of the legal principle. Problem solving takes place within the boundaries of the categories specified by the rules, precedents and principles. In contrast, adherents of CLS argue that:

> "Reality" is not carved up into categories that representational systems happen to match. Rather, "reality" is constructed in the very process of description or representation.
>
> Representation depends on prior categories within which events are taken as similar or dissimilar. When the categories are taken to reflect a reality that exists prior to the representational system, the analogical reasoning with the categories appears natural and necessary rather than artificial and contingent.[148]

In contrast to demonstrating a system of control by legal rules, cases and principles, CLS seeks to show:

> how power-ridden and manipulable materials gain a semblance of authority, necessity, and determinacy and thus how formalism and objectivism seem plausible.[149]

Roots of this view can be traced to the American Realists and statements such as Frank's that legal rules are 'indeterminate'.[150] However CLS pushes one step further this criticism of a reliance on legal rules and argues that legal rules and principles merely serve to protect the existing social order from criticism and change.[151] Accordingly, in critiquing the reliance on rules, cases and principles comes the freedom to reconceive social relations.[152] While American Realists stopped at highlighting indeterminacies in legal reasoning, CLS seeks to advance 'leftist' aims.[153] According to Unger:

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[148] Peller, G., 'The Metaphysics of American Law' (1985) 73 California Law Review 1151, 1177.

[149] Unger, above n. 126, 579.

[150] Frank, above n. 104.

[151] Unger, above n. 126, 563-7.

[152] Ibid. 579.

[153] Ibid. 566-7.

> The constructive outcome of our critique of objectivism is to turn us toward the search for alternative institutional forms of the available institutional ideals, most especially the market and democracy.[154]

This rejection of formalism thus views the resolution of legal disputes as subject to the 'normal modes of moral and political controversy.'[155]

This is a representation of law as manipulatable and a representation of legal reasoning as personal choice. At the extreme, it is a representation where law provides no guidance in decision-making and where reasoning is unconstrained. If legal materials are indeed indeterminate, or incorrigibly indeterminate, then potentially any, and all, results are justifiable.

Objectivist and CLS representations of law thus appear in stark opposition. Indeed, where objectivism seeks to remove the legal reasoner through focusing on the constraining power of the legal materials themselves, CLS embodies a conception of the legal actor as a 'radically free subject.'[156] Rather than being controlled by the legal materials, this radically free subject is free to reconceive social and legal structures, to choose amongst these alternatives and to implement the choice made. Rather than being controlled by objects of the legal order, the individual in CLS is able to perceive the elements of that order and to reconnect them to achieve any particular desired end.

However, Schlag argues that this seemingly stark contrast, this apparent divergence, actually masks a fundamental sameness. According to Schlag:

> The recurrent picture informing critical legal thought is that legal thinkers are already politically and morally competent subjects who are

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[154] Ibid. 583.

[155] Ibid. 579.

[156] Schlag, P., 'The Problem of the Subject' (1991) 69 Texas Law Review 1627.

> systematically mystified and constrained by an oppressive object-order of legal structures ...[157]

This 'object-order of legal relations' is of course the same order used by formalists to constrain discretion. Whereas the formalist uses this order to constrain, CLS sees the individual as perceptive of this order and free to move outside it. The sameness then is the acceptance of the existence of this object-order of legal structures.

For Schlag acceptance of the existence of this object-order of legal relations raises two problems:

> One problem is that we are missing any convincing accounts of who or what it is that thinks or produces law. Another problem is that apparently we and our legal rhetoric have been constituted to avoid inquiry into this question of who or what produces law.[158]

Schlag calls this desire by formalist theory on the one hand to eviscerate the legal thinker, and CLS on the other hand to free the thinker, the 'problem of the subject.'[159] In both cases the important focus is regarded as the rules, cases and principles that constitute the law. Where formalism sees these legal objects as providing control, CLS sees manipulatable materials. In both cases though the focus is on the objects of law rather than the subject of law who is controlled or who engages in manipulation. In neither case is there a real investigation of what it means to think about legal problems.

3.4 Legal reasoning as justification

The desire to uphold the ideal of the rule of law underlies legal theory's overwhelming disinterest in the legal subject. Like Holmes, Frank was highly critical of what he called 'mechanistic' law of which he said:

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[157] Ibid. 1685-6.

[158] Ibid. 1629.

[159] Ibid.

> there is the insistent effort to achieve predictability by the attempt to mechanise law, to reduce it to formulas in which human beings are treated like identical mathematical entities. Under such influences, there is proclaimed the ideal of "a government of law and not of men." The law is dealt with as if it were settled once and for all; its rules are supposed to operate impartially, inflexibly: justice must be uniform and unswerving.[160]

As part of his criticism of this view Frank argued that legal results were merely the result of personal hunches.[161] The implication being that there is a government of men and not laws, where rules of law are not impartial, and where justice is not uniform. The final implication being that justice is arbitrary.

Wasserstrom responded to Frank's criticisms, proposing that legal reasoning operated as a two-step process.[162] According to Wasserstrom, it is necessary to distinguish between the processes by which solutions to legal problems are created and the processes by which solutions to those problems are justified.[163] Wasserstrom argued that in law processes of creation are irrelevant and that only processes of justification need be investigated and explained - providing an account of how results are created is unimportant if it is possible to give an account of why those results are justified. Accordingly, any of the personal input in legal reasoning, the influence of personal views and values, can validly be ignored because legal propositions are only acceptable and accepted to the extent they can be justified. In which case the fact that they are legally justified makes it irrelevant that they may also be personally felt. As MacCormick states:

> The process which is worth studying is the process of argumentation as a process of justification.[164]

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[160] Frank, above n. 104, 118, ch. XVII.

[161] Ibid. 103, see ch XII for a discussion of the process.

[162] Wasserstrom, R.A., The Judicial Decision (1961) Stanford University Press, 25-31.

[163] Ibid. 26-7, ch. 2.

[164] MacCormick, above n. 91, 15.

Interestingly, CLS is also largely uninterested in processes of creation. Although Frank lucidly highlighted how the way in which facts are interpreted, how the facts are classified in a dispute, can have just as significant consequences as the classification of the law itself,[165] CLS tends to focus on how any position that might by whatever means be created, can also be justified. Showing the multitude of justifiable positions is enough to undermine the rule of law project. So again, processes of creation are regarded as peripheral.

The objectification of law and the associated fascination with justification maintain that resolving problems is simply a matter of referring to legal objects and connecting them in the 'right' way (for supporters of the rule of law), or the 'desired' way (for the critical legal theorist). However, problems with this exclusive focus on justification are hinted at by supporters of the rule of law themselves.

MacCormick and Dworkin both argue the need for coherence in legal justification.[166] It is striking then that MacCormick criticises Dworkin's theory:

> as an untenable form of ultra rationalism. Reason alone cannot wholly determine what we ought to do.[167]

However, if justification is the sole process of interest as MacCormick states,[168] then Dworkin's approach seems wholly sensible. The suggestion then is that despite arguing for coherence, MacCormick regards as unachievable the kind

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[165] See Frank, above n. 104. Justice Wald candidly makes the same point, stating:

> The facts can – and indeed must – be retold to cast a party as an innocent victim or an undeserving malefactor, to tow the story line into the safe harbour of whatever principle of law the author thinks should control the case. Wald, P.M., 'The Rhetoric of Results and the Results of Rhetoric: Judicial Writings' (1995) 62 University of Chicago Law Review 1371, 1386.

[166] MacCormick, above n. 91, ch.s V, VI, VII and VIII; Dworkin, above n. 138.

[167] MacCormick, above n. 91, 265.

[168] Ibid. 15.

of coherence for which Dworkin argues. A clue to MacCormick's concern may be the idea that things must cohere:

> in the sense that the multitudinous rules of a developed legal system should 'make sense' when taken together.[169]

Coherence relies on:

> 'what makes sense in the world' ... [and is] therefore in some degree *subjective.*[170]

3.5 Reasoning as sensemaking

An alternative to, on the one hand viewing law as composed of authoritative materials and to viewing legal reasoning as a process controlled by the legal materials, and on the other hand as involving a radically free thinker, is to view legal reasoning as a process of 'sensemaking'. Simply, the felt experience of legal work is neither of being controlled by a set of materials nor of being able to achieve anything whatsoever with those materials. While a feeling may persist that during reasoning there are multiple sources to choose from, this is far from the feeling that anything at all can be done with these sources. Accepting that law does not strictly bind is far from accepting that the possible moves with the law are completely free.

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[169] Ibid. 152.

[170] Ibid. 106. C.f. Balkin who argues that coherence must be seen as an individual function of the person constructing the coherence: Balkin, J.M., 'Understanding legal understanding: the legal subject and the problem of coherence' (1993) 103 Yale Law Journal 105. Similarly, Simon argues that in judicial decision making there is:

> a transformation of the way the dispute is represented in the judge's mind. During the course of deciding a hard case, the judge's mental representation of the dispute evolves naturally towards a state of coherence. (Simon, D., 'A Psychological Model of Judicial Decision Making' (1998) 31 Rutgers Law Journal 1, 19.)

Any coherence that may be achieved however, depends on how the individual mental representation evolves.

Kennedy provides an evocative and insightful description of this.[171] Kennedy describes the work of a judge faced with the need to rule on a (hypothetical) labour dispute involving workers picketing their employer's premises. Kennedy's judge is broadly sympathetic to the striking workers and is broadly in favour of transforming modes of economic life in the direction of greater worker control and worker management.[172] The judge is thus aware of the object order of legal relations and has an initial sense of 'how-I-want-to-come-out' (HIWTCO). However, the judge feels a quick intuition that the law is against his preferred position. According to Kennedy:

> from my point of view the *application of the rule to this case* feels like a nondiscretionary, necessary, compulsory procedure. I can no more deny that, if there is such a rule, the workers have violated it, than I can deny that I am at this minute in Cambridge, Massachusetts, sitting on a chair, using a machine called a typewriter. The rule just applies itself.[173]

Despite this feeling of the law's compulsion however, Kennedy's judge soon manages to review the rule from a more comfortable perspective:

> I stopped imagining the rule of "no interference" as the only thing out there – as dominating an empty field and therefore grabbing up and incorporating any new fact-situation that had anything at all "sort of like interference" in it. I tried to find other rules that set the limits on this one, so I could tuck my case under their wing. Once I identified those affirmative rules ... I restated the facts of the lie-in to emphasize those aspects of that fit ...[174]

Kennedy goes on to describe how the hypothetical judge might think about the dispute and how during this a process of change occurs. As the judge explores the law in more detail and reflects on how the facts might interact with the law,

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[171] Kennedy, D., 'Freedom and Constraint in Adjudication: A Critical Phenomonology' (1986) 36 Journal of Legal Education 518.

[172] Ibid. 520.

[173] Ibid. 520.

[174] Ibid. 525.

the judge begins to see both the law and the facts in a different light. The judge begins to re-characterise the scope of the rules of law that he has 'found' and to re-characterise the facts of the dispute. This re-characterisation of the rules and facts results in a changed perspective on the dispute. Kennedy describes how this re-experiencing of the problem results in change:

> my initial impression of conflict between the law and HIWTCO may disappear because HIWTCO changes, as well as because I manage to change the law. Further, the very resistance of the law to change in the direction of HIWTCO may impel HIWTCO to change in the direction of the law. I may find myself persuaded by my study of the materials that my initial apprehension of HIWTCO was wrong. I may find that I now want to come out the way I initially perceived the law coming out.[175]

In contrast to control by the legal materials or complete freedom to reconceive social relations, the experience of law is neither one of captivity nor freedom:

> One of the ways in which we experience law ... is as a medium in which one pursues a project, rather than as something that tells us what we have to do. When we approach it this way, law constrains as a physical medium constrains – you can't do absolutely anything you want with a pile of bricks, and what you can do depends on how many you have, as well as on your other circumstances.[176]

As Kennedy states, this suggests:

> that we should understand both freedom and constraint as aspects of the experience of work–chosen project constrained by material properties of

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[175] Ibid. 549.

[176] Ibid. 526. Notably, under this conception the notion of freedom within the law takes a different perspective.

> What then can be said of the body of legal materials "itself", considered in isolation from the particular contexts within which particular judges experience it? Not much. We have no reason to believe that the field is *ever* unbudgeable otherwise than as a consequence of the failure of particular judges to find a way to budge it. But we cannot assert the contrary either: it *may* be true that a given field was experienced as immovable because it *was* immovable, and that's all there was to it. (Ibid. 548).

> the medium – rather than thinking in the back of our mind of a transcendentally free subject who "could do anything," contrasted with a robot programmed by the law.[177]

Such descriptions of legal reasoning and legal problem solving suggest a very different conception of legal reasoning, one hinted at by MacCormick, of legal reasoning as a process of 'sensemaking'. The legal thinker can be said neither to be completely controlled by the legal materials nor to be completely free to reconceive those materials - feelings of control and freedom depend on the sense that is made from the materials. Control and freedom are not properties of the materials themselves but rather a result of the way those materials are perceived.

Central to sensemaking is the idea that reasoning is a matter of coming to understand the materials that are being reasoned about. When faced with an uncertain situation, with a problem to be solved, we must try to make sense of it. If it already fully made sense then it would not be a problem. We try to make sense of the problem and how the materials available might be used to resolve the problem. In order to make sense we try to fit our knowledge of the problem with our existing knowledge of the world. We try to integrate our beliefs about the world and wishes about how the world should be with the dictates of the problem. As Kennedy suggests, sensemaking is a matter of making these psychologically consistent.[178] Attempting to achieve consistency could involve revision in our beliefs and wishes, revision of our interpretation of the scope and requirements of the problem; or in a revision of both. Amongst other things, we interpret how physical things in the world work, we reason from and reason to causes and effects. We reason about other people in the world. We

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[177] Ibid. 527.

[178] C.f. 'dissonance theory' in psychology and its influence in legal reasoning: Jackson, B.S., Making Sense in Law: Linguistic, Psychological and Semiotic Perspectives (1995) Deborah Charles Publications.

reason about their intentions and motivations their beliefs and desires. We reason about morality, about what we regard as good and right, acceptable and unacceptable, and we reason about the law, whether things are legal or illegal, and whether they should be legal or illegal. We try to determine not only what we regard as acceptable and unacceptable but also what others would regard as acceptable or unacceptable. In a broad but important respect, in all these situations we are constructing theories about the things about which we are reasoning. We construct theories in order to try to determine why things are as they are, how things might be in the future and how we would like them to be in the future.

Rather than a process governed by the material – an impersonal process in which the individual is irrelevant – sensemaking is thus a highly individual process. It is a process in which personal beliefs and wishes are constantly subject to potential revision. Our beliefs about how we act, about how others act, and about the way the world works generally, are all open to question. Our beliefs about how we should act, about how others should act and about how we would like the world to be in general are all open to revision. The beliefs and wishes by which we define who we are and our relations to others are subject to continual potential revision. Weick highlights the very personal nature of this, stating that sensemaking is 'grounded in identity construction'.[179] According to Weick:

> the sensemaker is himself or herself an ongoing puzzle undergoing continual redefinition, coincident with presenting some self to others and trying to decide which self is appropriate. Depending on who I am, my definition of what is "out there" will also change. Whenever I define self, I define "it," but to define it is also to define self. Once I know who I am then I know what is out there.[180]

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[179] Weick, K.E., Sensemaking in Organizations (1995) Sage, 18.

[180] Ibid. 20.

White reaches the same conclusion, writing that the lawyer is engaged in a process of meaning making in which:

> "We" and our "wants" are constantly remade in the rhetorical process.[181]

In contrast to formalist views where the reasoner is irrelevant, sensemaking sees the meaning of materials as changeable - meaning depends on constructions provided by readers. However, in contrast to conceptions of a radically free subject where the materials are to be manipulated by a fully self-aware reasoner, sensemaking sees the subject as highly influenced by the materials. In Simon's terms, reasoning is 'bi-directional' – decisions:

> are determined by legal materials that are restructured in turn by the process of making the decision.[182]

While formalistic theory sees the problem environment as containing rules, cases and principles, and critical theory sees the environment as containing a free decision maker making choices driven by personal beliefs, sensemaking sees problems as involving an interaction between the decision maker and her beliefs, and the environment which she influences and is influenced by. Sensemaking might thus be seen as a perspective lying between objectivism and relativism. In saying that we make sense of the world is not necessarily to adopt a cynical stance towards the law or society. It is not to argue that we can make whatever sense of the world we want. According to Dervin, adopting a sensemaking perspective means that:

> information is not a thing that exists independent of and external to human beings but rather is a product of human observing.[183]

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[181] White, J.B., 'Law as Rhetoric, Rhetoric as Law: The Arts of Cultural and Communal Life' (1985) 52 University of Chicago Law Review 684, 691.

[182] Simon, above n. 170, 21.

[183] Dervin, B., 'An overview of sense-making research: Concepts, methods and results' (1983) Paper presented at the annual meeting of the International Communication Association, Dallas, TX, May 1983. Available at http://communication.sbs.ohio-state.edu/sense-making/art/artdervin83.html (accessed 15/2/2001), 4.

She concludes that all 'information is subjective.'[184] However, this view is not a necessary consequence of the perspective that reasoning is, at least partly, a process of sensemaking and that people both construct and are constructed by knowledge.[185]

To emphasise that legal reasoning is about sense making is not to ignore or to detract from the important role of principles, rules and cases in legal reasoning, nor to ignore the role of logic, deduction, induction and analogical reasoning in legal reasoning. In examining reasoning in law we could say that the individual applies the legal rules, the legal cases and the legal principles and any other materials to the problem at hand. However, in this context debates about the roles of rules and cases, and about the role of logic, deduction, induction and analogical reasoning can be understood in terms of the part they play in sense making.

In making sense of situations and problems, we may use deductive reasoning in some circumstances. When we are confident that our interpretation of a situation is correct then we may rely on this confidence as the basis to draw deductions. When we are sure that our interpretation of a rule or case is correct the application of that rule or case to the particular situation may appear deductive. Accepting that personal views, beliefs and wishes are always subject to potential revision does not mean that they are constantly revised. Only when an ambiguity is felt in the application of the legal materials must we look for something to bridge gaps in deduction. It is in such situations – where we are unsure as to what situation actually adheres or what situation should adhere – that solid ground on which to base a deductive inference is felt lacking. In this situation, as Kennedy discusses, sensemaking will more consciously precede

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[184] Ibid. 5.

[185] See Berger and Luckmann who discuss processes of "sedimentation" and "internalisation" of social knowledge: Berger, P., Luckmann, T., The Social Construction of Reality: A Treatise in the Sociology of Knowledge (1971) Doubleday.

deduction. Nevertheless, despite any felt certainty, all the sensemaking that has occurred prior to the application of a rule or case cannot be ignored. Or more accurately, we can only ignore all this prior reasoning if we deem it unimportant for the particular perspective we want to adopt on law and legal reasoning.

Similar observations apply to the various forms of inductive inference often said to operate in legal reasoning. For example, in induction by enumeration[186] if we are confident that the situations under comparison are all of the same type, then we can draw a general inference from them. However, focusing on reasoning in this way must not obscure important aspects of reasoning inherent in problem solving. For a central element in inductive reasoning is the perception of two, or more events as similar. If a group of events is not perceived as similar then it is not possible to form an inductive generalisation from them. This construction of similarity is important. In an important sense, the construction of similarity is a process of sensemaking. Coming to regard situations as similar is a matter of building a personal understanding of each situation. When considering a problem, a reasoner is necessarily faced not only with a particular conception of the situation itself but also with a conception of the materials relevant to that problem. It is the task of the reasoner to determine what materials are relevant to the problem and how they influence the problem. This is a matter of conceiving of the problem in a particular way; it is a matter of conceiving of the material in a particular way, of rejecting some material while emphasising other material. Even when a similarity seems obvious, focusing on induction simply as the generation of general rules masks all the sense making that has previously occurred in the perception of situations as indeed similar enough on which to base the induction. Moreover, it masks all the sense making that occurs in reaching the particular induction arrived at,

[186] Induction by enumeration occurs when several similar situations are observed and a general rule is proposed to explain those situations: Golding, above n. 123, 43-4.

rather than other possible inductive conclusions.[187] When we are not so confident that the situations under consideration are indeed similar, or that a particular result should follow, then making sense of the situations will need to more explicitly precede enumerative induction.

Just as in deductive reasoning and inductive reasoning, sense making is apparent in various forms of analogical reasoning. If we regard two things as sufficiently similar then we can import our understanding about one of them in order to inform about the other. However, as in enumerative induction this depends on confidence that the two situations are initially similar. Sometimes, perhaps indeed often, we may be confident in this sense of similarity without conscious reflection. At other times however, despite an initial feeling of difference, through conscious reflection we come to regard two situations as similar. In this process of reflection, situations can come to be perceived in new ways and situations that are otherwise seen as dissimilar can come to be seen as similar.

Legal reasoning is sometimes examined in terms of 'reflective equilibrium' and 'reasoning to the best explanation'. According to Brewer, reflective equilibrium, involves a 'process of reflective adjustment between specific examples ... and general normative principles'.[188] Central to this is uncertainty about the precise consequences of a finding of similarity amongst the precedents and uncertainty about the precise scope and requirements of the normative principles. Each is evaluated in light of the other. This inherently involves reasoning about what the precedents and the principles mean – it involves making sense of the

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[187] This is the 'problem of induction': Routledge, (ed.) Concise Routledge Encycolpedia of Philosophy (2000) Routledge.

[188] Brewer, above n. 123, 938-9 citations omitted. Compare Sunstein who also regards reflective equilibrium as an important part of legal reasoning: Sunstein, above n. 120, 781-3. However, while Brewer discussed reflective equilibrium as a 'vitally important instance of example-based reasoning', Sunstein regards the two as closely related though irreducible.

precedents and principles in light of each other. The attainment of equilibrium is in this respect the attainment of a new sense of the precedents and principles.

According to Lipton 'inference to the best explanation':

> has become extremely popular ... It is widely supposed to provide an accurate description of a central mechanism governing our inferential practices.[189]

In 'inference to the best explanation', a reasoner does not typically know why something has occurred, why something will occur or why something should occur, and reasons to such an understanding by attempting to provide explanations. The explanation that provides the best explanation for what has occurred, what will occur, or what should occur is said to provide reasons why something has occurred, why it will occur or why it should occur. Here understandings are modified according to how they fit with explanations that can be provided for an anomaly or for a desired result. Inherent in this is that judgments about what explains what, and what counts as a good explanation, are all made in light of prior knowledge. Within this model reasoning involves a backwards and forwards movement of hypothesising what is possible and then testing that against the actual or accepted. Inherent here is the iterative building of world pictures. The precise operation of inference to the best explanation and its role in legal reasoning is beyond the scope of this discussion, it is interesting simply because it highlights that inference iteratively involves proposition, exploration, testing, acceptance, rejection and refinement of sense as reasoning progresses. Through reorientation of our views about the law and our understanding of situations we can come to make sense of them in new ways.[190] In this respect, the sense we make and the sense we remake of situations drives the semantic flexibility observed in reasoning.

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189 Lipton, P., Inference to the Best Explanation (1991) Routledge, 2.

190 Pennington and Hastie's model of 'explanation-based decision making' has strong overlaps with the idea of reasoning to the best explanation, see section 3.5.2 for a discussion of Pennington and Hastie's work.

Judicial decision-making provides ample examples of sensemaking - such as *Donoghue v Stevenson.*[191]

Their lordships in *Donoghue* referred to numerous cases, these cases having differing results. Commenting on these cases Lord Macmillan said:

> It humbly appears to me that the diversity of view [sic] which is exhibited ... is explained by the fact that in the discussion of the topic which now engages your Lordship's attention two rival principles of the law find a meeting place where each has contended for supremacy. On the one hand, there is the well established principle that no one other than a party to a contract can complain of a breach of that contract. On the other hand, there is the equally well established doctrine that negligence apart from contract gives a right of action to the party injured by that negligence ....[192]

Lord Buckmaster dissented in the case and would have denied the appeal. According to Lord Buckmaster, the general considerations relevant to the case were that:

> The breach of the defendant's contract with A. to use care and skill in and about the manufacture or repair of an article does not itself give any cause of action to B. when he is injured by reason of the article proving to be defective.[193]

Two exceptions were contemplated:

> (1)In the case of an article dangerous in itself; and (2)where the article not in itself dangerous is in fact dangerous by reason of some defect or for any other reason.[194]

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[191][1932] A.C. 562, 566.

[192]Ibid, 609.

[193]Ibid, 569. Quoting Lord Summer in *Blacker v Lake & Elliot Ltd* 106 L.T. 533, 536.

[194][1932] A.C. 532, 569.

Within the sense made of the law by Lord Buckmaster, the sense made of the two rival principles, and the sense made of all the previous precedents, the situation in *Donoghue* was governed by the principles in conflict.

According to Lord Buckmaster no one could 'suggest that ginger-beer was an article dangerous in itself.'[195] Further, the second exception rests on the 'obligation to warn' the concealment of which is in the 'nature of fraud'.[196] Lord Buckmaster considered there to be no indication of fraud in the present case. Thus, regarding the general situation as governed by contract and admitting only strict exceptions, Lord Buckmaster refused the appeal. Given the sense made of the law, the facts could not be analogised to any of the precedents cited by counsel in argument because the bottle of ginger-beer was not an inherently dangerous item and nor was there any evidence on which to establish fraud.

In contrast, the majority opinion of Lord Atkin rested on a very different sense of the law. According to Lord Atkin, you:

> must take reasonable care to avoid acts or omissions which you can reasonably foresee would be likely to injure your neighbour. .... persons who are so closely and directly affected by my act that I ought reasonably to have them in contemplation as being affected when I am directing my mind to the acts or omissions which are called in question.[197]

With this conception, the examination thus focused on considerations such as whether the product was 'used immediately' and whether there was a 'reasonable opportunity of inspection' - whether there was a 'proximate relationship'.[198] The sense made of the law by Lord Atkin required a search for

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[195]Ibid.

[196]Ibid.

[197]Ibid, 580.

[198]Ibid, 582.

a different type of characteristic, which required different facts to prove and disprove, than the search for a product that is 'inherently dangerous' or for 'fraud'. Applying this conception, Lord Atkin regarded the case as analogous to several precedents and found for the appellant.

Consequently, while Lord Buckmaster's view that principles of contract governed resulted in a series of rejected analogies to cases involving 'inherently dangerous' items or involving fraud, Lord Atkin's view that 'sufficient attention' must be given 'to the general principle which governs the whole law of negligence'[199] resulted in the problem being regarded as analogous to several precedents. The analogies drawn between precedents, the construction of the facts upon which those analogies rested, and ultimately the outcome of the case depended on the framework through which the case was viewed.

It is not simply the 'facts' of a problem which are classified in terms of static laws. Potentially, the law is reconceived each time it is applied. While the objectification of law suggests that legal rules, legal cases and legal principles statically control problem solving, *Donoghue* also illustrates how principles interact and are moulded during reasoning. Commenting on the whole law of negligence, Lord Salmon noted:

> Here is an age long conflict of theories which is to be found in every system of law. "A man acts at his peril" says one theory "A man is not liable unless he is to blame" answers the other. It will not surprise ... to find that between these theories a middle way, a compromise has been found.[200]

The opposing judgments of Lord Buckmaster and Lord Atkin each express a different compromise between these principles. Neither judgment applied either principle in full. Lord Buckmaster's requirement that a contract is

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[199]Ibid, 594.

[200]*Read v J. Lyons & Co. Ltd.* [1947] A.C. 156, 180.

generally necessary to found liability can be seen as strongly influenced by the principle that 'a man is not liable unless he is to blame'. However, the acknowledgement of exceptions in cases involving 'inherently dangerous' objects or fraud is a small concession to the principle that 'a man acts at his peril.'[201] In contrast, Lord Atkin reached a different compromise between these principles - this compromise itself having come to be called the 'neighbour principle'. Lord Atkin can be thought to have been more influenced by the principle that 'a man acts at his own peril.' However, Lord Atkin did not fully apply this principle and the neighbour principle is a succinct expression of the balance to be drawn between the principle that 'a man acts at his peril' and the principle that 'a mans is not liable unless he is to blame.' Thus, both principles influenced each judge. Neither applied either principle in totality. It was the dynamic interaction between and influence of these principles that resulted in two different compromises which ultimately founded the different conceptions of the case.

As discussed thus far, sensemaking is a representation of legal reasoning as it occurs on an individual level. Interestingly, as Jackson discusses, the Anglo-Saxon adversarial legal system itself illustrates processes of sensemaking at an institutional level.[202] Inherent in this system is the opposition of two parties, and the opposition of two different interpretations of a situation. Each party is engaged in the legal process in order to present a particular version, their particular version, of a situation. Amongst other things the parties may differ on whether particular circumstances exist or have existed. They may differ on whether circumstances can be imputed from other circumstances. They may differ on the consequences of a set of circumstances. They may differ on what

[201]It could be argued that all Lord Buckmaster was actually doing was re-affirming a line of old cases, he was not thinking about principles at all. Apart from the question of why Lord Buckmaster focused on the particular cases that he did, even if this is accepted, it is argued that this line of old cases expresses the compromise between principles discussed above.

[202] Jackson, above n. 178, 163-84. See also: White, above n. 181, 688.

the law is or how the law should be. Whatever the particular disagreement is about, there is a disagreement, a difference of view as to a past state of affairs, their present implications and or their future effects. Each party attempts to present a version of events that presents a convincing story as well as a conception of the law that favours, indeed requires, resolution in their favour. If a dispute reaches an impasse that has to be officially adjudicated, the judge, or the judge and jury must review both perspectives and then decide based on which they find most convincing. Choice will depend on which account makes the most sense. Although juries do not detail their reasoning, in this respect judgments can be viewed as accounts of the sense made of the dispute - accounts that report how facts were viewed, how the law was construed and the consequences of each of these.[203] In a process highlighted by Levi, precedents are thus an institutional means of remembering what sense has been made of disputes and themselves become a resource for making sense in latter situations.

Sensemaking emphasises that central to problem solving is the perspective from which problems are understood, the way in which problems are perceived. This is a distinctly individual process. However, when perceived at an institutional level, sensemaking both highlights the operation of the institutional processes themselves but also indicates how those processes affect the sense that individuals make. Just as sensemaking is a perspective that can be applied to the operation of the legal process, theories of the operation of the legal process are themselves accounts of legal sense construction.[204] The theories we offer of the law and legal reasoning affect how we view those processes. As Jackson states:

> sense is created both of the language and psychological processes of the law, and through those very processes.[205]

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[203] See generally Simon, above n. 170.

[204] Jackson, B.S., Making Sense in Jurisprudence (1996) Deborah Charles Publications, 4.

[205] Ibid. 8.

Thus, when law is perceived as a process of rule application, problem solving becomes a search for rules and means to fulfil the requirements of those roles. When law is perceived as a process of analogising, problem solving becomes a search for precedents and a search for similarities and differences between precedents. When the problem solver is regarded as radically free, problem solving becomes an opportunity to advance personal values. This reaffirms the importance of legal theory in the construction of computer systems in law. When computer systems in law necessarily embody a theory of law and a theory of legal reasoning, it is important to adopt an appropriate representation of law and legal problem solving. Adopting a representation of legal reasoning as a process of sensemaking indicates that systems must be built to support the solution to a different kind of problem. Rather than automatically solve problems through deduction or automatically perform analogical reasoning, systems must support the resolution of 'wicked problems'.

3.5.1 'Wicked' problems

Sensemaking involves a reconceptualisation of problems as they are examined. The requirements of a problem and the materials relevant to the problem can both evolve during problem solving. However, an environment where the very shape of the problem under consideration changes during problem solving indicates a very different type of problem to the clear, structured problems posited in the objectification of law. Problems are ill-defined. An environment where problems are ill-defined and where problems must be identified before they can be approached not only suggests a very different type of reasoning, but also a very different type of problem to the structured, mechanistic problems implied in the objectification of law. Rittel and Weber perceptively contrast 'tame' problems with 'wicked' problems. Tame problems are found in science and aspects of engineering and are 'definable and separable and may have solutions that are findable'.[206] This is not to say such problems are easy though. In contrast, 'wicked problems' have several characteristics:

- There is no definitive formulation of a wicked problem – understanding the problem depends upon one's ideas for solving it;
- Problems can be explained in numerous ways and the choice of explanation determines the nature of the problem's resolution;
- In wicked problems, work is terminated not for 'logical' reasons but for considerations of time, or money, or patience;
- Solutions to wicked problems are not true or false, but good or bad;
- There is no immediate and no ultimate test of a solution to a wicked problem;
- Wicked problems do not have an enumerable, exhaustively describable, set of potential solutions;
- Every wicked problem is essentially unique. Despite seeming similarities one can never be *certain* that the particulars of a problem do not override its commonalities with other problems;
- Every wicked problem can be considered a symptom of another problem.[207]

Legal problems display each of these characteristics.

Understanding processes through which sense is made of wicked problems requires more than a focus on deduction, induction and analogy can provide. Psychological examinations of reasoning and decision-making have traditionally focused on the use of logic and models such as expected utility theory and multi-attribute utility analysis.[208] However, it has been consistently

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[206] Rittel, H.W.J., Webber, M.M., 'Dilemmas in a General Theory of Planning' (1973) 4 Policy Sciences 155, 160.

[207] Ibid. 161- 167.

[208] Johnson-Laird, P.N., Shafir, E., (eds.) Reasoning and Decision Making (1993) Elsevier Science Publishers, 3-5. Expected utility theory proposes that when making decisions, people assign a value to each possible outcome, with the highest value going to the most desired outcome. The theory proposes that the probability of each outcome is then

shown that people do not conform to logical requirements or the requirements of expected utility theory when they make decisions.[209] Indeed, according to Johnson-Laird and Shafer:

> the major psychological discovery about both reasoning and decision making is that normative theory and psychological facts pass each other by.[210]

The field of 'naturalistic decision-making' is one response that has developed to investigate this divergence. Unfortunately, apart from a rejection of classical decision-theory, there is almost no unified theory uniting naturalistic decision-making research.[211] However, two foundations that unite research are first an emphasis on 'mental imagery' and secondly, and emphasis on the importance for reasoning of the way that information is 'framed'.[212]

3.5.2 Mental imagery - sensemaking as argument

Mental imagery, which researchers argue involves categorisation and storytelling, aims at identifying and defining the very problem to be solved.[213] Naturalistic decision-making theory thus emphasises that in real world decision-making people dynamically construct mental images of their situation, which they use as the basis of reasoning.[214] In contrast to the well-defined

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multiplied by this value. Finally, the choice with the highest resulting score is chosen – since this is the choice giving the highest probable return: Baron, J., Thinking and Deciding (2nd edition) (1994) Cambridge University Press.

[209] Johnson-Laird and Shafir, ibid.

[210] Ibid. 6.

[211] Lipshitz, R., 'Converging Themes in the Study of Decision Making in Realistic Settings' p. 103, in Klein, G.A., Orasanu, J., Calderwood, R., and Zsambok, C.E. (eds.) Decision Making in Action: models and methods (1993) Ablex.

[212] Ibid. 132-3.

[213] Ibid.

[214] See generally: Klein, G.A., Orasanu, J., Calderwood, R. and Zsambok, C.E., (eds.) Decision Making in Action: Models and Methods (1993) Ablex Publishing. Also Billig, M. Arguing

problems traditionally investigated in decision-making research, 'natural' decisions occur in an environment characterised amongst other things by ill structured problems, uncertain dynamic environments, shifting, ill-defined, or competing goals, and time stress.[215]

The notion that people actively construct meanings has been influential in various fields including psychology,[216] communication theory,[217] organisational theory,[218] education theory[219] and law.[220] This wide heritage reflects not only the utility of the perspective but also the numerous influences on how people make sense. Amongst other things, Jackson discusses the importance of linguistics, philosophy and psychology for understanding how people make sense in law. Jackson traces the ways in which the words and phrases that make up communication, and the meanings we make from them, are socially constructed.[221] He examines theories of cognitive competence and language development, and personality and emotion for consequences they have on senses that are made. Jackson traces how these manifest in the law and the implications they have for law and legal institutions. For Jackson however,

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and thinking: a rhetorical approach to social psychology (1989) Cambridge University Press, 152.

[215] Orasanu, J., Connolly, T., 'The Reinvention of Decision Making' p. 3, in Klein, G.A., Orasanu, J., Calderwood, R., and Zsambok, C.E. (eds.) Decision Making in Action: models and methods (1993) Ablex, 7.

[216] Klein *et al.*, above n. 214; Billig, above n. 214, 152; Jackson, above n. 178, 188-93. Although the ideas of narrative, storytelling and mental imagery are slightly different and indeed used in different ways in different contexts, there is a close connection between them, as Jackson makes clear: Jackson, above n. 178, 153.

[217] Dervin, above n. 183.

[218] Weick, above n. 179.

[219] This perspective is embodied in 'constructivism' and 'constructivist' learning theory: Jonassen, D., Computers in the Classroom: Mind tools for Critical Thinking (1996) Prentice-Hall.

[220] Jackson, above n. 178.

[221] Ibid. ch.s 1 and 2.

central to sensemaking is the concept of 'narrative', which proposes that people make sense of the situations they are in and the way they should and shouldn't act through the adaptation and construction of stories. Essentially, sense is made of situations by trying to fit them within 'meaningful sequences of action'.[222]

Influential work on the psychology of juror decision-making emphasises the role that narratives play in making sense in law.[223] Pennington and Hastie propose a model of juror decision-making that they call 'explanation-based' decision-making.[224] The central hypothesis of explanation-based decision-making is that:

> decision makers construct an intermediate summary representation of the evidence, and that this representation, rather than the original "raw" evidence, is the basis of the final decision.[225]

Essentially this representation of the evidence is constructed as a story 'in which causal and intentional relations among events are prominent.'[226] The story is constructed from the evidence presented as well as prior knowledge:[227]

> General knowledge about the structure of human purposive action sequences, characterized as an *episode schema*, serves to organize events according to the causal and intentional relations among them as perceived by the juror. An episode schema specifies that a story should

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[222] Ibid. 142.

[223] E.g.: Pennington, N., Hastie, R., 'Explanation-based decision making: Effects of memory structure on judgment' p. 454, in Goldstein, W.M. and Hogarth, R.M. (Eds) Research on Judgment and Decision Making: Currents, Connections, and Controversies (1997) Cambridge University Press; Pennington, N., Hastie, R., `A theory of explanation-based decision making' p. 188, in Klein, G.A. and Orasanu, J. (Eds) Decision making in action: Models and methods (1993) Ablex Publishing; hereafter 'Pennington and Hastie 1993'.

[224] This has interesting overlaps with theories of reasoning to the best explanation discussed in section 3.5.

[225] Pennington and Hastie 1993, above n. 223, 188.

[226] Ibid. 191.

[227] Ibid. 192.

> contain initiating events, goals, actions, consequences, and accompanying states, in a particular causal configuration[228]

The central emphasis is on making sense through placing information within a set of relationships that is compatible with experience and prior knowledge.[229]

While mental imagery, storytelling and categorisation may partly explain how wicked problems are approached, they cannot be a full answer. For images, stories and categories must themselves be constructed, assessed and chosen. The elements of images and stories and the definitions of categories must be determined, as must the applicability of images, stories and categories in particular situations. As Billig states, psychologists:

> have tended to assume that categorization is a basic unit of thinking. At its simplest level, categorization involves the placing of a particular object, or entity within a general category.[230]

However:

> The problem with the categorization approach to cognition is that, from one-sided assumptions, a one-sided image of the person has developed.[231]

Billig notes a countervailing tendency to categorisation, categorisation is:

> the process by which a particular stimulus is placed in a general category: as a result of this process, the particular stimulus is robbed of its particularity, to become merely an instance of the general category. On the other hand, one might hypothesize that there is a reverse process: a stimulus need not be treated as being equivalent to other stimuli, but might be considered in its particularity.[232]

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[228] Ibid. 188 references omitted.

[229] That Pennington and Hastie provide evidence that people do seek consistency in their personal beliefs and their understanding of the law provides evidence for coherence theories of law.

[230] Billig, above n. 214, 151.

[231] Ibid. 160.

[232] Ibid. 161.

'Categorisation' thus does not exist as a thing in itself, rather it is part of a tension between the cognitive drive to generalise and the cognitive drive to specialise.[233] Whether researchers prefer to speak of mental images, stories or categories, there is an inherent element of assessment in their use.[234].

According to Lipshitz, in this context the 'root metaphor' for decision-making should be argument.[235] The content and structure of stories, narratives and images, and their appropriateness in a given context is argumentatively assessed in light of the available alternatives. As Billig concludes:

> If we then wished to offer a location for the essence of thinking itself, we might propose the following to be considered. Categorization does not provide the basis of thinking in a simple sense. The automatic application of categories is the negation of thinking, in that it is essentially a thoughtless process. Thinking starts when we argue or deliberate about which categorization to particularize, or how to categorize a particularization.[236]

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[233] Ibid. 163 citation omitted. More subtly, it is not merely a matter of choosing whether to classify an experience within an existing category or to treat it as *sui generis*, things can resemble and differ from each other in infinite ways. Categories can always be the subject of dispute. Thus according to Billig if one:

> set of categories is thrust at us, we might then make the implication explicit, and find ourselves arguing about the location of the heart of the issue. In consequence, it is not a matter of essences as such, but of arguments about the essence of the matter. (Ibid. 168).

[234] Jackson briefly discusses the relationship between argument and narrative: Jackson, above n. 178, 178-81.

[235] Lipshitz, R., 'Decision Making as Argument-Driven Action' p. 172, in Klein, G.A., Orasanu, J., Calderwood, R., and Zsambok, C.E. (eds.) Decision Making in Action: models and methods (1993) Ablex, 180. See also: Shafir, E., Simonson, I. and Tversky, A., 'Reason-based choice' p. 69, in Goldstein, W.M. and Hogarth, R.M. (Eds) Research on Judgment and Decision Making: Currents, Connections, and Controversies (1997) Cambridge University Press.

[236] Billig, above n. 214, 170.

Numerous psychological experiments highlight the role that argument plays in reasoning, decision-making and decision rationalisation. People rely on simple arguments to justify the choices they make and the absence of good argument for a choice, or the introduction of further arguments for alternatives can influence the choices that are made or indeed whether any choice is made.[237] As Shafir, Simonson and Tversky conclude:

> In contrast to the classical theory that assumes stable values and preferences, it appears that people often do not have well-established values, and that preferences are actually constructed – not merely revealed – during their elicitation.[238]

The centrality of argument for sensemaking should come as small surprise to legal theorists habituated to the systematised study of argument - although the powerful drive to objectification of the law requires its occasional reemphasis. As Balkin states:

> the dialectical structure of legal argument is not a distortion of our thought by an imperfect medium, but reflects the structure of legal and moral thought itself.[239]

Importantly, argument is central to reasoning, to sensemaking, not solely as a public pursuit. Argument is a key process that individuals engage in when making sense. As Billig emphasises:

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[237] Shafir, Simon and Tversky, above n. 235; Hogarth, R.M., Kunreuther, H., 'Decision making under ignorance: Arguing with yourself' p. 482, in Goldstein, W.M. and Hogarth, R.M. (Eds) Research on Judgment and Decision Making: Currents, Connections, and Controversies (1997) Cambridge University Press.

[238] Shafir, Simon and Tversky, above n. 235, 91 citation omitted. Shafir, Simon and Tversky say that while reliance on reasons has been a hallmark of social psychological analyses the analysis of reasons has been less influential in the analysis of individual decision making: ibid.

[239] Balkin, J.M., 'The Crystalline Structure of Legal Thought' (1986) 39 Rutgers Law Review 1, 76.

> "the same arguments which we use in persuading others when we speak in public, we employ also when we deliberate in our thoughts" .... "we use the same processes in argumentation, where we are disputing with another" as "in meditations, when we are considering and resolving anything with ourselves"[240]

In consequence, thought 'should possess a dialogic, rather than monologic, character', it should:

> not be seen as a process which is inevitably locked within the recesses of the brain and which is only dimly reflected in our words. Instead, the structure of the way we argue reveals the structure of our thoughts.[241]

Weick too, emphasises the centrality of argument in sensemaking. Psychological experiments confirm that people do indeed argue with themselves when thinking and making decisions.[242]

In this context, where argument is a central aspect of sensemaking, MacCormick's view that the process worth studying is the 'process of argument as a process of justification' must again be reassessed. Just as worthy of study is the process of argument as a process of sensemaking.

3.5.3 Visualisation

The way a problem is represented greatly effects how the problem is approached. For example, representing the law as composed of legal objects directs thinking around those objects and away from the thinker. Conversely, representing reasoning as a process of sensemaking focuses more directly on the thinker. The importance of problem representation has long been recognised in psychology. In the nineteenth century, Gestalt psychologists

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[240] Billig, above n. 214, 140 citations omitted.

[241] Ibid. 141.

[242] E.g. Hogarth and Kunreuther, above n. 237. The notion that argument is central to decision-making has become increasingly influential in psychology and has been called the 'argumentative turn' in psychology; Billig's work has been influential in this.

emphasised the importance of appropriate problem representation, arguing that improvements in thinking are dependent upon improvements in representation, and arguing that what separates the expert from the novice is the expert's ability to see things the novice cannot.[243] Although in a completely different paradigm, in their highly influential work on an 'information-processing' theory of mind Newell and Simon argue the importance of the correct representation of the problem.[244] As Best explains, a good representation of the problem will include a representation of the problem and an adequate specification of the goal - all searching for a solution is based on this representation – and without the 'right' elements the representation may be inadequate to attain the solution.[245] However, the focus of such examinations has been on internal representations – the way problems are represented in the mind of the reasoner. The way that problems are externally represented has largely been ignored on the assumption that they will be converted into an internal representation appropriate for processing.

Intuitively, the general view that the external form in which information is presented is unimportant for the way that information is used in the mind seems problematic. It is difficult to imagine how the feel of a piece of music or the sense of a painting could be conveyed in a work of sculpture or a passage of text. Psychology and cognitive science have recently begun to investigate the importance of 'external representations' in reasoning.[246] Commenting on this interest Zhang argues that:

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[243] Best, J.B., Cognitive psychology (4th edition) (1995) West Publishing, 420-1.

[244] Newell, A.C., Simon, H.A., Human problem solving (1972) Prentice-Hall, 90. The focus of external representations, and visual representations in particular, is not the focus of Newell and Simon's work however.

[245] Best, above n. 243, 443.

[246] Larkin, J.H., Simon, H.A., 'Why a Diagram is (Sometimes) worth Ten Thousand Words' (1987) 11 Cognitive Science 65; Stenning, K., Oberlander, J., 'A Cognitive Theory of Graphical and Linguistic Reasoning: Logic and Implementation' (1994) 19 Cognitive

> external representations are not simply inputs and stimuli to the internal mind; rather, they are so intrinsic to many cognitive tasks that they guide, constrain and even determine cognitive behaviour.[247]

Far from being irrelevant then, external representations can determine cognitive behaviour. As Larkin and Simon emphasise, one way to solve a problem in a poor representation is to translate it into a better one.[248] More than being simply beneficial in problem solving however, translating the form of presentation could possibly determine what solution is reached or if a solution is reached at all. According to Zhang:

> representational effect is not just a matter of different efficiencies and different behaviours .... the format of the representation can determine what information can be perceived, what processes can be activated, and what structures can be discovered from the specific representation. This is called *representational determinism.*[249]

In parallel with work on external representations, researchers emphasise the importance of diagrams for reasoning in many situations. This work on 'diagrammatic reasoning' investigates benefits that diagrams, as opposed for example to textual representations, have for reasoning. Researchers examining diagrammatic reasoning argue that diagrammatic presentations of information have various differences from pure textual representations of information, including:

Science 97; Zhang, J., 'The Nature of External Representations in Problem Solving' (1997) 21(2) Cognitive Science 179.

[247] Zhang, ibid.

[248] Larkin and Simon, above n. 246, 66. This may not be intuitive however:

> a problem solver often also needs the knowledge of how to construct a "good" diagram that lets him take advantage of the virtues we have discussed. (Ibid. 99).

[249] Zhang, above n. 246, 213.

- Diagrams can group together all information that is used together, thus avoiding large amounts of search for the elements needed to make a problem-solving inference;[250]
- Diagrams typically use location to group information about a single element, avoiding the need to match symbolic labels;[251]
- Diagrams automatically support a large number of perceptual inferences, which are extremely easy for humans.[252]
- Diagrams provide 'free rides'.[253]

A comparative examination of the operation and intricacies of the various cognitive models that have been proposed for reasoning with diagrams is beyond the scope of this work.[254] Notable however, is the consensus that diagrams can be more efficient for reasoning and that the way in which information is presented is extremely important for the way it is used. With appropriate diagrams, patterns and relationships emerge from the information. A graphical presentation of information can present a powerful visual picture which allows the mind to 'see' patterns and relationships. Hence the exclamation 'Ah, I see!' meaning 'I understand'.

The importance of visual information appears evident on a daily basis. It is difficult to imagine how a textual representation of Monet's 'Water lilies' could convey the same sense as does seeing the original. Similarly, navigating the London underground with a map of the 'tube' seems infinitely easier than with a textual representation of the position of stations, the lines they run on, the

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[250] Larkin and Simon, above n. 246, 98

[251] Ibid.

[252] Ibid. 98.

[253] Gurr, C.A., 'Effective Diagrammatic Communication: Syntactic, Semantic and Pragmatic Issues' (1999) 10 Journal of Visual Languages and Computing 317, 323.

[254] See: Zhang, above n. 246; Larkin and Simon, above n. 246; Stenning and Oberlander, above n. 246; Shimojima, A., 'The Graphic-Linguistic Distinction' (1999) 13 Artificial Intelligence Review 313.

location of interchanges etc.[255] Diagrams are widely used day to day. Geographical, political and weather maps are common. We encounter graphs, for example of the stock market, almost everyday. Calendars and project planners are widely used. Even in more analytical fields, the use of visual representations is widespread e.g.: Venn diagrams; truth tables; visual logic; and Feynman diagrams to name but a few. De Bono advocates diagrams to improve management thinking.[256] The maxim 'A picture is worth ten thousand words' remains intuitively true.

Numerous researchers, from diverse domains, have argued the educational benefit of diagrammatic presentations of information. For example, Barwise and Etchmedy strongly argue the benefit of visual presentations of information in teaching first order logic.[257] Cheng argues the benefit of teaching physics with 'law encoding diagrams.'[258] In educational psychology, Novak has championed the benefit of visual presentations.[259]

The claimed benefits of diagrams for reasoning strongly suggest the use of diagrams to support sensemaking in law.[260] Regarding argument as an

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[255] For a brief but interesting history of the development of the tube maps, see: London Transport Museum, 'Mapping the way' (1994) Information Sheet, 14, 1 1994; London Transport Museum, 'Decorative maps' (1997) Information Sheet, 20, 1997.

[256] de Bono, E., Atlas of Management Thinking (1983) Penguin Books.

[257] They have developed 'HyperProof' to demonstrate this: Barwise, J., Etchemendy, J., Hyperproof (1995) CSLI Publications.

[258] Cheng, P.C.-H., `Problem solving and learning with diagrammatic representations in physics' p. 47, in Peterson, D. (Ed) Forms of Representation (1996) Intellect Books.

[259] Novak, J.D., 'Concept Mapping: A Useful Tool for Science Education' (1990) 27 Journal of Research in Science Teaching 937. Methods for visualisation in teaching and learning are generally explored in the educational literature under the title of 'Graphic Organizers.'

[260] Note visualisation plays an increasingly important role in the presentation of evidence during trials. This trend is interesting for the general emphasis it places on the importance of the visual presentation of information. This trend is however, only peripherally related to the work undertaken here and so will not be examined further.

important component of the process of legal sensemaking it would accordingly be easy to conclude that people are good at argument – that people are good at constructing arguments and at assessing arguments. After all, people appear to coherently manage day by day. However, research by Kuhn strongly suggests that this is not the case; Kuhn's research indicates that argument is a specific skill that must be learned.

In her research, Kuhn asked subjects about the causes of three social problems: what causes prisoners to return to crime after release; what causes children to fail at school; and what causes unemployment. She surveyed a cross-section of people in different age groups, with different educational levels and who were either expert or non-expert in the problems being examined. Kuhn concluded that across all age groups and education levels, and for both genders, people were not good at constructing arguments. People often did not manage to present evidence for their own arguments, did not contemplate alternative arguments and did not manage to rebut alternative arguments, neither if autonomously thought of nor if provided by the researchers. Notably, this was the same for subjects with expertise in a given area. Indeed, Kuhn concluded that:

> The performance of experts indicates that expertise with respect to a content area may expand the amount of knowledge that is available, but it does not necessarily enhance the forms of reasoning that are used. ... if anything, experience with respect to a topic may make it more difficult to recognize opposing views ...[261]

Notably, the only group that performed well in Kuhn's assessment of argumentative ability was the group of doctoral students that she tested. Kuhn hypothesised that this is because this group had much formal training in the construction and assessment of arguments. Kuhn's research thus supports the idea that the skills of argument are specific, learnt, skills – they are not necessarily absorbed from the general cultural background or other

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[261] Kuhn, D., The skills of argument (1991) Cambridge University Press, 262-3.

educational experience. That people can manage day by day without thorough skills of argument suggests, amongst other possibilities, either that argument is not that important an aspect of daily sensemaking or that only shallow skills are needed on a day to day basis. In law however, which is much more consciously argument oriented, it also suggests the possibility of improving argumentative skills.

In a series of experiments, Robinson and colleagues have investigated the influence on learning of the graphical presentation of arguments. They conclude that using matrix presentations of information, students learned more hierarchical and coordinate relations, and were more successful in applying that knowledge and in writing integrated essays, than students studying outlines or text alone.[262] In related experiments results have shown that readers who searched either graphical presentations or outlines found answers to fact questions more quickly than those who searched text, and students who searched graphic presentations found answers to comparison questions and pattern questions more quickly than those who searched either outlines or text.[263] The results of these studies demonstrate that the purely textual presentation of arguments was the least effective means for students to learn the structure of argumentative texts. Network presentations as well as matrix presentations were all more effective as means to present arguments than purely textual presentations. Research by Veerman reports similar results. Her

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[262] Robinson, D.H., Kiewra, K.A., 'Visual Argument - Graphic Organizers are superior to outlines in improving learning from text' (1995) 87(3) Journal of Educational Psychology 455; Robinson, D.H., Skinner, C.H., 'Why graphic organizers facilitate search processes: Fewer words or computationally efficient indexing?' (1996) 21 Contemporary Educational Psychology 166; Robinson, D.H., 'Graphic organizers as aids to text learning' (1998) 37(2) Reading Research and Instruction 85; Kiewra, K.A., Kauffman, D.F., Robinson, D.H., Dubois, N.F. and Staley, R.K., 'Supplementing floundering text with adjunct displays' (1999) 27 Instructional Science 373.

[263] Robinson and Skinner, ibid.

research indicates that graphical presentation encouraged argumentative exchange amongst students.[264]

Work by Carr and Hair conflicts however, on whether diagrams are beneficial in improving argument skills in law. Carr studied the effect of using computer-based diagramming tools on argumentation by second year law students.[265] Carr reports that the test group did not have better test scores than the control group.[266] In contrast however, Hair reports a similar experiment in which the test group did outperform the control group.[267] Without further data it would appear that benefits of diagramming legal arguments is inconclusive.

However, the experiments performed by Carr and Hair must be interpreted with caution. First, the experiments aimed to test whether diagramming arguments was useful for teaching argument skills. Moreover, the aim was to teach the abstract structure of argument, rather than argument about a particular area of law. This is very difficult where, as Carr observes of his test group, the students 'were already very good at legal argument.'[268] It is difficult to think of any method that would be good for teaching an abstract skill that is already well understood. These experiments thus leave largely uninvestigated the benefit of diagramming as part of a process of sensemaking. The experiments focus on teaching the process of argument rather than supporting

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[264] Veerman, A., 'Computer-supported Collaborative Learning Through Argumentation.' (2000) Ph.D. Dissertation, Universiteit Utrecht, The Netherlands.

[265] Carr, C.S., 'CSCA in Legal Education' (1999). Paper presented at workshop on Computer-Supported Collaborative Argumentation for Learning Communities, 1999, Stanford University. Available at http://d3e.open.ac.uk/cscl99/Carr/Carr-paper.html (accessed 6/3/2001).

[266] Ibid. section 5.

[267] Hair, D.C., 'Using the Interface to Improve Performance of Complex Cognitive Tasks' (1990) Technical Report CU-CS-490-90, Department of Computer Science, University of Colorado at Boulder, Discussion.

[268] Carr, above n. 265, Effectiveness.

the construction of pieces of argument as part of a process of sensemaking. Indeed, Carr reports that while diagramming did not improve the quality of argument produced, diagramming did improve the efficiency of argument production.[269] This suggests that argument diagramming may be useful in supporting sensemaking.

The second reason that these experiments examining legal argument diagramming must be interpreted with caution is that they used different representations of argument. As cognitive theories of diagrammatic reasoning indicate, the representation that is used guides, constrains and may even determine problem solving. Different representations would thus be expected to have different effects on reasoning.

It thus remains that much theory and evidence indicates that diagramming is beneficial for reasoning. How the diagramming of legal argument in support of legal sensemaking might be supported however, remains to be examined.

3.6 Discussion

The representations of law and the representations of legal reasoning embodied in computer systems that support legal knowledge work are extremely important. This chapter has reviewed several representations of law and legal reasoning that have been influential not only in legal theory, but also in attempts to create legal knowledge-based systems. These representations of law and legal reasoning were argued to gloss important aspects of legal problem solving. In contrast, this chapter presented a representation of law and a representation of legal reasoning as a process of sensemaking. Sensemaking involves building a picture of a problem and materials relevant to a problem. It involves the construction of a picture of the world as it was, as it currently is and as we would like it to be. It is about interpreting, applying, and

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[269] Ibid.

perhaps manipulating the law in order to achieve results. It is in this vein that reasoning with the law, and reasoning about the law, is a process of sensemaking. It is about using the law as a tool to make sense of the world but also using the world as a reference point from which to makes sense of the law. It thus involves an interaction between 'the law' and 'the world'. Viewing law as a process of sensemaking provides a useful basis from which to approach the construction of knowledge-based systems that augment legal work.[270]

Two processes were argued to be highly significant for sensemaking. First, argumentation is central to the construction of sense. We argue with ourselves when exploring our beliefs and views and when constructing explanations. Secondly, the visualisation of information can be highly beneficial for sensemaking. More specifically, visualisations of argument have been shown to be beneficial to reasoning. Together, these suggest that augmenting legal knowledge work could usefully be achieved by supporting the visualisation of argumentative processes of sensemaking. As Lipshitz calls for, this is an attempt to develop decision support systems compatible with human information processing and knowledge representation methods.[271]

In order to construct computer systems that support visual representations of argument however, it is necessary to know more about the structure of

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[270] In this respect it has not been argued that sensemaking is <u>the right</u> way of viewing law and legal reasoning - only that sensemaking is a useful perspective and a useful perspective from which to approach the construction of legal knowledge-based systems. Sensemaking is presented as a description of processes of legal reasoning. This says nothing about the usefulness of other representations of legal reasoning for other purposes. For example, if normative theory is felt appropriate, it is perfectly possible to accept that people engage in sensemaking and concurrently argue that 'such and such' a method is how they *should* proceed. Such considerations are however, beyond the scope of this work.

[271] Lipshitz, above n. 211, 131-4. In a similar vein, Weick raises the need for sense making support systems: Weick, above n. 179, 179.

argument. The following chapter examines theories of argument and examines methods developed to diagram the structure of argument.

4 Diagramming sensemaking

How can I know what I think until I see what I say?

E. M. Forster

4.1 Introduction

The previous chapter examined sensemaking as a perspective on legal reasoning. Theories of sensemaking were examined and the importance of argument as a component of sensemaking was emphasised. In particular, it was claimed that visualising the structure of argument would be beneficial for legal sensemaking. This chapter examines theories of argument and theories of argument diagramming. These theories are examined for the assistance they may provide in the support of legal sensemaking. This chapter attempts to apply argument diagramming in the analysis of a legal judgment. It concludes that while well-established methods of argument diagramming exist, unaided, these methods can only provide limited support for legal sensemaking. This is both because there is no consensus on how argument should be represented and more importantly, because legal sensemaking involves processes other than bare argument. In order to support sensemaking, supporting processes wider than argument will often be necessary. This chapter attempts to apply techniques for diagramming wider aspects of sensemaking in the analysis of a legal judgment. It is concluded that such diagramming methods are problematic. Methods for diagramming argument and other aspects of sensemaking are subject to *representational effect* which influences their usefulness.

Following this introduction, the next subsection examines logical approaches to argument analysis. This subsection reviews research examining logic-based approaches to argument analysis and which argue that such approaches to argument analysis are an inappropriate basis for a method to diagram arguments. Subsection three of this chapter examines theories of 'everyday' argument, which have been proposed as alternatives to logical approaches to argument analysis. Theories of everyday argument are particularly interesting because argument diagramming is an established analytical tool and relatively conventional diagramming methods exist. Subsection four of this chapter examines the influential Toulmin method of argument analysis and highlights several problems with this method. Subsection five examines the 'standard' method of argument diagramming. It is asserted that while theories of everyday argument can be useful for the analysis of argument and hence for the diagramming of sensemaking, they are limited as means to support sensemaking. It is claimed that although argument is an important aspect of sensemaking, argument is only one aspect of sensemaking and wider processes of sensemaking require diagramming support. Subsection seven of this chapter examines approaches to supporting such wider aspects of sensemaking and discusses the limitations of these approaches.

4.2 The logic of argument

Just as logic has heavily influenced both the study of legal reasoning in legal theory, and the study of reasoning and decision making in psychology, the study of argument has also been hugely influenced - indeed dominated - by what many current argumentation theorists call 'formal logic.' Just as deeply held views about the role of law in society can be traced back to Greek philosophy, so too can the study of argument – in particular to the work of Aristotle.[272]

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[272] According to van Eemeren *et al.*, the backgrounds of argumentation theory lie in Greek antiquity from where they evolved during beginning in the 6th and 5th centuries BC. van Eemeren *et al.* argue that at this time, the prevalent mythological picture of the world, under which nature and the social order of the city-state were regarded as a divinely ordained immutable order, began to change. Thinkers began to try to explain the existence of their environment - from the natural to the social order. Disagreements over the origin and state of the world and of people's place in the world all clamoured for acceptance - this

According to Aristotle, all new knowledge, insights and opinions, to the extent that they arise from rational thought, are based on existing knowledge, insights and opinions.[273] For Aristotle argument was the means of using what was already known to establish such new knowledge, insight and opinion. Aristotle regarded thinking and argument as amenable to systematic, scientific study, stating:

> As a start, we must say what this inquiry is about and to what subject it belongs; namely, that it is concerned with *apodeixis* [i.e. the way in which conclusions are to be established] and belongs to the science (*episteme*) of their establishment.[274]

For Aristotle, logic was the tool for this systematic and scientific study and consequently logical arguments led to certain and reliable knowledge.[275]

For Aristotle, the deductive syllogism provided the model for reliable arguments. A deductive syllogism consists of a major premise, a minor premise and a conclusion. The major premise is a general statement. The minor premise is a specific state of affairs. The conclusion is the result of combining the major premise and the minor premise. A standard example is:

All men are mortal	(major premise)
Socrates is a man	(minor premise)
Socrates is mortal	(conclusion)

lead to questions of what actually amounts to a good opinion and under what circumstances something could be said to be true: van Eemeren, F.H., Grootendorst, R., Henkemans, F.S., Blair, J.A., Johnson, R.H., Krabbe, E.C.W., Plantin, C., Walton, D.N., Willard, C.A., Woods, J. and Zarefsky, D., Fundamentals of Argumentation Theory: A Handbook of Historical Backgrounds and Contemporary Developments (1996) Lawrence Erlbaum Associates, 29-31.

273 Ibid. 31.

274 Quoted in: Toulmin, above n. 113, 2.

275 Although in his work Aristotle referred to this study as 'analytic' the term 'logic' has subsequently become widely used in replacement.

The movement is from the general to the specific and it is impossible for each premise to be true and the conclusion to be false.[276] As Walton states, an argument in this sense is a:

> group of propositions of which one, the conclusion, is claimed to be true on the basis of other propositions, the premises, that are asserted as providing grounds or reasons for accepting the conclusion.[277]

In this conception, argument is centrally concerned with ideas of truth and falsity, and validity and invalidity.[278]

The ability to sort arguments that are certain and reliable from those that are not certain and reliable has fascinated philosophers ever since. With such a powerful system, it would be possible to determine what are good and bad arguments, what are valid and invalid inferences, what amounts to a true or false conclusion and more broadly, perhaps, what it means to be rational.

However, while Aristotle viewed logic as merely one aspect of a study of argument, both the normative and descriptive study of argument have come to be dominated by this tradition with its conception of argument as a deductive system and the associated concern with validity and invalidity, truth and falsity.[279]

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[276] van Eemeren et al., above n. 272, 31. C.f.: Carroll, L., 'What the Tortoise said to Achilles' (1995) 104 Mind 691.

[277] Walton, D.N., Argument structure: a pragmatic theory (1996) University of Toronto Press, 5.

[278] As van Eemeren *et al* state:

> if an argument is valid in propositional logic it is impossible that its conclusion be false whereas its premises are true. ... this does not mean that the premises are required to be true. A valid argument may very well have false premises. Valid arguments that do have true premises are usually called "sound" .. (van Eemeren et al., above n. 272, 10)

[279] E.g.: van Eemeren et al., above n. 272, 51; Walton, ibid.; Govier, T., Problems in Argument Analysis and Evaluation (1987) Foris. Johnson states that while formal logic is concerned with truth, informal logic is concerned with argumentation: Johnson, R.H., 'The Relation between Formal and Informal Logic' (1999) 13 Argumentation 265. However, while

The deductive syllogism is a compact and powerful tool for analysis. It apparently provides a concise method for analysing arguments and a straightforward method for visualising the structure of arguments. Unfortunately, the deductive syllogism proves difficult to apply.

4.2.1 Enthymemes

Perhaps the major difficulty with the deductive syllogism is that the vast majority of commonly encountered arguments often do not 'fit' the required 'shape'.[280] The deductive syllogism relies on the existence of explicit statements to which the syllogistic template can be applied. However, in most commonly encountered arguments, the argument contains unexpressed premises. As an

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informal logic may be less concerned with establishing the truth of propositions and arguments, it is inaccurate to imply that formal logic is unconcerned with argumentation – much work has been conducted attempting to use formal logic to model argument, see e.g.: Pollock, J.L., 'How to reason defeasibly' (1992) 57 Artificial Intelligence 1 and works examined at 2.5.3.

[280] Four main problems are commonly cited in the application of formal logic to every-day argument: (1)arguments contain unexpressed elements; (2)arguments display argumentation structures; (3)arguments utilise argumentation schemes; and (4)some arguments are fallacies, e.g. van Eemeren et al., above n. 272, 12; Walton above n. 277. The study of argument structures investigates the various ways in which premises can combine to support a conclusion. Premises can mutually or independently support a conclusion. The syllogistic analysis of argument has not traditionally investigated such structures and this requires non-logical, pragmatic criteria: ibid. The study of argumentation schemes investigates the common principles which arguments often use to transfer acceptance from premise to conclusion: van Eemeren et al., above n. 272, 19. The study of fallacies is a traditional concern in logical approaches to the study of argument, however, many argumentation theorists argue that a full treatment of arguments that have traditionally been regarded as fallacious cannot be based solely on formal methods and require pragmatic assessment criteria. Problems with syllogistic logic will only be examined from the existence of unexpressed premises as this is sufficient to highlight the need for a

example van Eemeren *et al.* cite the argument 'Amos is a teacher, so Amos is pig-headed' which might be analysed as:

Amos is a teacher

Amos is pig-headed[281]

This clearly lacks one of the premises that constitute deductive syllogisms. According to Van Eemeren *et al.*, the argument can be read as missing the premise 'Teachers are pig-headed'. This would give the deductive syllogism:

Teachers are pig-headed

Amos is a teacher

Amos is pig-headed[282]

Just as arguments may leave either the major or minor premise implicit, the conclusions may also be implicit.[283]

All such missing statements are called 'enthymemes'.[284] *Prima facie,* the existence of an enthymeme in an argument means that a deductive syllogism is not present and that the rules for manipulating deductive syllogisms are not applicable. In order to apply the rules governing deductive syllogisms, some method is necessary to 'find' enthymemes. Identification of enthymemes may be straightforward in some circumstances. However, in other situations, the identification of enthymemes can be problematic - often there are multiple possibilities. For example, in the argument:

Fred is a lawyer

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wider scope of examination. The remaining three issues will not be explicitly discussed here, though issues relevant to these topics arise throughout this work.

281 van Eemeren et al., above n. 272, 14.

282 Ibid.

283 Ibid. 16. Although van Eemeren et al. argue that such implicit conclusions are easier to identify.

284 Note that as conceived by, Aristotle an 'enthymeme' was simply a premise in an argument which was not completely reliable. However, the term has come instead to refer to any unstated, implicit, statements that might be read into an argument. It is in this latter sense that the term is used here.

Fred makes lots of money

What is the missing premise? Is it that anyone who is a lawyer makes lots of money? Is it that professionals make lots of money? Or might it be that Fred is a conscientious worker? Without further information each of these possibilities, and others, are possible candidates.[285] Identifying enthymemes thus requires non-logical pragmatic-criteria.[286]

However, the need to clarify arguments by inserting statements reduces the benefit of the deductive syllogism. The claimed benefit of the deductive syllogism is that it can sort valid argument from non-valid arguments, truth

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[285] This is a particular concern in the law, in particular for the interpretation of precedents. Precedents are often said to contain an authoritative *ratio* that expresses the rule in the case. However, as jurists question, how do you determine exactly what the *ratio decidendi* of a case contains? Indeed jurists such as Stone have argued that the *ratio* can be regarded as standing for as many different things as there are combinations of distinct propositions in a case: Stone, above n. 42.

[286] Argumentation theorists have adopted various approaches. At one extreme, theorists suggest that enthymemes should be read with the statement which makes the argument the strongest it could possibly be. This would suggest a rule linking premise and conclusion. Against this it is often argued that making the argument as strong as is possible is ungenerous in that it too greatly ignores the original argument. Rather, arguments should be left as they are and left to stand or fall with their enthymematic gaps. This certainly does justice to the original argument, although in some circumstances it can be harsh to assess an argument based on obvious and easily filled omissions. There is no solid solution to this interpretive problem and as such, the principle of 'moderate charity adopted by Govier seems reasonable:

> Moderate charity directs us not to interpret others as having made implausible claims or faulty inferences unless there is good empirical reason to do so. Empirical reason is provided in the first instance by the wording of the discourse and also by the context in which the discourse appears and background knowledge pertaining to the arguer. (Govier, above n. 279, 152)

She continues:

> When relevant empirical evidence does not determine one or other interpretation and when moderate charity is indicated, we adopt that interpretation according to which the claims made are most plausible and the inferences most reasonable. (Ibid.)

from falsity. However, it is possible to insert a premise to make any argument deductively valid.[287] When every argument can be made deductively valid though, the ability is necessarily lost to sort good arguments from bad arguments, valid arguments from invalid arguments. Moreover, even when each premise is explicit, as will be discussed in more detail shortly, the link between the major premise, minor premise and conclusion itself needs support.[288] This further undermines the ability to sort valid arguments from invalid arguments.

Aristotle was aware of difficulties in applying the deductive syllogism, stating that precision should not be sought from where it is not available.[289] In addition to the deductive syllogism, Aristotle also studied dialectic and rhetoric - where arguments did not lead to valid conclusions.[290] However, it is the deductive syllogism that has dominated theories of argument.[291]

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[287] Govier, above n. 279, 25.

[288] Carroll has provided an amusing, though serious, example of this: Carroll, above n. 276.

[289] Aristotle, Rhetoric, translated by J. H. Freese (1926) Heinemann.

[290] According to Aristotle, while deductive arguments prove their conclusions, the premises of dialectical arguments are only generally accepted (or accepted by the 'wise') and because the premises are only generally accepted, the conclusions are also only generally accepted: van Eemeren et al., above n. 272, 32. In contrast to logic and dialectic, as conceived by Aristotle rhetoric was concerned with how to best convince an audience. The sole concern of rhetoric was methods by which an orator could move the audience to accept the orator's conclusion. Hence, the premises would have to be chosen to best convince the audience. According to van Eemeren, the audience must accept the move from premises to conclusion and whether the reasoning is valid by demonstrative or dialectical criteria was not relevant: ibid. For Aristotle, the notion of 'rhetoric' and 'rhetorical argument' did not have the pejorative overtones that the terms have come to be burdened with.

[291] van Eemeren et al. trace the study of argumentation subsequent to Aristotle, in its Roman and Renaissance forms, and argue that it has largely involved ever more detailed cataloguing within Aristotle's framework: van Eemeren et al., above n. 272, 45-50.

4.3 Everyday arguments

Concerns over the utility of the syllogism for analysing arguments has led to the rise of 'informal logic.' Informal logic has been characterised as a practical subject:

> whose task is to develop non-formal standards, criteria, procedures for the analysis, interpretation, evaluation, criticism and construction of argumentation in everyday discourse.[292]

This conception has proved attractive and as well as research into the academic uses of informal logic, has been embraced in instructional courses on 'critical thinking'.[293]

There is some controversy over the applicability of the term 'informal logic' itself.[294] Critics argue that by definition, a 'logic' is a well-defined system for drawing inferences and as such the label 'informal logic' is nonsensical. To avoid entering into this debate, the term 'informal logic' will be avoided here and instead the assessment of 'everyday' argument will be discussed.[295]

In deductive arguments a true conclusion is the goal. It is the truth of the premises that is transferred to the conclusion. However, if it cannot be shown that an argument is deductive – either because the argument is enthymematic or because the premises do not conform to the required form - then the premises must exist in some relation to the conclusion other than that of

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[292] Johnson, above n. 279, 270.

[293] The appeal of the study of informal logic is indicated by two primary journals devoted to the subject, *Informal Logic* and *Argumentation*, and two societies, the *Association for Informal Logic and Critical Thinking* and the *International Society for the Study of Arugmentation*,

[294] Johnson notes several authors sceptical that informal logic exists: Johnson, above n. 279, 265.

[295] Reclaiming the term 'logic' for wider use is of peripheral concern. If the assessment of everyday arguments is informative then it is worthwhile regardless of whether it is strictly logical in the sense of confirming to defined and specified rules.

transferring truth. Once it is accepted that everyday arguments do not conform to the deductive model, the question arises as to what relationship exists between an argument's conclusion and its premises. In investigating this question, argumentation theorists have revived Aristotle's concern with dialectic and rhetoric. Following Aristotle, and more recently Perelman and Olbrechts-Tyteca,[296] argumentation theorists argue that it is the audience's acceptance that is transferred from the premises to the conclusion. According to van Eemeren:

> It should not be taken for granted that anyone who puts forward an argument is automatically involved in an attempt to logically derive the conclusion from the premises. Yet, in some way or other, a transfer of acceptance from the explicit premise to the standpoint must be aimed at.[297]

Through the presentation of acceptable premises, an arguer seeks to move an audience to accept what would otherwise be a controversial conclusion. The investigation of everyday argument is thus concerned with ways in which conviction is transferred from premises to conclusion during argument.

Reconceiving the goal of argument requires reconceiving what constitutes an argument. In contrast to the view of argument as a series of premises that prove a conclusion, van Eemeren *et al.* define argument as:

> a verbal and social activity of reason aimed at increasing (or decreasing) the acceptability of a controversial standpoint of the listener or reader, by putting forward a constellation of propositions intended to justify (or refute) the standpoint before a rational judge.[298]

This is a much wider conception of argument than the deductive syllogism allows. This conception of argument is not directly concerned with truth and

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[296] Perelman, C., Olbrechts-Tyteca, L., The New Rhetoric: A Treatise on Argumentation (1969) University of Notre Dame Press.

[297] van Eemeren et al., above n 272, 19.

[298] Ibid. 5.

falsity and it is inherently social, involving at least two parties and a rational judge. The terms 'argument' and 'argumentation' mask an ambiguity that has previously been glossed over - both terms are commonly used to refer both to the process of arguing and also to the product resulting from that process.[299] Formal logic is solely concerned with the product, i.e. whether a conclusion can be validly derived from a given set of premises.[300] In contrast, the study of everyday argument is also concerned with the process of argument. Instead of viewing argument from the standpoint of formal logic, van Eemeren *et al.'s* explicitly dialectical view of argument inevitably involves consideration of the audience, and the manner of convincing that audience.

Numerous studies of everyday argument exist.[301] It is not the aim here to review or critically discuss these. The focus of this discussion is the diagramming of arguments; as such this examination concentrates on techniques for diagramming arguments developed in argumentation theory.

4.4 Toulmin's analysis of arguments

Toulmin was amongst the first and one of the most influential theorists to question the possibility of having a science of syllogistic logic that is also applicable to everyday arguments. Toulmin asserted that, except for very limited types of argument, the syllogism disguises important steps of reasoning. Most importantly according to Toulmin, the syllogism conceals that the application and relevance of the major premise to the minor premise is a reasoning step that itself needs justification. According to Toulmin, recognising this leads to the ability to freshly and more realistically, reassess notions such as

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[299] Ibid.

[300] Ibid. 6.

[301] E.g.: Govier, above n. 279; van Eemeren et al., above n. 272; Walton, above n. 277; Freeman, J.B., Dialectics and the macrostructure of arguments: a theory of argument structure (1991) Foris Publications; Snoeck Henkemans, F., Analysing Complex Argumentation (2nd edition) (1997) SICSAT.

'reasonableness', 'logically', 'probability', 'improbability', and 'necessity'. More importantly for present purposes, Toulmin argued that recognising this would lead to the better understanding and communication of arguments.

Toulmin argued that syllogistic logic is wholly inapplicable to 'practical' reasoning, of which legal reasoning is a type, and was concerned to both make arguments more comprehensible and to provide a new logic for arguments.[302] Toulmin proposed an alternative structure to the syllogism for examining the arguments that constitute everyday reasoning. The claim that syllogistic and formal logics are wholly inapplicable to everyday reasoning might be regarded with some scepticism and Toulmin's proposal for a new logic, to which all arguments must conform, has not received wide support. However, Toulmin's rejection of the syllogism and his use of diagrams to illustrate his own arguments, have proved highly influential.[303]

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[302] Toulmin, S., The Uses of Argument (1964) Cambridge University Press, 149-169.

[303] Citation analysis indicates a wealth of citation to Toulmin's work. The model has been widely adopted in argument oriented computer applications, e.g.: Dick, J.P., 'Representation of legal text for conceptual retrieval' p. 244, in The Third International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1991) ACM Press; Stranieri, A., Zeleznikow, J., Gawler, M. and Lewis, B., 'A hybrid rule - neural approach for the automation of legal reasoning in the discretionary domain of family law in Australia' (1999) 7 Artificial Intelligence and Law 153; Bench-Capon, T.J.M., Staniford, G., 'PLAID-Proactive Legal Assistance' p. 81, in The Fifth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1995) ACM Press; Marshall, C.C., Halasz, F.G., Rogers, R.A. and Janssen, W.C., 'Aquanet: A hypertext tool to hold your knowledge in place' in Proceedings of Hypertext '91 Conference (1991) ACM Press, Loui, R.P., Norman, J., Altepeter, J., Pinkard, D., Craven, D., Lindsay, J. and Foltz, M., 'Progress on Room 5: A Testbed For Public Interactive Semi-Formal Legal Argumentation' p. 207, in The Sixth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1997) ACM Press; Freeman, K., Farley, A.M., 'A Model of Argumentation and Its Application to Legal Reasoning' (1996) 4 Artificial Intelligence and Law 163; further systems are mentioned in the remainder of this work.

According to Toulmin, in every argument there is 'Data' which acts as the foundation for the 'Claim' that it is sought to establish.[304]

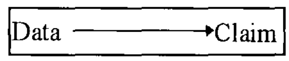

Figure 2: Toulmin's Data and Claim

One of Toulmin's criticisms of the syllogism was that even accepting a major premise and a minor premise, it is unclear how the two are connected and how the two premises necessarily lead to the conclusion. Toulmin argued that it is easy to skip a step in inference. Thus, Toulmin argued that the movement from the Data to the Claim is itself always a step that must be supported. According to Toulmin, a 'Warrant' provides the support for this move. The Warrant acts as a general hypothetical statement 'bridging' the move from Data to Claim and supporting movement from one to the other.[305]

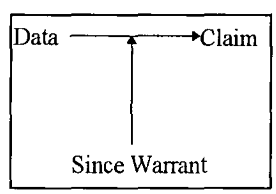

Figure 3: Toulmin's Warrant

However, according to Toulmin, Warrants themselves need support. Toulmin argued that the Warrant, supporting the move from the Data to the Claim, can itself be controversial, i.e. not universally accepted. Consequently, Toulmin argued that the Warrant required 'Backing', such Backing providing the authoritative status of the Warrant.[306]

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[304] Toulmin, above n. 302, 97.

[305] Ibid. 98.

[306] Ibid. 103.

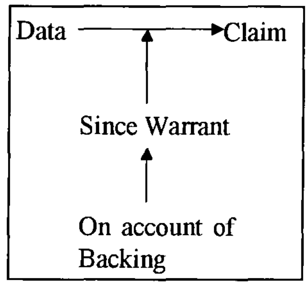

Figure 4: Backing in arguments

Finally, according to Toulmin the Data only supports a Claim to some limited degree. Hence the claim must be 'Qualified'. Similarly, Toulmin argued that the Data will not support a Claim in all circumstances - there are circumstances in which the Claim can be 'Rebutted'.[307]

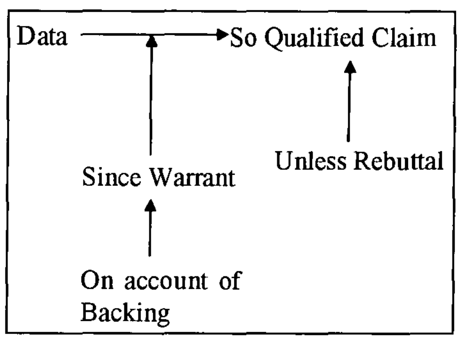

Figure 5: The complete Toulmin model

According to Toulmin, all arguments (including syllogisms) follow this basic structure, regardless of whether or not such structure is made fully explicit.[308]

Toulmin was heavily influenced by jurisprudential models of argument (as still are many argumentation theorists). Toulmin's model thus apparently provides a good basis for diagramming legal argument and indeed Toulmin provided a legal example to support his theory of argument structure. Thus, the argument 'Harry was born in Bermuda so Harry is a British subject' has the following underlying structure:

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[307] Ibid. 101.

[308] Ibid. 109-111.

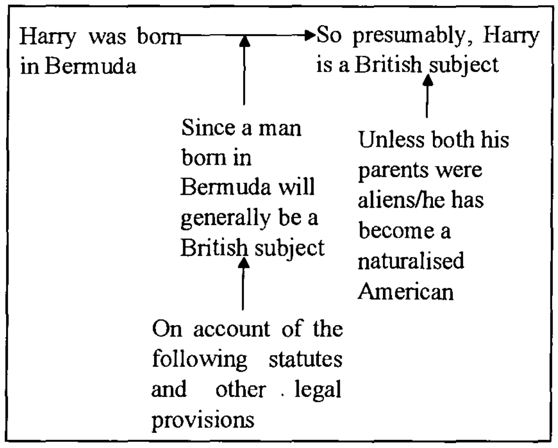

Figure 6: An example argument in Toulmin's model[309]

To reiterate, according to Toulmin the importance of using this structure for examining everyday arguments stems from it facilitating a quicker and clearer understanding of arguments.[310] This structure highlights that informal logic is concerned with the 'appraisal' of arguments on their 'merits' and that telling sound arguments from untrustworthy ones requires experience, insight and judgment.[311] Toulmin argued that trying to cast everyday arguments within a syllogistic form hinders their appraisal and hinders acceptance of the need to assess arguments on their merits.

4.4.1 Problems with Toulmin

Given Toulmin's radical proposals concerning the structure of argument, it is unsurprising that they have been subject to much criticism.

One of the striking aspects of Toulmin's model is the requirement that the move from Data to Claim be warranted. Toulmin provided forceful arguments supporting the need for a Warrant and indeed justification of the move from claim to conclusion has become a central concern of argument theory.

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[309] Ibid. 105

[310] Ibid. 149-169.

[311] Ibid. 187-8.

However, Toulmin's treatment of Warrants is inconsistent – for just as the assertion that Data supports a Claim may need support, so the assertion that a Warrant justifies such a move may itself need support. While Data may give support to a Claim, as van Eemeren *et al.* note:

> There is absolutely no reason, however, why the same should not apply to the warrant. If a warrant is not immediately accepted as authoritative, then an attempt must be made to remove the objections by means of a new argumentation in which the warrant from the first argumentation serves as the claim.[312]

If a warrant is the subject of argument, this must be viewed in the Toulmin model as a separate preliminary argument.[313] Moreover, the particular Warrant provided may not be accepted and so itself need support. There is no reason to assume that a Warrant will immediately be accepted as authoritative. While Toulmin would supply support with Backing, why the move from Backing to Warrant should be accepted, or why the particular Backing supplied should be accepted, may in turn need support.

Similarly, why a Rebuttal should be regarded as detracting from a Claim or why a particular Rebuttal should be regarded as authoritative may itself need clarification. There seems little reason to attach an unsupported statement of rebuttal directly to the claim and not allow the reasoning behind the rebuttal to itself be a fully expressed argument. Nor does the model allow rebuttal of Claims, Warrants or Backing. In a modification of the original model researchers who have attempted to analyse everyday arguments with the model often allow Warrants to be the subject of argument, and sometimes allow argument about Rebuttals. If modified, Toulmin's model can be used to diagram arguments about Warrants, Backing and Rebuttals. However, as originally presented, Toulmin's model is restrictively asymmetrical.

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[312] van Eemeren, above n. 272, 158.

[313] Ibid. 158.

Argumentation theorists and several authors who attempt to apply it have noted these inconsistencies in Toulmin's model.[314] However, once the need for such modification is accepted, there appears much less reason to separate Warrants, Backing and Rebuttals as privileged aspects of argument. According to Toulmin, Warrants are general hypothetical statements authorising the movement from Data to Claim. However, theorists argue that what authorises such moves is often not such a bare, individual general statement. Rather, authorisation of the move from premise to conclusion may itself result from a chain of preliminary argument. Similarly, Toulmin envisages the Backing for Warrants as a bald authoritative source supporting the Warrant; however there seems little reason to limit Backing in this way. Warrants might themselves be backed by preliminary arguments. Thus, rather than being able to distinctly separate Data, Claims, Warrants and Backing, what amounts to these things will depend on the role they play in the overall argument. The conclusion of one argument might thus be called a Warrant if it is subsequently used to authorise the movement from Data to a Claim. Data might be called Backing if it is used to support a Claim that is then used as a Warrant.

Researchers' claims that it is extremely difficult to distinguish between Warrant and Backing when applying the model reflect these problems with Toulmin's model.[315] In part this stems from Toulmin's restrictive notions of Backing and

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[314] E.g.: Govier, above n. 279, 18; Gasper, D.R., George, R.V., 'Analyzing argumentation in planning and public policy: assessing, improving, and transcending the Toulmin model' (1998) 25(3) Environment and Planning B - Planning and Design 367, 381; Newman, S., Marshall, C., 'Pushing Toulmin too far: Learning from an argument representation scheme' (1991) Technical Report SSL-92-45: Xerox Palo Alto Research Centre, Palo Alto, California.

[315] E.g.: Newman and Marshall ibid.; Gasper and George ibid. 381; Fulkerson, R., 'The Toulmin Model of Argument and the Teaching of Composition' p. 45, in Emmel, B., Resch, P., and Tenney, D. (eds.) Argument Revisited; Argument Redefined: Negotiating Meaning in the Composition Classroom (1996) Sage Publications.

Warrant.[316] In addition to limiting Warrants to general hypothetical statements and Backing to authoritative sources for such statements, Toulmin argued that Backings and Warrants must come from the same 'field.' A fundamental problem is determining what counts as a field in the first place.[317] Toulmin was extremely vague about this.[318] Although it has been suggested that law and science, for example, would each constitute a different field,[319] a precise separation remains elusive. Equally problematic, arguments where Backing from one field is used to supplement a Warrant from a putatively different field appear common e.g. supplementing a warrant that smoking is bad for the health using a moral argument as backing.[320].

After attempting to represent numerous legal arguments using Toulmin's scheme, Newman and Marshall highlight several limitations with the scheme: Data must be extended to cover things more general than facts; how multiple facts leading to the same generalization should be represented is unclear; Claims were often not backed by a single statement but rather several operating together; Warrants and Backings are often implicit and grounded in common sense. [321]

These problems with Toulmin's model directly hint at another more general problem. As van Eemeren *et al.* question:

> Is the model really, as Toulmin claims, a model of the structure of argumentation on the micro-level? If this is to mean that it refers to the smallest unit of argumentation, then we think that this is not the case. By

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[316] Indeed van Eemeren et al. ague that Toulmin provides inconsistent and sometimes conflicting characterisations of Warrant and Backing: van Eemeren et al., above n. 272, 155-159.

[317] Govier, above n. 279, 17; van Eemeren et al., above n. 272, 155.

[318] Toulmin, above n. 302, 14-5.

[319] Johnson quoted in Govier, above n. 279, 17.

[320] Ibid. 17.

[321] Newman and Marshall, above n. 314, 14-25.

including a backing, Toulmin turned his model from a model of single argumentation into a model of complex argumentation.[322]

Similar observations apply to the inclusion of Rebuttals. Rebuttal naturally appears to fall within the dialogical aspects of argument. Rebuttals are proposed by an opposing party or by an arguer playing 'devils advocate' and anticipating responses to his or her own argument. In a model that attempts to capture the most 'basic' structure of argument - argument in its simplest possible form - it thus seems more justifiable to omit rebuttals from the basic argument structure. Rebuttal can be reintroduced at a latter stage in investigating the dialogical aspects of argument.

Given these criticisms, the model as originally presented by Toulmin is often not adopted. Toulmin's original conception of Warrant, Backing and Rebuttal appear overly complicated and unnecessary. However, Toulmin's emphasis on the non-deductive nature of everyday arguments and the need to support the inference from data to claim and the use of diagrams to illustrate his ideas are both important

4.5 The standard method of argument diagramming

Although Toulmin's method of argument analysis has not caught on, argument diagramming itself is a standard technique in argumentation theory.[323] Although disagreements about argument diagramming remain,[324] the basic elements are sufficiently settled as to be called the 'standard method' of argument diagramming.[325]

In the standard method of argument diagramming, a characteristic distinction is the particular aspect of argument focused on. Broadly, arguments can be

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[322] van Eemeren et al., above n. 272, 158.

[323] This can be traced to Toulmin and Beardsley: ibid. 175.

[324] E.g. how to diagram modalities and rebuttals: Freeman, above n. 301.

examined from a 'macro' and/or a 'micro' perspective. The analysis of argument on the micro level focuses on the relation between an individual premise and a claim. In addition to this microstructure, the standard method is also concerned with the macrostructure of argument - the ways in which recurring patterns are often observed in the relation between groups of premises and conclusions. Argumentation theorists argue that arguments display common macrostructures which play an important role in argumentation.

4.5.1 Microstructure

In contrast to Toulmin structures, the standard method of argument diagramming analyses the basic structure of all argument in terms of movement from the single premise to the single conclusion.[326]

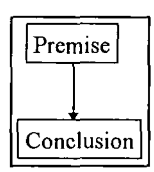

Figure 7: The microstructure of argument

While the terminology often differs, argumentation theorists almost universally adopt this structure.[327]

The simplicity of this structure contrasts with Toulmin's five-part model. No explicit distinction is drawn here between Premise and Conclusion and no distinctive Warrant or Backing are hypothesised. Each is simply treated as part of basic argument. Toulmin's concern with the need to justify the move from Premise to Claim can be accommodated using multiple basic arguments 'chained' together to form structures that are more complex.

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[325] Walton, above n. 277, 84; Freeman, above n. 301, 1.

[326] Walton, above n. 277, 84.

[327] E.g. compare premise/conclusion, premise/claim, premise/standpoint, data/claim, claim/conclusion: van Eemeren et al., above n. 272, 16.

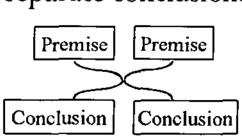
4.5.2 Macrostructure

The various ways in which basic arguments can be chained together to form larger arguments is called the macrostructure of arguments. Again the terminology used to describe the structures differs, however, the argument structures themselves remain largely the same.[328]

Within the standard method, the single premise and single conclusion is called a 'Single Argument'.[329] This is the simplest type of argument. As an example, Walton provides the argument:

> Webb was promoted to vice-president.
>
> Therefore, she will move to Pittsburgh.[330]

[328] The divergence in terminology is partly due to the history of argument diagramming: van Eemeren et al., above n. 272, 175; Walton, above n. 277, 126. The terminology used by Walton is adopted here. Different theorists occasionally argue for the existence of further standard structures. For example, Walton argues that two premises can combine to support separate conclusions.



Walton does not give a specific name to this argument structure but argues that it occurs when a linked argument (see below) combines with a divergent argument (see below). As discussed in detail throughout the remainder of this work, choosing the structures with which to represent arguments is a matter of choosing a representation for argument. Representations may be more or less appropriate, more or less useful in specific contexts. These structures may be more or less appropriate depending on the context of use. Hence, they will not be discussed in detail here.

[329] Walton, above n. 277, 85.

[330] Ibid. 84.

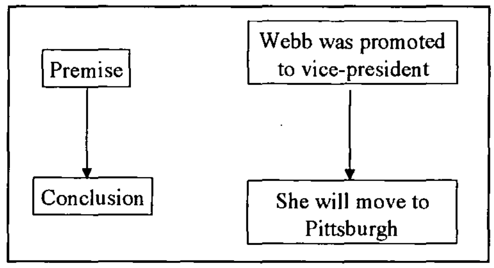


Figure 8: 'Single' argument

In a 'Serial Argument', the conclusion of one argument forms the premise in a subsequent argument.[331] Walton provides the following example:

> The room was sealed, and empty when we entered.
>
> Therefore no one could have left it. And therefore, the murderer was never in the room.[332]

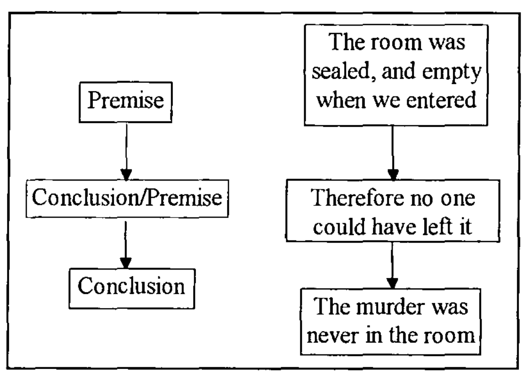


Figure 9: 'Serial' argument

A 'Linked Argument' involves two or more premises and one conclusion. In a linked argument, 'the premises function together to give support to the conclusion.'[333] While each premise supports the conclusion, none of the premises supports the conclusion independently.[334] Walton provides the following example:

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[331] Ibid. 89.

[332] Ibid. 89 adopted from Beardsley

[333] Ibid. 85.

[334] Ibid. 86.

> Competent individuals are at liberty to make their own medical treatment decisions; incompetent individuals are not. Thus competence and liberty are inextricably interwoven.[335]

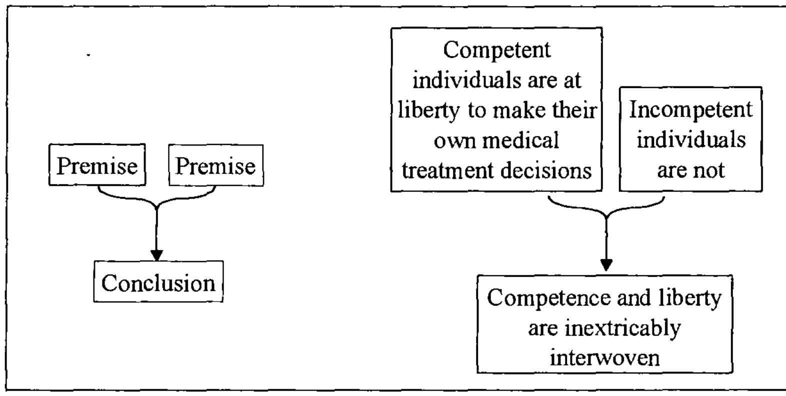

Figure 10: 'Linked' argument

Walton argues that many deductively valid arguments, are linked arguments e.g.:

> If Sally has agreed to run, Jane will not be elected.
>
> Sally has agreed to run.
>
> Therefore, Jane will not be elected.[336]

In contrast to the above linked arguments where premises join together to support a conclusion, in a 'Convergent Argument' there is more than one premise and each premise provides independent support for the conclusion.[337] As an example, Walton cites:

> I've opposed the death penalty all of my life. I don't see any evidence that it's a deterrent and I think there are better and more effective ways to deal with violent crime.[338]

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[335] Ibid.

[336] Ibid. 87.

[337] Ibid.

[338] Ibid. 88.

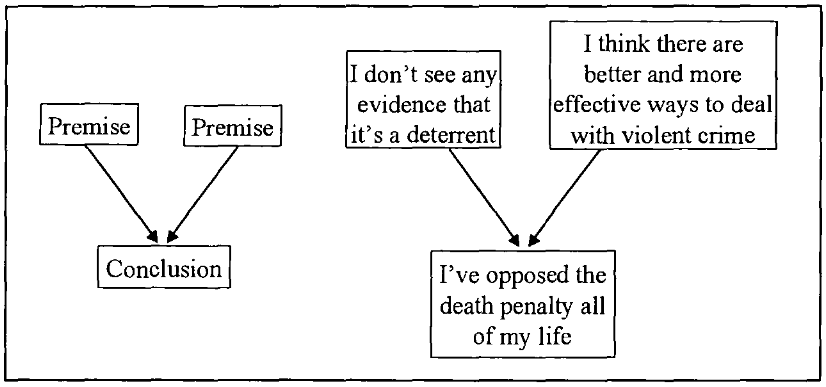

Figure 11: 'Convergent' argument

Finally, in a 'Divergent Argument' one premise supports multiple conclusions.[339]

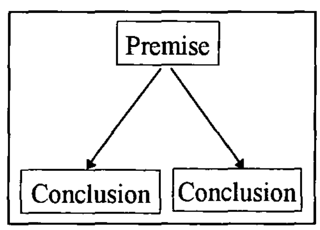

Figure 12: 'Divergent' argument

However, while these argument structures are widely used, theorists can and do differ greatly as to when one particular argument structure is applicable rather than another. For example, whether a particular argument is an example of a linked argument or an example of a convergent argument. Theorists apply a multitude of tests in attempts to determine when an argument is linked or when an argument is convergent.[340] Such issues of interpretation however,

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339 Ibid. 91.

340 Walton identifies five main tests:

Falsity/No Support Test: If one premise is false, the conclusion is not given any support.

Suspension/Insufficient Proof Test: If one premise is suspended (not proved, not known to be true), the conclusion is not given enough support to prove it.

Falsity/Insufficient Proof Test: If on premise is false, the conclusion is not given enough support to prove it.

simply highlight the degree to which the analysis of everyday arguments is an interpretive process. This is not problematic for the technique of argument diagramming, which is neutral with respect to interpretation decision that happen to be made.

The wide acceptance within argument theory of the standard method of argument diagramming suggests that the method would be the ideal basis on which to construct systems to aid legal sensemaking.

4.6 Problems with the standard method of argument diagramming

As a means to support legal sensemaking there are several problems with the standard method of argument diagramming. These problems relate to the ability of the method to represent argument and more generally the suitability of the method to support sensemaking.

Suspension/No support Test: If one premise is suspended (not proved, not known to be true), the conclusion is not given any support.

Degree of support test: What degree of support does each premise give to the conclusion? If the degree of support provided to the conclusion is significantly greater than each individual premise alone, then the argument is linked. Otherwise it is convergent. (Ibid. 119-20.)

Walton prefers the 'Degree of support' test; ibid. 181-2. The use of a particular test is a matter for discussion and argument within a group that is analysing an argument. As such it is peripheral to the current concern of diagramming argument structures. However, Walton indicates the interpretation of whether an argument is itself linked or convergent is an aspect of argument that can itself be diagrammed. By diagramming these interpretive choices, the method of diagramming would itself aid in the clarification and resolution of problems. As Walton states:

> Better, we think, as a policy for analysis of arguments, to admit that you don't really know what the non-explicit premise (or conclusion) is, in those cases where the textual evidence is incomplete. Even better, in cases where two argument diagrams are both possible, based on two different interpretation of the text of discourse, the evidence for both reconstructions should be laid out. (Ibid. 253.)

A commonly stated problem with diagramming is that a great deal of interpretation may be needed to diagram an argument in order to determine what structures to use. For example, whether to choose a 'linked' or 'convergent' structure. However, while it is correct that interpretation is needed to choose amongst structures, as previously discussed in the context of enthymemes, a lot of interpretation is needed in deciphering arguments generally. Interpretation is not a problem peculiar to the diagramming of arguments. If a reader or listener interprets an argument, that person has to decide whether the argument is linked or convergent. The fact that they choose to express their interpretation in terms of an argument diagram is irrelevant. For example, if a reader had chosen, instead of diagramming their decision, to write 'This is a linked argument' or 'This is a convergent argument' the same objections should be made. This writing also 'masks' a lot of interpretation of the argument. Therefore, unless all choices are subject to this criticism, in which case the analysis and evaluation of arguments is impossible, it must be conceded that diagramming in itself is not at fault. When it is chosen to diagram a structure it is the interpretative decision that can be questioned, not the decision to diagram the decision as such.

A more cogent argument is perhaps that diagramming arguments somehow 'fixes' the interpretation in a reader's mind and so makes it less likely that they will reinterpret an argument once diagrammed. This is possible. On the other hand however, if an interpretation that is known to be contentious is flagged in the diagram as such, this concern might be mitigated. Indeed, if multiple interpretations are explicitly diagrammed this might alleviate the possibility of fixation and indeed contrary to the concern expressed, possibly keep alternative interpretations open for longer. In any event, it is not immediately obvious that diagramming argument structure 'locks' interpretation of that structure. This is open to and in need of investigation. Hence, that argument diagramming involves the interpretation of arguments is not itself a detraction from the method.

More problematic is that *prima facie* the standard method of argument diagramming does not cover certain types of arguments. For example, it is not immediately apparent how analogies should be diagrammed. Standard texts commonly do not cover analogical argument.[341] As widely noted, analogical reasoning is common in everyday reasoning, in scientific reasoning and in legal reasoning. A method for diagramming analogies thus appears essential for any system that seeks to allow the easy diagramming of everyday argument and legal argument.

The diagramming of analogies has however, occasionally been investigated. For example, Newman and Marshall suggest three possibilities for diagramming analogies. Although Newman and Marshall's suggestions were made in relation to the use of Toulmin structures, these suggestions are equally helpful when examining the standard method. These suggestions are shown below in generic form and as applied by Newman and Marshall in attempting to diagram an example from US law relating to the right of police officers to search property without a warrant:

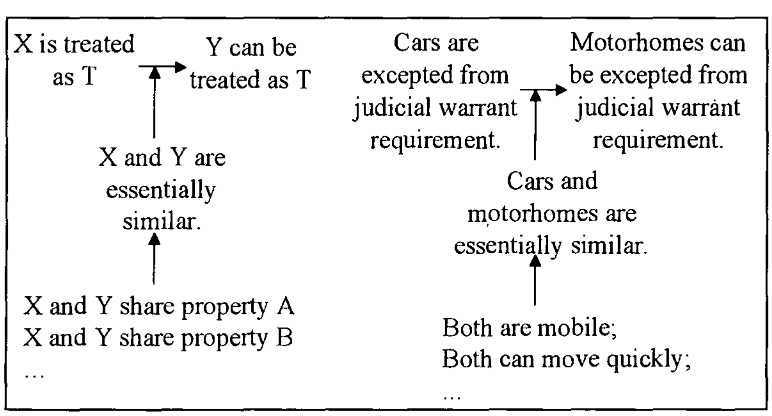

Figure 13: Diagramming analogies, possibility 1[342]

This method asserts that because X is treated in a particular way, Y can be treated in the same way – based on X and Y being similar on the specified

[341] For example, Walton does not provide a single mention analogies in his work on argument and argument diagramming.

[342] Adapted from: Newman and Marshall, above n. 314, 30.

grounds. This method explicitly highlights the similarity between situations and explicitly expands these similarities.

The second method is more complex and highlights the argument supporting the conclusion in each of the situations said to be analogous.

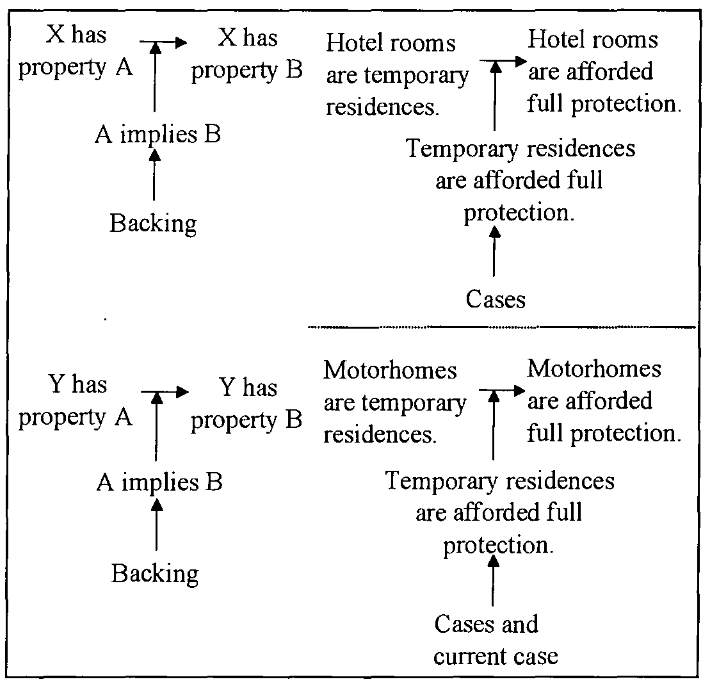

Figure 14: Diagramming analogies, possibility 2[343]

With this method, the similarity between situations is not made as evident.

The third possibility for diagramming analogies is based on classification decisions which are often said to underlie analogies.

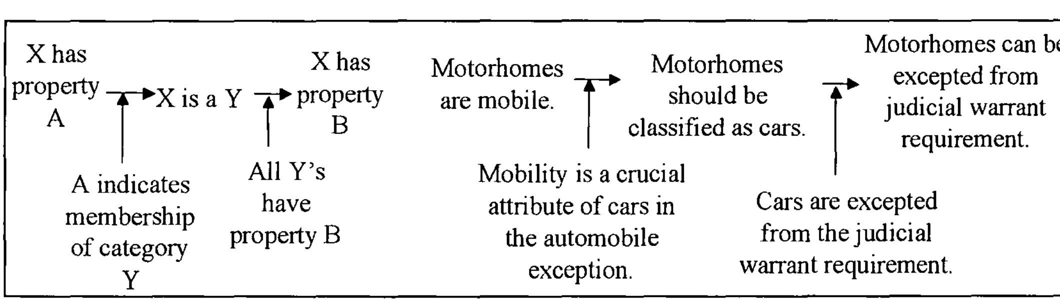

Figure 15: Diagramming analogies, possibility 3[344]

[343] Adapted from: ibid.

[344] Adapted from: ibid.

Each of the possibilities discussed by Newman and Marshall appears to express aspects of what is involved in analogical reasoning and as such are apparently suitable for diagramming analogies. Conversely however, the existence of multiple possibilities necessitates choosing one option in preference to the others. Moreover, other possibilities can be envisaged. For example:

A $\Rrightarrow$ B Cars $\Rrightarrow$ Motorhomes

Figure 16: Diagramming analogies, possibility 4

This simply asserts that two situations are similar. Here, the assertion of similarity is made central, though the reasons supporting or detracting from that similarity are not initially provided. Various other possibilities can be imagined.

Just as the standard method of argument diagramming does not deal with the diagramming of analogies, nor does it deal with several other aspects of argument. For example, arguments that depend on 'the balance of considerations', 'coherency' arguments, nor 'arguments to the best explanation.'

Further, given that theorists increasingly focus on argument as a dialogical process - and that even the individual constructing and reflecting on an argument is regarded merely as a variant of this in which a single party adopts multiple roles – it is striking that the standard method of argument diagramming does not deal with the dialogical nature of argument.[345] While Toulmin's model does allow Rebuttals, as previously discussed, this has several problems. The standard method of argument diagramming could be modified to display counter-arguments. However, it is not immediately obvious how all

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[345] E.g. van Eemeren and Grootendorst's 'pragma-dialectics' is concerned with understanding argument within a discourse and with specifying norms for effective argument: van Eemeren et al., above n. 272, 274.

the interactions that can exist between arguments and counter-arguments should be expressed and diagrammed.

These aspects of the standard method of argument diagramming - the questions surrounding the diagramming of analogies discussed by Newman and Marshall, the omission of diagrams for various types of arguments, and the disregard of the dialogical aspects of argument - pose problems for the standard method of argument diagramming. Underlying the standard method of argument diagramming are at least three theoretical convictions. First is that methods other than 'formal' logic are required to analyse everyday arguments. Second is that diagramming is a helpful tool in such analysis. Third is that a 'standard' method for analysis and diagramming exists. The first two of these convictions appear anecdotally, philosophically and psychologically well supported. However, the existence of multiple ways to diagram analogies hints at problems in the project of developing a single, universal, standard method of argument diagramming.

Analogising can occur in many ways: analogising to a concept exemplified by a prototypical exemplar; analogising to a concept exemplified by multiple examples; and 'case to case reasoning'.[346] When analogising to a prototypical exemplar, it is claimed the reasoners use that exemplar as the primary reference with which to form the analogy to the situation under consideration. In contrast, in analogising involving multiple examples, rather than referring to a single exemplar, the reasoning about the situation under consideration occurs with reference to those multiple examples. Finally, in case-to-case reasoning as with exemplar based analogising, the situation is only compared to one example. The difference with exemplar based reasoning however, is that while the exemplar is regarded as the paradigm example of a larger category, in case-to-case reasoning the two single cases are compared with each other as

[346] Helman, D.H., (ed.) Analogical reasoning: Perspectives of Artificial Intelligence, Cognitive Science and Philosophy (1988) Kluwer.

such. The diagramming options examined above express different aspects of analogising. However, a single 'standard' method of diagramming must be able to accommodate each of these kinds of analogising. It is difficult to imagine how this might be done.[347]

Even if standard methods could be agreed to diagram *each* aspect of analogising, a subtler characteristic of diagramming emerges - each representation of analogising itself highlights and occludes particular aspects of analogising. For example, possibility 1 (figure 13) highlights the argument as to why two situations are similar and the properties on which that similarity is based. In contrast, possibility 2 (figure 14) highlights the consequences of a particular classification and the supporting authority for the classification. Possibility 4 (figure 16) simply asserts a bare similarity without itself discussing that similarity or its consequences. Just as each representation highlights aspect of analogising, each representation also de-emphasises aspects of analogising. For example, while possibility 4 (figure 16) highlights the similarity between cars and motorhomes, neither the arguments supporting the assertion of similarity, nor the consequences of it, are expanded upon. Each remains out of sight and hence occluded. In that each representation focuses on different aspects of analogising, each representation highlights and occludes different aspects of analogising.

It is not just in analogising that argument diagramming channels examination. The standard method focuses examination of argument in particular ways.[348] Comparing simple arguments diagrammed with Toulmin's model and with the

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[347] The standard method could of course adopt an individual standard for each aspect of analogising. Difficulties with the diagramming of analogies are compounded by the lack of discussion of analogising in works examining everyday argument and argument diagramming.

[348] This is in addition to ignoring analogising, various types of argument and the dialogical aspects of argument.

standard method demonstrates this. Given the argument 'Andrew has red hair and so Andrew is short tempered', this could be diagrammed as:

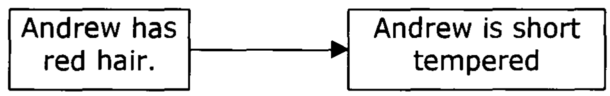

Figure 17: Questioning inferences

However, as Toulmin emphasised, the movement from premise to conclusion may need support – as in this argument. One unspoken implication in the above argument is that having red hair is connected to having a short temper. Toulmin might express this as:

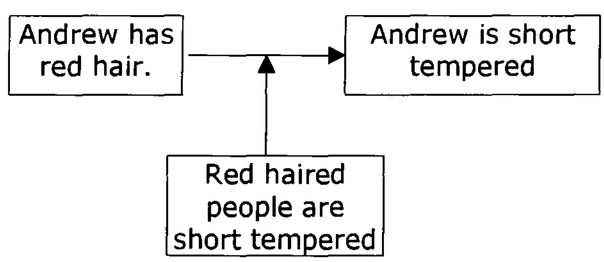

Figure 18: Toulmin's emphasis on inference warrants

Here, 'Red haired people are short tempered' is used as a Warrant (in Toulmin's terms) to justify the move from premise to conclusion. The standard method might diagram the argument as a linked argument:

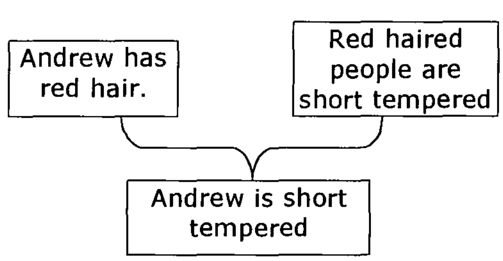

Figure 19: Diagramming inference warrants with the standard method

Both diagrams indicate that the statements 'Andrew has red hair' and 'Red haired people are short tempered' are together proposed to justify the conclusion. However, Toulmin's method emphasises that the move from premise to conclusion is itself an argument.

One possible objection to the above argument is that 'Not all red haired people are short tempered'. However, this single challenge can be read in at least two ways, diagrammed below:

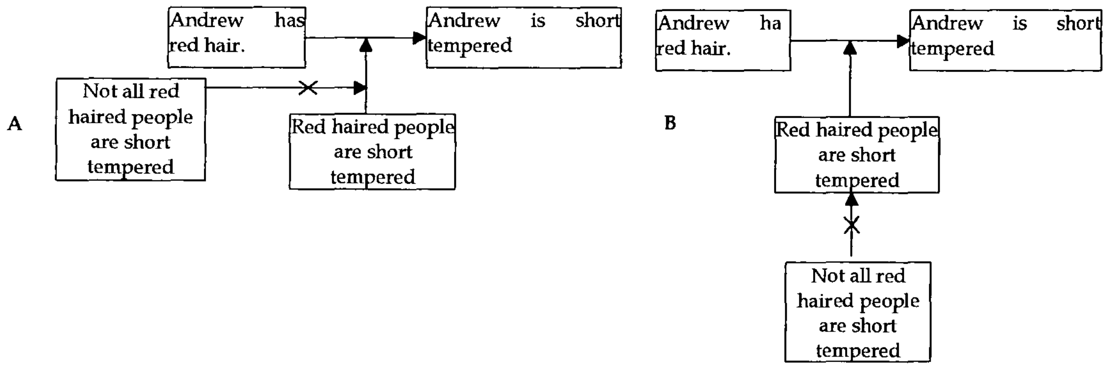

Figure 20: Challenging arguments 1[349]

In part 'A' of figure 20 the objection concerns whether it is justifiable to support the argument 'Andrew has red hair so Andrew is short tempered' with 'Red haired people are short tempered'. This revolves around what amounts to a good justificatory argument – about what the standards of argument are. In part 'B' of figure 20 in contrast, the challenge is to the acceptability of the justificatory statement itself – and is not related to the standards of justificatory argument.

With the standard method of argument diagramming the objection 'Not all red haired people are short tempered' might be diagrammed as

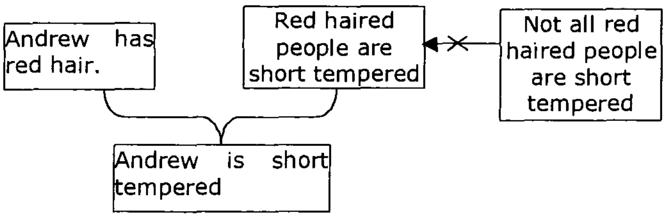

Figure 21: Challenging arguments 2

[349] This diagram is only loosely based on Toulmin's model, as previously discussed, Toulmin did not allow Rebuttals to attach to anything other than a Claim. Further, Toulmin did not provide any convention for indicating that one statement contradicts another statement – indicated in the diagram by a connecting arrow marked by a cross. This convention is used in subsequent diagrams in this chapter.

This leaves unclear which of the objections is being made. Of course, which objection is being made can be expressed through a rewording of the statements themselves, or it may emerge during subsequent argument. However, it is not that these different representations prevent the expression of particular ideas, but rather that representations direct expression in particular ways. Representations direct the ways in which ideas are expressed. As argued by Zhang, and Larkin and Simon, representations direct thinking.[350] This is a fundamental property of representations themselves.

In this light, even if conventions are adopted for diagramming analogies and other types of argument, and for diagramming the dialogical aspects of argument, these conventions will inevitably channel expression and channel thinking.[351]

That diagrams channel thinking is evident when attempting to apply argument diagramming in a legal context. Argument diagramming could serve many purposes, for example the better construction of arguments, the better communication of arguments or the better analysis of arguments, amongst other possibilities. Argumentation theorists suggest that argument analysis is a key application. As such, diagramming judicial judgments should be a perfect application for the method. Judgments are commonly said to report the justificatory arguments underlying judicial decisions. However, trying to diagram the arguments as presented in judicial judgments can be extremely difficult using the standard method.

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[350] It is important to distinguish this aspect of representations from the interpretation of arguments that occurs in locating enthymemes or in the reading of arguments as linked or convergent. The latter are matters of interpretation that occur within a given framework. The former is concerned with choosing the framework, the conventions, in which to analyse and interpret arguments.

[351] Work examining argument with different representations supports this: see discussion above p. 97.

For example, below is an extract from the judgment of Lord Slynn in *R v Bow Street Stipendiary Magistrate and others, ex parte Pinochet Ugarte (Amnesty International and others intervening)*:[352]

> It is said (in addition to the argument that functions mean only international functions which I reject):
>
> (i) that the functions of the Head of State must be defined by international law, they cannot be defined simply as a matter of national law or practice; ....
>
> As to (i), I do not consider that international law prescribes a list of those functions which are, and those which are not, functions for the purposes of article 32 [of the Vienna Convention on Diplomatic Relations 1961]. The role of a Head of State varies very much from country to country, even as between Presidents in various States in Europe and the United States. International law recognises those functions which are attributed to him as Head of State by the law, or in fact, in the country of which he is Head as being functions for this purpose, subject to any general principle of customary international law or national law, which may prevent what is done from being regarded as a function. (Lord Slynn)[353]

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[352] [1998] 4 All ER 897. Hereafter 'Pinochet'.

[353] Ibid. 907. Although the result in this case was subsequently overturned this does not detract from the analysis presented here: *R v Bow Street Metropolitan Stipendiary Magistrate and others, ex parte Pinochet Ugarte (Amnesty International and others intervening)(No 3)* [1999] 2 All ER 97.

One possible way to diagram the argument presented by Lord Slynn in this passage is as follows:

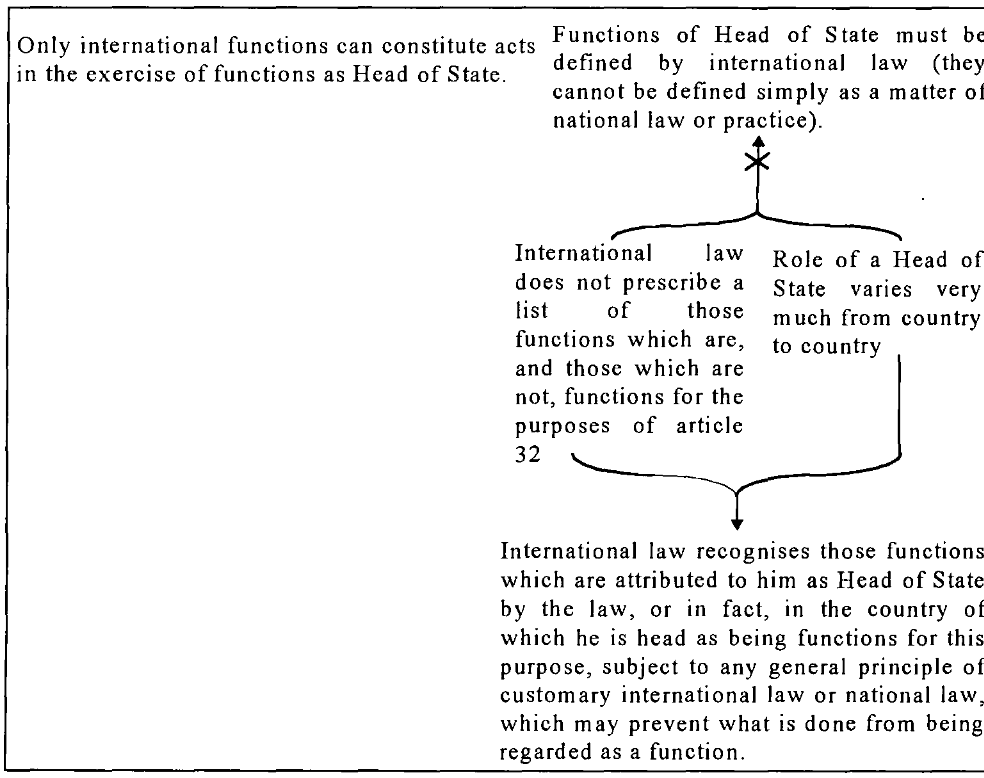

Figure 22: Diagramming judgments using the standard method

However, the diagram presented above misrepresents an important aspect of Lord Slynn's judgment. The diagram suggest that Lord Slynn himself proposed two arguments: (a) Only international functions can constitute acts in the exercise of functions as Head of State; and (b) Functions of a Head of State must be defined by international law (they cannot be defined simply as a matter of national law or practice). The diagram does not indicate that (a) was rejected and it is unclear how this would be diagrammed given that no argument was provided. The standard method does not specify how to diagram statements that do not easily connect to the main argument. The diagram further suggests that Lord Slynn used two premises, which he proposed, to reject his own argument (b). The diagram further suggests that Lord Slynn used these same two self-proposed premises to justify the acceptance of a conclusion as to what the real rule should be.

In fact, the first two propositions, (a) and (b), that Lord Slynn considers were not proposed by him but by counsel for parties in the case. This is evident from other judgments and the words 'It is said', which commence the above passage of Lord Slynn's judgment. In this respect, the standard method misrepresents the 'flow' of the argument. Similarly, the standard method does not allow labelling of links, such as the use of 'X' to indicate the rejection or contradiction of a statement (and in this respect the above diagram does not strictly conform to the requirements of the standard method of argument diagramming). As discussed below, labelling in this way can aid comprehension of both links and propositions themselves, although it raises further issues concerning representational appropriateness. The point is not that the standard method of argument diagramming is of no value in analysing judgments, nor that the standard method is so fundamentally flawed as to be beyond useful adaptation. Neither is the case. For example, simply labelling statements with who made them is a modification to the standard method that could be made in order to, at least partially, address the dialogical nature of argument.

Problems with the standard method of argument diagramming are hinted at by Govier who states that there is no 'theory of argument' than can be used to analyse all arguments.[354] In this light, the standard method of argument diagramming would apparently be one amongst many methods for argument analysis and no better, or worse, than Toulmin's model. As the work on

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[354] Govier, above n. 279, 13. According to Govier, amongst other things a 'theory of argument' would discuss the nature and purpose of arguments and specify and defend standards for the appraisal of arguments. It would specify how many different types of arguments there are and what standards are appropriate to assess each type. It would explain when and why it is reasonable to read into discourse statements which are not explicitly stated, and whether and how the personalities and beliefs of arguers and audiences logically affect the merits of argumentation. See also Kopperschmidt who states that no unified theory of argument exists only discipline specific examinations: Kopperschmidt, 'An Analysis of Argumentation' p. 159, in van Dijk, T.A. (eds.) Handbook of Discourse Analysis: Dimensions of Discourse (1985) Academic Press, 160.

representation in psychology shows, representations channel thinking in particular ways and it is important to have the appropriate representation for the task. Choosing a representation appropriate for the argumentative task, rather than a universal representation, thus becomes central.

More problematic as a means to support sensemaking, is that immediately preceding the above quoted passage, Lord Slynn expressly poses the question 'What can constitute acts in the exercise of functions as Head of State?' This statement suggests that far from presenting and then rejecting two of his own arguments, his lordship has used two arguments presented by counsel for the parties to try to answer a question he has asked of himself. Two possible answers to this question are the responses of counsel for the parties. However, in the above quoted passage, his lordship rejects these solutions and instead presents argument justifying his own preferred third solution.

A possible diagram for this is:

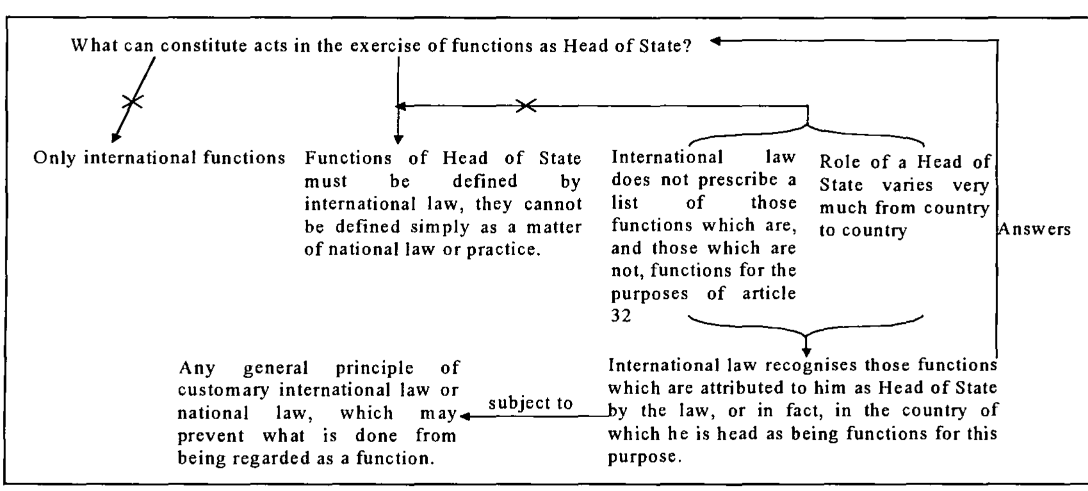

Figure 23: Diagramming judicial questions

Again, it would be useful to be able to diagram the dialogical nature of arguments. It would be much clearer to expressly indicate on the diagram that the two possibilities rejected by his lordship were proposed by the parties in the case and that his rejection was a rejection of their arguments. And just as it is sometimes useful to label links with an 'X', it can be useful to indicate that a statements 'Answers' a question or that one statement is 'subject to' another.

The diagram indicates not only that it is useful to be able to label links between statements, but also that for sensemaking support it is necessary to diagram things beyond claims and conclusions. The ability to diagram questions, possible responses to those questions, the status of those responses and the final answer adopted to a question are all necessary. This need arises from the nature of judgments and indeed of legal reasoning more widely. Rather than being reports of pure argument, judgments are expressions of, and legal reasoning generally involves, aspects of reasoning beyond argument. That is, aspects of reasoning wider than pure argument. While theorists argue that argument is central to reasoning – the converse consequence of this is that argument occurs within a wider framework of reasoning. Amongst other things, this framework involves asking questions, proposing answers, rejecting, and accepting those answers. Argument is a method used in responding to such questioning.

While it can be said that judgments report the arguments that judges rely on to support their conclusions, judgments also report traces of the wider process of reasoning that the judgment stems from.[355] Hence, the difficulty for the standard method of argument diagramming in expressing all that a judgment contains. A consequence of this is that by itself the standard method of argument diagramming is not sufficient to diagram the structure of judgments

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[355] Simon states that the judicial opinion:

> is not, and thus should not be perceived to be, an account of the process itself. It is best perceived as a snapshot image of the representation of the decision at the end point of the process: an exposition of the reasons that were perceived by the judge as best supporting the decision. (Simon, above n. 170, 35.)

It may be true that a judgment does not express all the arguments considered during the making of a decision, but rather a selective sample of those arguments at the endpoint of decision. As a representation of the decision at the end of the decision process though, judgments nevertheless express more than the reasons perceived as best supporting a decision.

- or legal reasoning itself. Argument diagramming needs supplementation by methods with which to diagram these wider aspects of reasoning.

4.7 Diagramming reasoning

The standard method of argument diagramming is inadequate to diagram all that is expressed in legal judgments and all the reasoning that is involved in resolving legal problems. While the standard method of argument diagramming provides several classifications with which to analyse arguments, the method does not express a number of aspects of argument and reasoning. As the basis for tools to aid lawyers in resolving legal problems, the standard method of argument diagramming is limited. The standard method of argument diagramming arose as a means to analyse pre-existing arguments, as a method to visualise argument as a product. The method is far less useful when seeking to augment the processes through which arguments arise.

While it is useful to aid the examination and comprehension of arguments as a product, in many situations it would be useful to have support for processes of argumentation and the wider non-argumentative processes of reasoning of which argumentation is a part. Legal reasoning is aimed at practical problem solving. Faced with a problem, amongst other things lawyers must locate the relevant law, envisage possible solutions to the problem, assess the benefits and consequences of the possible solutions, choose a preferred option from amongst these possible solutions, and construct arguments justifying the choice of the particular option and argument justifying the rejection of the remaining options. In such situations arguments are not simply presented devoid of context. Rather, arguments are presented in order to justify the acceptance of a particular response out of many possible responses. Argument is part of a process of reasoning. A reasoner does not typically know the outcome that will finally be achieved and is in the process of exploring options for a possible outcome. Which outcome is finally settled upon is determined by many things, such as how well that outcome is felt to explain an anomaly or answer a question under consideration in comparison with the other options that are considered.

When argument is viewed as part of a process of reasoning, it is clear that the propositions and claims that make up the final argument as a product do not exist perfectly formed *a priori*. Those propositions are interactively and iteratively proposed, explored, rejected, accepted and refined as problem solving progresses. Thus, if the processes of reasoning and argument formation are themselves to be diagrammed, and not just the arguments that result from these processes, the method of argument diagramming must be supplemented to accommodate the reasoning interactions involved.

4.7.1 Diagrammatic elements

As when diagramming arguments, a fundamental question that arises in attempting to diagram reasoning is - what representation should be used for reasoning? What is to be diagrammed? What elements are necessary and allowed in the diagram? Such questions apparently require knowing what the very elements of reasoning are - which itself apparently raises the question of how human reasoning operates. Answering these questions appears to require a fully-fledged theory of human reasoning. Reasoning and the intimately connected topics of judgment and decision-making are studied in many areas and from many different perspectives. Philosophy, logic, psychology, cognitive science, artificial intelligence and law, and legal theory, amongst others, all provide numerous examinations of reasoning. Such examinations focus on the different types of reasoning e.g. theoretical reasoning vs. practical reasoning that are evident in human problem solving, as well as the characteristics and variations in reasoning in different problem solving areas e.g. reasoning in science, reasoning in policy making, reasoning in medical decision making, common-sense reasoning, and legal reasoning. The spirit of these investigations varies according to how reasoning is conceived and at what 'level' it is analysed. For example, systems such as Aristotle's syllogistic logic are attempts to formalise important aspects of reasoning and to specify what constitutes acceptable reasoning. Such logics are normative in that they seek to specify how reasoning should occur; they prescribe how it is rational to reason. Descriptive status has also been claimed for such logical theories, for example in the various theories of natural deduction which posit that people have deductive rules of inference, equivalent to the rules of logic, 'hard-wired' into their brains. If logic is accepted as all there is to reasoning then a system to diagram reasoning would simply have to provide visual equivalents to the logical rules with which statements are connected in the logic.[356] Similarly, if expected utility theory is accepted as a description of how either people reason or a specification of how they should reason[357] then visual presentations could be constructed on this. However, in a situation where not all possible solutions to a problem are known (or perhaps the issues, values and other influences that bear upon solutions to the problem) a large aspect of reasoning and decision making will involve exploration. For example, exploration of what possible options exist, what values are relevant and how those values influence the acceptability of potential solutions. While theory exists investigating such aspects of reasoning, it is fragmented.[358] In the absence of a unified theory, all that can apparently be aimed for is a partial theory of reasoning appropriate to the particular context. It is certainly not proposed to survey in detail these theories of reasoning, nor to propose a unified theory, or even to propose and defend any one particular conception of reasoning or legal reasoning. These tasks have been undertaken and widely discussed elsewhere. Legal reasoning is widely discussed in legal theory and various theories of legal reasoning exist.[359] Rather, the present purpose is to indicate how researchers have approached the diagramming of reasoning and how such techniques might be used in a

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[356] See Barwise and Etchmedy, above n. 257.

[357] See the discussion above n. 208.

[358] See discussion at 3.5.1.

[359] See discussion at ch. 3.

legal context. Responding to the question 'what is to be diagrammed?' becomes a matter of finding *appropriate* elements with which to express reasoning.

Given the diversity of reasoning and its importance, it is surprising how few methods exist for expressing reasoning. The methods examined in his subsection – mind mapping and concept mapping, and design rationale – have been chosen in part to highlight the diversity of reasoning and the diverse approaches to diagramming reasoning. Design rationale as a representation for reasoning is discussed in depth because it provides a detailed framework for diagramming reasoning and because it has been highly influential in work on diagramming reasoning. The appropriateness of this method for supporting legal sensemaking is discussed. The examination of diagrammatic methods provided here forms a prelude to the examination provide in the next chapter of various computer systems for diagramming argument and reasoning.

4.7.2 Brainstorming - mind mapping and concept mapping

Mind mapping is a popular technique for 'brainstorming' developed by Buzan.[360] The aim is to promote creativity by stimulating the free flow of ideas. In mind mapping, a central idea is written on a page and then ideas that are in any way felt related to it are drawn around the idea and connected to it. There is no restriction on what counts as an idea. Thus, amongst other things a concept could be a physical object, a concept, a question to be answered, a problem to be solved or a goal to be achieved. Diagramming continues so that each idea that was stimulated by the initial idea is itself used as the 'seed' for the generation of further ideas. Every further idea generated by these ideas is written on the diagram and connected to the idea which invoked it. This process continues until the person drawing the mind map exhausts their ideas. In this manner, a person can construct a visual 'map' of their ideas and the connections between their ideas.

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[360] Buzan, T., Buzan, B., The Mind Map Book (1995) BBC Books.

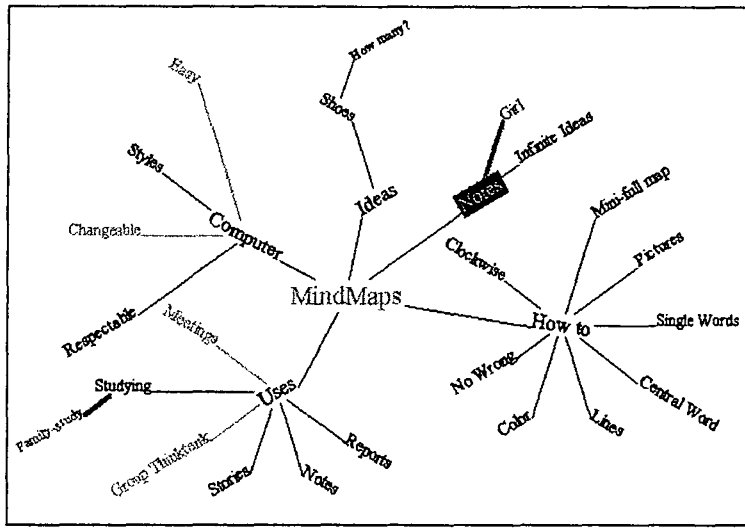


Figure 24: Mind map about mind mapping

Apart from the claim that the process of creating mind maps encourages fluid and creative thinking, it is claimed that once created such maps serve as a useful reference point for more structured thinking about a problem.

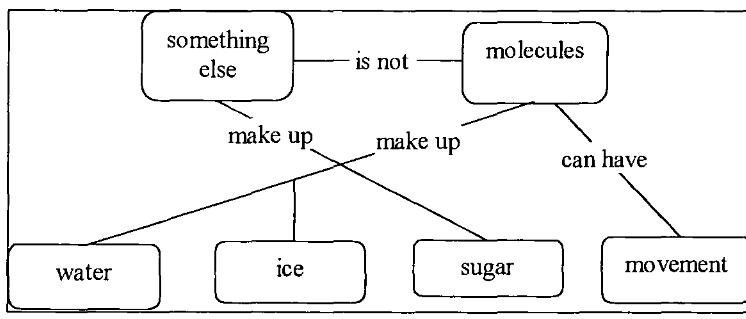
Numerous computer programs are dedicated to the construction of mind maps.[361] Notably, mind mapping does not impose restrictions on what can be diagrammed nor on the connections that are allowed between ideas in the diagram. In this respect, mind maps are completely unstructured.

Concept mapping is a technique similar to mind mapping.[362] Novak developed Concept mapping during a long programme in educational research and it originated as a means for researchers to better comprehend the development of their subjects' knowledge during different stages of learning. However, Novak also reports that concept maps have proved useful for students themselves as an aid during learning. Students are encouraged to diagram the ideas in an area that they are learning about, and to draw links between ideas to indicate the

[361] Support for mind mapping is provided by many programs e.g.: Windows Mind Mapper (1994) EGLE Magic; SMART Ideas (1996) SMART Technologies Inc; VisiMap Lite (1998) CoCo Systems Ltd; Idons-For-Thinking (1999) Idon Thinking Resources Ltd.

[362] Novak, above n. 259.

to indicate the relationships between them.[363] Novak reports that the method is a useful way for students to become aware of their own gaps in knowledge. By drawing diagrams, students get a better sense of what they do and do not know. Jonassen calls concept mapping a 'mindtool' and argues it supports constructivist learning in students.[364]



[365]

Figure 25: Concept map

Like mind maps, concept maps are relatively unstructured, in the sense that there is little prescription on the what counts as an idea, on the connections that can be included in a map or on the connections that can be made between ideas. Concept mapping is not used as a means to provide a structured representation of reasoning or argument.

Mind mapping and concept mapping are techniques that augment aspects of reasoning – they promote creativity and the externalisation of ideas and reflection on those ideas. However, both techniques are completely unstructured. Given this wide generality, it might be possible to express the exploratory questioning that occurs during reasoning. However, while supporting the creative, brainstorming, aspects of problem solving neither mind mapping nor concept mapping is specifically tailored to supporting problem solving. Given this generality, neither mind mapping nor concept

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363 Ibid.

364 Jonassen, above n. 219.

365 A student's concept map, modified from: Fisher, K.M., 'Semantic Networking: The New Kid on the Block' (1990) 27(10) Journal of Research in Science Teaching 1001.

mapping provides explicit support for processes of problem solving. In contrast, the techniques in design rationale examined below have been developed specifically to provide structured support for reasoning.

4.7.3 Design Rationale

Design rationale is the name given to a recent approach to supporting the design process. The philosophy underlying design rationale is that when designing artefacts, it is often insufficient simply to have the artefact itself - knowing the reasoning behind the many design choices that make up the artefact is itself important.[366] Proponents of design rationale argue that allowing designers to express the reasoning behind their designs will improve those designs. Design rationale research investigates methods with which these choices and the reasoning behind them can be captured and stored for latter reference. It has been applied in various disciplines including computer design, architectural design and policy formulation. The latter is particularly interesting, based as it is on the idea that human problems essentially involve the 'design' of appropriate individual and institutional responses. This has clear overlaps with the diagramming of legal reasoning. Both efforts seek to capture aspects of reasoning to improve reasoning as it occurs and to store it for latter reference. Research into design rationale presents the most complex attempt to diagram problem solving, and as such is a good source of information for research into diagramming of legal reasoning.

Various approaches to design rationale have been developed. These, and their computer implementations, are discussed in the following chapter. The remainder of this subsection examines the 'design rationale language' (DRL) developed by Lee.[367] DRL is the most recent and most complex approach to

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[366] Buckingham Shum, S., Hammond, N., 'Argumentation-Based Design Rationale: What Use at What Cost?' (1994) 40(4) International Journal of Human-Computer Studies 603.

[367] Lee 1990a, above n. 82; Lee, J., 'SIBYL: A tool for managing group decision rationale' p. 79, in Proceedings of the ACM Conference on Computer-Supported Cooperative Work

design rationale and so the following analysis will be based on the use of DRL. The remainder of this subsection outlines and discusses attempts to use DRL to diagram the reasoning in *Donoghue v Stevenson*. Rather than outline all aspects of DRL at the outset, its features and use will be highlighted through its application. The attempt here is to diagram the judgment of Lord Atkin in *Donoghue v Stevenson*.

The following extract from Lord Atkin's judgment is used as a starting point. The numbers (1)-(6) in brackets above have been added to aid reference to the statements contained in the judgment.

> (1)My Lords, the sole question for determination in this case is legal; (2)Do the averments made by the pursuer in her pleading, if true, disclose a cause of action? (3)I need not restate the particular facts. (4)The question is whether the manufacturer of an article of drink sold by him to a distributor, in circumstances which prevent the distributor or the ultimate purchaser or consumer from discovering by inspection any defect, is under any legal duty to the ultimate purchaser or consumer to take reasonable care that the article is free from defect likely to cause injury to health. (5)I do not think a more important problem has occupied your Lordships in your judicial capacity: important both because of its bearing on public health and because of the practical test which it applies to the system under which it arises. (6)The case has to be determined in accordance with Scots law; but it has been a matter of agreement between the experienced counsel who argued this case, and it appears to be the basis of the judgment of the learned judges of the Court of Session, that for the purposes of determining this problem the laws of Scotland and of England are the same.[368]

(1990) ACM Press hereafter 'Lee 1990b'; Lee, J., Lai, Kum-Y., 'What's in Design Rationale?' p. 21, in Moran, T.P. and Carroll, J.M. (eds.) <u>Design Rationale: Concepts, Techniques and Use</u> (1996) Lawrence Erlbaum.

[368] *Donoghue* 578-9.

Using DRL, analysis begins with the statement of a 'Decision Problem' - which represents 'the problem that requires a decision.'[369] An obvious candidate for the decision problem in the above quotation is the question Lord Atkin asks himself in (2). This could be diagrammed as:

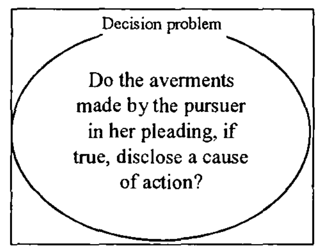

Figure 26: The Decision problem in *Donoghue*

Statement (3) will be ignored. Diagramming (4) immediately raises problems however. What is the relation between the question asked in (4) and the question posed in (2)? An obvious response would be that (4) is a refined, a more precise, restatement of the problem. We might expect to diagram this as:

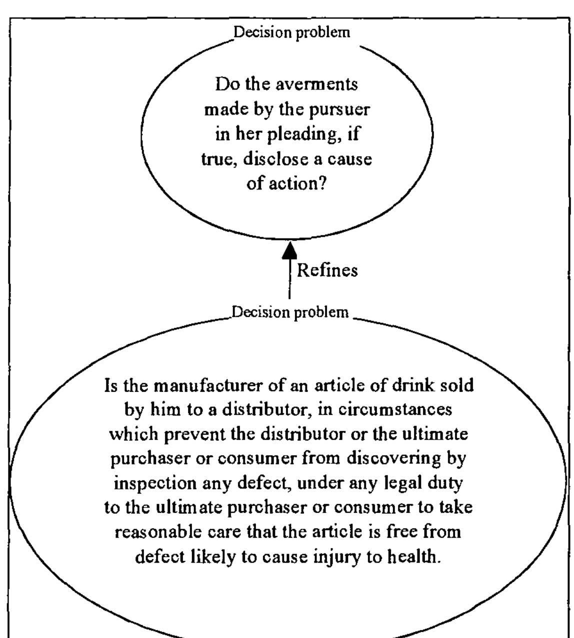

Figure 27: Related Decision problems in *Donoghue*

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369 Lee and Lai, above n. 367, 37.

The problem however, is that DRL does not contain a 'Refines' relationship with which to link objects.

In DRL, the most obvious way to diagram the above relationship would be using the 'Is a Subdecision of' relationship as follows:

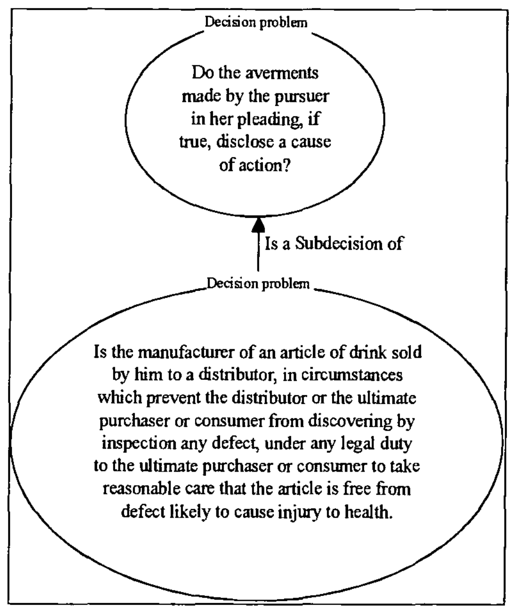

Figure 28: Sub decisions in *Donoghue*

The 'Is a Subdecision of' relationship is meant to indicate that answering the subdecision facilitates answering the parent decision. The problem with diagramming Lord Atkin's judgment in this way however, is that the 'Is a Subdecision of' implies that there is 'more to come' – that the subdecision is only one amongst many decisions that will need to be decided. It thus fails to capture the notion that the second question replaces the first question. Once this second question is answered there are no further considerations needed to answer the first question. DRL thus immediately appears to require the massaging of reasoning to fit its constraints.

A second possibility for diagramming the above relationship in DRL would be to use the 'Suggests' relationship in which the first question is said to suggest the second question. Again however, this fails to capture the notion that the second question is a more precise replacement of the first question.

Ignoring these problems (and proceeding using the DRL conventions diagrammed in figure 28) (5) poses further problems. Two obvious possibilities within DRL for diagramming (5) are to treat it as a series of 'Claims' or to treat (5) as a 'Criterion' backed by two 'Claims'. The first possibility is diagrammed below:

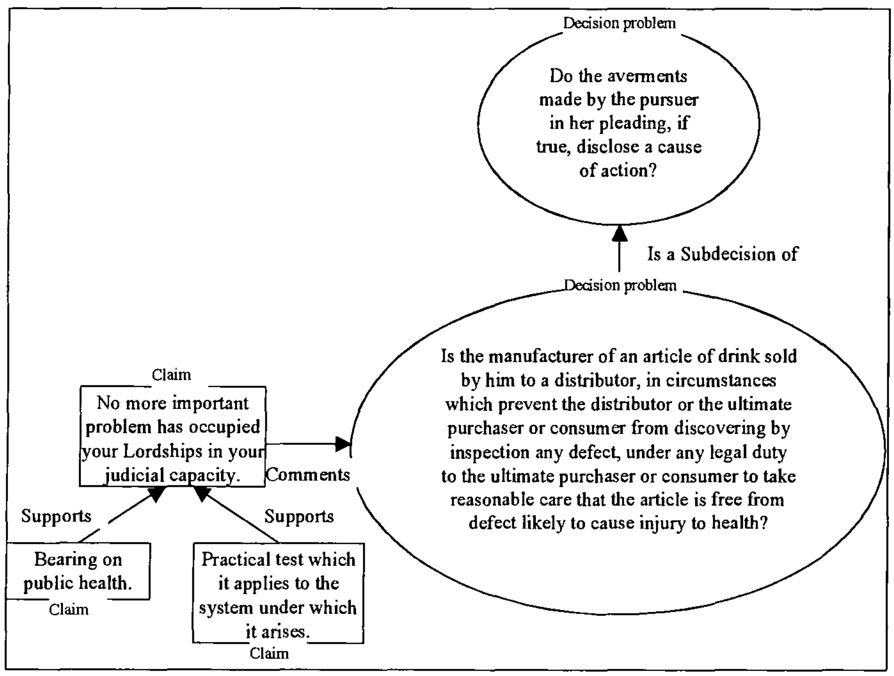

Figure 29: Claims in *Donoghue*

It is a matter of interpretation exactly what purpose (5) is intended to serve. It is reasonable to interpret the phrase merely as a remark on the question under consideration. However, another reasonable interpretation is that in emphasising the seriousness of the question being considered Lord Atkin is expressing a consideration that influences how responses to the question will be resolved. Thus, the fact the no more important question has arisen influences latter assessments of possible solutions.

A second alternative to diagramming (5) is thus to treat it is a 'criterion'. However, DRL does not explicitly provide for criteria. Lee claims that all criteria can be restated as 'goals' and thus they are subsumed within the notion of goals. In DRL goals are meant to describe 'desired states of the world';[370] it is difficult to see how (5) could be interpreted in this manner without significant extra manipulation, interpretation and restatement. Figure 29 thus seems the best option when trying to diagram (5) within DRL.

Similar complications arise when considering how to diagram (6). This too could be diagrammed as a Claim making a Comment:

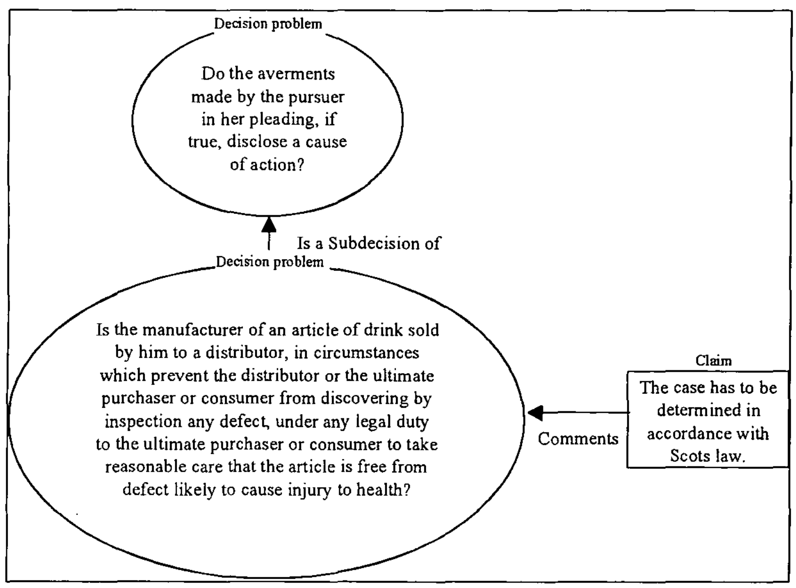

Figure 30: Claims as comments in DRL

However, this seems to miss an important aspect of the claim that Scots law applies. This claim provides a standard for assessment of solutions to the question that has been asked, and thus does not merely comment on the question. In a sense, it too is a criterion that solutions to the problem must satisfy:

[370] Ibid. 37 fn 5.

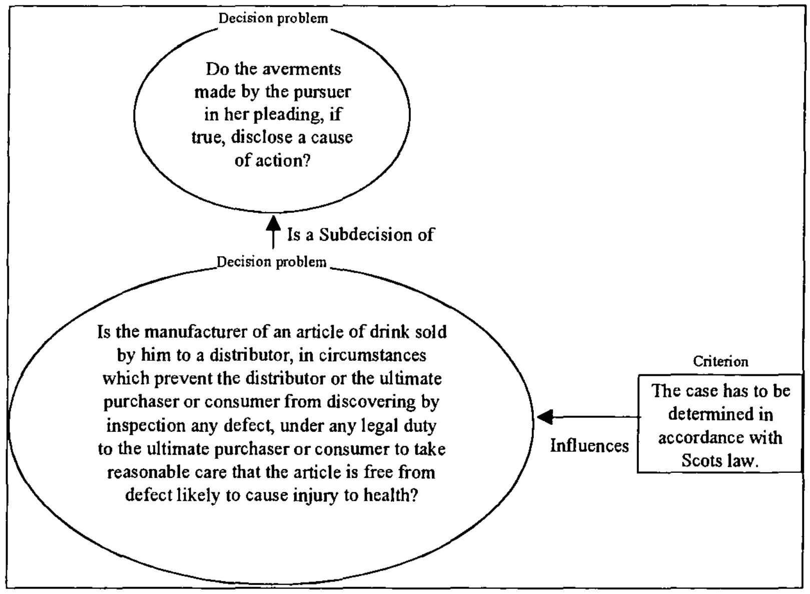

Figure 31: Criteria in decision making

Restating the above statement as a goal – as a desirable state - greatly distorts it. For example 'The case should be determined in accordance with Scots law' misrepresents the imperative nature of the statement as expressed by the use of 'has to'.

The above problem highlights another difficulty using DRL to express legal reasoning – as yet ignored for simplicity. In DRL, all problems start with a 'Decision Problem'. A Decision Problem is supposed to have the general form 'Choose X optimal for Y.'[371] However, it is obvious that the questions asked by Lord Atkin were not expressly of this form:

> The question is whether the manufacturer of an article of drink sold by him to a distributor, in circumstances which prevent the distributor or the ultimate purchaser or consumer from discovering by inspection any defect, is under any legal duty to the ultimate purchaser or consumer to take reasonable care that the article is free from defect likely to cause injury to health.

It is very difficult to see how the above question could be restated in the form required by DRL. Perhaps it could be restated as:

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[371] Lee, above n. 82, 112.

> Find the optimal interpretation of the law such that it becomes clear whether the manufacturer of an article of drink sold by him to a distributor, in circumstances which prevent the distributor or the ultimate purchaser or consumer from discovering by inspection any defect, is under any legal duty to the ultimate purchaser or consumer to take reasonable care that the article is free from defect likely to cause injury to health.

However, although the question might be restated in this form, this certainly involves much interpretation and manipulation and violates the aim of trying to use the system to capture reasoning as it is expressed.

Even if the content of a Decision Problem is relaxed to that of a Goal, so that it 'represents a desirable state or property' it appears difficult to shoehorn the above question into the required form. Again, it is difficult to see how the question could be easily restated to satisfy this form. It thus appears that in a legal context the necessity of starting all problem solving with a goal is too restrictive. Interestingly, in some of the examples used to illustrate the use of DRL, Goals are stated which do not seem to have the correct form. For example

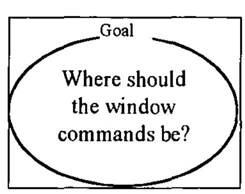

Figure 32: Inconsistencies in the use of DRL[372]

Even on the part of the designers of DRL, there thus appears the need to commence reasoning with a question rather than a goal.

The basic elements of DRL are problematic when diagramming legal reasoning and legal argument. It is informative to attempt to diagram further aspects of Lord Atkin's judgment in *Donoghue*. Lord Atkin continued his judgment:

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[372] Lee and Lai, above n. 367, 37.

> (7)The law of both countries appears to be that in order to support an action for damages for negligence the complainant has to show that he has been injured by the breach of a duty owed to him in the circumstances by the defendant to take reasonable care to avoid such injury. (8)In the present case we are not concerned with the breach of the duty; if a duty exists, that would be a question of fact which is sufficiently averred and for present purposes must be assumed. (9)We are solely concerned with the question whether, as a matter of law in the circumstances alleged, the defender owed any duty to the pursuer to take care.[373]

Given the restraints imposed by classifying (4) discussed above, (7) could be added to the diagram as an 'Alternative':

[373] *Donoghue* 579.

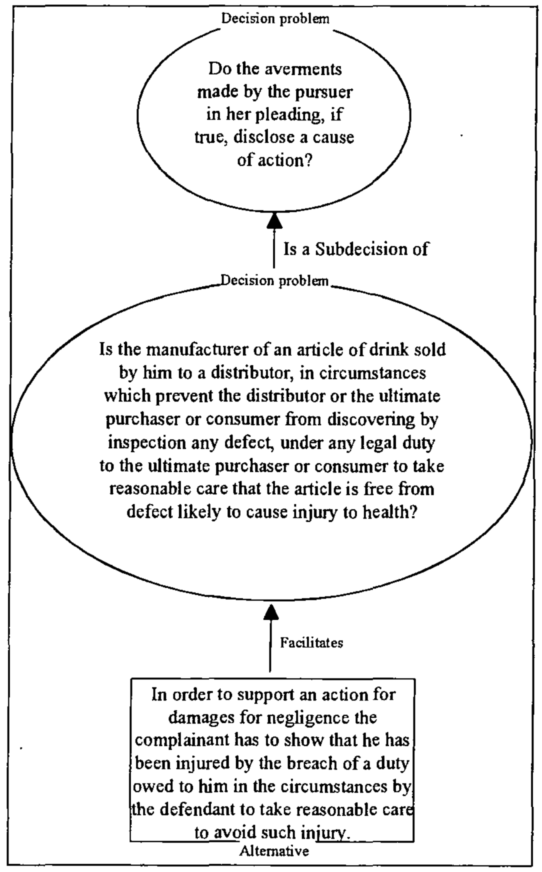

Figure 33: Using Alternatives in DRL[374]

This structure is necessary because Alternatives are the preferred responses for Decision Problems in DRL. However, diagramming in this way has several problems. First, classifying the statement as an Alternative implies that other alternative statements will also be linked to the parent. Lord Atkin does not provide them and indeed they do not seem necessary. Secondly, using a 'Facilitates' connection between the Alternative and the Decision problem does

[374] Unfortunately, in different reports about DRL, its authors have changed exactly what relations exist in the system. So for example in an early report on DRL "Facilitates(Alternative, Goal)"; "Qualifies(Claim, Claim)"; "Queries(Question, Claim)" and "Influences(Question, Claim)" all appear in the system: Lee 1990a, above n. 82, 111. However in a latter discussion of the system none of these relationships are present. However, "Presupposes(Claim, Claim)"; "Achieves(Alternative, Goal)"; "Tradeoffs(Object, Object, attribute)"; "Suggests(Object, Object)"; "Raises(Object, Question)" and "Comments(Claim, Object)" all appear in the system: Lee and Lai, above n. 367, 36. In this discussion of DRL these differences are not examined and relationships from both version of the system are used interchangeably.

not really capture the fact that (7) is intended to respond to the parent to which it is linked in the above diagram. Thirdly, classifying (7) as an Alternative has the unfortunate consequence that (7) could not be the subject of argument within DRL. In DRL only a Claim can be the subject of argument. Thus, if there was disagreement about the correctness of (7) this could not be directly expressed within DRL.

An alternative diagram incorporating (7) could be:

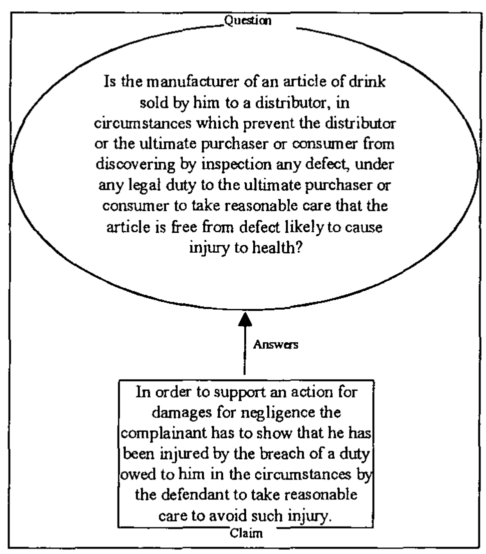

Figure 34: Using Answers in DRL

Diagramming in this way has the important benefit that (7) is classified as a Claim and thus becomes subject to argument. However, if (7) is classified as a claim then it becomes necessary to reconsider the classification of the parent to which it is connected. DRL does not allow links between a Claim and a Decision Problem. If the topmost node is reclassified as a Question, as in the above diagram, then a *prima facie* intuitive diagram can be created in which (7) is a Claim which Answers a Question that has previously been asked. Whether the Answers relationship is appropriate will be discussed in more depth below. However, while having the benefit of being intuitive, this diagram is not allowed in DRL for, as discussed above, the topmost node in the above diagram cannot be classified as a Question within DRL.

A further possibility for diagramming (7) is to use the 'Raises' relationship:

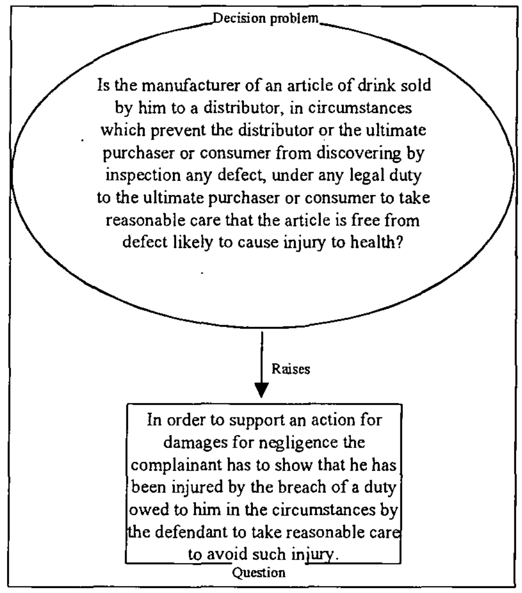

Figure 35: Using the Raises relationship in DRL

However, the Raises relationship results in a Question object and so utilising this relationship requires reinterpreting and restating (7) in the form of a Question. Again, this involves manipulating the materials in order to fit them within the constraints of the system.

The final option for diagramming (7) would be to use the 'Suggests' relationship:

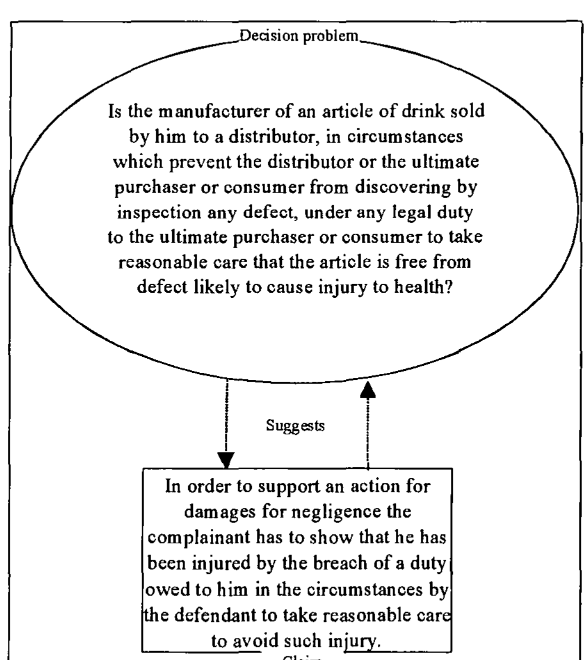

Figure 36: Using the Suggests relationship in DRL

Although the diagram contains two arrows this is merely used to indicate that two possible diagrams could be drawn, one where the Decision problem suggests the Claim and another in which the Claim suggests the Decision Problem. The benefit of using the Suggests relationship is that (7) can again be classified as a Claim. The drawback however depends on how informative the Suggests link is regarded to be in this situation. It is difficult to see in what sense either the Claim is suggested by the Decision problem or in what sense the Decision problem is Suggested by the Claim. Neither captures the feeling that (7) was made as a response to an earlier query.

Assuming that (7) is classified as a Claim, it is reasonable to classify (8) and (9) as Questions raised by it.

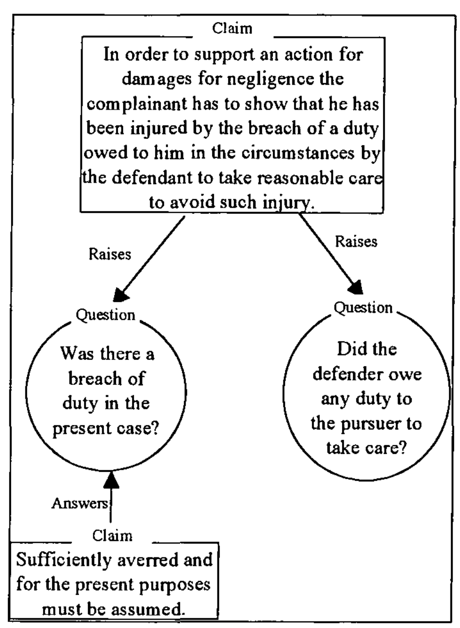

Figure 37: Claims raising Questions in DRL

This does not raise particular problems.

Lord Atkin continued:

> (10) It is remarkable how difficult it is to find in the English authorities statements of general application defining the relations between parties that give rise to the duty. (11) The Courts are concerned with the particular relations which come before them in actual litigation, and it is

> sufficient to say whether the duty exists in those circumstances. (12) The result is that the Courts have been engaged upon an elaborate classification of duties as they exist in respect of property, whether real or personal, with further divisions as to ownership, occupation o control, and distinctions based on the particular relations of the one side or the other, whether manufacturer, salesman or landlord, customer, tenant, stranger, and so on. (13) In this way it can be ascertained at any time whether the law recognizes a duty, but only where the case can be referred to some particular species which has been examined and classified. (14) And yet the duty which is common to all the cases where liability is established must logically be based upon some element common to the cases where it is found to exist. ....
>
> (15) At present I content myself with pointing out that in English law there must be, and is, some general conception of relations giving rise to a duty of care, of which the particular cases found in the books are but instances.[375]

(10) intuitively appears to be a Claim, a claim about the state of the authorities in Scottish and English law. Three possible relationships that could exist between this claim and the prior question are 'Answers', 'Suggests' and 'Comments'. Neither the Question seems to suggest the Claim, nor the Claim to Suggest the Question so this possibility will not be discussed further. It might be argued that the Claim Answers the Question or at least comments on it. Either of these two possibilities appears defensible.(11) and (12) also appear to be Claims related to (10):

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[375] *Donoghue* 579-80.

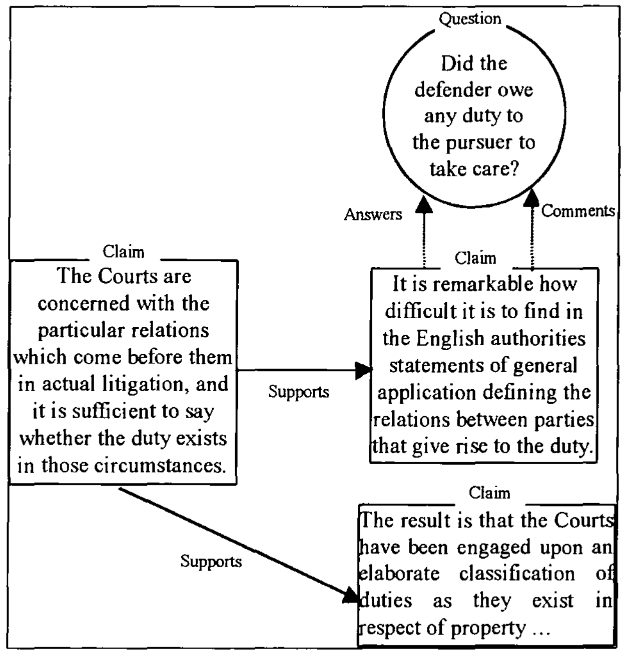

Figure 38: Relating claims in DRL

More problematic is including (13), (14) and (15) in the diagram. (13) and (15) are here interpreted as being alternative conceptions of the structure of the law as it existed when *Donoghue* arose and thus alternative answers to the Question asked by Lord Atkin. As alternative answers it would seem natural to use the 'Alternative' object in DRL to express this. However, the only ways that DRL allows Alternatives to be linked to a Question is through the 'Suggests' relationship or the 'Raises' relationship. The Raises relationship is unsuitable as it implies that the Alternative raises the Question. The Suggests relationship appears similarly unsuitable as neither the Question suggests the Alternatives nor the Alternatives suggest the Question. The second possibility is to classify (13) and (15) as Claims and link them to the Questions as Answers:

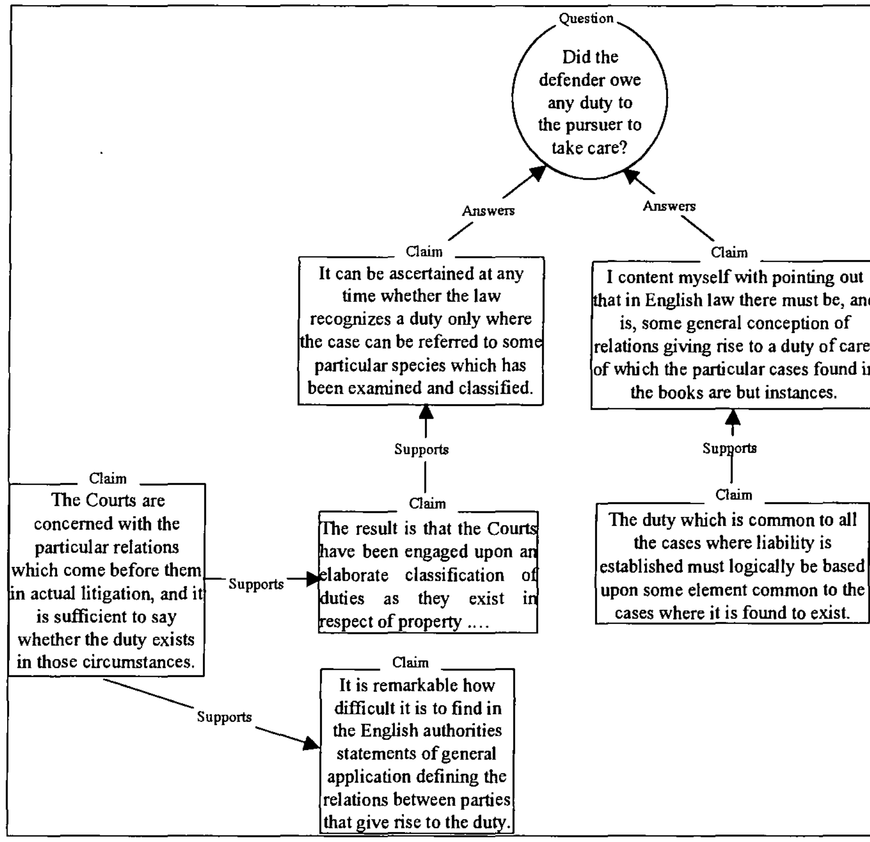

Figure 39:Claims as answers in DRL

While this does seem to capture many of the aspects of the structure of the argument presented in this passage of Lord Atkin's judgment, it does not make clear that the two Claims, diagrammed above as Answers to the Question, are themselves alternatives to each other. As previously discussed, the Alternative object provided by DRL is unsuitable here as the links allowed between it and a Question are unsuitable and Alternatives cannot be the subject of argument (which it is necessary to allow, as they clearly are above).

A final problem with DRL is that it does not allow factual statements or assumptions about the world to be directly included in the diagram. For example, Lord Atkin states:

> A manufacturer puts up an article of food in a container which he knows will be opened by the actual consumer. There can be no inspection by any purchaser and no reasonable preliminary inspection by the

consumer. Negligently, in the course of preparation, he allows the contents to be mixed with poison.[376]

The only conceivable way that such statements might be included in a DRL diagram might be to interpret them as 'Claims'. Interpreted in this way these Claims might be interpreted as supporting a particular conclusion:

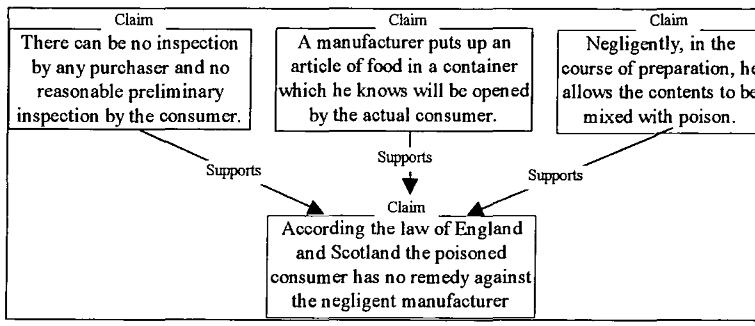

Figure 40: Multiple claims supporting a conclusion in DRL

However, interpreting these statements as Claims appears to misrepresent their nature. They are not presented by Lord Atkin as statements which are controversial and potentially the subject of argument. They are not claims that might need defending. They are statements presented as assumed to be true, or assumed to be true for the purposes of argument. Such statements are presented as a state of affairs upon which to base an argument. Requiring such statements to be classified as claims misrepresents their nature.

Focusing on DRL and its shortcomings as a method for diagramming legal reasoning is not to criticise DRL as a system *per se.* DRL is an extremely interesting and important attempt to capture design rationale. Despite difficulties with DRL in its application to diagramming legal reasoning, DRL is suited to diagramming some aspects of legal reasoning. The simple notion that one Claim 'Supports' another Claim and that one Claim 'Denies' another Claim is often applicable. For example to diagram how cases are cited in support of or in objection to a particular claim. Interestingly, DRL does not contain means to diagram the 'macro' aspects of argument, such as whether premises are linked or convergent. DRL uses 'Groups' to link Claims (and other objects) together.

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[376] Ibid. 582.

Objects within a Group are specified as being either disjunctive (they operate independently) or conjunctive (they operate in dependence on each other) and so could be used to express macro argument structures. No visual representation is provided for this however. DRL provides other interesting features, notably 'dependency management' and 'plausibility management'. Dependency management allows users to specify that aspects of a decision depend on other aspects of the decision. Thus, for example, if a Claim is rejected, then an Alternative that depends on that claim might be removed from the list of possible choices. Plausibility management is a specialised form of dependency management – here however, the plausibility of Claims and Alternatives is calculated and displayed based on the probabilities of the Claims and Alternatives on which they depend. Both dependency management and plausibility management provide limited, though interesting and potentially highly useful, degrees of automated reasoning management.

DRL provides an interesting representation with which to diagram reasoning and provides interesting tools for aiding reasoning based on this representation. However, as a means for representing legal reasoning, DRL has several shortcomings. Legal reasoning has to be 'massaged' in order to be expressed using DRL. While DRL provides more support for diagramming reasoning than does the standard method of argument diagramming, it is subject to several of the same concerns. Just as with the diagramming of argument, the diagramming of reasoning is based upon representations. These representations must be appropriate to the particular task that they are being used to support. DRL is an important approach to capturing design rationale, however, it presents difficulties for expressing legal reasoning.

4.8 Discussion

As work in the psychology of reasoning demonstrates, providing visualisations for arguments and reasoning can be highly beneficial. Argument theory provides the standard method of argument diagramming as a means to visually present the structure of argument. However, attempting to apply argument diagramming to display the structure of legal argument is problematic. First, the standard method of argument diagramming does not explain how to diagram numerous aspects of argument – in particular, analogical arguments and dialogical aspects of argument. This is not to argue that the standard method of argument diagramming is invalid or without benefit. Rather, it emphasises that the diagramming system itself highlights and occludes particular aspects of argument. For example, the standard method of argument diagramming highlights the link between premises and conclusions. However, the method does not emphasise the nature of that link, for example whether it is based on a deduction or whether it is based on an analogy or whether it 'supports' or 'detracts' from, 'accepts' or 'rejects' another argument. There is no universal theory of argument on which to base more comprehensive diagramming.

Secondly, legal argument occurs in a wider framework of reasoning – the standard method of argument diagramming is not capable of expressing the structure of such reasoning. Again, this does not itself detract from the standard method of argument diagramming, it re-emphasises that the method highlights certain things and occludes others. When the goal is to diagram the processes of reasoning that precede the presentation of argument as a product something more than argument diagramming is necessary. A 'perfect' solution to diagramming problem solving would utilise a universally accepted theory that covers all aspects of reasoning. No such theory currently exists. In the absence of such all-encompassing theory, all that can be achieved is the more limited goal, a partial theory that is appropriate for informing about particular reasoning being considered.

Researchers have proposed various methods for diagramming the structures of reasoning. One of the most recent and complex of these methods is DRL. However, the complex and specific nature of DRL itself means that legal reasoning must be 'massaged' to fit within its constructs. Like the standard method of argument diagramming, DRL channels thinking in particular ways and highlights and occludes aspects of reasoning. As with the standard method of argument diagramming, it is not that the method is thereby invalid, only that it is more suited to some tasks than it is to others.

In the absence both of a universal theory of argument, and of a universal theory of reasoning, all that appears achievable is a theory appropriate for particular circumstances. The particular representation that is chosen must be determined by the area the representation is designed to operate in and the aim it is designed to serve. Consequently, all that appears achievable are diagrams appropriate to particular circumstances. The following chapter examines various computer systems that attempt to augment argument and reasoning.

5 Computer tools to augment argument and reasoning

Give me a lever long enough and a prop strong enough and I can single-handedly move the world.

Archimedes

5.1 Introduction

The previous chapter examined methods to diagram argument and reasoning. That chapter argued that central to methods for diagramming argument and reasoning is the representation on which the method is based. An inherent aspect of representations is that they highlight and occlude aspects of argument and reasoning. These representations themselves channel reasoning and problem solving.

This chapter examines various computer systems that have been built to aid the diagramming of argument and reasoning. Systems have been proposed for numerous purposes, from structuring writing, to pedagogy, to structuring meetings, to supporting control of the International Space Station.[377] This diversity of uses reflects not only the broadly felt benefit of such systems but also the diverse origins of research. Research into hypertext has provided the framework for much important work.[378] However, work has also been performed from the perspective of 'computer supported cooperative work',

[377] O'Neill, J., Wales, R., 'CSCA Issues Raised by Mission Control for the International Space Stations'. Paper presented at workshop on Computer-Supported Collaborative Argumentation for Learning Communities, 1999, Stanford University. Available at http://d3e.open.ac.uk/cscl99/ONeill/ONeill-paper.html (accessed 3/3/2001)

[378] E.g.: Conklin, J., Begeman, M.L., 'gIBIS: A hypertext tool for exploratory policy discussion' (1988) 6 ACM Transactions on Office Information Systems 303.

'computer-mediated-communication',[379] and 'computer-based learning'.[380] The examination of systems provided in this chapter has three purposes. First, by highlighting the diversity of systems which have been created and the wide range of uses to which these systems have been put this examination emphasises the extensive scope for the use of diagrammatic representation to augment human sensemaking. Secondly, through highlighting the diversity of existing systems this examination emphasises the variety of representations which have been, and which could be, created to augment sensemaking. Thirdly, through highlighting the variety of representations which have been and could be created to augment sensemaking, this examination substantiates the need for a theoretical basis with which to design, and choose amongst, diagrammatic representations that augment sensemaking.

Systems designed to support the structuring of argument and debate can be analysed from a number of different perspectives - such as the type of computer platform they operate on and the field they were designed for use within. From the perspective of augmenting sensemaking, of most interest is the representation on which systems are based and the consequent structure imposed on argument and reasoning that occurs with the system. Of related interest are the automatic services provided for manipulation of these representations.

In order to highlight the diversity of systems created to augment sensemaking and the diversity of the representations on which they are based this chapter specifically adopts a 'flat' classification scheme. This chapter examines systems according to whether they attempt to support argument or whether they also attempt to support wider aspects of reasoning. Systems are further classified according to whether or not they are designed to operate in or outside law.

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[379] E.g.: Sillince, J.A.A., Saeedi, M.H., 'Computer-mediated communication: problems and potentials of argumentation support systems' (1999) 26 Decision support systems 287.

[380] E.g.: Novak, above n. 259; Fisher, above n. 365; Jonassen, above n. 219.

However, given that there are few systems specifically designed to operate in law all these systems, whether they seek to augment legal argument and/or legal reasoning, are examined together.

Following this introduction, the next subsection examines systems built to support argument in various fields. The third subsection of this chapter examines systems built to support reasoning in various fields. The fourth and final substantive subsections in this chapter examines systems built to augment legal argument and legal reasoning.

5.2 Systems supporting argument

Much work exists examining automated argument and reasoning – both in and outside law.[381] In contrast, this subsection examines systems that support a person engaged in a task that is in some way argumentative. Methods to support argument are not new. One of the most straightforward methods for diagrammatically structuring arguments is using tables. Benjamin Franklin was an advocate of this technique, writing:

> My way is to divide half a sheet of paper by a line into two columns; writing over the one *Pro*, and over the other *Con*. Then, during three or four day's consideration, I put down under the different heads short hints of the different motives, that at different times occur to me for or against the measure. When I have thus got them all together in one view, I endeavour to estimate the respective weights ... find at length where the balance lies ... And, though the weight of reasons cannot be taken with the precision of algebraic quantities, yet, when each is thus considered, separately, and comparatively, and the whole matter lies before me, I think I can judge better, and am less liable to make a rash

[381] The limitations of these systems has been discussed above at 2.5.

> step; and in fact I have found great advantage for this kind of equation, in what may be called *moral* or *prudential algebra*.[382]

Tables can be structured in various ways and research in educational psychology provides empirical evidence of the benefits of tables as means to structure arguments.[383]

Tabular methods for organising arguments will not be investigated in any further detail – for present purposes, it is sufficient to be aware that tables can be used to organise arguments. The remaining examination will focus on 'richer' network-based representations. Such network-based representations are composed of 'nodes', and 'links' that connect those nodes together. Nodes typically contain text and are typically labelled according to what 'type' of text they contain.[384] Toulmin's argument representation scheme[385] and DRL[386] are both classic examples of network-based representation schemes. Toulmin contained labelled nodes including 'Data', 'Claim' and 'Warrant'. DRL contained labelled nodes including 'Decision Problem', 'Claim' and 'Question'. Toulmin's scheme and DRL differ however, in not only the type and number of nodes provided, but also in that DRL utilised labelled links as well as labelled nodes. Links in Toulmin's scheme remain unlabelled. It is the kinds of nodes and links that a particular system uses which comprise its representation. The variety amongst such representations is striking, in not only the specific nodes and links provided, but also in the choice of, or dearth of, nodes and links that any particular system provides. The 'weight' of representations varies from the 'heavy', many different nodes and links, to the 'light', few predefined types of

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[382] Benjamin Franklin cited in Shafir, Simonson and Tversky, above n. 235, 11-12.

[383] See: work by Robinson and colleagues, above n. 262.

[384] The use of textual nodes and links to connect those nodes provided the early impetus for work in hypertext on such systems. More recently, research has explored the use of media other than text in nodes, such as images, sounds and movies. Systems are commonly referred to as 'hypermedia' systems to reflect this widening.

[385] See above discussion of Toulmin schemes: chapter 4.4.

[386] See above discussion of DRL: chapter 4.7.3.

nodes and links. Regardless of whether systems are heavy or light however, many allow customisation and the definition of new types of nodes and links.

One of the benefits of computer-based systems is that they allow automation. Once a representation is stored in a computer, it can be manipulated in ways that would often otherwise be unimaginable. Such manipulation can be straightforward, such as storage and printing, or the facilitation of easy editing and reorganisation. Automation can however, be more complex; for example, DRL uses information about Answers and Options to automatically remove from view those Options which have become invalid. Even 'semi-formal' representations can facilitate useful automation in the support of argumentation.[387]

The difference between argument support systems and systems that support reasoning can in some cases be quite small. Some systems use a representation that can be interpreted as supporting argument, or in addition, as supporting reasoning. For the purposes of this examination, only systems which are specifically aimed at argument support are examined under this heading. However, nothing hinges on how any particular system is classified.

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[387] A 'semi-formal' representation is one in which 'structure' information is represented formally while 'content' information is represented informally: Smolensky, P., Bell, B., Fox, B., King, R. and Lewis, C., 'Constraint-based Hypertext for Argumentation' in Hypertext '87 Proceedings (1987) ACM Press, hereafter Smolensky 'Hypertext for Argumentation', 219. For example, Toulmin's representation scheme distinguishes Data, Claim and Warrants and specifies ways in which they can relate. However, the details of any Data, Claim or Warrant are not considered. Smolensky's distinction is useful in that it highlights the purpose of any given representation – the distinction drawn cannot be a definite one however.

5.2.1 Augment

The inspiration for much work on hypermedia systems and the augmentation of human work using computers came from Engelbart. In pioneering work exploring the concept of augmentation, Engelbart proposed a system, appropriately called 'Augment', designed to improve human work. Notably, in discussing Augment, one of the key examples that Engelbart provided revolved around 'structuring an argument.'[388] Engelbart was concerned with the way that traditional ways of working structure the way that people think about problems:

> You usually think of an argument as a serial sequence of steps of reason, beginning with known facts, assumptions, etc., and progressing toward a conclusion. Well, we do have to think through these steps serially, and we usually do list the steps serially when we write them out because that is pretty much the way our papers and books have to present them--they are pretty limiting in the symbol structuring they enable us to use.[389]

Engelbart regarded computers as providing a means whereby people could free their thinking from old methods:

> The old paper and pencil methods of manipulating symbols just weren't very adaptable to making and using symbol structures to match the ways we make and use conceptual structures. With the new symbol-manipulating methods here, we have terrific flexibility for matching the two ...[390]

For Engelbart the power of computer-based tools arose from the facilitation of manipulation of representations, such as the as the ability to edit, re-word, compile, and delete the statements that make up an argument. Engelbart discussed how a user might:

> establish arbitrary linkages between different substructures, and of directing the computer subsequently to display a set of linked

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[388] Engelbart, above n. 79, III.B.4.

[389] Ibid.

[390] Ibid.

> substructures with any relative positioning we might designate among the different substructures. You can designate as many different kinds of links as you wish, so that you can specify different display or manipulative treatment for the different types.[391]

Engelbart made several astute observations, such as how linkages could be used to compile lists of the antecedents and consequents of statements, how labelling nodes such as by the time they were added, could aid argument comprehension, and how things such as the spatial layout and the use of underlining could provide useful information and aid comprehension.

However, Engelbart's primary concern was to show how computers could be beneficial in general. As such, he did not discuss in detail the particular types of nodes and linkages nor the layouts and services that could be provided with such representations.

Interestingly, for Engelbart, it was the little things that were important:

> impressive new tricks all are based upon lots of changes in the little things you do. This computerized system is used over and over and over again to help me do little things--where my methods and ways of handling little things are changed until, lo, they've added up and suddenly I can do impressive new things.[392]

5.2.2 Toulmin based systems

Toulmin's work is amongst that which has inspired the most work on argument diagramming.[393] As Toulmin's first main work was published in 1958, he did not discuss the use of computers to diagram arguments. Toulmin did however,

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[391] Ibid.

[392] Ibid.

[393] See previous discussion of Toulmin's work: 4.4.

use diagrams to illustrate his arguments about the structure of argument and this has inspired numerous computer systems.

These systems have diverse goals. For example, early versions of 'Belvedere' were 'designed to support the practice of critical discussion'[394] and to help users understand 'the logical and rhetorical relations within a debate'.[395] Belvedere was designed to help teach high school students about argumentation in scientific fields. Although early versions of Belvedere were loosely based on Toulmin structures,[396] they contained some specialisation for scientific argumentation by allowing negative as well as positive links, by allowing multiple linkages to allow complex arguments and by providing a 'Miscellaneous' node.[397] Researchers have explored the use of Toulmin schemes in various educational settings.[398]

Toulmin's analysis has been used in many other systems. For example, Lowe uses Toulmin's scheme to represent the structure of reasoning and debate.[399] Homer-Dixon and Karapin use Toulmin's scheme to analyse arguments about

[394] Suthers, D., Weiner, A., 'Groupware for Developing Critical Discussion Skills' p. 341, in Schnase, J.L. and Cunnius, E.L. (Eds) Proceedings of the First International Conference on Computer support for Collaborative Learning (1995) Lawrence Erlbaum Associates.

[395] Ibid.

[396] Ibid. 343.

[397] Ibid.

[398] Fulkerson, above n. 315; Zumbach proposes using Toulmin structures to support problem based learning: Zumbach, J., Reimann, P., 'Combining Computer Supported Collaborative Argumentation and Problem-Based Learning: An Approach for Designing Online Learning Environments' (1999) Paper presented at workshop on Computer-Supported Collaborative Argumentation for Learning Communities, 1999, Stanford University. Available at http://d3e.open.ac.uk/cscl99/Zumbach/Zumbach-paper.html (accessed 22/2/2001).

[399] Lowe, D.G., 'Cooperative structuring of information: the representation of reasoning and debate' (1985) 23 Journal of Man-Machine Studies 97

the arms race.[400] Ball, and Gasper and George use Toulmin's scheme to analyse arguments in public policy.[401] Toulmin's scheme has also been modified and combined with other representation schemes.[402] Numerous systems in law have been constructed around Toulmin's representational method, these are discussed separately.[403]

5.2.3 NoteCards

NoteCards was an early hypertext system built around an analogue of the cue card.[404] In NoteCards, information could be recorded on virtual cards and these cards could be linked with each other. In this way, a structured network of cards could be constructed. This network would represent the user's understanding of the information contained in the cards. To aid construction, manipulation and comprehension of information contained in cards, NoteCards provided graphical presentations of the network of cards. The whole network of cards could be graphically presented, as well as selected local areas of the network.

Designed as a general system without specialisation for any particular use, NoteCards did not impose any structure on the type of cards used, or on the

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[400] Homer-Dixon, T.F., Karapin, R.S., 'Graphical Argument Analysis: A New Approach to Understanding Arguments, Applied to a Debate about the Window of Vulnerability' (1989) 33 International Studies Quarterly 389

[401] Ball, W.J., 'Using Virgil to Analyze Public Policy Arguments: A System Based on Toulmin's Informal Logic' (1994) 12(1) Social Science Computer Review 26; Gasper and George, above n. 314.

[402] See the discussion of Aquanet in the following sub-subsection and the discussion of Toulmin-based systems in law at: 5.2.2.

[403] See discussion: 5.4.2.

[404] Halasz, F.G., Moran, T. and Trigg, R.H., 'NoteCards in a Nutshell' p. 45, in Proceedings of the ACM CHI+GI Conference (1987) ACM Press; Halasz, F.G., 'Reflections on NoteCards: Seven issues for the next generation of hypermedia systems' (1998) 31 Communications of the ACM 836.

way that they could be connected. As such, NoteCards did not itself provide explicit support for argumentation. However, a prominent feature of NoteCards was that the system was highly customisable. Users could define types of cards and specify ways in which cards could be clustered together and interconnected. The systems allowed almost complete customisation of the work environment.[405]

The flexible environment provided by NoteCards has been used to construct numerous systems. For present purposes the most interesting of these systems is Aquanet.[406] Aquanet uses NoteCards to build a computer environment for constructing and manipulating Toulmin structures. Indeed, the criticisms reported by Newman and Marshall of Toulmin structures as an argument representation method were encountered while using Aquanet.[407]

5.2.4 TEXTNET

Unlike Augment and NoteCards which were both conceived as general systems to construct and manipulate representations in some manner, TEXTNET was a system primarily designed to aid the composition and comprehension of scientific texts.[408] As such TEXTNET facilitated writing by providing support for the organisation of pieces of text into nodes and their linked connection. Nodes contained 'chunks' of text, which could be interconnected using labelled links. In TEXNET, in addition to supporting authoring, this structure was envisaged as a means to support reader comprehension of texts. Users could use the structure given to a document as a means to navigate a document while reading it. Moreover, by adding their own nodes and links, readers could comment on and critique documents being read.

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[405] Halasz, Moran and Trigg, ibid.

[406] Marshall, Halasz, Rogers, and Janssen, above n. 303.

[407] For a discussion of these problems, see: 4.4.1.

[408] Trigg, R.H., Weiser, M., 'TEXTNET: A Network-Based Approach to Text Handling' (1986) 4(1) ACM Transactions on Office Information Systems 1.

TEXTNET supported argument through the provision of labelled nodes and through their connection with labelled links. TEXTNET divided nodes and links into two main types: (1) nodes containing the substance of a scientific text and links, such as 'Summary', 'Argument-by-Analogy', 'Example' and 'Continuation', for connecting those substantive nodes; and (2) nodes containing argument or comment on a scientific text and links, such as 'Refutation,' 'Support', 'Comment', 'Criticism', 'Argument-Immaterial' and 'Style-Incoherent', to connect that commentary to the main text. However, it should be noted that a network could potentially become confusing as the same types of nodes and links could be used both by an author for structuring a document and by a reader for commenting on a document.

The difference is striking between the representation provided by TEXTNET and both Toulmin's scheme and the standard method of argument diagram. TEXTNET contains not only different elements in its representation, but also many more elements in its representation of argument. In this respect, TEXNET provided a comparatively 'heavy' vocabulary.

While providing support for the creation of documents however, the main focus was not on idea exploration or argumentation but on reading and comprehension – specifically reading and criticism in the scientific community.

5.2.5 Scholarly Ontologies Project – ScholOnto

ScholOnto is a project in several respects similar in aim to TEXTNET. TEXTNET focused on expressing the relationships between claims made within single documents as support for improving the writing process, or claims made about single documents. Also focusing on scientific text, the use of 'rhetorical networks' has been proposed as a means to enhance scientific information retrieval.[409] Rather than attempting to represent the details of the arguments presented in a single document, rhetorical networks aim to provide a broad description of how a particular document fits with other literature to which it is related.. To this end, Kircz proposes that every text be stored with a rhetorical network representing whether the text supports or detracts from the ideas that the text discusses and whether the text supports or detracts from, is consistent with, or contradictory to, other relevant literature in the field.[410] In this way, Kircz proposes that researchers would be better able to appreciate the overall shape of a field of research.

The idea of rhetorical networks has recently been pursued in the ScholOnto project.[411] Unlike TEXTNET, ScholOnto aims to support expression of 'high' level inter-document relationships – relationships between documents themselves.[412] ScholOnto is envisaged as a system with which authors could broadly describe the content of their documents. In describing the content of their document, authors would indicate how the document relates to the ideas which it discusses (see figure 41) and how the document fits within existing

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409 Kircz, J.G., 'Rhetorical Structure of Scientific Articles: The case for argumentational analysis in information retrieval' (1991) 47(4) Journal of Documentation 354. The idea of using rhetorical structure to improve information retrieval has also been explored in law: Dick, above n. 303; Hosking, P., 'Argument Representation and Conceptual Retrieval for Litigation Support' (1994) Technical Report CS-TR-94/19: Department of Computer Science, Victoria University of Wellington, New Zealand. Interestingly, the latter attempt to provide a detailed representation of the arguments presented in texts and to use this for legal information retrieval.

410 Although Trigg and Weiser did mention in passing the use of TEXTNET to explore document relationships, this is not something they explored in depth.

411 http://kmi.open.ac.uk/projects/scholonto/

412 In contrast to systems that represent the detailed argumentative contents of single documents – intra-document relationships – systems can also represent the relationships between groups of documents – inter-document relationships: Buckingham Shum, S., Domingue, J. and Motta, E., 'Scholarly Discourse as Computable Structure' (2000) Knowledge Media Institute, Technical Report, KMI-TR-93.

research in the field (see figure 42). Although the structures are different to those in TEXTNET, ScholOnto provides a comparatively heavy representation. Authors would express this in terms of a standard 'ontology' of objects and claims about those objects (see figure 41). ScholOnto is very similar to Kircz' idea of rhetorical networks, however while Kircz only envisaged expression of rhetorical structures ScholOnto allows expression of more general contents.

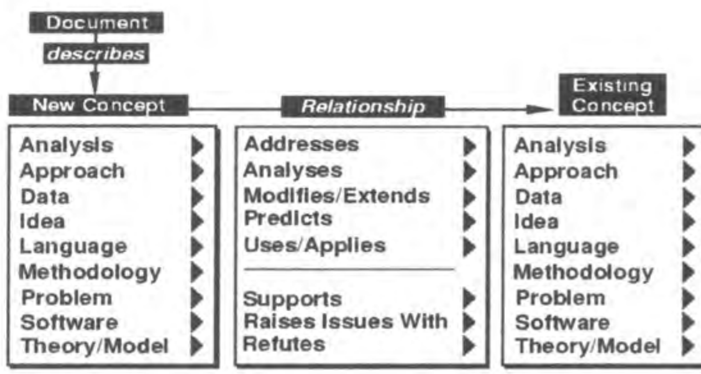

Figure 41: Describing document contents in ScholOnto[413]

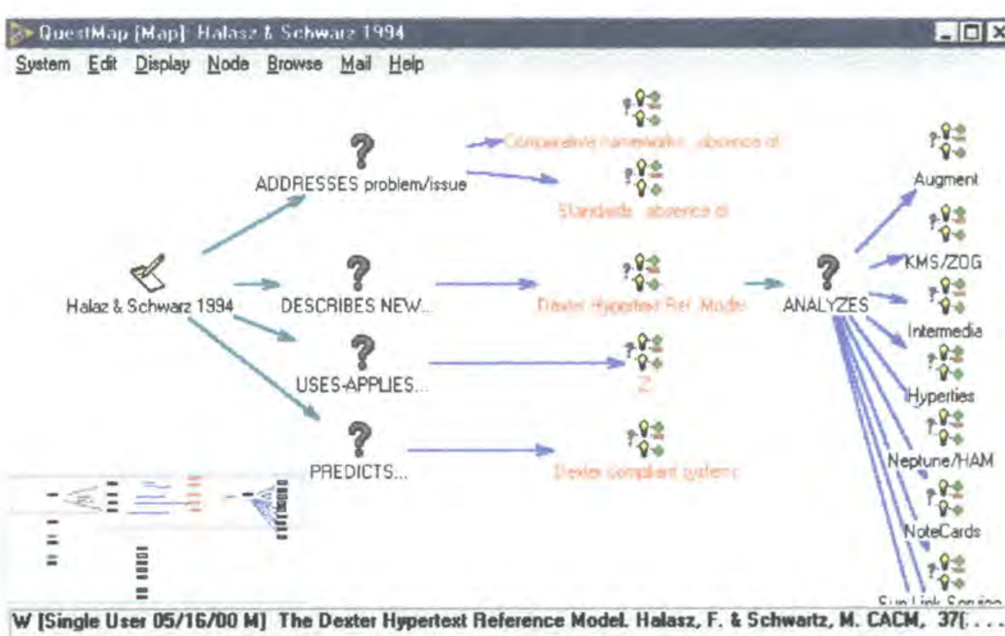

Figure 42: Displaying document contents in ScholOnto[414]

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[413] Ibid. 5.

Once the contents of documents have been described using ScholOnto, readers could navigate the network of documents – a network which captures knowledge about the research area (see figure 43).

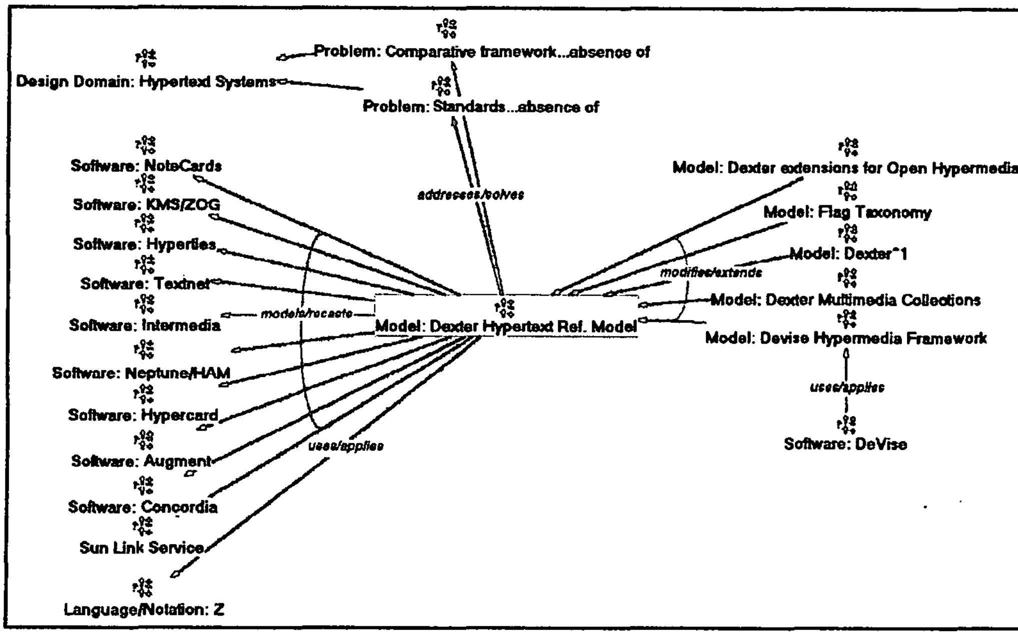

Figure 43: Browsing a conceptual area in ScholOnto[415]

So for example, all documents that support a particular theory could be found, as could all documents that contradict a particular theory. Automatic services could be used to browse and search the area. The authors argue that with such a network of documents researchers could more easily and efficiently grasp the intellectual structure of a domain.[416]

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[414] Buckingham Shum, S., Motta, E. and Domingue, J., `ScholOnto: an ontology-based digital library server for research documents and discourse' (2000) 3 International Journal on Digital Libraries 237.

[415] Ibid.

[416] This work has interesting overlaps with systems commonly used both in academia and professionally, such as 'Web Of Science' and 'Current Law' which allow searching based on the citation relationships between documents. ScholOnto also overlaps with the provision of document 'keywords'. All of these aim to support understanding of an area through provision of information about document interrelationships. ScholOnto however, attempts

5.2.6 Argnoter

Argnoter was an early system developed by XEROX as part of a larger project investigating the creation of tools to support 'collaborative decision making'.[417] In Argnoter, decision making is broken down into a three phase process: proposing; arguing and evaluating.[418] Proposing provides possible solutions to a problem; a brainstorming tool is provided to facilitate this. Arguing involves the argumentative examination of proposals and evaluation involves assessment and choice from amongst the proposals. Argnoter provided a simple means with which participants at a meeting could argue about proposals.[419] Participants could simply label arguments as for or against particular proposals - as either 'pro' or 'con'.[420] It is left to participants to evaluate arguments and to determine which proposal has the strongest arguments. According to the creators of Argnoter, problems arise with argument simply because people do not express their assumptions and arguments or the criteria by which they assess options. Hence, simply through making explicit the arguments and making explicit the ways in which arguments support and detract from proposals, Argnoter provides support for the evaluation of arguments and

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to produce a 'richer' representation of the relationships between documents - and a representation based on the argumentative relationships between documents.

417 Stefik, M., Foster, G., Bobrow, D., Kahn, K., Lanning, S. and Suchman, L., 'Beyond the chalkboard: Computer support for collaboration and problem solving' (1987) 30(1) Communications of the ACM 32.

418 Ibid. 38.

419 Ibid. 38.

420 SPIDER is a tool very similar to Argnoter. Boland describes SPIDER as a tool with which managers can communicate and exchange understandings of the situations they face. Like Argnoter, SPIDER relies on a simple node and link representation in which links are simply labelled as '+' or '-'; Boland, R.J.J., Maheshwari, A.K., Te'eni, D., Schwartz, D.G. and Tenkasi, R.V., 'Sharing Perspectives in Distributed Decision Making' p. 306, in Proceedings of the conference on Computer Supported Cooperative Work (1992) ACM Press.

proposals.[421] By making these explicit, Argnoter hoped to improve group decision-making. Recent experiments support the idea that diagramming can make explicit, tacit knowledge, that making knowledge explicit can change that knowledge and that potentially this can affect decision-making.[422]

Interestingly, in addition to making explicit the actual arguments that decision-makers rely upon, the creators of Argnoter suggest that the beliefs underlying arguments could also be made explicit. They suggest beliefs could be subsumed within general categories such as: 'compatibility'; 'cost'; 'development time'; 'efficiency'; 'feasibility'; 'simplicity'; and 'utility'.[423] Once made explicit, they propose that individual beliefs could be marked as 'true' or 'false' and the consequences for the argument that rely on those beliefs traced through the argument.[424] While an interesting idea, the extent to which beliefs can be consistently categorised is debatable – however since this proposal was not discussed in any depth it will not be further considered.

5.2.7 Argument Representation Language

The Argument Representation Language (ARL) is a representation designed to support 'reasoned discourse'.[425] To this end, Smolensky *et al.* have produced a tool that helps:

> people create and assess reasoned arguments and communicate these arguments to others. The tool provides reasoners with a *language*, ARL,

[421] Stefik et al., above n. 417, 38.

[422] Rodhain, F., 'Tacit to explicit: transforming knowledge through cognitive mapping - an experiment' p. 51, in Proceedings of the 1999 ACM SIGCPR conference on Computer personnel research (1999) ACM Press, 51

[423] Stefik et al., above n. 417, 39.

[424] Ibid.

[425] Smolensky 'Hypertext for Argumentation', above n. 387, 216.

> for expressing their arguments in a clear, precise, and relatively standardized fashion.[426]

As Smolensky *et al.* note, the key is to provide:

> A language which has sufficient expressive power to represent realistically sophisticated arguments[427]

ARL thus provides numerous link types with which to classify relationships between pieces of text and thereby to support argument. These include 'Claim,' 'Asserts,' 'Main-Point,' 'Supports,' 'Contradicts,' 'Relevant-to,' 'Requires,' 'Refutes,' 'Mapped' and 'Mean'. In both the type of objects provided and their richness, ARL is similar to TEXTNET and ScholOnto. Notably, despite the richness of the vocabulary provided, the authors argue that users must be able to define their own link types.[428]

In terms of expressing arguments, the most relevant objects in ARL are 'Claims' and 'Arguments' which can be related through, the most relevant ways for present purposes, 'Contradicts' and 'Supports' links. As indicated above, ARL provides various other entities with which to structure reasoned discourse. These do not focus on expressing wider aspects of reasoning such as does DRL.

Smolensky *et al.* regard one of the largest benefits of representing reasoned discourse as the automation that is made possible.[429] ARL focuses heavily on how to perform computations over the arguments expressed in the system. For example, Smolensky *et al.* discuss how larger argument forms – such as a 'misrepresentation' – can be defined within the system. A 'misrepresentation' would occur when someone presents another's argument in an inaccurate

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[426] Ibid. 217.

[427] Smolensky, P., Fox, B., King, R. and Lewis, C., 'Computer-Aided Reasoned Discourse or, How to Argue with a Computer' p. 109, in Guindon, R. (eds.) Cognitive Science and its application for human-computer interaction (1988) Lawrence Erlbaum Associates, hereafter Smolensky 'How to Argue', 112.

[428] Smolensky 'Hypertext for Argumentation', above n. 387, 218-9.

[429] Smolensky 'How to Argue', above n. 427, 128.

manner. Smolensky *et al.* suggest that misrepresentation is characterised by the existence of arguments connected to other arguments in standard and distinctive ways. Smolensky *et al.* suggest that by defining such argument forms, a computer implementation of ARL could automatically detect the presence of a misrepresentation in an argument. This is an interesting goal. Its success however depends on the ability to unambiguously define the ways in which arguments interconnect in each argument form. The diversity and complexity of everyday argument casts doubt on this possibility - however, since ARL remains largely unimplemented this will not be examined further.

5.2.8 ReasonAble!

'ReasonAble!' is a system based on a simple 'Claim'-supports-'Conclusion' structure and is primarily designed to help students learn how to argue.[430] ReasonAble! uses a graphical interface with which users can construct arguments.

ReasonAble! contains several interesting features. First, ReasonAble! contains an automated assistant which provides advice to users when they input arguments into the system. For example, when a user inputs a Claim, the assistant informs users to focus on what point is being made and to formulate it in a single sentence. When a user inputs multiple claims into the system, the assistant asks whether the claim 'helps' or whether it independently supports a conclusion - thus forcing the user to focus on whether the claims are parallel or convergent.[431] This is an interesting automated implementation of aspects of argument theory and is not something offered by other systems.

[430] www.goreason.com

[431] However, ReasonAble! is based on a particular representation of argument in which convergent claims are split into a 'main' claim and a helper claim.

Secondly, ReasonAble! contains a mechanism whereby users can assess the strength of their arguments. This is achieved through a simple mechanism whereby users select how well supported they think an argument is (see figure 44).

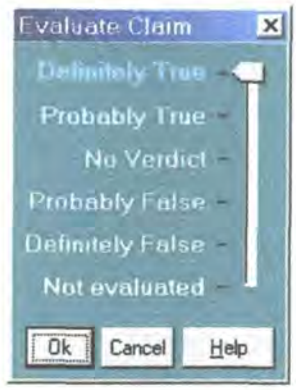

Figure 44: Evaluating claims using ReasonAble!

The strengths of claims and objections is visually indicated in ReasonAble! By the colour of the claim and the colour of the link to a Conclusion that it supports (see figure 45).

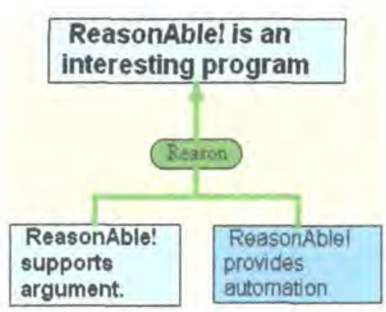

Figure 45: Evaluated arguments in ReasonAble!

However, while the strength of arguments can be specified and visually indicated, ReasonAble! does not use these assessments to automatically assess the status of conclusions.[432]

[432] ReasonAble! provides a further mechanism for evaluating premises through their classification into types of 'Ground'. However, as implemented in ReasonAble!, Grounds are problematic (for example, they cannot be the subject of argument) and it is difficult to see what they add to argument creation and evaluation. They will not be discussed further.

Notably, ReasonAble! has been used to teach informal reasoning in an undergraduate university course. Research reports that students who studied using ReasonAble! performed significantly better than did a control group taking a conventional course in informal reasoning.[433]

5.2.9 Argument Maps

Horn has argued for the use of Argument Maps to display that nature of complex scholarly arguments.[434] There are several notable aspects of Horn's work. First is that the maps do not make use of a standardised vocabulary. Although aspects of debates are linked as in other approaches, linkage is *ad hoc*. Further, the maps make large use of clip art and other imagery to illustrate and emphasise points made during debate. Although too small to appreciate the detail, figure 46 is an argument map created by Horn and colleagues as part of a series to illustrate the status of debate surrounding the question of whether or not computers can think. Figure 46 illustrates the general structure of argument maps as envisaged by Horn.

[433] van Gelder, T., Bulka, A., 'Reason!: Improving Informal Reasoning Skills' presented at the Australian Computers in Education Conference, 2000, University of Melbourne.

[434] Horn, R.E., Yoshimi, J., Deering, M. and McBride, R., `Using Argumentation Analysis to Examine the History and Status of a Major Debate in Cognitive Science' p. 1102, in Shafto, M.G. and Langley, P. (Eds) Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society (1997) Erlbaum.

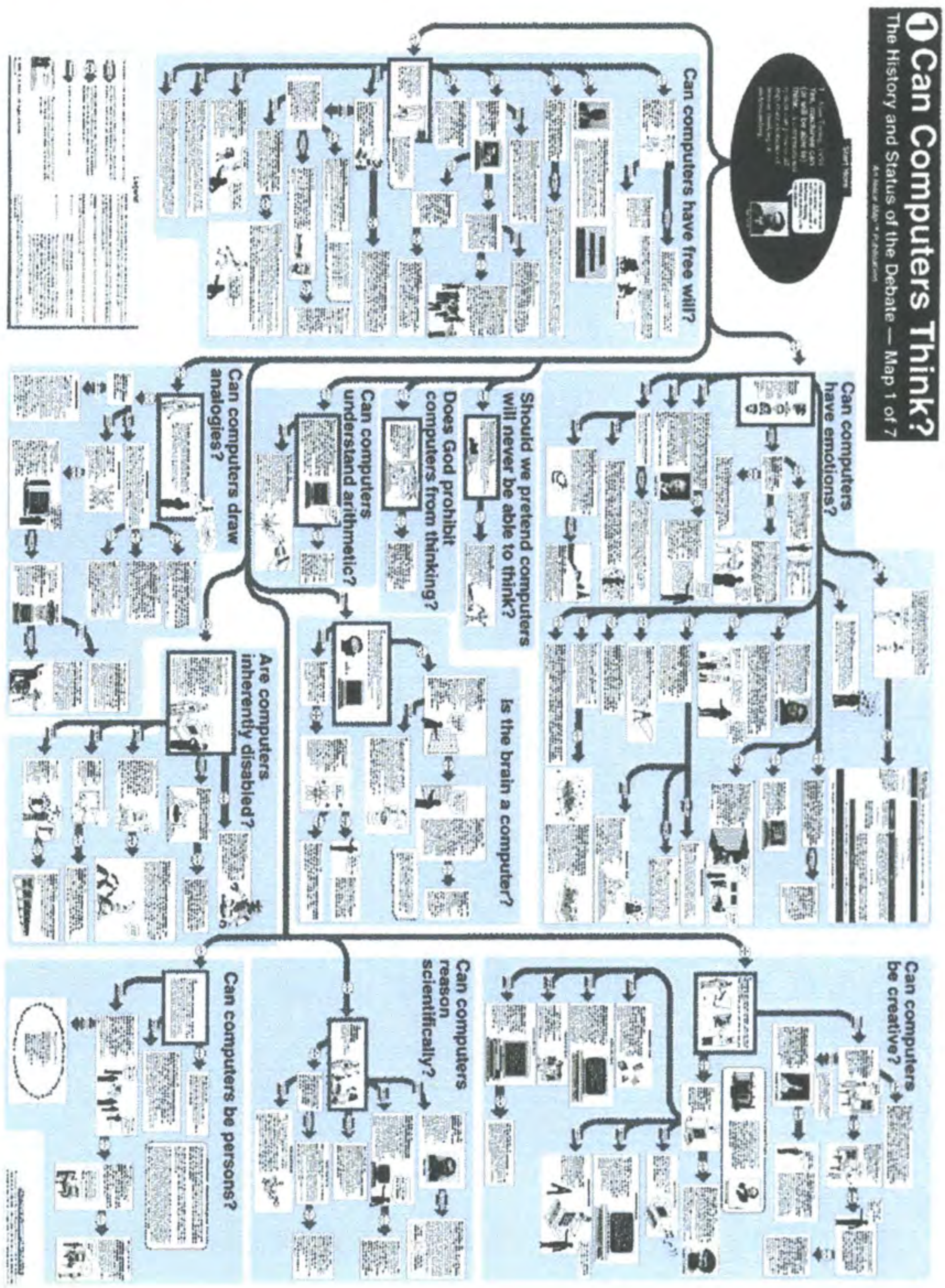

Figure 46: Horn's argument map about artificial intelligence

Figure 47 provides more detail from a map created by Horn concerning whether the Turing test is a good test for detecting intelligence in computers.

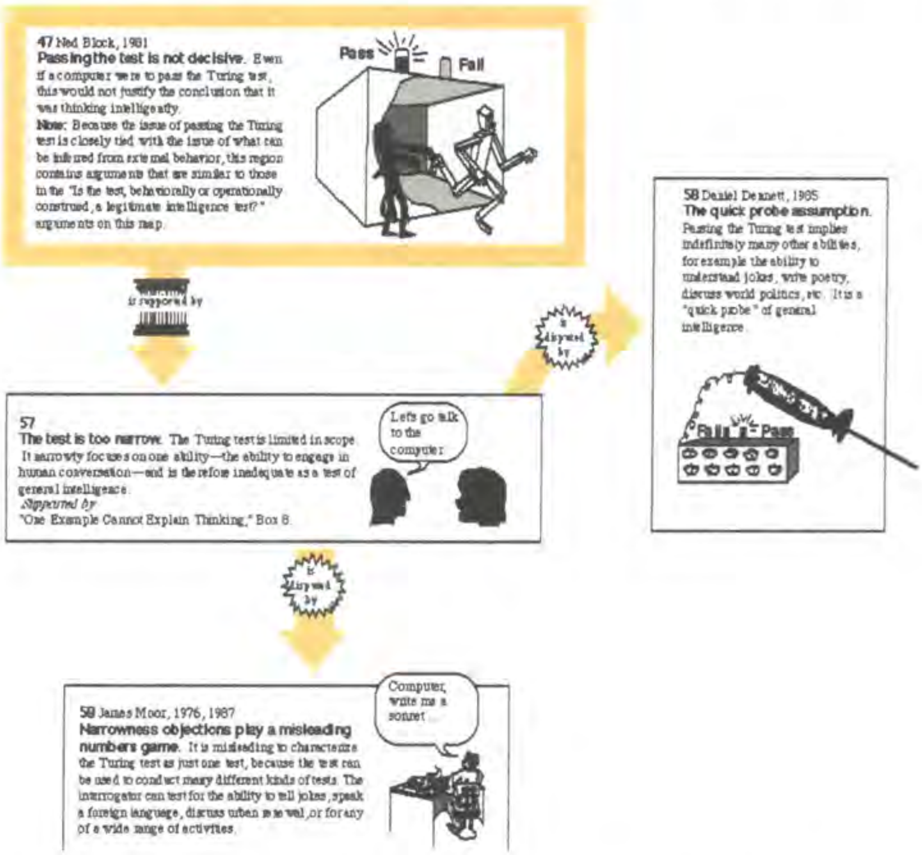

Figure 47: Detail from an argument map about the Turing test.

Horn's maps are striking not only for their breadth and complexity but also the richness of the imagery that they use.

The second notable aspect of the argument maps created by Horn is that they have been created by a joint team of academics and are thus comprehensive and to some degree authoritative commentaries on the areas that they cover. As such, these argument maps are sold as teaching resources and have received praise as useful teaching tools.[435] However, there is of course nothing inherent

[435] Metzinger, T., 'Teaching Philosophy with Argumentation Maps: Review of Can Computers Think? The Debate by Robert E. Horn' (1999) 5(30) PSYCHE: An interdisciplinary journal of research on consciousness http://psyche.cs.monash.edu.au/v5/psyche-5-30-metzinger.html (accessed 21/2/2001); Chandler, J., 'Mapping The Great Debates' (1999) The Philosopher's

in the techniques for creating argument maps that requires either comprehensiveness or contributions from domain experts.

Unfortunately, while Horn's maps are impressive, Horn does not provide detailed discussion of how to create maps and there is no computer environment dedicated to doing so. While Horn advocates the extensive use of clip art, it remains for the individual to make use of this as they see fit. Creation of argument maps retains a large element of art.

5.2.10 A diversity of diagrams

From the above examination, it is evident that the idea of argument diagramming - 'argument mapping' – is widely interpreted. Systems differ greatly in the representation of argument that they impose. Indeed, the idea of an argument diagram sometimes seems to be lost. For example, the 'Multimedia Forum Kiosk' allows comments to be linked with categories such as 'and', 'or', 'but' and 'i.e.'. [436] Strangely however, while the graphical representation of the argument provides a photo of the contributor to the argument, it provides no representation of their substantive contribution – while it is possible to 'see' who has responded to who during an argument it is not possible to see the actual content of their arguments. In this 'argument map' it is thus not possible to 'survey' the overall structure of the argument – only to survey the structure of the sequence of contributions that make up the argument.

The representation of argument provided in a system is extremely important as it directs how argument will occur using the system. For many tasks though,

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The Philosopher's Magazine 11. The type of argument map envisaged by Horn has also been used commercially in an attempt to improve decision-making: see www.austhink.org.

[436] Hoadley, C.M., Hsi, S., 'A multimedia interface for knowledge building and collaborative learning' p. 103, in INTERACT '93 and CHI '93 conference companion on Human factors in computing systems (1993) ACM Press.

supporting argumentation is insufficient and support for wider aspects of problem solving is necessary. The following subsection examines systems that attempt to represent and support aspects of problem solving wider than argument.

5.3 Systems supporting reasoning

Systems to represent argument are useful. However, to fully support sensemaking representing reasoning is also often necessary. Various systems exist which attempt to support aspects of reasoning. Mind mapping tools, as aids to brainstorming, have already been discussed.[437] However, various other tools attempt to provide more structured support for reasoning. Like argument support tools, these tools vary greatly in the situations they are designed to be used in and support, and in the representations they provide.

Reasoning is investigated from many perspectives and in many fields. An important element of this research into reasoning is the development of models designed to improve decision-making. Decision analysis and the use of models such as expected utility theory can undoubtedly be of benefit for numerous tasks. Graphical representations of such decision analytic methods are well developed and widely used.[438] However, such quantitative methods are not examined here. This examination focuses on systems which support qualitative reasoning.[439] Moreover, the following examination is not presented as comprehensive – innumerable systems have not been examined which could nevertheless in some way said to support reasoning. The systems examined here have been included partly because they have proved influential, and more simply, merely to highlight the diversity of systems that exists and the diversity of representational structures they employ in the support of reasoning.

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[437] See 4.7.2.

[438] For example, decision trees.

5.3.1 Discussion systems

A popular objective for system creators is to support group reasoning through facilitation and organisation of group communication. Numerous systems exist that facilitate joint discussion and that facilitate discussion of, organisation of, and commentary upon documents.

5.3.1.1 HyperNews

HyperNews is a variation of the traditional Usenet News.[440] HyperNews modifies Usenet News in several ways. Two of these are that in HyperNews, discussion is hyper-linked, and contributions to a discussion all have an associated type. This type indicates how the contribution relates to the existing discussion. Contributors to a HyperNews discussion label their contributions as: 'None', 'Question', 'Note', 'Warning', 'Feedback', 'Idea', 'More', 'News', 'OK', 'Sad', 'Angry', 'Agree', 'Disagree'. These have associated visual icons.

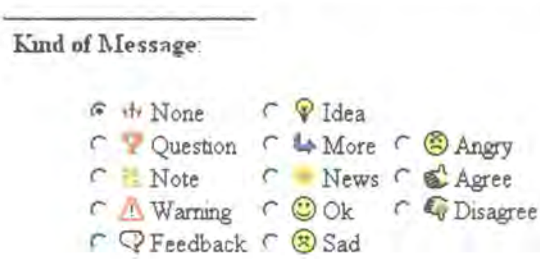

Figure 48: Types of HyperNews contributions

The rationale underlying such labelling is that it allows readers to more quickly and easily scan a discussion, judge its tone and select parts of the discussion that they wish to read. While HyperNews contains the straightforwardly argumentative 'Agree' and 'Disagree' labels, other labels provided in the system are far more diverse.

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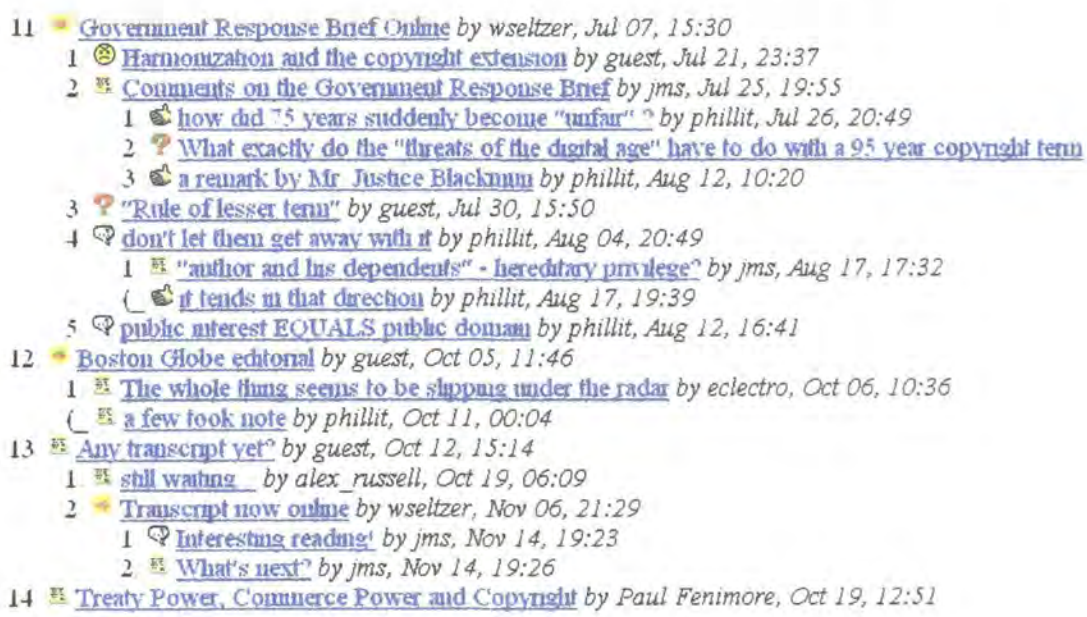
[439] For a discussion for the importance of the distinction between quantitative reasoning and qualitative reasoning, see: 3.5.

[440] www.hypernews.org

Notably, HyperNews has been used as a central element in the 'OpenLaw' project.[441] OpenLaw is described as:

> an experiment in crafting legal argument in an open forum .... we will develop arguments, draft pleadings, and edit briefs in public, online. Non-lawyers and lawyers alike are invited to join the process by adding thoughts to the "brainstorm" outlines, drafting and commenting on drafts in progress, and suggesting reference sources.[442]

As indicated, OpenLaw seeks to solicit public contribution in the research and organisation of public interest lawsuits. Using HyperNews, amongst other things, participants can discuss the issues in a case, suggest arguments relating to those issues, critique arguments made by others and suggest new argument. Figure 49 is a sample from an OpenLaw discussion concerning a proposal to extend the term of copyright protection in the United States of America.



11 Government Response Brief Online *by wseltzer, Jul 07, 15:30*
- 1 Harmonization and the copyright extension *by guest, Jul 21, 23:37*
- 2 Comments on the Government Response Brief *by jms, Jul 25, 19:55*
  - 1 how did 75 years suddenly become "unfair" ? *by phillit, Jul 26, 20:49*
  - 2 What exactly do the "threats of the digital age" have to do with a 95 year copyright term
  - 3 a remark by Mr Justice Blackmun *by phillit, Aug 12, 10:20*
- 3 "Rule of lesser term" *by guest, Jul 30, 15:50*
- 4 don't let them get away with it *by phillit, Aug 04, 20:49*
  - 1 "author and his dependents" - hereditary privilege? *by jms, Aug 17, 17:32*
  - (_ it tends in that direction *by phillit, Aug 17, 19:39*
- 5 public interest EQUALS public domain *by phillit, Aug 12, 16:41*

12 Boston Globe editorial *by guest, Oct 05, 11:46*
- 1 The whole thing seems to be slipping under the radar *by eclectro, Oct 06, 10:36*
- (_ a few took note *by phillit, Oct 11, 00:04*

13 Any transcript yet? *by guest, Oct 12, 15:14*
- 1 still waiting *by alex_russell, Oct 19, 06:09*
- 2 Transcript now online *by wseltzer, Nov 06, 21:29*
  - 1 Interesting reading! *by jms, Nov 14, 19:23*
  - 2 What's next? *by jms, Nov 14, 19:26*

14 Treaty Power, Commerce Power and Copyright *by Paul Fenimore, Oct 19, 12:51*

Figure 49: Example OpenLaw discussion

OpenLaw has been used to collect information and argument that has formed the basis of submissions in litigation in the United States of America concerning

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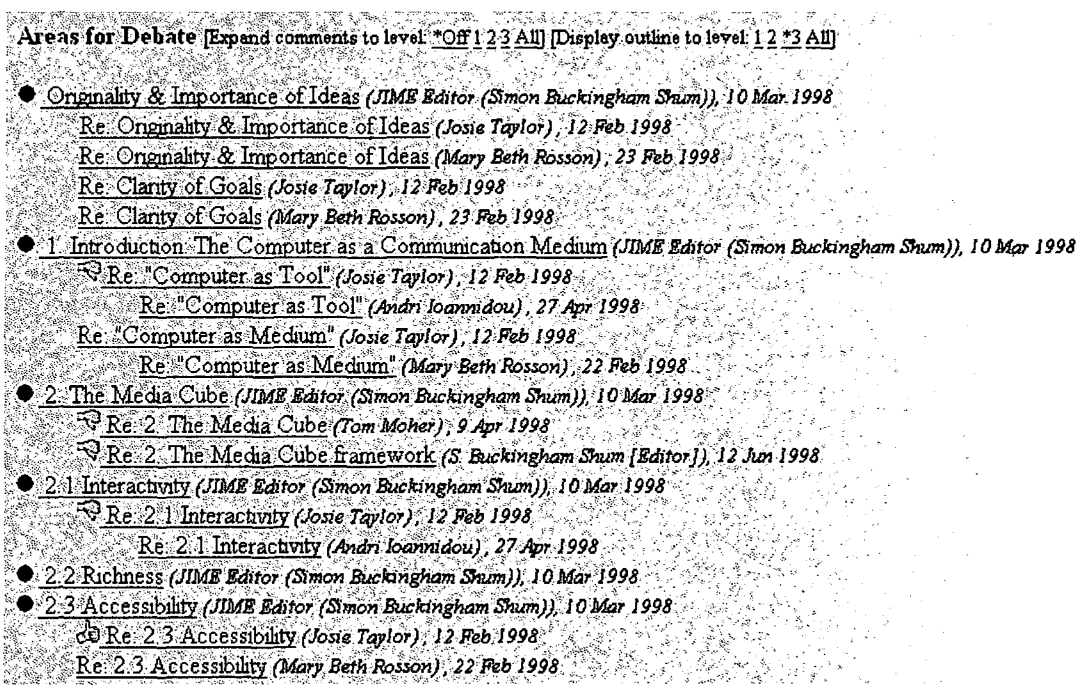
[441] http://eon.law.harvard.edu/openlaw/

[442] Ibid.

the Microsoft monopoly trial, open access to cable networks, the circumvention of digital encryption controls, and the extension of the copyright term.

5.3.1.2 Digital Document *Discourse Environment (D3E)*[443]

D3E is an environment for publishing documents. For present purposes, one of its interesting aspects is that readers can comment on documents in the system. The comments that readers make are hyper-linked to the section of the document which is being commented upon. As a simple aid to navigation, comments are labelled as 'Agree', 'Disagree' or 'Unclassified'.


Areas for Debate [Expand comments to level: *Off 1 2 3 All] [Display outline to level: 1 2 *3 All]

- Originality & Importance of Ideas *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
  - Re: Originality & Importance of Ideas *(Josie Taylor), 12 Feb 1998*
  - Re: Originality & Importance of Ideas *(Mary Beth Rosson), 23 Feb 1998*
  - Re: Clarity of Goals *(Josie Taylor), 12 Feb 1998*
  - Re: Clarity of Goals *(Mary Beth Rosson), 23 Feb 1998*
- 1. Introduction: The Computer as a Communication Medium *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
  - Re: "Computer as Tool" *(Josie Taylor), 12 Feb 1998*
    - Re: "Computer as Tool" *(Andri Ioannidou), 27 Apr 1998*
  - Re: "Computer as Medium" *(Josie Taylor), 12 Feb 1998*
    - Re: "Computer as Medium" *(Mary Beth Rosson), 22 Feb 1998*
- 2. The Media Cube *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
  - Re: 2. The Media Cube *(Tom Moher), 9 Apr 1998*
  - Re: 2. The Media Cube framework *(S. Buckingham Shum [Editor]), 12 Jun 1998*
- 2.1 Interactivity *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
  - Re: 2.1 Interactivity *(Josie Taylor), 12 Feb 1998*
    - Re: 2.1 Interactivity *(Andri Ioannidou), 27 Apr 1998*
- 2.2 Richness *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
- 2.3 Accessibility *(JIME Editor (Simon Buckingham Shum)), 10 Mar 1998*
  - Re: 2.3 Accessibility *(Josie Taylor), 12 Feb 1998*
  - Re: 2.3 Accessibility *(Mary Beth Rosson), 22 Feb 1998*

Figure 50: Example discussion provided by D3E[444]

This is reminiscent (though simplified) of the types of commentary facilitated by HyperNews. D3E differs from HyperNews however in the tight integration it provides between documents and discussion about documents. In HyperNews,

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[443] http://d3e.open.ac.uk/

[444] Taken from a discussion of an article published in the 1998 volume of the Journal of Interactive Media in Education (JIME), discussion available at: http://www-jime.open.ac.uk/Reviews/get/repenning-98-7-reviews.html

document browsing occurred separately to discussion about those documents. In D3E, comments link directly to relevant documents and parts of documents.

5.3.1.3 Open Meeting

'Open Meeting' was a program designed to 'support productive, wide-area collaboration for policy planning and problem solving'.[445] The system, which ran over the World Wide Web, allowed users to discuss proposals for bureaucratic reforms, such discussion then being used as feedback to refine those reforms. To provide some structure to the comments made by users, all comments had to be categorised within defined types. Open Meeting allowed seven types of comments: 'Agree'; 'Disagree'; 'Qualify'; 'Alternative'; 'Example'; 'Question'; and 'Answer'.

Icon	Link Type	Description
	Agree	A reason to support the recommendation or action.
	Qualify	A qualification that explains exceptions or extensions for a recommendation or action.
	Alternative	An alternative way to implement a recommendation or action.
	Disagree	A reason to challenge why or how a recommendation or action can work.
	Example	A report of a promising practice that illustrates one good way to realize a recommendation.
	Question	A question about a recommendation or action.
	Answer	An answer to someone else's question.

Figure 51: Contributions in Open Meeting

[445] Hurwitz, R., Mallery, J.C., 'The Open Meeting: A web-based system for conferencing and collaboration' in Proceedings of the Fourth International Conference on The World-Wide Web (1995) World Wide Web Consortium.
Available at: http://www.w3.org/pub/Conferences/WWW4/papers2/349 (accessed 3/12/2000)

This is reminiscent of Hyper News. However, in Open Meeting, only certain links between comments were allowed. For example, no 'Alternative' was allowed for a 'Qualification' or an 'Alternative' to an 'Example' were allowed. The creators of the system regarded such contributions as illogical.[446]

Open Meeting is interesting for its use in an official government sponsored context. Open Meeting was used to elicit and structure discussion about reform of the federal administration in the United States of America. Its creators rate this use of Open Meeting as a success.[447]

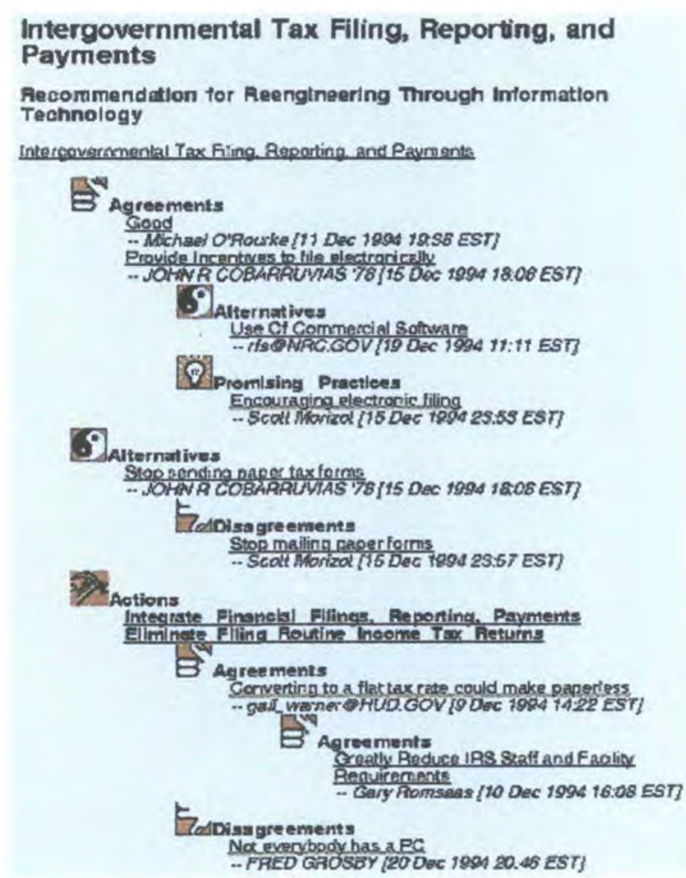

Figure 52: Discussions with Open Meeting[448]

[446] However, some of further moves that are excluded as illogical seem highly sensible, e.g. an alternative to a question; an alternative to an alternative; and an alternative to an answer.

[447] Hurwitz and Mallery, above n. 445.

[448] Ibid.

The discussion systems examined here are interesting first because of the wide use they have received. Both HyperNews and D3E are used daily. Secondly, these systems are interesting for the variation amongst the representations that they utilise. Not only are different types of comments supported, but the ways that those comments can be linked to previous comments varies. While HyperNews and D3E do not restrict linkages, Open Meeting imposes a defined semantics on links. Interestingly, the linear structure imposed on contributions itself inherently limits linkage between contributions – contributions can only concern the immediately preceding comment. Network-based representations in contrast, allow potentially unlimited linkage between any node and any other. Interestingly, each of these systems attempts minimal formalisation of contributions to a discussion – comments are simply given a general label indicating their overall tone. This contrasts with Toulmin and DRL for example, which respectively support formalisation of detailed aspects of argument and reasoning.

5.3.2 Belvedere

Belvedere is an interesting system for diagramming reasoning developed by Suthers *et al.* Belvedere was designed to aid high school students in learning about scientific reasoning and arguments in science. Interestingly, Belvedere has existed in various different forms. Each of these forms has provided a slightly different representational structure.

In its early forms, Belvedere was based on Toulmin's model of argument, though modified for use specifically in a scientific context.[449] These versions of Belvedere contained objects such as 'Principle', 'Theory', 'Hypothesis', 'Claim', and 'Report'.[450] However, early versions of Belvedere sometimes operated without the 'Principle' and 'Report' objects but instead providing 'Warrant',

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[449] Suthers and Weiner, above n. 394.

[450] Ibid.

'Observation'/'Data' and 'Law' objects. Similarly, the way objects were linked in early versions of Belvedere varied. Belvedere sometimes used 'Supports', 'Explains', 'Conflicts', 'Justifies' and 'Undercuts' relationships while at other times omitting the 'Justifies' and 'Undercuts' relationships and using 'Causes' and 'Negates' relationships instead.[451]

Belvedere is thus interesting because it has experimented with the underlying representation that is provided. As Suthers states, the objects and relationships included in the system depend on the particular knowledge and skills of its users - thus part of the process in the design of Belvedere was to design:

> argumentation palettes ... for everyday and scientific argumentation. The palettes vary in granularity, distinctions available (e.g., whether "justifications" are included as a component type), and relationships emphasized (e.g., theory versus domain). We plan to use these palettes to effect transitions between everyday and scientific argumentation in a manner fitting students emerging competencies and readiness to appreciate new distinctions.[452]

Interestingly, later versions of Belvedere contain much simpler objects and relationships. For example, recent versions of Belvedere merely allow 'Data' to be linked to 'Hypothesis' through 'Consistency' and 'Inconsistency' relationships.[453] According to Suthers, the simplification of the objects and relationships provided in recent versions of Belvedere arose because students were not able to understand the distinctions between objects provided in earlier versions.[454] This probably relates in part to the structure of Toulmin arguments on which Belvedere was based. Even for readers knowledgeable in a domain it

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[451] Ibid.

[452] Ibid.

[453] Suthers, above n. 81.

[454] Ibid.

can be difficult to classify objects within Toulmin structures.[455] Further, early versions of Belvedere sometimes contained 'Theory', 'Hypothesis', 'Warrant' and 'Law'. However, it is very difficult to precisely state what the difference is between a 'Warrant' and a 'Theory', a 'Warrant' and a 'Hypothesis' or a 'Warrant' and a 'Law'. Difficulties encountered using the objects within Belvedere highlight the need for clear and appropriate representations. The simplification of the representation underlying Belvedere during its evolution could be taken to suggest that simple, 'light', representations are more appropriate than complex representations. However, the ambiguities in the various representations used in Belvedere detract from this conclusion. Moreover, as Suthers stresses, the light representational system is for use by non-expert students and is designed, on the contrary, to 'scaffold' their learning. In a context where users are a knowledgeable and well-trained group with a large degree of homogeneity, representational schemes that are more complex might be appropriate.

Belvedere supports reasoning and argument as engaged in by early high school science students. Belvedere does not (or rather with its adjustable pallets, has not yet been used to) support wider reasoning tasks. Research indicates that Belvedere is successful in prompting and constructive argument amongst students who use it.[456]

5.3.3 Issue-Based Information System (IBIS)

IBIS is an approach to problem solving developed by Rittel and Weber as a means to tackle 'wicked problems'.[457] Interestingly, in IBIS argumentation plays an important role in exploring and deciding wicked problems. IBIS is itself widely used but has additionally been highly influential in efforts to create

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[455] See the discussion of Toulmin's scheme: 4.4.1.

[456] Veerman, above n. 264.

[457] For a discussion of 'wicked problem' see: 3.5.1.

computer tools to support problem solving, in particular, work on design rationale.

The IBIS theory of problem solving revolves around 'Issues', 'Positions' and 'Arguments'. Issues are used to diagram problematic facets of a situation - Issues spotlight specific aspects of a problem that must be addressed. Possible solutions to Issues are called 'Positions'. 'Argument' nodes are used to argue about the advantages or disadvantages of Positions.

The IBIS method defines specific relationships by which Issues, Positions and Arguments can be related to each other. For example, Positions can be linked to Issues with a 'Responds-to' link, Arguments can be linked to a Position with either a 'Supports' or an 'Objects-to' link, Issues can 'Generalize' or 'Specialize' other Issues. Figure 53 illustrates all the nodes and links allowed in IBIS.

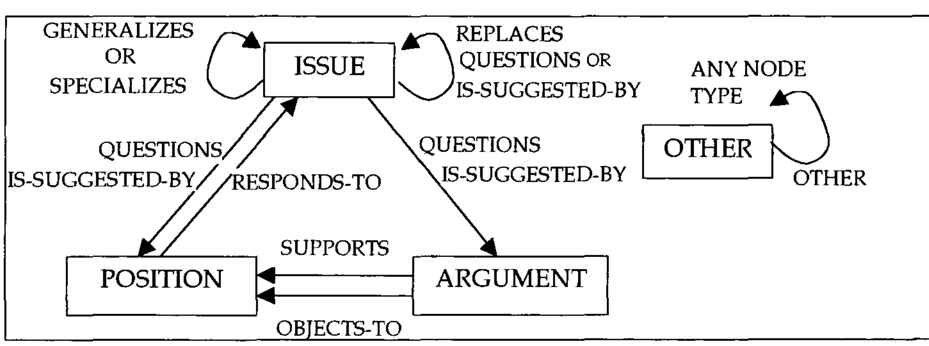

Figure 53: Objects and links provided in IBIS[458]

IBIS promotes a particular view about the way problems are structured and the way that they should be resolved. The IBIS method has spawned several variations including gIBIS, wIBIS and the commercial program Questmap[459]

[458] Conklin and Begeman, above n. 378, 305.

[459] www.gdss.com. Also: Hashim, S.H., 'WHAT: An argumentative groupware approach for organizing and documenting research activities' (1991) 1 Journal of Organizational Computing 275. OMNI is another issue based system like gIBIS. Its primary uniqueness is its application to business decisions and the use of voting procedures to close issues: Lange, B., Treleaven, J.B. and Gershman, A., 'OMNI: a model for focused collaborative work

and has been used for a variety of tasks including policy planning,[460] meeting support[461] and architectural design.[462]

Interestingly, despite a seemingly general representation having general applicability, users of IBIS can have trouble fitting their work within IBIS constructs.[463] It is thus not only Toulmin's representations, with their comparatively complex constructs, that can cause confusion. However, there is some evidence that in the case of IBIS, users soon learn to use the

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through issue management' p. 190, in Proceedings of the conference on Organizational computing systems (1993) ACM Press. Horita discusses an 'Argumentative Analysis of Options' which is in many ways similar to IBIS: Horita, M., 'Folding Arguments: A Method for Representing Conflicting Views of a Conflict' (2000) 9 Group Decision and Negotiation 63. However, Horita uses the number of supporting and detracting argument connected to an Option to calculate a 'positive ground rate' – a number intended to indicate how strongly Arguments support an Option. However, an assessment needs to be conducted of the utility of such a single number to express degree of support – especially given that such calculation does not capture the individual strength of particular arguments in supporting or detracting from a proposition. While some arguments might be strongly supportive, others might be only weakly supportive. Detracting arguments might be strongly detracting while others only weakly so. Further, the utility of a single number as an expression of degree of support as compared to indicating the arguments for and against a proposition needs to be assessed.

[460] Rittel and Weber, above n. 206.

[461] Conklin and Begeman, above n. 378; Conklin, J., Begeman, M.L., 'gIBIS: A tool for all reasons' (1989) 40 Journal of the American Society for Information Science 200; Conklin, J., 'Seven Years of Industrial Strength CSCA in an Electric Utility' (1999). Paper presented at workshop on Computer-Supported Collaborative Argumentation for Learning Communities, 1999, Stanford University. Available at http://d3e.open.ac.uk/cscl99/Conklin/Conklin-paper.html (accessed 15/3/20001).

[462] Fischer, G., McCall, R. and Morch, A., 'JANUS: Integrating Hypertext with a Knowledge-based Design Environment' p. 105, in Proceedings of Hypertext '89 (1989).

[463] Isenmann, S., Reuter, W.D., 'IBIS--a convincing concept...but a lousy instrument?' p. 163, in Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques (1997) ACM Press, 169; Conklin, above n. 461.

representation - suggesting that while all representations structure thinking and need to be learned, some can nevertheless be clearer than others.[464]

5.3.4 Design Rationale

In specialised contexts, specialised representations may be appropriate. One area in which a lot of work has been performed on the structuring of problem solving, is 'design rationale.' As indicated when discussing DRL,[465] design rationale seeks to capture and represent the kind of reasoning that the designers of artefacts engage in during the design process and the rationale underlying why problems involved in the design of an artefact were resolved the way they were.[466] This work has been inspired by Rittel and Weber's IBIS method (above). In addition to DRL, QOC is another prominent method in design rationale.

5.3.4.1 Questions, Options, Criteria (QOC)

The QOC system is composed of 'Questions', 'Options' and 'Criteria'. Questions express key issues involved in a design.[467] Options provide tentative answers to Questions. Criteria provide information about an Option, they support or object to the Option, and are used to assess Options amongst each other. Figure 54 illustrates the objects in QOC.

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[464] Isenmann, ibid. 170.

[465] See above 4.7.3.

[466] Buckingham Shum and Hammond, above n. 366.

[467] MacLean, A., Young, R.M., Bellotti, V.M.E. and Moran, T.P., 'Questions, Options, and Criteria: Elements of Design Space Analysis' p. 53, in Moran, T.P. and Carroll, J.M. (Eds) Design Rationale: Concepts, Techniques and Use (1996) Lawrence Erlbaum.

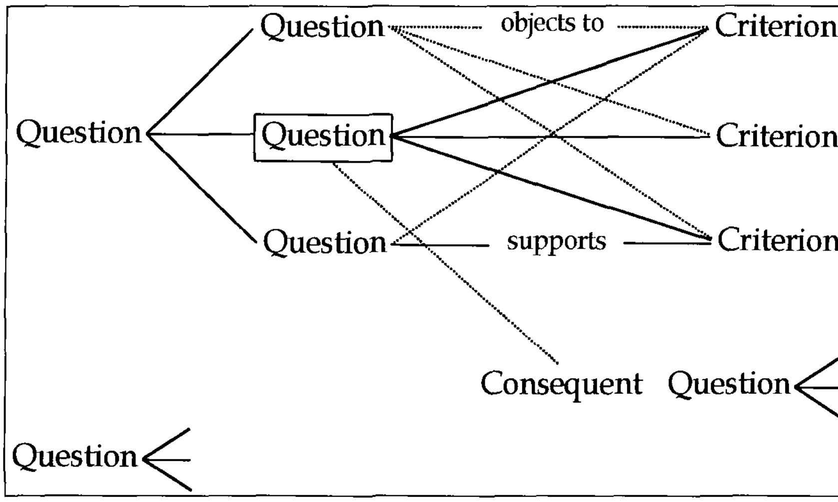

Figure 54: Objects provided in the QOC method

Superficially, the system for problem solving promoted in QOC is similar to that in IBIS. However, while QOC and IBIS do provide slightly different objects it is misleading to conclude that this as the biggest difference that exists. As Stumpf discusses in detail, the representations differ in that while IBIS focuses on structuring how issues are discussed, QOC focuses on the process by which alternatives are generated and evaluated – a difference that Stumpf characterises as encouraging 'depth-first' search and 'breadth-first' search respectively.[468] Seemingly small representational differences can be consequential.

5.3.4.2 Design Rationale Language DRL

DRL, which has already been discussed and applied in a legal context,[469] is a second influential system aimed at capturing design rationale. DRL is described as a 'Qualitative Decision Management System'.[470] While the detailed

[468] Stumpf, S., 'Argumentation-based Design Rationale - The Sharpest Tools in the Box' (1998) Computer Science Department, University College London, Research Note RN/98/103.

[469] See: 4.7.3.

[470] Lee 1990a, above n. 82.

application of DRL to the diagramming of a legal judgment has previously been discussed, it is worthwhile examining more general aspects of this representation.

The representation used in DRL is much more complex than that provided in either IBIS or QOC. DRL consists of three fundamental objects that Lee regards as central to decision making: GOALS; ALTERNATIVES; and CLAIMS.[471] Goals are ends to be achieved. Alternatives indicate possible ways to achieve a Goal. Claims are linked together to represent the arguments for choosing amongst alternatives and can relate to each other through: SUPPORTS; DENIES; or QUALIFIES links.[472] Other relations included in the system such as QUERIES or INFLUENCES cannot link claims.[473] Notably, Lee states that statements of relation between claims are themselves subject to argument and hence can be the subject of argument.[474] DRL also provides various other objects for discussing designs, however, different versions of DRL have utilised different representations, the details of which are not important for present purposes. Echoing the idea of argument maps, Lee calls diagrams created using DRL, 'decision graphs'.[475]

Lee has produced a computer-system, SIBYL, which supports constructions of representation using DRL. Interestingly, in SIBYL the user does not view the whole decision graph underlying a question at any one time. Instead, the system displays specific aspects of the graph according to the problem currently being worked on.[476] SIBYL has a number of automatic services inbuilt: dependency management;[477] plausibility management;[478] viewpoint

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[471] Lee 1990a, above n. 82, 111.

[472] Ibid. 113.

[473] Ibid. 112.

[474] Ibid. 113.

[475] Ibid. 111.

[476] Ibid. 116.

[477] Ibid. 116-8.

management;[479] and precedent management.[480] Each of these services is provided to help users create, navigate, manipulate and understand decision graphs. Dependency management attempts to automatically 'prune' alternatives from a graph as those alternatives become unacceptable or impossible. Dependency management relies on the user precisely stating how alternatives relate to the goal.[481] Plausibility management attempts to indicate which is the most acceptable amongst a series of alternatives. Plausibility management depends on the user assigning a plausibility measurement to claims and relations entered into the system.[482] Precedent management attempts to support the reuse of decision graphs in latter problem solving.[483]

DRL and QOC are in some respects similar and according to MacLean, the main difference between the two systems is the increased number of nodes that exist in DRL. However, to conflate a mere difference in number of nodes with a similarity between the systems is misrepresentative. The focus of reasoning in DRL is quite different to that in QOC. DRL focuses reasoning on very different objects than does QOC and focuses reasoning into smaller fragments. According to Lee, the major difference between IBIS and DRL is that IBIS does

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[478] Ibid. 118-22.

[479] Ibid. 122-4.

[480] Ibid. 124-6.

[481] Ibid. 118.

[482] Ibid. 120.

[483] One problem in precedent management is determining when a problem relates to common goals. Lee states that simply matching the names used to describe goals is insufficient since goals can be differently described and instead suggests providing a taxonomy of goals from which users can select when constructing decision graphs: ibid. 126. The similarity is notable between this suggestion and the use of a taxonomy of beliefs in Argnoter and indeed, fields for Warrants in Toulmin's scheme. The possibility of each remains questionable.

not contain the equivalent of the Goal contained in DRL.[484] Other differences are that unlike DRL, IBIS allows the creation of arbitrary link and node types. Moreover, IBIS does not allow argument about links themselves. In IBIS it is not possible to directly discuss or argue about whether links themselves are appropriate. For example it is not possible to directly dispute whether an Argument connected to another with a Supports link really does provide support.

Perhaps the major difference between SIBYL and both QOC and IBIS is that while the latter two focus on the presentation of objects, SIBYL focus on the automated service that can be provided with a representation.[485]

5.3.5 Convince Me

'Convince Me' is described as a 'domain-independent computational 'reasoner's workbench'.[486] Like Belvedere, Convince Me is designed to support students reasoning about science problems. Convince Me is based around a simple 'Evidence' and 'Hypothesis' representation in which evidence and hypothesis can support or contradict each other. There is nothing striking in this representation.

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[484] Ibid. 128. However, the Goal node is used in DRL multiple ways – when used as a general question is largely corresponds the IBIS Issue node. IBIS does not contain an equivalent to the use of a Goal node to state a criteria.

[485] E.g. the management of the dependency among objects: ibid 129. For a detailed discussion of and comparison between IBIS, QOC and DRL see: Stumpf, above n. 468.

[486] Schank, P., Ranney, M., 'Improved Reasoning with Convince Me' p. 276, in Proceedings of CHI'95 (1995) ACM Press; Ranney, M., Schank, P., 'Toward an Integration of the Social and Scientific: Observing, Modelling, and Promoting the Explanatory Coherence of Reasoning' in Read, S. and Miller, L. (Eds) Connectionist and PDP models of social reasoning (1998) Lawrence Erlbaum.

The innovative aspect of Convince Me however, is that it includes a model of 'explanatory coherence'.[487] This model proposes that statements are more acceptable to the degree that they are believed, that they are self-consistent and to the degree that they are not contradicted. In Convince Me, users can assign 'weights' to Evidence and Hypothesis to indicate how strongly they believe or disbelieve each statement. To this extent, Convince Me is similar to ReasonAble! However, Convince Me's model of explanatory coherence enables the system to itself calculate weights for each statement, which indicate the support for each statement.

Convince Me's authors suggest that by reflecting on the differences between weights self-assigned to statements, and those generated by the system, students can refine their beliefs and understanding of a subject. Schank and Ranney have conducted experiments that ostensibly illustrate improved learning in students who use Convince Me.[488]

Interestingly, one of the original applications used to illustrate the operation of the theory of explanatory coherence was a murder trial.[489] Thagard attempted to diagram the evidence and claims presented during trial and thereby calculate the 'strength' of the prosecution case. The precise operation of the theory of explanatory coherence is beyond the scope of this examination. Suffice to say that its operation critically depends on what statements it is chosen to include in a diagram and how it is chosen to connect those statements together. The operation of the theory of explanatory coherence intrinsically depends on how a problem is represented. Such application does show however that the theory of explanatory coherence and systems like Convince Me might have wider application than to teaching high school science.

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[487] Thagard, P., 'Explanatory Coherence' (1989) 12 Behavioral and Brain Sciences 435.

[488] Schank and Ranney, above n. 486.

[489] Thagard, above n. 487.

5.3.6 Combined representation systems

Different representations facilitate different aspects of reasoning. In an attempt to overcome the limitations of any particular representation, researchers attempt to combine representations, for example, allowing users to brainstorm ideas and then to restructure those ideas in terms of a more structured representation. Attempts are also made to combine structured representation systems themselves; for example, DRAMA is a program that utilises a representation integrating elements from IBIS and DRL.[490] Several authors have noted the split highlighted here between systems that primarily represent argument and those that primarily represent reasoning. On the one hand, systems such as Toulmin's represent the 'micro-structure' of arguments and on the other hand, systems such as IBIS, QOC and DRL represent wider aspects of reasoning. Researchers have sought to combine micro and macro representation schemes in order to provide richer systems.

Several systems combine Toulmin's scheme with the IBIS representation of problem solving. For example, SEPIA is a 'hypermedia' authoring environment that is designed to facilitate the collaborative creation of documents.[491] SEPIA provides a 'planning space' in which authors can externalise plans and goals and establish an agenda for document creation – this provides coordination for collaborative document creation.[492] The IBIS representation is used to structure this space. In addition, SEPIA provides an 'argumentation space' which facilitates the elaboration of the argumentative structure underlying a document. Toulmin structures are used to structure this space. However, while

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[490] http://www.enviros.com/index/softw/drama/

[491] Streitz, N., Haake, J.M., Hanneman, J., Lemke, A., Schuler, W., Schütt, H. and Thüring, M., 'SEPIA: A Cooperative Hypermedia Authoring Environment' p. 11, in Proceedings of ECHT (1992) ACM Press.

[492] Ibid.

both IBIS and Toulmin structures are used, there is no coordination between them, both spaces remain separate and distinct.

Author's Argumentation Assistant (AAA) is another tool designed to support the writing process.[493] Like SEPIA, AAA integrates the IBIS problem structuring representation with Toulmin's argument representation scheme.[494] However, AAA contains several additional nodes and links, such as a 'Fact' node type, which can link to all node types, an 'Answer' link indicating that a position answers an issue and 'Contributes' indicating that a position or argument contributes to another position or argument.[495] In addition, new types of links and nodes can be defined,[496] as can schemas, which are collections of nodes.[497] Unlike SEPIA, AAA integrates the IBIS and Toulmin representations into a single representation.[498] Despite the representational differences, SEPIA and AAA are designed for similar uses.[499]

An interesting aspect of AAA is that it has separate Argumentative and Rhetorical modes.[500] While the argumentative mode is used for constructing and organising arguments, the rhetorical mode enables the author to organise the issue and argumentative structures that are created and to arrange them

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[493] Schuler, W., Smith, J., 'Author's Argumentation Assistant (AAA): A Hypertext-Based Authoring Tool for Argumentative Texts' p. 137, in Rizk, A., Streitz, N., and André, J. (eds.) Hypertext: Concepts, Systems and Applications (1990) Cambridge University Press.

[494] Ibid. 140.

[495] Ibid. 143.

[496] Ibid. 146-8.

[497] Ibid. 148. These are reminiscent of the argument forms in ARL. Here however, schemas are not used as the basis of automated reasoning and so are perhaps more valuable.

[498] However, both schemes are altered during this integration, for details: ibid. 144-5.

[499] The systems differ in several ways however. For example, while SEPIA is designed for collaborative authoring, AAA is designed for the individual author. While SEPIA supports hypermedia documents, AAA is limited to text documents.

[500] Schuler and Smith, above n. 493, 145.

according to his or her rhetorical objectives and principles.[501] In rhetorical mode, argumentation structures can be spatially reorganised and annotated. AAA envisages writing as a linear movement commencing with argumentation, moving to rhetorical organisation and then to final text production.[502]

5.4 Review of systems in law

This subsection focuses on systems that have been built for use in law. Intriguingly, the evidence theorist Wigmore performed pioneering work on diagrammatic evidence analysis - long before the benefits of the diagrammatic analysis of argument and reasoning became widely accepted. Wigmore's work is examined below. However, there remain few systems in law for diagramming argument or reasoning and apart from Wigmore's groundbreaking work, these systems are based on the systems previously examined.

This subsection examines diagrammatic oriented computer systems that have been constructed to support legal argument and legal reasoning. While much work has been undertaken on argumentation in law, on computer models of legal argument, and on computer-based models of legal reasoning, for the reasons discussed earlier, this work is not examined here.[503] This review focuses solely on systems in which the visual presentation of argument or reasoning is a priority.

5.4.1 Wigmore on evidence analysis

In 1913, Wigmore proposed a new and innovative method for evidence analysis. Wigmore's method is straightforward and revolves around 'charting'

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[501] Ibid.

[502] Ibid. 149.

[503] The adequacy or otherwise of these frameworks as frameworks for legal argument is a separate topic to that examined here. In addition to focusing on representation this work is concerned with reasoning wider than argument.

the structure of the evidential elements that constitute a proof. For this purpose, Wigmore proposed various conventions for constructing and structuring diagrams in order to best represent this evidence.

In developing his method, Wigmore apparently had two goals. First, he stated a desire to turn the process of proof into a 'science' – to discover the 'principles of proof.'[504] Secondly, he wanted to provide a better method for understanding evidence. Whatever is made of the first goal,[505] the arguments for a more lucid presentation of information are as valid as when originally proposed. Wigmore's method is an examination of techniques for structuring evidence to best prove a proposition and to aid understanding of chains of proof.

Central to Wigmore's work is his view that it is important to provide information about the proof presented in a case in a form in which it can be easily understood. He argued that:

> to the extent that the mind is unable to juxtapose consciously a larger number of ideas, each coherent group of detailed constituent ideas must be reduced in consciousness to a single idea; until the mind can consciously juxtapose them with due attention to each, so as to produce its single final idea.[506]

This has clear parallels with recent work on external representations and diagrammatic representations.

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[504] Wigmore, J.H., 'The Problem of Proof' (1913) VIII(2) Illinois Law Review 77.

[505] It is unclear precisely what Wigmore envisaged in a 'scientific' method of proof, however, this goal must be understood in light of his statements that his charting scheme was not designed to specify what 'ought logically to be our belief' – an impossibility according to Wigmore as logic had not yet established such laws: ibid. 82-3.

[506] Ibid. 80.

To 'enable all the data to be lifted into the consciousness at once'[507] Wigmore devised a detailed system of symbols and relations aimed at classifying all the kinds of evidence that could be presented in a case, and the kinds of assessments that could be made about that evidence. Figure 55 provides examples of these evidence symbols.

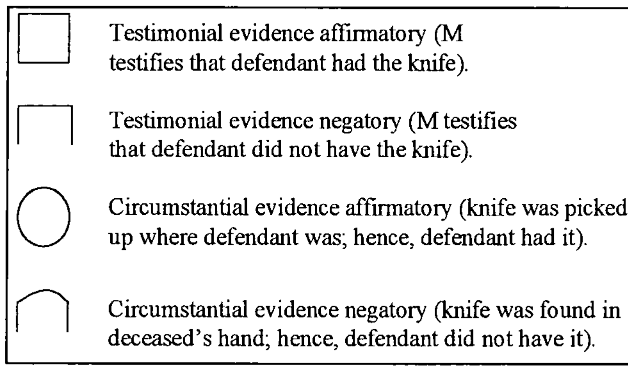


Figure 55: Wigmore's evidence symbols

In total, Wigmore's system incorporated 14 types of evidence (with associated symbols) classifying testimonial evidence, circumstantial evidence as well as evidence offered by the defendant, evidence offered by the prosecution, facts known as general knowledge, facts presented to the tribunal's own senses, and explanatory evidence and corroborative evidence offered by either party.

Relations between pieces of evidence were indicated by their spatial arrangement in a diagram in relation to each other, and with the use of symbols to connect them. Figure 56 shows two of the ten basic relational symbols that Wigmore proposed.

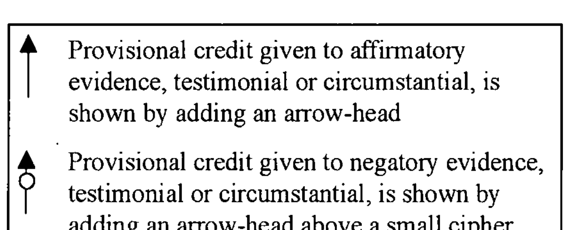


Figure 56: Wigmore's assessment symbols

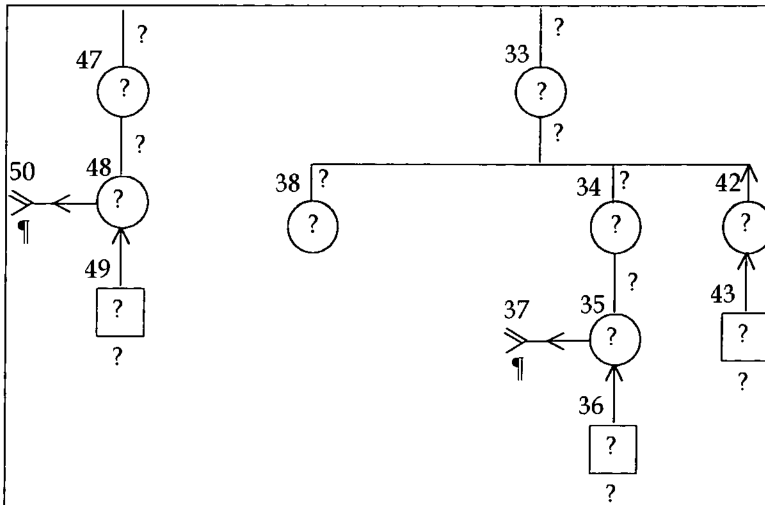
507 Ibid. 82.

Further symbols could be used to express, amongst other things, strong credit, doubt, belief, and strong belief. Thus:

> A supposed fact tending to prove the existence of another fact is placed *below* it.
>
> A supposed explanatory or corroborative fact, tending to lessen or to strengthen the force of a fact thus proved, is placed to the *left* or *right* of it, respectively.
>
> A single *straight* line (continued at a right angle, if necessary) indicates the supposed relation of one fact to another.[508]

Wigmore illustrated the use of his system with various examples, building up complex diagrams. Figure 57 illustrates part of an evidence chart created by Wigmore.

[508] Ibid. 85.



33 U. had uneasy consciousness of guilt about J.'s disappearance.

34 U. lied about J.'s going to Granby.

35 U. said J. had gone there, though J. was dead.

36 Anon. witness to this.

37 J. might really have gone there, not being killed till later.

38 U. was conscious that the well was a place where damaging things would be discovered.

42 U. lied about the reason for Olds and K. searching the well.

43 Anon. witness to this.

47 U. knew that J. was dead, though others did not.

48 He gave away J.'s boots and said that J. would not come back; this was about the middle of January.

49 Anon. witness thereto.

50 Like others, U. may merely have believed that J. had given up work at the farm.

Figure 57: A Wigmore chart for Commonwealth v Umilian[509]

In an extended examination of evidence analysis methods, Anderson and Twining state that the Wigmore's method is the 'most rigorous and comprehensive' of methods available.[510] They point to two key benefits of

509 Ibid. 93. This diagram is included simply to illustrate the general style of Wigmore diagrams and it is not possible to fully interpret without all the associated evidence and relation symbols.

510 Anderson, T., Twining, W., Analysis of Evidence (1991) Weidenfeld and Nicolson, 106.

Wigmorean analysis. First, such analysis highlights the structure of argument; it creates an awareness of the steps in evidential proof that are typically glossed over or left implicit and by making such steps explicit it makes it easier to judge the soundness and probative force of arguments.[511] Secondly, the method forces taking facts seriously, it forces a rigorous and coherent connection between the controlling propositions of law and the actual data.[512] In short, the method forces precision and promotes rigorous analysis.[513]

Although a handful of researchers endorse Wigmorean analysis,[514] Wigmore's proposals have not proved widely popular. Twining and Anderson, speculate two reasons for this. First 'Wigmore failed to develop fully the uses and limitations of the chart method as a practical tool.'[515] Secondly, the sheer complexity of the method has proved daunting:

> In our experience, resistance to learning these symbols is a significant obstacle to mastering the basic techniques of Wigmorean analysis.[516]

Twining and Myers seek to address the first reason through a detailed analysis and demonstration of the method. In order to reduce the complexity of learning and using Wigmore's method, Anderson and Twining simplify the number of symbols used - from twenty-five, to eight.[517] However, Anderson and

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[511] Ibid. 119.

[512] Ibid.

[513] Ibid. 142-3.

[514] Tillers, P., Schum, D, 'Charting New Territory in Judicial Proof: Beyond Wigmore' (1988) 9 Cardozo Law Review 907; Robertson, B., Vignaux, G.A., 'Taking Fact Analysis Seriously' (1993) 91 Michigan Law Review 1142. Hosking has used a Wigmore like notation as the basis of a legal information retrieval system: Hosking, above n. 409. However, as Anderson and Twining note that 'no two masters of the method are likely to produce identical charts for the same case' this casts doubt on the possibility of using such complex representations for information retrieval as envisaged by Hosking: Tillers and Schum ibid. 131.

[515] Anderson and Twining, above n. 510, 106.

[516] Ibid. 107.

[517] Ibid. 144ff.

Twining do not discuss how computer support might alleviate the 'considerable effort required to draw and revise' charts[518] or indeed change charting itself.[519]

The differences are interesting between Wigmore's method for representing assessments of legal evidence, Toulmin's argument analysis scheme and schemes to represent reasoning such as DRL and IBIS. Essentially, Wigmore's system is highly specialised and strongly tailored specifically for evidence analysis. The representation thus does not provide means to express assessments about many aspects of argumentation, nor ways to diagram and structure wider aspects of reasoning. As previously discussed, the ability to diagram both things is often useful. Several systems have been proposed to diagram such aspects of reasoning.

5.4.2 Toulmin based systems

Toulmin's model of argument, and computer systems built around this system, were described above.[520] Several computer systems that utilise Toulmin structures have been built in law. Most of this work has utilized Toulmin structures within an artificial intelligence paradigm – in order to provide more robust expert systems,[521] or as the basis for models of automated argument.[522]

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518 Ibid. 153.

519 When charting evidence, Wigmore advises to examine all the proof and all the propositions to be proved and after considering their interrelations, to *then* commence charting. The effort in creating charts that Anderson and Twining allude to, arises when propositions for a chart have been decided upon and graphically arranged, but latter need to be revised. Anderson and Twining do not appreciate that computer support, which would allow the *interactive* charting of evidence and propositions, would also likely change charting itself by making it a more fluid process. Similarly, computer support would remove the need for separate 'key lists' and hence improve the clarity of charts.

520 Respectively, see: 4.4 and 5.2.2.

521 Stranieri, Gawler and Zeleznikow, above n. 303; Zeleznikow, J., Stranieri, A. and Gawler, M., 'Project Report: Split-Up- A Legal Expert System which Determines Property Division upon Divorce' (1996) 3(4) Artificial Intelligence and Law 267.

Dick has used Toulmin structures to encode information as the basis for information retrieval.[523] The focus in this work has been on automation. Toulmin structures have however, also been used as the basis for systems that augment argument construction and that augment legal education.

Significant early work on argument augmentation utilised Toulmin structures as the basis for computer tools. Newman and Marshall created a system, 'Aquanet', to support the formulation, organization, and presentation of arguments.[524] Representing legal argument was an important test of Aquanet's benefits.[525] Aquanet provided a graphical workspace with which users could construct diagrams of the arguments presented in legal proceedings. Using Aquanet, Newman and Marshall analysed various United States Supreme Court cases and attempted to use Toulmin's scheme to represent aspects of the oral arguments presented in the cases. Using Toulmin's scheme in this way proved problematic.[526] Notably as well as highlighting problems with Toulmin's representational scheme itself, Newman and Marshall also note the need for representational structures with which to organize reasoning.[527] In particular, they discuss the value of using IBIS or DRL extensions. One such system, discussed below, has been constructed in law.

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[522] Freeman and Farley, above n. 303.

[523] Dick, above n. 303. This work is very similar to that of Hosking the difference being the representation scheme used, see: Hosking, above n. 409. The limitations in Hosking's work apply equally to Dick's work, and problems with identifying appropriate Toulmin structures with which to encode an argument (see 4.4.1 for a discussion of these problems) apply, *mutatis mutandis*, to the work of Hosking.

[524] Marshall, Halasz and Rogers, above n. 303.

[525] Marshall, C.C., 'Representing the Structure of a Legal Argument' p. 121, in The Second International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1989) ACM Press; Newman and Marshall, above n. 314.

[526] For a discussion of the problems with Toulmin's scheme and problems encountered by Newman and Marshall, see: 4.4.1.

[527] Newman and Marshall, above n. 314, 33-5.

Systems to teach legal argument have also been constructed based on Toulmin's representation scheme. Bench-Capon *et al.* propose a system that uses Toulmin structures to support training in the skills of legal argument.[528] Bench-Capon *et al.*'s proposal is for a system that would structure argumentation conducted between two students. Each student would input their argument into the system, indicating, for example, whether they were making a claim, providing data for a claim, providing a warrant for one of their previous arguments or challenging one of the other student's arguments. The system would mediate the argument between two students by managing the dialogue between them – keeping track of which statements had been challenged, which statements had been accepted and which statements remained as yet unconsidered. Although a prototype system has been built, this prototype does not support the graphical construction or manipulation of the argument.[529] Work by Carr and Hair tentatively supports the benefit of creating such systems to help teach the skills of legal argument.[530]

Loui *et al.* have also constructed an interesting system based on Toulmin's representation scheme.[531] Room 5 is designed to support public argument about topics. The system runs over the World Wide Web and the public can access the system, review arguments already in the system and enter new arguments into the system. Room 5 is an interesting parallel to discussion systems such as HyperNews used in the OpenLaw project.[532] Apart from being an interesting idea, Room 5 is notable for the visual representation of

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[528] Bench-Capon, T.J.M., Leng, P.H. and Staniford, G., 'A Computer Supported Environment for the Teaching of Legal Argument' (1998) 3 The Journal of Information, Law and Technology. Available at http://www.law.warwick.ac.uk/jilt/98-3/capon.html (accessed 1/4/2001).

[529] This is however, an extension that the authors discuss.

[530] See the discussion of this work above at p. 97.

[531] Loui et al., above n. 303.

[532] See: 5.3.1.1.

arguments that it uses. Unlike other systems based on Toulmin structures, Room 5 uses a matrix layout for arguments.

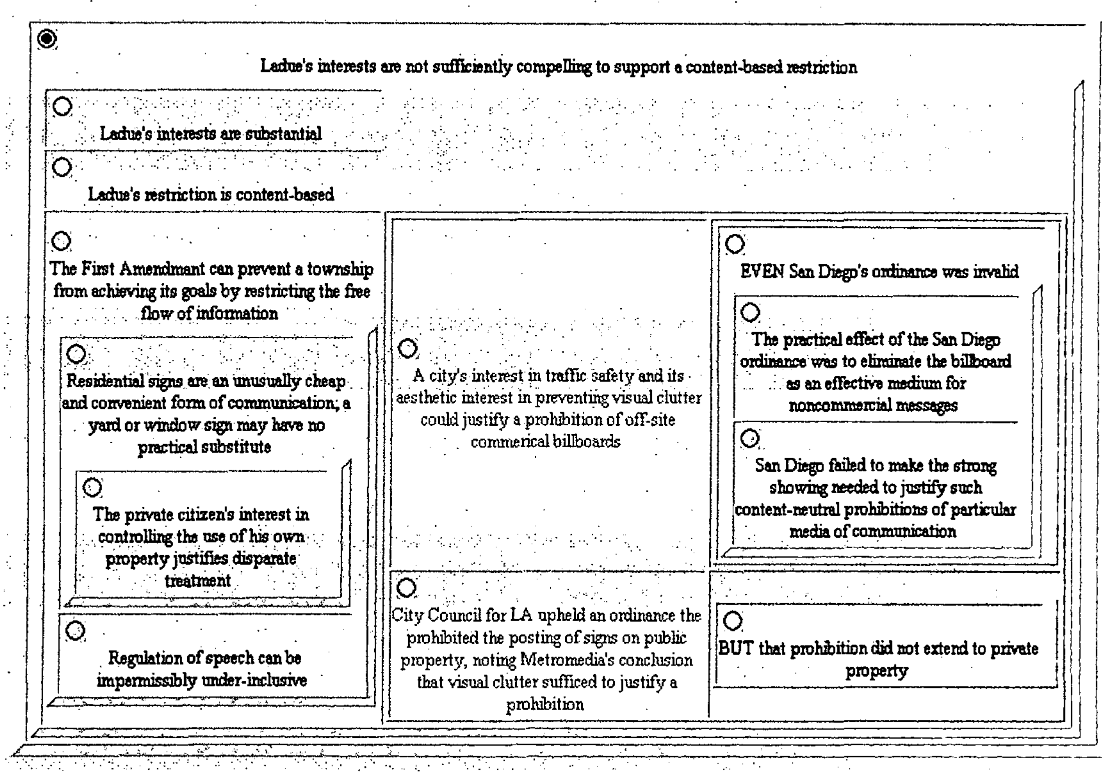

Figure 58: Matrix layout of Toulmin structures in Room 5

In this matrix presentation, argument support is indicated not by a connecting arrow, but by 'encapsulation'. A supporting statement is contained in the 'box' provided by the supported statement. Similarly, a counterargument is placed beside the argument that it contradicts. In addition, statements are coloured according to which party in the dispute made the statement. The use of encapsulation rather than arrows to indicate argumentative relationships is said to avoid the 'pointer spaghetti' that can affect network-based representations.[533]

This matrix presentation of Toulmin representations highlights an aspect of diagrammatic representations that has been glossed over thus far -

[533] Loui et al., above n. 303, 209. 'Pointer spaghetti' is a phrase used in computer supported cooperative work when there are so many boxes and links that structure becomes difficult to distinguish and the screen resembles a tangled mass of spaghetti.

diagrammatic representations involve both an underlying representational vocabulary that shapes their use, and a visual presentation which itself influences representational comprehension. Thus, while matrix presentations might avoid pointer spaghetti, they can have other affects on representational use.[534] The following chapter examines in more detail the visual aspect of representations.

5.4.3 Statutor

Statutor is another system developed for teaching in law.[535] Unlike the teaching systems based on Toulmin's representational scheme however, Statutor is based on a simple claim-supports-conclusion model. Statutor is designed to teach students about substantive elements of legislation. To this end, in Statutor students must construct a 'proof tree' that connects facts and propositions of law together in order to prove an ultimate proposition. When using Statutor to teach students to solve problems, students are visually presented with the conclusion to be established, as well as a selection of factual statements concerning the problem. Students must choose from amongst these factual statements and construct a 'proof tree' that supports the conclusion that must be established (figure 59).

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[534] Suthers is one of the few system designers to explicitly note the importance of visual presentation on representational use: Suthers and Weiner, above n. 394. However, the lack of work in this area restricts Suthers to concluding that this is a topic for future research.

[535] Hegarty, C., Routen, T., 'Statutor: Intelligent Tutoring System?' in BILETA '96 Conference Proceedings (1996) <u>The Journal of Information, Law and Technology</u> (JILT). Available at http://elj.warwick.ac.uk/jilt/BILETA/1996/3hegarty/default.htm/ (accessed 3/4/2001)

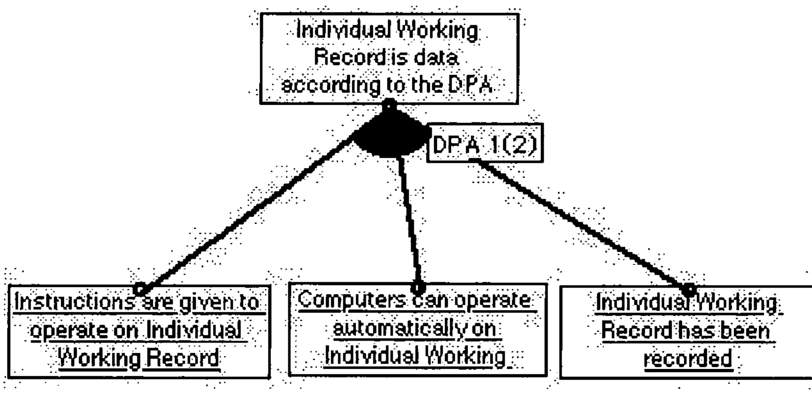

Figure 59: Proof tree constructed in Statutor[536]

As indicated in figure 59, the statements constituting a proof can be connected with an arc in order to indicate that they conjointly support the conclusion – that the argument is linked. Arguments not joined in this way are convergent. Similarly, the reason a statement supports a conclusion can be indicated on the link connecting the two. The system can provide limited feedback on proof trees that students construct.[537]

Statutor is interesting for the specific context that it operates in, because its creators report very positive student comment on the graphical presentation of the arguments, and because its creators suggest that Statutor improved students' 'logical perception' of arguments.[538]

5.4.4 ArguMed

ArguMed is an argument assistance system developed by Verheij.[539] Early versions of ArguMed were presented as a useful tool for teaching legal

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536 Adapted from: ibid.

537 Centinia, F., Routen, T., Hartmann, A. and Hegarty, C., 'STATUTOR: Too intelligent by half?' p. 121, in Hage, J.C., Bench-Capon, T.J.M., Cohen, M.J., and van den Herik, H.J. (eds.) Legal knowledge based systems JURIX '95: Telecommunication and AI & Law (1995) Koninklije Vermande.

538 Ibid. 129.

539 Verheij, B., 'Automated argument assistance for lawyers' p. 43, in Proceedings of the Seventh International Conference on Artificial Intelligence and Law (1999) ACM Press.

argument, however, difficulties were noted with this.[540] ArguMed is presented as the basis for a system to provide automated argument assistance to lawyers.

ArguMed uses an argument structure similar to that in Toulmin in which reasons support conclusions and where links between reasons and conclusions must be warranted (if challenged).

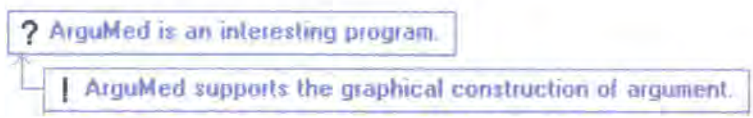

Figure 60: The most basic possible argument in ArguMed

The precise details of the theory of argument which ArguMed embodies will not be discussed here. For present purposes, it is sufficient to indicate that this is a strict representation of argument based on 'Reasons', 'Conclusions' and 'Warrants' and does not attempt to represent wider aspects of reasoning. ArguMed however, embodies a formal definition of argument, which allows it to calculate the status of statements. As statements are challenged and as new statements are added, the system simultaneously displays the status of arguments higher in the argument chain.[541]

5.4.5 GeoMed

GeoMed was created as part of a long-running research project on computer-based argumentation and was created as a:

ArguMed is a successor to Argue!: Lodder, A.R., Verheij, B., 'Computer-Mediated Legal Argument: Towards new Opportunities in Education' (1999) 2 The Journal of Information, Law and Technology. Available at http://www.law.warwick.ac.uk/jilt/99-2/lodder.html (accessed 15/3/2001).

[540] Lodder and Verheij, ibid. Verheij says the user interface was too unfamiliar for intended users and that the argumentation theory was not sufficiently transparent: Verheij, ibid 44. Argue! itself implemented a theory of argument called CumulA: Lodder and Verheij, ibid. This emphasises how the theory of argument must be separated from its presentation.

[541] For further details, see: Verheij, above n. 539.

> *mediation system* for the World Wide Web, which shall enable public review procedures in a way which is more efficient, transparent, fair and, it is hoped, democratic than current practice.[542]

To this end, GeoMed implements a version of the IBIS representation of problem solving. However, the IBIS method is modified to allow argument that is more detailed. As originally presented, IBIS only allowed pro and con arguments about Positions. In addition, GeoMed allows pro and con arguments about other arguments. This allows more debate to occur within the system. Like ArguMed, GeoMed also implements a formal model of argument, which allows the system to calculate and display the status of arguments.[543] With this formal model of argument, GeoMed can be used to make simple inferences about the quality of the alternative positions for an issue.

5.5 Discussion

The previous chapter examined methods to diagram argument and reasoning and argued that central to methods for diagramming argument and reasoning is the representation on which the method is based. This chapter reviewed numerous computer systems that have been constructed to augment argument and reasoning, both specifically in law, and more generally.

One of the most conspicuous aspects of all these systems is their diversity – in particular the diversity amongst the representations upon which each is founded. While there is some commonality in systems that seek to support argumentation, even here the difference in representations is striking. Given however, that representations channel argument and reasoning by highlighting and occluding different aspects of argument and reasoning, it is essential that a representation be appropriate for the use to which it is put. System designers

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[542] Gordon, T.F., Karacapilidis, N., 'The Zeno Argumentation Framework' p. 10, in The Sixth International Conference on Artificial Intelligence and Law: Proceedings of The Conference (1997) ACM Press.

however, rarely explicitly discuss the importance of 'representational fit'. Without such discussion it is difficult to assess the adequacy of any particular system. The following chapter examines theories of representation for insight they might provide into the choice and design of appropriate representations to support argumentation and reasoning.

[543] For details: ibid.

6 Legal Sensemaking Support Systems

If all you have is a hammer, then everything looks like a nail.

Anonymous

6.1 Introduction

The centrality of representations in the construction of computer systems in law has been emphasised throughout this work. People have, often intuitive, representations of the area in which they work. Computers operate using explicit representations of a domain in which they operate. Chapters 4 and 5 examined various representations of argument and reasoning which researchers argue can support sensemaking. These representations may be useful for supporting legal argument and legal reasoning. However, one striking aspect of these representations is their diversity. Given this diversity, some means is necessary to choose amongst representations. This chapter examines whether, and if so how, a principled choice might be made between representations that are useful for legal sensemaking.

An important aspect of diagrammatic representations, thus far not emphasised, is their visual presentation. Psychological literature indicates that visualisations are important and influential in sensemaking. Just as representations affect sensemaking, the visualisation of a representation can also affect representational use, and hence sensemaking. Work on argument support and reasoning support systems typically does not discuss the choice behind a particular visualisation. This chapter examines whether a principled choice can be made amongst representations and visualisation to support reasoning and argument.

The following subsection analyses two major theoretical approaches to analysing representations. It is concluded that while loose guidelines can be provided for evaluating representations, no determinate method exists to choose amongst them. The third subsection examines visualisations and theories concerning the construction of visualisations. As with representations themselves, it is concluded that such theories do not determine how to choose amongst possible visualisations. Choosing amongst representations and visualisations for those representations retains an element of art. Despite the lack of definitive design guidelines, the fourth subsection discusses a class of yet largely unexplored legal knowledge-based system – legal sensemaking support systems.

6.2 Representations for sensemaking

As discussed in chapter 2, a representation is a conceptualisation of a domain - it is a picture of the objects and concepts that are important in a domain and how they interact. Thus a representation of law as rules promotes legal rules as the important point of focus and promotes a view of legal reasoning as the application of those rules. More generally, representations of law that reify legal objects focus exclusively on those objects. This exclusive focus is to the exclusion of other aspects of the legal setting. Most notably, the objectification of law ignores the role of the legal thinker.

This is a general characteristic of representations. Representations only represent certain things. Representations represent those things that are part of the representation and ignore those things that are not part of the representation. Representations highlight those things that are part of the representation and, by implication, de-emphasise those things that are not part of the representation. Representations filter perception.

This point is comparatively straightforward in the context of descriptive, natural language, representations of a domain. If a representation needs clarification or to be extended, it is simply a matter of describing the clarification or of describing an extension. It is different however with external, diagrammatic, representations. While descriptive, natural language, representations can leave much implicit, external diagrammatic representations are characterised by their explicitness.

In the most general terms a representation is something that stands for something else – it is a model of the thing that is represents. This indicates the existence of a *represented* domain and a *representing* domain and a connection between the two.[544] Representations differ in the aspects of a domain that are represented, the objects chosen to do the representing and the relation between them.

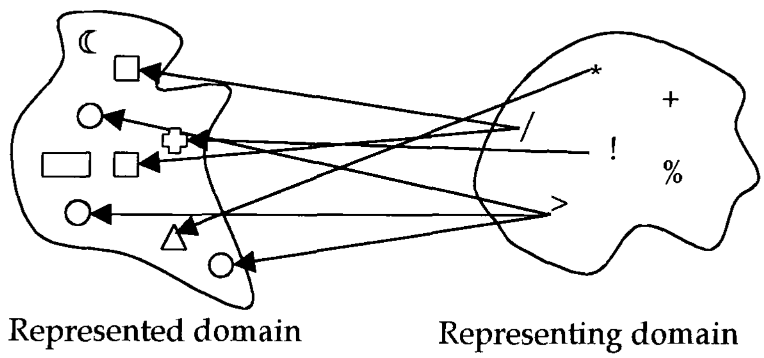

Figure 61: Representing and represented domains

In figure 61 for example, the '>' symbol is used to represent 'O' and the '/' symbol is used to represent '□'. There is no necessary relationship between either of these though, and '>' could instead have been used to represent '☾', giving a different representation. There is thus a multitude, of possible representations, both because the things that can be represented are multitudinous and the ways that they can be represented are multitudinous. The benefit however, is that by using a system of representation that is clearer and simpler than the original domain itself, insight can be gained into that represented domain. Hopefully, the system of representation is easier to manipulate and conceptualise than the original domain.

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[544] Palmer, S.E., 'Fundamental Aspects of Cognitive Representation' p. 259, in Rosch, E. and Llyod, B.B. (Eds) Cognition and Categorization (1978) Lawrence Erlbaum.

The variability of representations can be seen in systems supporting sensemaking through the visualisation of argument and reasoning. The systems examined in chapters 4 and 5 highlight the multitude of representations for argument and reasoning that exist. The choice of particular representation by which to represent sensemaking amounts to choosing a vocabulary through which to work and reason. This vocabulary is composed of symbols that are used to represent the area being worked on and reasoned about. The representation that is used in a system underlies the things that can be done with that system. At a broad level, certain things cannot be expressed in certain representations. At a more subtle level, certain representations are more amenable to certain forms of thinking. Representations direct thinking into defined paths.

Broad classes of representations have been proposed to support creativity, reasoning, argument and negotiation. However, both the diversity amongst representations within each group, and the similarities between representations in different groups casts doubt upon the universality of such classifications. Given the multiplicity and variety of representations that have been proposed, it would be desirable to be able to make a systematic, theoretically underpinned choice about the representation that is chosen in any given situation. It would be desirable to make a justified choice about what representation is the most appropriate in a given situation. This is an issue rarely discussed in examinations of computer supported argument and reasoning visualisation.[545]

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[545] In computing, perhaps the most comprehensive examination of problem representations and symbol systems has been undertaken in the fields of cognitive science and artificial intelligence. However, subject to the discussion below, these will not be discussed in detail here. Cognitive science and artificial intelligence have been overwhelmingly concerned with *internal representations*. That is, the way information is represented in the mind and the processes that operate on these representations. These are important philosophical questions. However, they are separate to the question examined here. Only relatively recently has cognitive science become interested in *external representations*. Cognitive scientists have proposed various theories in an attempt to explain the usefulness, creation

Making such a reasoned choice amongst representations requires understanding more about representation itself. Two influential theories of representation are that provide by Goodman and the more recent theory of 'structure mapping'. Each of these will be analysed in turn.

6.2.1 Goodman

Goodman has provided one of the most influential studies of representational systems. According to Lee, Goodman has provided the *locus classicus* of comparative study between graphical and linguistic systems, stating that Goodman's apparatus has formed the basis for nearly all subsequent examinations of the subject.[546] Similarly, Goel states that Goodman's apparatus is the most sophisticated yet developed for the study of graphical systems.[547] Goodman's account is interesting not only for its discussion of representations in general but also because this discussion was provided in the context of visual representation systems. This has clear potential in investigations of visual support for sensemaking. In the choice of appropriate representations to support legal sensemaking, Goodman may thus provide some guide.

Goodman was primarily concerned with the nature and function of representation in the arts. However, in order to investigate this he developed a sophisticated apparatus for examining representations in general. Goodman analysed representation in terms of 'symbol systems'. Essentially a symbol system consists of a group of symbols - the representing domain - which refer to

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and processing of external representations. This work has in turn spawned work in psychology and computing, under the rubric of *diagrammatic reasoning* that examines the benefit of and provision of support for reasoning with different external representations.

[546] Lee, J., 'Words and pictures - Goodman revisited' (1998) Paper presented at workshop on Visual Representations and Interpretations 1998, University of Liverpool, hereafter Lee 'Goodman revisited'.

[547] Goel, V., Sketches of Thought (1995) MIT Press, 18.

another domain - the represented domain (see figure 61).[548] Goodman discussed the characteristics of symbol systems in detail and provided five criteria with which to analyse symbol systems:

1. symbols of the same type must be interchangeable with each other – they must be 'indifferent'.[549]
2. the symbols must be 'articulate' - it must be possible to distinguish the symbols from each other.[550]
3. the fragment of the represented domain referred to by a symbol must be 'unambiguous'[551] -the symbol must always refer to the same fragment of the represented domain.
4. the aspects of the represented domain referred to by symbols must be 'disjoint'[552] - symbols cannot refer to the same part of the represented domain.
5. the system as a whole must be 'semantically differentiable' in that for every part of the represented domain it must be possible to determine whether it is referred to by a symbol.[553]

The first two of these criteria specify properties of the representing domain. For present purposes, nothing is lost in simply saying that the representing domain must consist of symbols.[554] In the systems examined in this work it is not distinguishing symbols which is difficult, but distinguishing what those symbols refer to.

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[548] Goodman called these the 'symbol scheme' and 'field of reference' respectively: Goodman, N., Languages of Art: An approach to a theory of symbols (1976) Hackett Publishing Company.

[549] Ibid. 132.

[550] Ibid. 135-7.

[551] Ibid. 148.

[552] Ibid. 150.

[553] Ibid. 152.

[554] These two of Goodman's criteria aim to determine if symbols do in fact exist.

Essentially, Goodman specifies baseline criteria for the existence of clear symbol systems. As Goodman discusses, symbol systems that satisfy these five requirements are, essentially, more precise than those that do not meet the requirements.[555]

Goodman applied this framework to analysing numerous representational systems, from musical scores, to architectural drawings, to paintings, to natural languages such as English. Notably, the apparatus does not distinguish between visual and other representations. Given this apparently wide applicability, the apparatus would thus appear suitable for examining diagrammatic representations to support legal sensemaking. The apparatus suggests a means to select amongst diagrammatic representations to support sensemaking and moreover, criteria for the design of diagrams to support sensemaking. Representations could apparently be selected and designed so as maximise their precision and clarity. Representations that do not meet the five requirements could be rejected in favour of those that do, or modified to comply.

6.2.2 Difficulties with Goodman's apparatus

Unfortunately, there are several difficulties with attempting to use Goodman's apparatus as a basis for designing diagrammatic representations to support legal sensemaking. Notably, relatively few representations meet all of Goodman's requirements. For example, natural languages do not meet all the criteria. This suggests a strictness in the criteria. The criteria apparently sift out systems that are nevertheless extremely useful. Although few representations satisfy all the criteria, however, Goodman's analysis may still be a useful framework with which to examine representations.

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[555] Under Goodman's apparatus, the major distinction is between notational and non-notational symbol systems. The attractive property of notational symbol systems is that they are semantically precise.

A second concern apparent with Goodman's apparatus is that it does not explicitly discuss visual representations. While the criteria can be used to examine visual representations, the criteria have little to say about what, if anything, makes visual representations unique and beneficial. Goodman was concerned to provide a broad theoretical examination of representation and representations. He was not concerned to provide examinations of specific 'types' of representation. As Goodman states, the apparatus is not designed to ensure a good vocabulary for a given task.[556] Thus:

> a good many other features that might be thought essential are not covered either. No requirement of a manageably small or even finite set of atomic characters, no requirement of clarity, of legibility, ... of ease of writing or reading, of graphic suggestiveness of mnemonic efficacy, ... has been imposed.[557]

Given both the strictness in the apparatus and the lack of specific examination of visual representations, the criteria might at most be a minimal foundation for assessing diagrammatic representations to support legal sensemaking. The criteria might specify a very broad first sort of possible representations that would then need to be distinguished on other grounds.

Most problematic is the argument that Goodman's apparatus is not adequate to distinguish between representations at all. Simply, Lee argues that without background knowledge it is not possible to either unambiguously determine what amount to symbols within a system, nor to determine to what they refer.[558] In essence, Lee argues that while Goodman requires that aspects of the representing domain and the represented domain be differentiated, Goodman provides no indication as to how this differentiation occurs. There are many

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[556] Ibid. 154.

[557] Ibid.

[558] Lee 'Goodman revisited', above n. 546 ,'Symbol systems in use'.

ways of looking at any represented domain, many perspectives that can be taken, but which perspective should be taken is not something that the apparatus addresses. In the representing domain, there are many ways to refer to a represented domain, but which of these should be adopted is not something that the apparatus addresses. According to Lee, problems with Goodman's apparatus can only be addressed by examining the 'reality of practice'[559] i.e. the way symbols are actually used. This is certainly not a criticism of Goodman, only an indication of further limits on what can be hoped for from the apparatus.[560] Given a represented domain and symbols to refer to it, the apparatus can broadly indicate how reference should be structured. However, the apparatus can do no more than this. The apparatus cannot indicate what the representing domain should be, or what the represented domain should be, or how the representing and represented domains should be divided.

6.2.3 Structure mapping

While Goodman's examination may be the *locus classicus* of work on representation, concerns with the ability of the framework to fully explain the nature of representation have motivated much further work. Prominent amongst these is the concept of structure mapping of which various researchers stress the importance. The joint work of Gurr, Lee and Stenning is a good example of this.[561]

Lee argues that Goodman's apparatus is insufficient to determine representation and that rather than the five criteria provided by Goodman, the

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[559] Ibid.

[560] Although Goodman himself anticipated these, acknowledging the role of context in determining what amounts to the symbols of a system: Goodman, above n. 548, 138-9.

[561] For an examination of theories of representation, and a more detailed examination of theories that employ the idea of structure mapping and differences between them, see: Shimojima, above n. 254.

key criteria is that the representation be 'systematic'.[562] Lee expands this idea stating that all formal representations and notations are based on 'structure-mappings' that preserve 'higher-order' properties in a represented domain.[563] In the context of diagrams, this means that the elements that compose a diagram must relate to each other in ways that reflect the relationships in the represented domain. Venn diagrams are said to illustrate this. Venn diagrams are used to illustrate set relationships in mathematics and are illustrative of 'structure mapping' because mathematical set inclusion is mapped to spatial inclusion in the diagrams. Set inclusion is a higher-order property because it refers to a relationship between objects – sets- in the represented domain. Venn diagrams provide a systematic mapping because they use spatial inclusion, a higher-order relationship between objects of the representing domain, to represent set inclusion. This is discussed in more detail below. Systematicity appears a powerful criterion for specifying representations.

The major issue for representations then is how to ensure systematicity.[564] Gurr, Lee and Stenning propose four criteria to enhance systematicity – diagrams should be:

1. lucid;
2. sound;
3. laconic; and
4. complete.[565]

A lucid representation is one in which a symbol in a representation represents at most one object in the represented domain. A non-lucid representation is

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[562] Lee 'Goodman revisited', above n. 546.

[563] Ibid.

[564] Gurr, C., Lee, J. and Stenning, K., 'Theories of Diagrammatic Reasoning: Distinguishing Component Problems' (1998) 8 Minds and Machines 533, 551.

[565] Gurr, above n. 253, 333.

one in which a symbol in the representation represents more than one object in the represented domain. Figure 61 illustrates a lucid representation.[566]

A sound representation is one in which every symbol in the representation represents at least one object in the represented domain. An unsound representation is one in which a symbol does not represent anything in the represented domain. Figure 61 does not illustrate a sound representation as '+' and '%' are not used to refer to anything.

A laconic representation is one in which every object is represented by at most one symbol in the representation. A non-laconic representation is one in which some object in the represented domain is represented more than once. Figure 61 illustrates a laconic representation.

A complete representation is one in which every object in the represented domain is represented by at least one symbol in the representation. An incomplete representation is one in which some object in the represented domain is not represented. Figure 61 does not illustrate a complete representation, as two elements of the represented domain are not referred to by anything in the representing domain.

Despite an apparently different focus, it is interesting how similar these criteria actually are to Goodman's. Although the requirements are differently expressed, the major differences appear to be the requirements of soundness and completeness. Thus, a symbol that is not lucid would not be disjoint within Goodman's apparatus. Although Goodman did not explicitly require laconicism, this is inherent in the requirement that symbols be disjoint.[567] Goodman's criteria did not enforce soundness and would allow symbols that did not represent anything. Goodman's criteria similarly did not enforce

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[566] Above p. 226.

[567] Goodman, above n. 548, 151-2.

completeness and would allow things to remain unrepresented. In this respect, these criteria impose further restrictions on the relationship between representing domain and represented domain. While Goodman specified criteria to test the clarity of the link between representing domain and represented domain, soundness and completeness specify wider characteristics that are desirable for that link.

Despite criticism of Goodman on the ground that knowledge of context is necessary to understand a representation however, the same criticism applies to these criteria. There is no way to apply these criteria without wider knowledge – there is no way to determine what amounts to a systematic representation without knowledge of the represented domain and the use of the representation. Lee, Gurr and Stenning acknowledge as much, as Gurr states, to apply the criteria:

> requires an understanding not only of the domain which the diagram represents, but also of the task or purpose for which the representation is to be used.[568]

Hence, the notion of systematicity, which the criteria were designed to ensure, cannot be definitively specified. For if a representation only acquires a mapping by virtue of use in a community for particular ends then the use made of a representation in a community must be understood before systematicity can be discussed. As Gurr, Lee and Stenning state, the:

> nub of the matter in all cases, however, is that structures of objects and relations have to map to structures that are in some suitable sense "similar".[569]

This similarity provides a means to interpret diagrams in a sensible way. However, this leaves the problem:

> of what counts as similar here. Wherever some properties and so on are preserved, some are not.[570]

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[568] Gurr, above n. 253, 334.

[569] Gurr, Lee and Stenning, above n. 564, 543.

Despite Goodman's theory and attempts to use 'structure mapping to clarify it, all that can be concluded is that the properties to be preserved and included as part of the vocabulary must be those that are relevant to the inferential objectives of making the mapping.[571]

6.2.4 The need to define use

Despite all the criteria, again it is knowledge of the context of use that informs the quality of a representation. It is this knowledge that informs the appropriateness of a particular representation. Both Goodman's criteria and systematicity collapse into methods to constrain meaning in a representation. However, what a representation should be taken to mean is external to the criteria.

Given the importance of knowledge about the domain a representation will be used in and knowledge about the use to which a representation will be put, it is surprising that neither Goodman, nor Gurr, Lee and Stenning make choice of domain and task an explicit first requirement for representations. Perhaps this is because all were primarily interested in the theoretical structure of the link between representing and represented domains.

The importance of explicitly examining domain and use when assessing representations is however emphasised by various researchers. For example, in discussing external representations Peterson highlights the need for a good 'task-fit'.[572] Task-fit focuses on the appropriateness of a representation for its context of use. As Peterson states, a representation is:

> Created, consulted or manipulated as a means to an end. We may wish to manipulate it ... to draw inferences of some particular sort ... to

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[570] Ibid.

[571] Ibid.

[572] Peterson, D., 'Introduction' p. 7, in Peterson, D. (Ed) Forms of Representation (1996) Intellect Books, 9.

> develop ideas in an exploratory manner; to land an aeroplane or determine a transport schedule; to help us to play, transpose or re-arrange a piece of music; to show that it constitutes an axiom-set with the property of completeness to develop a scientific theory with predictive properties; to communicate something to a particular group of people; to augment internal working memory; and so on.[573]

In addition to task-fit, Peterson highlights the need for 'ontology-fit'.[574] Ontology-fit focuses on whether the particular features of a domain picked out by a representation are appropriate. As Peterson states:

> In order to land an aeroplane we need to consider runways any pylons but not the positions of underground gas mains and the boundaries of electoral constituencies.[575]

Essentially, Peterson makes express, requirements that are inherent in both Goodman's representation and in theories of representation based on the requirement of systematicity.

Together, the necessity of delineating task and ontology can be called the 'use' criteria. In contrast, the requirements discussed by Gurr, Lee and Stenning can be called the 'link' requirements.[576]

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[573] Ibid.

[574] Ibid.

[575] Ibid.

[576] Goodman's requirement of indifference and articulate symbols will not be discussed further. It is a boundary requirement for symbols to be so called. For clarity of discussion such symbols will be assumed. Goodman's requirements that the field of reference indicated by a symbol be unambiguous, disjoint and differentiable are covered by Gurr, Lee and Stenning's criteria and will be discussed within them.

6.2.5 Practical criteria

While the use criteria and the link criteria focus representational choice, they neither individually or jointly ensure representational fit and in addition to the use and link criteria researchers often resort to practical criteria for assessing representations. Conversely, Goodman's explicit exclusion of practical assessments such as legibility, graphic suggestiveness and mnemonic efficacy from his representational requirements highlights his interest in the theoretical nature of the representational link. In examining Toulmin's structure, Newman and Marshall propose four criteria for assessing representations: *coverage*; *perspicuity*; '*encodability*' and *comprehensibility*.[577] Coverage assesses 'whether the phenomena we recognize as central ... are captured by the representation.'[578] This covers the same ground as assessment of ontology-fit. Perspicuity examines how well a representation 'delineates and highlights salient structural characteristics of the domain.'[579] This assessment is related, though subtly different to an assessment of coverage. While coverage assesses whether the elements of a domain are included in a representation, assessment of perspicuity examines how well the representation highlights the relevant aspects of the domain. This is not a requirement imposed by the other theories of representation examined above.

Encodability concerns 'how readily and consistently elements' in a field can be mapped to elements provided by a representation.[580] This is not a requirement explicitly imposed by the other theories of representation examined above. Goodman's requirements that symbols have invariant, disjoint and distinguishable fields of reference is in some part similar to this encodability requirement. A representation that did not meet these requirements would not be consistent under the encodability requirement, and vice versa. However,

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[577] Newman and Marshall, above n. 314, 27.

[578] Ibid.

[579] Ibid. 29.

[580] Ibid. 31.

Goodman's criteria have no requirement of 'ready' encodability. The ease or difficulty of using a representation is irrelevant to Goodman's criteria, which are solely concerned with setting boundary conditions for what amounts to a representation. The criteria for assessing representations provided by Gurr, Lee and Stenning do not explicitly require ready encodability. Ready encodability might be said to be inherent in Peterson's requirement for task and ontology fit. If a representation does not allow ready encoding it might be said not to be good for its particular task. Essentially, however, this turns on how widely the requirements are read. The requirement for task and ontology fit could be interpreted as both a theoretical requirement and a practical requirement. If the latter, then it overlaps with the requirement for ready encodability. The net result though, is that in assessing the practicalities of representations, ready encodability is desirable.

Finally, Newman and Marshall require representations be comprehensible.[581] However, it is unclear precisely what this requirement covers. Newman and Marshall state that comprehensibility is used to 'throw into relief' aspects of a domain that are <u>not</u> highlighted by a representation.[582] Examining those aspects of a domain not covered by a representation could undoubtedly be beneficial, for example to highlight whether task and ontology choice have been appropriately made. Assessing what is not covered by a representation could thus lead to reassessment and redesign of the representation. However, the converse, assessment of task and ontology fit, which involve choosing what <u>is</u> to be represented, inherently involves choosing what is not represented. Assessing perspicuity and readiness of encodability can also, peripherally, indicate what has been left out of a representation. In this respect, assessment of comprehensibility is superfluous. Nevertheless, specifically examining what a representation omits, rather than indirectly examining this through focusing on what is included in the representation, cannot be detrimental. The purpose

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[581] Ibid. 32.

[582] Ibid.

here is not to propose orthogonal criteria for what amounts to representations in a general sense, only to find useful guidelines for design of representations and examination of existing representations. In another sense, examination of comprehensibility may be different from examination of task and ontology fit. For while a representation selects things to represent, and omits other things, the number of things that are not represented is potentially enormous. Focusing on comprehensibility could provide a focused way to reassess those things omitted from a representation.

In addition to good task-fit and good ontology-fit, Peterson also discusses user-fit and circumstance-fit as requirements for representations.[583] User-fit examines the extent to which a representation is useful for any individual user, with their own cognitive strengths, capacities, and expertise.[584] Process-fit examines how easy a representation is to manipulate.[585] Circumstance-fit examines how the environment in which a representation is used affects the representation. For example, blackboards, paper and computers all allow and encourage different manipulations – implying that different representations would be appropriate.[586]

In discussing representations, Sloman proposes various assessments for representations, including: learnability, expressive power, stability, ease of construction, extendibility and robustness.[587]

The point is not that any one of these assessments, or that combining all these assessments, will result in the appropriate representation for a given task; only to emphasise that representations must be judged according to their context of

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[583] Peterson, above n. 572, 10-11.

[584] Ibid. .10

[585] Ibid.

[586] Ibid. 11.

[587] Sloman, A., 'Towards a general theory of representations' p. 118, in Peterson, D. (Ed) Forms of Representation (1996) Intellect Books, 136-7.

use and that there are many facets to this. These criteria are not exhaustive and others could potentially be added. In contrast to 'use' and 'link' assessments, which examine epistemological adequacy, these practical assessments must be made after examining the actual use of a representation.

6.2.6 Visualisations

The above assessments are concerned with structuring a meaningful mapping between a set of symbols, which constitute the representing domain, and the represented domain. Notably however, despite Goodman's interest in art, Peterson's interest in external representations, Gurr, Lee and Stenning's interest in diagrammatic reasoning and Newman and Marshall's interest in Toulmin structures, none of the above representational assessments actually discuss the visual aspects of representations. For just as different representations can be provided for a domain, so too can different visualisations be provided for a representation.

As with selection amongst representations themselves, it would be desirable to be able to make a reasoned, theoretically underpinned choice between alternate possible visualisations for a representation. Amongst other things according to Gurr, Lee and Stenning, cognitive theories of diagrammatic reasoning aim to explain how diagrammatic vocabularies are used, their syntax and soundness, and the general pragmatic issues that surround the use of diagrams.[588] The suggestion is that cognitive theory can provide a comprehensive theory of diagrammatic reasoning – including guidelines for the visual design of representations. Unfortunately, cognitive theories of diagrammatic reasoning actually provide limited guidance for the design of diagrams.

[588] Gurr, Lee and Stenning, above n. 564.

The controversy over simply specifying exactly what constitutes a diagram highlights the difficulty for cognitive theory in specifying what amounts to a good diagram. Work on this 'boundary' problem attempts to elaborate the defining elements of diagrams, to elaborate what constitutes 'textual' representation and hence what the differences are between textual and diagrammatic representations.[589] Pinpointing the 'essence' of diagrams would, *prima facie*, help clarify what amounts to a diagram and aid the design of better diagrams. However, even defining this boundary has proved elusive.

Larkin and Simon suggest that:

> the fundamental difference between our diagrammatic and sentenial representations is that the diagrammatic representation preserves explicitly the information about the topological and geometric relations among the components of the problem, while the sentenial relation does not.[590]

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[589] Unfortunately, much of this work seems confused. Firstly, the terms sentenial and linguistic are sometimes used in substitution - in contrast to diagrams. However, there can obviously be great difference between sentenial in the sense of textual representations and linguistic representations which can be construed much wider to include spoken aspects of communication. However, even if "textual" is used instead of "sentenial" of "linguistic" the contrast with diagrammatic representations still seems artificial. Goel is one of the few to note that theories must explain these intuitively based categories and not merely assume them: Goel, above n. 547. As Gurr acknowledges, words on the printed page are also visual, and so perhaps diagrammatic (although Gurr maintains a distinction based on linearity see below): Gurr, above n. 253. The difficulty is increased when we consider that elements of design and layout are obviously important in textual communication. On a surface level, witness the importance of font choice, text colour, text size, bolding, italics and underlining. More deeply, the use of spatial layout is important, such as headings, indentation, and tables. The textual obviously contains elements of the visual. The use of this false dichotomy in much work in cognitive science examining diagrammatic reasoning is problematic.

[590] Larkin and Simon, above n. 246, 66.

Thus, in designing diagrams topological and geometric relations should apparently be preserved.

However, while seemingly intuitive this cannot be a fundamental characteristic of diagrams. There are obvious graphical representations that do not conform to this. For example, many paintings seemingly preserve few of the topological or geometric relations of what they represent.[591] The intention might however, have been to restrict this definition to diagrammatic rather than pictorial representations. Even with this limitation though, the requirement is problematic. For example, the tube map does not maintain the topological and geometrical relations of the train lines and stations that it represents.[592] Or more precisely, it does not preserve all of them. For this is a key problem for the above definition. It leaves unclear what information is to be preserved in the diagram. In speaking of preserving 'the' topological and geometric relations, Larkin and Simon oversimplify the issue. Perhaps anticipating such problems, Larkin and Simon provide a second defining distinction whereby in a sentenial representation 'elements appear in a single sequence' whereas in a diagrammatic representation 'information is indexed by two-dimensional location.'[593] Shimojima however, demonstrates the existence of 'sequential diagrams', diagrams in which elements appear in a single sequence.[594] Larkin and Simon's intuitive classifications cannot provide the sought for criteria.

Stenning and Oberlander locate the difference between 'graphical' and 'sentenial' representations elsewhere. According to Stenning and Oberlander graphical representations exhibit 'specificity' in that they:

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[591] Goodman discussed this at length: Goodman, above n. 548.

[592] Whitby, B., 'Multiple knowledge representations: maps and aeronautical navigation' p. 67, in Peterson, D. (Ed) <u>Forms of Representation</u> (1996) Intellect Books, 69-70.

[593] Larkin and Simon, above n. 246, 68.

[594] Shimojima, above n. 254, 318.

> compel specification of ... information, in contrast to systems that allow arbitrary abstractions.[595]

Thus while a description of a man may 'fail to mention whether or not the man is wearing a hat', a picture 'has to go into details'.[596] However, it is certainly not the case that diagrams must be specific about what they represent. For example, we could choose to utilise the age-old astrological symbols to represent men and women:

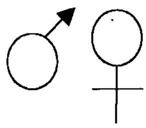

Figure 62: Non-specific diagrams

Such usage no more represents whether a man is wearing a hat than it does whether a woman is wearing a skirt. As with any diagram, some information is specified and some is left unspecified and the key is determining what information is and is not specified. Diagrams are in this respect not necessarily any more specific than textual representations. Specificity cannot of itself be the defining characteristic of diagrams.

In reviewing theories of diagrams, Shimojima examines theories which characterise the distinction between diagrammatic and sentenial representations as based on the use of 'relational symbols'.[597] Accordingly, sentenial representations represent relations using symbols whereas diagrams represent relations by relations.[598] For example:

> the word "precedes" in the sentence "A precedes B" is not a relation ... although it "means" a relation. In the case of a map, however, "the fact that one place is to the west of another is represented by the fact that the

[595] Stenning and Oberlander, above n. 246, 99.

[596] Dennet quoted by Shimojima, above n. 254, 323.

[597] Ibid. 318-20.

[598] Ibid. 318.

> corresponding place on the map is to the left of the other; that is to say, a relation is represented by a relation."[599]

Shimojima argues however, that sentenial languages do not necessarily use relational symbols. Thus

A is-left-of B;

and

AB

are both sentenial representations of the fact that 'A' is to the left of 'B', yet only the first uses a relational symbol.[600] Similarly, Shimojima argues that diagrams often use relational symbols - such as lines and arrows in genealogical charts to indicate family relationships.[601] Use of relational symbols cannot then be determinative of diagrams.

The final characteristic often argued to define diagrams is that diagrams utilise the 'intrinsic' properties of graphics to represent the domain.[602] Venn diagrams are the near universal example used to illustrate this idea. Venn diagrams represent relations such as:

All A's are B's; and

All B's are C's

Figure 63 illustrates this as a Venn diagram.

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[599] Ibid.

[600] Ibid. 319. However, in a strong sense the second example does seem to be understood in a different way to the first. For example, in the sentence 'B is-to-the-right-of A' the 'relational symbol' cannot be removed to give 'BA'. This however, does not overcome Shimojima's second objection.

[601] Ibid. 320.

[602] Shimojima reviews several theories that adopt this approach, including his own: ibid. Gurr, Lee and Stenning adopt this approach.

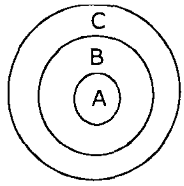


Figure 63: Venn diagram

According to Gurr *et al.*, the use of circles to represent A, B and C automatically results in the conclusion that all A's are C's. Gurr *et al.* state that spatial inclusion automatically maps to set inclusion giving this 'free ride'.[603] While the fact that all A's are C's is not explicitly stated it is immediately evident from the diagram. This is inherent from the use of spatial inclusion to represent set inclusion. The idea of intrinsic constraints suggests that diagrammatic representations should utilise such inherent properties of the diagram to represent properties in the represented domain.[604]

The notion of 'intrinsic' constraints is intuitively appealing and is suggestive as to why Venn diagrams improve reasoning for the type of problems they represent. Unfortunately, the discussion of intrinsic properties is sparse and it is difficult to understand what 'intrinsic' properties generally exist. In the case of set inclusion in Venn diagrams, a mapping between the domain and inherent aspects of the diagram may appear 'natural'. Unfortunately, it is difficult to see what such a mapping would involve in general.

Gurr provides another example in which letters represents integers and a connecting arrow represents the 'greater-than' relation. Thus '1<2<3<4' could be represented by

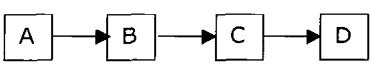
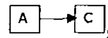


Figure 64:Representing '<'

[603] Gurr, Lee and Stenning, above n. 564, 554

[604] The mapping should be lucid, laconic , sound and complete as discussed above.

This seems straightforward. Here a 'path' of connecting arrows maps the transitivity of the 'greater-than' relation. Just as 1<3 indicates that '1' is less than '3', so the chain of arrows between 'A' and 'C', 

, indicates that 'A' is less than 'C'. Gurr indicates a number of possible variations on this representation:

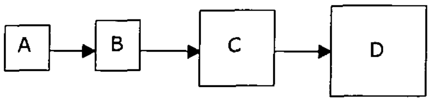


Figure 65:Second representation for '<'

Here the greater-than relation is also indicated by box size.

However, rather than clarifying the notion of intrinsic constraints, that at least two ways can be found to represent '<' using only squares and arrows indicates that there is in fact nothing intrinsic in the graphical objects themselves that represent the '<' relation.[605] Rather, it is the meaning placed upon the properties of the graphic objects. It is a matter of choice to interpret the size of a square as indicating the relative size of the number represented. For example relative number size could also be indicated by rotation of a square from the vertical.

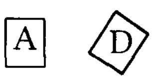


Figure 66: Rotation indicating relative size

Figure 67 indicates that D is greater than A. Given that there are multiple ways to represent information, what an intrinsic mapping might amount to is unclear.

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[605] Further, in the second representation "->" and the size of the square are both used to indicate "greater-than". This violates the criteria of laconicism. Goodman's and Gurr's criteria can be used to clarify graphical representations So to that extent the criteria do specify what the elements of a representation should be. However, the criteria do not specify that "->" should be used in preference to size, or any other feature of the representation.

What inherent structure might amount to in systems to support legal sensemaking is unclear. For example, a simplified argument system might represent 'Claims' and 'Conclusions', and the 'supports' and 'detracts' relationships that can exist between them. Representations typically use structures such as in figure 67 to display this.

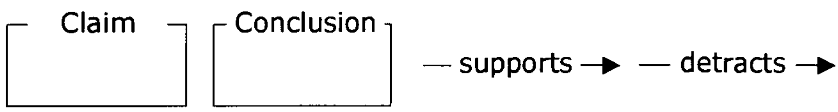

Figure 67: Graphic elements in a representation of argument

There is nothing 'intrinsic' in this however, and 'supports', for example, could be indicated in a number of ways as in figure 68.

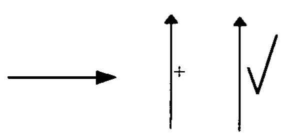

Figure 68: Alternative representations of 'supports'

Indeed, Toulmin uses the first possibility, Wigmore something similar to the second possibility and DRAMA the third possibility.

Moreover, argumentative relationships can be indicated using completely different forms, such as tables or the use of matrix representations (e.g. Room5). In this respect, Suthers suggests it will become easier to perceive and remember argumentative relationships as a representation moves from text, to table and matrix representations to network-based representations.[606] The work of Robinson and colleagues provides some support for this.[607] It remains an open question however, whether any similar effect can be found for other aspects of argumentative presentations.

While it is difficult to determine an intrinsic representation for the basic support relationship, this becomes even more difficult when considering other

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[606] Suthers, above n. 81.

[607] See: 3.5.3.

aspects of argument, such as deduction, induction and analogising (compare the multiple possibilities discussed at 4.6). How broader aspects of argument, such as coherence arguments and argument as to the balance of consideration should be intrinsically represented is even less clear. It is similarly difficult to imagine what an intrinsic representation would be in diagrams representing aspects of reasoning.

More pertinent is Gurr's observation that the representation should be consistent. As Gurr emphasises, the diagram should consistently employ the visual elements of which it is constituted. For example, the consistent use of shapes makes a diagram easier to understand. Thus, in systems such as Toulmin's, IBIS and SIBYL, if it is chosen to represent Claims using rectangles and Issues using ovals, all Claims and Issues should be represented using rectangles and ovals respectively, and rectangles and ovals should not be used to represent anything else. While a sensible suggestion, this is far from the idea of inherent diagrams suggested by Venn diagrams - there seems nothing 'inherent' in using a rectangle to represent a claim rather than an oval or a triangle.

Perhaps the notion of inherent structure prohibits representations employing practices such as using red arrows to indicate a 'support' relationship - red is too frequently used for indicating, and hence associated with, warning or attack. Similarly, it may caution against using a crossed link to indicate support.

Figure 69: Problems in inherent structure

The cross is too often used for, and hence associated with, attack. Even in these situations however, there does not seem anything inherent in these visualisations – apart from their drawing on familiar everyday cues.

Interpreted in this manner, part of the problem is the term 'intrinsic' itself. The word 'intrinsic' suggests that there are inherent, 'natural', properties of diagrams that can be used in representation. Properties that are natural in the sense that they are based on immutable scientific laws. Rather, representations are 'intrinsic' only in the sense that they make use of 'common' interpretations - interpretations that tap into shared understandings. As Scaife and Rogers state, someone using a diagram must have knowledge about the diagrammatic conventions employed.[608] They write:

> A circuit diagram, an architectural plan or a mathematical notation comprise a set of meaningless symbols to the uninitiated; they only take on their intended meaning through the conventions associate with them.[609]

Understood in this way, diagrams are more 'specific' as required by Stenning and Oberlander, and 'intrinsic' to the degree they trade on shared understandings for their diagrammatic conventions. That a diagram is more specific and is intrinsic are then merely products of the existence of these shared conventions - they are not properties of diagrams themselves but imported from shared understandings which constrain the sense that is made, the meaning, of the diagram.

If 'intrinsic' is understood in this manner, this is not itself problematic. It merely amounts to the claim that if diagrams are easy to interpret it is because they 'piggyback' on common understandings. In terms of diagram design this merely indicates that diagrams should highlight those aspects of importance in a representation and that these diagrams should be based on shared understandings. The problem for designing diagrammatic representations for the manipulation of arguments and reasoning is that there is no commonly agreed visual system by which to represent common argument elements such as implies, supports, detracts from, contradicts, analogy, etc. The lack of a visual

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[608] Scaife, M., Rogers, Y., 'External cognition: how do graphical representations work?' (1996) 45 International Journal of Human-Computer Studies 185, 195.

[609] Ibid. 199.

system by which to represent aspects of argument is reflected in the number of different representations seen in the various systems already produced. Moreover, while a representation can attempt to trade on common understandings, this does not ensure that the representation will be clear. This is particularly the case where diagrammatic representations combine with textual representations. While the objects may themselves be relatively unambiguous, as a natural language the text is ambiguous. Moreover, combining the two leads to further possible ambiguities where the text does not correspond to the object containing it as in figure 70:

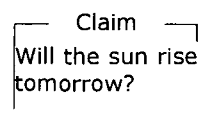

Figure 70: Ambiguous representation

There appears little way to avoid this. Notably however, this is not a problem peculiar to this type of representation and paradoxical sentences are well known.[610]

Cognitive theories of diagrammatic reasoning do not explore what shared understandings are and to this extent such cognitive theories actually say very little about the visual aspects of representations. In this respect the work of authors such as Bertin,[611] Tufte[612] and Horn[613] are particularly relevant. Bertin and Tufte examine the components of diagrams, such as shape, texture, colour and size and how these components can be used to build more or less effective diagrams. Horn examines how diagrammatic components are commonly used to convey meaning. Horn goes so far as to argue that the emergence of 'visual

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[610] For example, 'This is not a sentence.' Paradoxical drawings, such as those by M. C. Escher are also well known.

[611] Bertin, J., Barbut, M., Sémiologie graphique: les diagrammes, les réseaux, les cartes (2nd edition) (1973) Mouton.

[612] Tufte, E.R., Envisioning information (1990) Graphics Press.

[613] Horn, R.E., Visual Language: Global Communication for the 21st Century (1998) MacroVu, Inc.

languages' can be observed in which there is a 'tight coupling of words, images and shapes into a unified communication unit.'[614] The emerging discipline of 'information design' studies how such visuals can be used to communicate. Information design, which is 'the art and science of preparing information so that it can be used by human beings with efficiency and effectiveness' contrasts with other forms of design which value novelty, fashion and style over clarity of communication.[615] Despite the work of authors such as Bertin, Tufte and Horn however, there is no general theory informing information design but only a series of *ad hoc* heuristics - visualisation remains an art.

Consequently, in addition to the task, link and practical criteria, the above visualisation criteria can be added. The task criteria remain foremost amongst these criteria, though none of these criteria determine either the representation or a visualisation. The best that can be drawn from the criteria is an awareness of the need to represent those elements in the domain that are important to the task. This will make the representation more transparent than it would otherwise be.

6.2.7 Applying the criteria

The use, link, practical and visualisation criteria do not provide an unambiguous classification of representations. These criteria cannot mechanically sort 'proper' from 'improper' representations. However, while the use, link, practical and visualisation criteria cannot determine representations, they do provide guidelines with which to examination representations.

For example, although it is unclear whether Wigmore's charting system was designed as a means to analyse evidence structures as presented in already

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[614] Ibid. 11-4.

[615] Horn, R.E., 'Information Design: Emergence of a New Profession' in Jacobson, R. (Ed) Information Design (1999) MIT Press, 16.

decided cases or as a means to prepare evidence for trial, the ontology proposed by Wigmore has been claimed to be beneficial for both uses.[616] To this end, Wigmore's charting system appears to be lucid, laconic, sound and complete and it appears relatively straightforward to determine what types of evidence correspond to the charting elements defined in the method. The system has been said to be unnecessarily complex however, making it overly difficult to use and learn. Similarly, the visual presentation of the method can be criticised. While the method visually distinguishes each type of evidence included in the evidence and the relationships that exist amongst that evidence, the visualisations adopted seem far from intuitively meaningful. It is highly probable that this contributes to difficulty in learning and using the method.

As with Wigmore's method, it is difficult to determine precisely what use Toulmin's method was proposed for - whether as a method to analyse the structure of existing arguments or as a means to better construct arguments. It has been used in both capacities. In both cases however, the ontology provided is problematic. As a means to analyse arguments the ontology is problematic because it requires classification into objects that typically do not exist in arguments. For example, Toulmin's conception of Claim, Warrant and Backing are very narrow, and the method does not distinguish the dialogical nature of arguments. As a practical matter it can be difficult to determine when elements of an argument fit within one aspect of the representation rather than another. As a means to represent reasoning as a process of argument, the representation is problematic as it does not provide ontological objects with which to express aspects of reasoning wider than argument. The representation is lucid, laconic, sound and complete, despite it being difficult to encode actual arguments. The visual presentation of Toulmin structures is interesting for two reasons. First, the visualisation can be criticised for lack of clarity. For example, Toulmin did not visually distinguish between Data, Claim and Warrant. The only way to distinguish between these is through their spatial layout - Data always being to

[616] Anderson and Twining, above n. 510.

the left of a Claim and a Warrant always lying below and between the two. Secondly, the method simply connected elements with undifferentiated lines. For example, arrows were not used to indicate that Data supported Claim, rather than the converse, and no visual distinction was used to highlight the different role of Rebuttals in arguments. Although the choice of actual diagrammatic elements can be problematic, distinguishing diagrammatic elements is one, minimal, requirement. The alternate visual presentation used in Room5 addresses some of these problems. However, it is doubtful whether spatial inclusion is a more intuitive method to indicate support and attack than is the use of arrows. It would be interesting to compare comprehension of large argument structures visualised in traditional form and in Room5 to determine whether there is any difference in ease of comprehension of macro aspects of argument.

IBIS is a general means for problem solving and provides a comparatively simple ontology for this task. However, the representation distinguishes far fewer aspects of argument than representations such as Toulmin or ARL. This makes IBIS less appropriate as a tool for argument analysis. However, for the use for which it was originally presented, the ontology appears to be lucid, laconic, sound and complete. Although the elements in IBIS are visually distinguished, there is nothing inherently meaningful in their presentation. Notably, commercial versions of IBIS provide greater visual distinction by liberally using icons. There is evidence that commercial versions of IBIS have been beneficial.[617]

DRL is similar to IBIS in that it supports problem-solving. However, this has been highly tailored for use in creating and recording design rationale. The ontology provided in DRL is reflective of this. Like IBIS, DRL does not provide a rich vocabulary to discuss argument. For the original task however, the representation appears lucid, laconic and sound - although it can be difficult to

[617] Conklin, above n. 461.

encode elements within the ontology. Like IBIS, DRL provides minimal visual distinction between elements of the representation and there appears little that is intrinsic in the visualisation used.

6.3 A class of legal sensemaking support systems

There is much evidence that representations facilitate sensemaking. However, it is not just any representation that facilitates sensemaking – representations must be tailored for their context of use. A representation must be appropriate for the use that will be made of it. A representation must fit its use. Characterising use in more detail thus becomes central. In a broad sense, 'legal use' might be regarded as one use and thus a single representation expected to support all the sensemaking that occurs in law. Examination however, indicates numerous different tasks is law. A consequence of this is that multiple representations are needed to support legal sensemaking for these different tasks. Accordingly, there is a class of computer systems, each built around one of these representations, that support legal sensemaking. Each system in this class of sensemaking support systems is characterised by the use of visualisation in support of the augmentation of legal sensemaking.

The class of legal sensemaking support systems is mapped by a combination of the representation provide for the domain and task which this system is designed to support, and a visualisation of this representation. It remains however that the task determines the representation – the representation must be appropriate to the task. A systematic classification of the tasks that need to be supported in legal sensemaking would therefore define the boundaries of this class of legal sensemaking support systems. With a systematic classification of tasks in law, it would be possible to more systematically explore the kinds of representations that could be provided to support legal sensemaking. Unfortunately a systematic classification proves elusive.

The tasks that legal sensemaking support systems might augment can be conceived in various ways. For example, the task might be to support general processes of reasoning - in which case an examination and classification of processes of reasoning would be necessary. Philosophy, psychology, cognitive science, and computer science all investigate precisely such general processes of human reasoning. For example, investigations of the role of deductive logic, inductive logic, analogising, abduction, expected utility theory, and reasoning to the best explanation all propose that the phenomena investigated are general processes of reasoning, processes evident in diverse areas such as science, medicine, philosophy and law. If such processes are indeed ubiquitous, then they could seemingly be used to inform the creation of representations to support legal sensemaking. In this sense, providing support for such reasoning processes would provide support for reasoning in a diverse range of situations. However, regardless of how systematic such classifications are or how universal such strategies of reasoning are, simply focusing on classifying such strategies of reasoning appears insufficient. While such classifications can be useful conceptual markers and useful as a means to mentally separate and distinguish aspects of reasoning, providing representations at this level of generality provides limited benefit. Although people might be said to create and test explanations until satisfied they have the best explanation in a situation, unless they are engaging in self reflection and examining their own reasoning they largely do not make sense through consciously reflecting that 'I am engaging in reasoning to the best explanation'. Although labelling particular relations and moves as 'deductive', for example, might be part of building an understanding, it is certainly by itself insufficient. The whole benefit of one representation over another representation is that the representation is tailored for a particular task – the representation is tailored to highlight salient aspects of the task and hence facilitates reasoning about the task. Benefit comes through tailored specialisation. This strategy for constructing representations does not provide this. Moreover, if representations are tailored to use then the classification of general processes of reasoning, to an even lesser degree, defines how representations are useful. For when representations are tailored to use, it is the criteria used to tailor the representation which are just as important in shaping the resulting representation. There is thus little to suggest that focusing solely on general processes of reasoning could define a single representation appropriate to all aspects of sensemaking. Hence, even a systematic classification of processes of reasoning would not define the representation to be used for any particular task. It is difficult to conceive how focusing solely on such general classifications of processes of reasoning could define representations.

The field of 'computer-supported cooperative work' provides an alternative view of tasks to be supported. Here computer systems are often examined according to whether they support things such as creativity, reasoning, argument, negotiation or presentation.[618] For example, mind mapping was proposed as a means to support the creative aspects of problem solving and can successfully be used to stimulate ideas in diverse areas, including law. In this vein, Verheij distinguishes between arguments-assistance systems and argument-mediation systems.[619] Research in computer-supported cooperative work highlights the importance of the social setting in which a sensemaking support system will be used. As with a classification of the processes of reasoning however, this type of classification does not define an exact representation for a use in a particular specific situation. For example concept mapping is a, slightly, different method to mind mapping whose creators argue can also stimulate creativity.

Classifications of processes of reasoning and examinations of things such as creativity, negotiation and presentation are comparatively general. Work in artificial intelligence suggests an alternative approach to examining tasks. In

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[618] E.g.: Smith, J.B., Weiss, S.F. and Ferguson, G.J., 'A hypertext writing environment and its cognitive basis' p. 195, in Proceedings of the Hypertext `87 Workshop (1987).

[619] Verheij, above n. 539. Though Verheij goes on to refer to Room 5 and GeoMed as argument assistance systems: ibid. 44.

artificial intelligence, researchers have attempted to analyse problem solving in terms of the 'generic' tasks that it involves.[620] Generic tasks are said to be tasks that are universal across problem solving and are said to include 'diagnosis', 'planning', 'classification', 'abstraction' and 'explanation', amongst others. Work in artificial intelligence and law has attempted to apply this methodology in system construction.[621]

Generic tasks appear a potentially fruitful approach for systematically examining representations. Although there is some dispute over precisely what the idea of generic tasks covers - generic tasks are categorised differently by different researchers and the idea of generic tasks has itself been questioned[622] - whether or not the tasks are truly 'generic' and regardless of the particular classification provided for tasks, in many respects there is a lot of commonality across areas in the tasks that are said to be generic. Examining generic tasks might thus provide a systematic way to explore the range of representations on which sensemaking support systems might operate. Generic tasks might provide a way to map the domain of representations.

However, even adopting any particular classification of generic tasks, there is still a need to specify the application of tasks in the precise situation that it is sought to support. The types of task discussed in the generic task literature appear qualitatively different to those tasks typically discussed in the representational literature. For example, while Peterson talks of

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620 For a criticism, see: O'Hara, K., Shadbolt, N., 'Locating Generic Tasks' (1993) 5(4) Knowledge Acquisition 449. Note that the idea of 'generic tasks' is a specific approach in the AI tradition. Here the idea of 'generic' tasks is used more widely to cover all conceptualisation of tasks that are said to be in some way universal.

621 E.g.: Valente, above n. 86; Visser, above n. 86. Note that these take a different view on tasks.

622 O'Hara and Shadbolt, above n. 620. Valente and Visser in the field of AI and law have a slightly different conception of tasks. Valente provides a good discussion of the notion of tasks in artificial intelligence; Valente, above n. 86, 60-70.

representations to help land a plane, there is no 'landing a plane' task discussed in generic task classifications. Similarly, there is no 'argument' task in the classifications. Systems advocating the use of diagrams to support reasoning have been proposed for use in diverse types of situation. Systems have been designed for use solely by individuals and also to support group processes. Group oriented systems can be aimed at either users directly interacting with the system or use through a 'facilitator'.[623] Systems can be designed for friendly or hostile groups. A system used by friendly groups may need different representations and services than a system used for hostile groups.[624] Systems, both aimed at individual use and aimed at group use, can be designed primarily for use prior to the main stream of work, concurrent with the main stream of work or subsequent to the main stream of work. For example, a system could be used primarily as a means to prepare for meetings. Alternatively, the system could be used in real-time during meetings, as a means of stimulating discussion, or after meetings as a means to solidify and archive the results and ideas generated during the meeting. The system could be synchronous or asynchronous. Each of these potentially requires the representation of different things. In the educational setting, systems are likely to be quite different from those for use in practice. Educational systems might

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623 The facilitator mediates between the system and participants in a discussion - interpreting the reasoners and expressing their reasoning in the representation used by the system thereby reducing the need for each participant to learn all the intricacies of any particular representation and any particular system. The practical benefit of having a facilitator has been argued by, e.g.: Rodhain, above n. 422, 52; Saeedi, M.H., Sillince, J.A.A., 'Incorporating rhetorical and plausible reasoning in a system for simulating argumentation' (1999) 12 Knowledge-Based Systems 113, 117. Nunamaker gives the facilitator a wider role, that of "sense-giver" - one who directs the process and point to salient information: Nunamaker, J.F., 'Future research in group support systems: needs, some questions and possible directions' (1997) 47 International Journal of Human-Computer Studies 357, 379. The drawback is that in a facilitated system all work must pass through the facilitator, potentially slowing work and making it less fluid.

624 Work on 'Negotiation Support Systems' explores some of the issues relevant to this difference.

be expected to provide more detailed ways to breakdown and classify arguments than systems for legal practice. Systems for post-hoc argument analysis may be different from one for pre or concurrent argument construction. The former might only need to represent supports or detracts relationships but not things such as issues and possible answers. In contrast the former might need to represent more detailed aspects of argument such as the degree of support between a claim and a conclusion and it might need to allow the direct classification of statements in terms of whether they are generalisations, or inductions, or analogies etc. A system for concurrent analysis in contrast would likely not need to make use of such fine grained representations of strength relationships between claims and conclusions. The point is not that these requirements are mutually exclusive or that all of these factors cannot be subsumed into a task analysis. It might be possible to analyse all of these requirements in terms of the universal tasks typically discussed in the artificial intelligence literature. However, how this would be done and how specific representations would be achieved from an analysis of such universal tasks is unclear. It remains that representations are specific and the factors that influence the design of a representation are potentially many and varied.

As Visser discusses, classifications of generic tasks are non-specific and require decomposition into sub-tasks, sub-sub-tasks, and so on.[625] As when examining processes of reasoning, generic tasks are not tailored to any specific situation and consequently will not focus on and highlight those aspects of an area that are specific and important to reasoning in the area. However, as a representation becomes more and more specifically tailored for a particular problem solving application, it is less the classification of generic tasks which defines the representation and more the tailoring itself.

These classifications of generic tasks are based on a problem solving perspective – on examinations of the ways that people approach and resolve

[625] Visser, above n. 86, 63.

problems. As Valente notes however, classifications of legal tasks can be based on other perspectives. As an example, Valente cites Bench-Capon who examined legal work in terms of: 'adjudication'; 'policy making'; and 'advice giving'.[626] Similarly, Valente notes the work of Clark and Economides who examine legal work in terms of: 'transacting'; 'advising'; 'negotiating'; 'representing' and 'structuring'.[627] According to Matthijssen 'making a contract' is a legal task and generally, a task is 'a group of activities and procedural steps that are directed towards a common goal.'[628] Each of these classifications provides an alternative classification of tasks and an alternative perspective from which to attempt to systematically support representations for sensemaking. Suffice to say that with each of these classifications, problems of specialisation and tailoring arise. Moreover, every task classification provides an apparently alternative means to delimit legal tasks. However, these classifications are not mutually exclusive. For example in a task primarily involving planning, creative elements can be envisaged, as can argumentative and presentational aspects. A task involving adjudication could involve planning and would likely involve some creativity. To a large extent then, task classifications simply provide alternative viewpoints for looking at legal work.

Observing that task classifications do not define representations is not to disparage the benefit of such classifications. This says nothing, for example, about the benefit of focusing on generic tasks as a method in artificial intelligence. It is only to argue that in examining representations to support sensemaking it is extremely doubtful that focusing on generic tasks can itself define exact representations for use in specific situations. Though useful, even a systematic breakdown of tasks provides limited information for designing representations.

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[626] Valente, above n. 86 141.

[627] Ibid. 141-2.

[628] Matthijssen, L., 'A Task-Based Interface to Legal Databases' (1998) 6(1) Artificial Intelligence and Law 81, 84

Without a comprehensive model of tasks, devising diagrammatic representations to support legal sensemaking remains a partially *ad hoc* affair. Focusing on tasks and attempting a comprehensive classification of tasks is a 'top-down' approach to representational design and system construction. However, when this is inadequate the only alternative is an, at least partial, 'bottom-up' focus in which systems are iteratively conceived, constructed, tested and refined. Here, representations and systems using those representations, are designed with specific application in mind, rather than from within a classification of tasks. System creation here proceeds from an appreciation of need rather than an examination of all the tasks that might exist and how they might be supported. In this vein, incremental construction and formalisation of representations have been suggested as means to address the difficulties inherent in choosing representations with which to work.[629] Incremental construction and formalisation hold some promise as means to construct representations. However, while flexibility in representations may be desirable, simply letting the problem solver develop their own representations is insufficient.[630]

Moreover, an important aspect of computerising the construction and manipulation of representations is that this facilitates automation. Importantly, this automation is not of reasoning itself, however, nor need it be simply the layout and manipulation of the graphical elements in a representation. Computerisation can facilitate collection of information about the representation that is constructed. For example, when using the standard method of argument diagramming, a computer system could keep track of all statements that are unsupported, what the support for each statement is, all

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[629] Shipman, F.M., McCall, R.J., 'Incremental Formalization with the Hyper-Object Substrate' (1999) 17(2) ACM Transactions on Information Systems 199.

[630] The very *raison d'être* of providing representations to support sensemaking is to facilitate the task being performed – to scaffold a user's reasoning.

arguments that are linked and all arguments that are convergent. In a representation that accounts for dialogical aspects of argument, automated services could keep track of such things as all the arguments that are 'attacked' by opposing arguments, all arguments that are undisputed, and those arguments that are disputed but to which a response has yet to be made. In general a system could keep track of all types of statements that have been made. In representations which cover aspects of reasoning, such as IBIS, automatic services could keep track of things such as all Issues that have been raised, all Positions that have been proposed in response to given Issues, all Issues that have no Positions linked to them (indicating that they have not been considered) all Arguments that weigh for a given Position and all Arguments that weigh against a given position. The system could track all Issues that have been decided and all Issues that remain to be decided. In general, a system could list nodes according to how much argument or discussion occurs around them. Those nodes which are highly linked to other nodes are more likely to be controversial than nodes linked to comparatively little discussion or argument. In a representation tailored for legal use, the representation might provide 'Fact', 'Rule' and 'Authority' objects. With such a representation, a computer system could for example, track the disputed and undisputed facts, and which rules and authorities have been relied upon. More complexly, the system could keep track of dependencies between arguments and options, such as occurs in SIBYL. Further, limited systems of inference could be implemented - in an argumentation system for example - to keep track of which argument is 'winning' such as occurs with ArguMed. Rather than automating reasoning, such automation 'informatises' – by using computers to construct and manipulate representations, information is provided about argument and reasoning that would otherwise not be available.

Little consideration has been given in the literature to the full range of possibilities provided by such automation. Although research into computer-based argument investigates the formalisation of argument status, this is not immediately directed at the more general aim of supporting argument through simple provision of information. Similarly, Lee's work on SIBYL is directed at automating reasoning management and not simply at the provision of information about the flow of reasoning. Each different representation will allow different automated services. There is an inherent link between the representation and the potential automated services. In general however, automation allows the system to perform services that the user would otherwise have to perform themselves. It allows a system to perform services that would otherwise be onerous to perform because they are repetitive or because effort is required simply to remember to perform them. Automation can be highly beneficial. However, automation requires formalisation. Automation requires formalisation of the representation and the use of the representation. Systems that seek to support incremental formalisation must support the formalisation of the processes of representational use and not just representational creation.

Given the range of possible representations to support legal sensemaking, comparatively little work has been performed on legal sensemaking support systems. Systems have been built for evidence assessment, for argument construction and analysis, for teaching statutory law, and for geographical mediation. There appears to be much that has not been explored. It is interesting to consider systems that might be constructed. For example, the use of computerised negotiation support tools in law remains unexplored. As do the potential benefits that a corporate memory, a precedent bank, using visualisation of relationships within documents and between documents. The educational systems that have been discussed have focused on providing representations of argument or providing a graphical proof tree for statutory provisions. Other educational applications can be envisaged. For example, it has been argued that legal argument displays a 'crystalline' structure in which standard justifications are used in arguments.[631] This idea has been adopted in artificial intelligence and law in attempts to improve automated

[631] Balkin, above n. 239.

argumentation.[632] Automated argumentation proves difficult for the reasons previously discussed. However, providing a database of classified hierarchical argument justifications could prove useful in a system to teach students about the structure of legal argument. The system could provide a student with a list of typical 'warrants' used in law and require all arguments to ultimately be justified by such warrants. The system could inform both when an argument has not been so justified and also allow comparison of the justifications that are used. In a similar vein a system could provide a database of argument fallacies which students could select and use as the 'templates' for the criticism of arguments entered into the system. While the former system teaches students about argument justification, this system would teach students about argument refutation. Again, such systems are not envisaged as automatically constructing arguments, automatically determining what the next argument move should be, nor automatically determining which argument wins – only to support students in learning about argument.

It is not only to teach argument or to structure group decision making that sensemaking and visualisation could be useful. Just as tools can be envisaged to support learning and sensemaking in an educational context, systems for use in legal practice can be envisaged. Again, different representations are necessary. For example, contrast pure argument analysis where simple claims and conclusions might suffice, with a system for evidence analysis where differentiations of types of evidence might be useful. Wigmorean evidence analysis can be both a means to *ex post facto* assess the proof in trial and a tool to clarify thought processes in preparation for trial. However, Wigmore's method is a method which only supports some of the sensemaking processes,

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[632] Skalak, D.B., Rissland, E.L., 'Argument Moves in a Rule-Guided Domain' p. 1, in The Third International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1991) ACM Press; Palmer, J., 'Legal Merit Arguments, Legal Semiotics and The Design of Legal Knowledge-Based Systems' p. 198, in The Sixth International Conference on Artificial Intelligence and Law: Proceedings of the Conference (1997) ACM Press.

those tightly revolving around the chain of proof itself. It does not support more tangential exploration of or establishment of that chain of proof.

When preparing a matter for trial, for example, it is not only the chain of proof nor the argument that has to be organised. Facts themselves have to be established. Typically, some facts will be agreed and only some facts will be in dispute. The plaintiff will challenge some of the disputed facts while the defendant will challenge others. Undisputed facts will be established by pieces of evidence, be they documentary, or oral, while the attempt is to support disputed facts with evidence which is itself undisputed. In a reasonably complex matter, tracking all these facts, be they agreed or disputed, and their precise relation to the evidence, can be complex. Support for the management of such information is an ideal task for computer support. Such support might involve simply providing chronological lists of all the facts in the dispute, listing those facts asserted by the plaintiff, those facts asserted by the defendant, and those agreed and those in dispute. Support can be more complex however. Facts are not disputed in a vacuum, and disputed facts will be relevant to establishing issues relevant to the dispute. A system to support trial preparation could be constructed to provide support for management of the issues in the dispute. The system could be used to highlight the issues in dispute and the arguments that weigh upon the resolution of those issues. The system could maintain a list of facts that are relevant to establishing or negating each issue and could store arguments about the facts, such as why one version of the facts should be accepted in preference to an alternative version of the facts. Such arguments could themselves link to further issues and facts that support those arguments.

Prior to trial, it is likely that work remains in order to actually establish all the facts and to strengthen the particular reading of the facts being relied upon. Further questioning of witnesses may be necessary, further documents and other evidence may be required. A system to aid trial preparation could help maintain a list of all the uncertainties in a case, and the facts and issues that they bear upon, as well as strategies for resolving those issues – such as questions that need to be asked of witnesses, documents that need to be located or evidence that needs to be gathered. In such ways the system could help manage the process of fact finding, and fact interpretation, as well as issue management and argument construction, that are inherent aspects of case preparation. Given the utility of such a system, it is unsurprising that a system similar to this has been developed.

6.3.1 CaseMap

CaseMap[633] is a tool to aid 'case analysis' and operates along the lines outlined above. According to its creators:

> Complexity obstructs effective thinking. .... [Cases] involve dozens of witnesses and organizations, hundreds of critical facts, and hundreds, if not thousands, of documents. Brainstorming sessions can help you deal with case complexity problems.
>
> Early in case preparation, brainstorming helps you flesh out the critical factual disputes and set goals for discovery. As trial approaches, brainstorming helps you assess case strengths and weaknesses, develop themes, and finalize trial strategies.[634]

Although its creators talk of 'brainstorming' this does not revolve around idea generation, and is actually more akin to case organisation and case analysis.

Case analysis in CaseMap revolves around four main things: Facts, Objects, Issues and Questions. For example, in a hypothetical dispute about breach of contract between a department store and a supplier, facts include such diverse things as that 'Diamond is a California-based department store', that 'SDS is a wholesale distributor for West Coast area' and that 'SDS was already doing business in Southern California before SDS service Agreement for Southern

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[633] www.casemap.com

[634] Krehel, G., 'Brainstorming Your Way to a Winning Case Strategy' (1999) CaseSoft publication. Available at http://www.casesoft.com (accessed 2/3/2001).

California'. Facts are stored, amongst other things, with the date they occurred, the source for the fact, whether the fact is disputed and the issues in the case that the fact is relevant to. Building a database of facts is important in order to build a chronology of the events in the dispute and to support subsequent arguments. Facts can be linked to the documents in which they are established and to the issues to which they are relevant.

Objects in CaseMap are used to reference things such as all the individual participants in the dispute, all the organizations in the dispute, and all the documents, pleadings and physical evidence that have been collected. Objects can be linked to the Issues that they are relevant to.

Issues in CaseMap reference elements of the dispute such as whether the contracts were written or oral, whether equitable estoppel bars any claim and what damages might be payable upon breach of contract.

Questions are used to reference things that must be addressed in preparation of the case. Example questions are 'Who will be our expert witness for damages?' and 'Do we have records documenting Sunrise growth following business dealings with Diamond?'. Questions can be linked to facts, objects and issues that they relate to.

By organising information with CaseMap, its creators argue that the chronology of facts, the 'cast of characters', the document index, the hierarchy of claims and arguments, and the lists of questions that are generated, all provide better insight into and hence management of a dispute. CaseMap provides various flexible search and display tools to help manage all the information and provides tools to help understand the evidence. CaseMap uses a 'data refinery' that allows information that meets desired criteria to be searched for and highlighted. For example, all facts disputed by the opposition can be listed separately. Documents produced by a certain person or after a certain date can be listed. All the facts that are relied upon to establish an issue can be displayed. All the disputed facts relevant to an issue can be displayed. All the questions that remain to be answered can be listed.

CaseMap displays all information in tables, figure 71 displays an example fact table.

Date & Time	Fact Text	Source(s)	Status	Linked Issues
Not Applicable #3	All Diamond contracts with suppliers were short-term and "at will."	Renny Lawlor Deposition, Volume 2, Page 20, Line	Disputed by:	Sunrise Deserved Termination
Not Applicable #4	H.G. Jewels headquartered in Las Vegas, NV.	Monica Reynolds Deposition, Volume 1,	Undisputed	Oral
Not Applicable #5	Ted Dunlap and Burt Landers were close friends and business associates.	Ted Dunlap Deposition, Volume 1, Page 3, Line 1;	Undisputed	Punitive
Tue 08/29/1961	Diamond founded by Dick Gem.	Dick Gem Deposition, Volume 2, Page 1, Line 29	Undisputed	Punitive
Tue 08/29/1961 #2	Diamond is a California-based department store.	Ilene Landers Deposition, Volume 2, Page 20, Line	Undisputed	Punitive
Tue 08/29/1961 #3	Ted Dunlap becomes CEO of Diamond.	E. Winston Murray Deposition, Volume 1,	Undisputed	Punitive
Mon 09/25/1961	Dick Gem opens first Diamond in San Francisco.	Bruce Mathers Deposition, Volume 2,	Undisputed	Punitive
Sun 02/02/1969	Joseph Bates employed by Diamond as Vice President of Procurement.	Joseph Bates Deposition, Volume 1, Page 9, Line	Undisputed	Oral
Mon 08/30/1971	Charles Higgins Thomas employed at Diamond as Controller.	Dick Gem Deposition, Volume 2, Page 5, Line 8	Undisputed	Punitive
Mon 05/14/1973 #2	Burt Landers starts Sunrise.	Burt Landers Deposition, Volume 1, Page 6, Line 26	Undisputed	Punitive
Mon 05/14/1973 #3	Sunrise is wholesale distributor for West Coast area.	Ted Dunlap Deposition, Volume 2, Page 14, Line	Undisputed	Compensatory

Figure 71: Fact table in CaseMap

However, the use of tables can make it difficult to 'see' all the relationships in a case - for example, to quickly see all the issues in a case, the arguments supporting each issue in the case and the evidence supporting each argument. Diagrammatically displaying case information would be beneficial so that the network of relationships between issues, arguments and evidence could be easily perceived and navigated.

CaseMap is an interesting application and provides a type of support not seen in other programs. It directly supports sensemaking by allowing a 'picture' of a case to be constructed and by allowing that picture to be selectively filtered and explored. CaseMap has been tailored for a specific legal task and provides a representation of the task to support this. CaseMap has limitations however. For example, although allowing the storage of issues, the system is more strongly aimed at management and preparation of facts and evidence. Support is limited for issue exploration and structuring, and argumentation. Although issues can be arranged in hierarchies with indented lists, issues cannot be interrelated. This is most limiting in that the only way to enter arguments in CaseMap is to deem them to be issues. However, since issues cannot be linked with each other there is no intuitive way to indicate that one argument (issue) supports another argument (issue). Notably, although CaseMap uses similar terminology as in programs such as IBIS, the focus is slightly different. IBIS has a clear conceptual separation between Issues, Positions and Arguments. Issues in CaseMap cover what would be both Positions and Arguments in IBIS. Essentially, the methods for structuring problem decomposition in CaseMap are not as explicit as in systems such as IBIS. The focus of CaseMap is more heavily on making sense of and managing the evidence.

6.3.2 Information foraging

Sensemaking and visualisation can also provide new approaches to information retrieval. Information retrieval is a widely examined task and many approaches to information retrieval have been investigated in law. Research on information retrieval typically focuses on how to improve precision and recall in retrieval.[635] Researchers examine ways to manage the assignment of keywords to documents, and to otherwise provide 'extra' information on which to search documents.[636] Much work also examines the uses of visualisation in information retrieval, both visualisation during search construction and visualisation of search results as an aid to their comprehension. This is simply based on the idea that it is easier to understand visual indicators of a document's relevance than it is to interpret a list or understand a numerical measurement indicating relevance. Visualisation during search construction and visualisation of search

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[635] Recall measures how many of the relevant document in a corpus are returned by a search. Precision measures the degree to which the documents returned by a set are relevant to the search. Recall is the proportion of relevant documents retrieved. Precision is the density of relevant documents among those retrieved: Kowalski, G., Information retrieval systems: theory and implementation (1997) Kluwer.

[636] E.g. Dick, above n. 303.

results both aim to provide the user with a better understanding and easier management of information.

However, much of this work on information retrieval tends to view searching as a 'one shot' process. A search is typed into a database, which then returns a group of documents. The user then analyses those documents, and based on this analysis, either ceases to search for information or reformulates the query and re-types the query into the database. The only support provided is in construction of the search and, perhaps, management of the results. However, individual searches do not arise spontaneously. Each search request is a response to perceived failures of earlier search efforts and from questions that arise during these search efforts. Searching is an iterative process in which searches are refined and redirected according to the results of prior searches.[637] As Tißen states, it is an 'inherently interactive', 'navigational and exploratory information-seeking process'.[638] The results of one search are used as the basis for exploration and as the basis for decisions as to where to search next.[639] As a user explores the available information the very focus of the search may change. No support is typically provided for the evolutionary and exploratory aspects of information searching. Searchers are left to reformulate queries and run them through the database, to keep track of past search strategies and the results of those search strategies, how each search strategy related to others, and what future directions remain to be explored. Information retrieval systems generally do not allow the user to construct an ongoing visualisation of their search strategy. In typical search environments, how searching widens and

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[637] O'Day, V.L., Jeffries, R., 'Orienteering in an Information Landscape: How Information Seekers Get From Here to There' p. 438, in Proceedings of INTERCHI'93 (1993) ACM Press; Tißen, A., `A Case-Based Architecture for a Dialogue Manager for Information-Seeking Processes' p. 152, in Proceedings of the fourteenth annual international ACM/SIGIR conference on Research and development in information retrieval (1991) ACM Press.

[638] Tißen, ibid. 152.

[639] O'Day and Jeffries, above n. 637, 438.

narrows, and how the very question to be answered may change, all remain implicit. That is, the searcher has to remember the actual question that they want answered and has to formulate words and phrases to run through the database in order to try and answer that question. If, after browsing the documents retrieved with the search, the documents are not found to be appropriate then the search has to be discarded and a new search started. The searcher will have to mentally formulate a new strategy. They will have to deduce what was wrong with the previous strategy and attempt to divine what search might actually answer their question. This new search will return another set of documents which itself may or may not be appropriate. The refinement of the search strategy and the formulation of new searches will iteratively continue until a satisfactory set of returned documents is achieved or until the user becomes convinced that all useful strategies have been exhausted and that the database does not contain useful documents.

In a typical search system each time a new search is performed the old document set is discarded and the new search is typed in and run. Although some systems allow a list of previous searches to be maintained this is typically only the list of words or phrases that has actually been run through the system; and even this storage may not remain longer than a single use of the database. Systems generally do not store the actual question that it is sought to answer. Moreover, the reasons why a particular search was felt unsuitable, or the reasons why a search was refined in a particular way and turned into another search, are not stored. Other information, such as which documents were actually looked at, and whether the user felt them to be useful, is not recorded. It is left to the user to maintain a history of their searches – perhaps in their head, perhaps on scraps of paper, or perhaps implicitly through the structure and content of a document that is being written. In all cases though, the actual search strategy and the search information specific to individual searches (such as which documents were looked at) is not externalised.

The acuteness of this lack of support becomes more manifest as the duration of searching grows longer. If a search is typically finished in one short session, or even during the course of a day, the lack of express external information about the search strategy itself may seem less problematic. However, as searching is extended over days, weeks and months, the difficulties with lack of express external expression of the search strategy become more apparent. As time passes it becomes more and more easy to forget why searches were performed or indeed what searches were performed. It becomes increasingly easy to forget, or rather, increasingly difficult to remember, what documents were looked at and what was thought of them. Clearly, for efficient searching it is desirable to remember both what searches were run, why those searches were run, the results of those searches and thoughts on how they related to the question that was being asked - and indeed, how the question being asked has slowly mutated.[640] A system that allows storage of all these things would be desirable, and a system that allowed all these things would most likely benefit from the use of external diagrams to map the search strategy and its progress.[641]

A skeletal system to support information foraging can be imagined, based on the types of representation that have been previously discussed. For example, rather than beginning a search directly with a series of search terms, a searcher could begin by entering the question that they are trying to answer:

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[640] O'Day and Jeffries have argued for similar requirements: ibid. 444. In general, Wexelblat argues that computerised tools suffer from a lack of "interaction history" and say that providing such interaction histories opens new possibilities: Wexelblat, A., Maes, P., `Footprints: History-Rich Tools for Information Foraging' p. 270, in Proceeding of the CHI 99 conference on Human factors in computing systems: the CHI is the limit (1999) ACM Press.

[641] O'Day and Jeffries, above n. 637, 445.

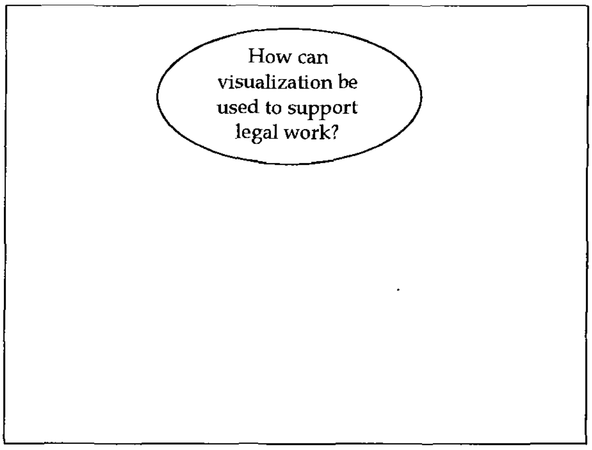

Figure 72: The search question

This question could then either be broken into sub-questions, or directly into keyword searches that are used to retrieve documents. Figure 73 is an example of the latter.

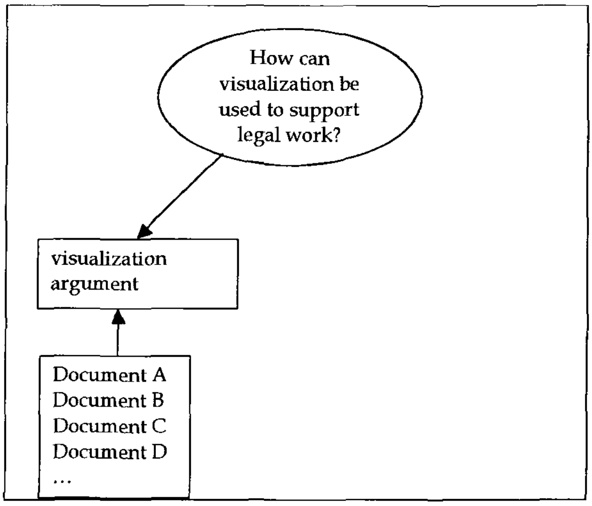

Figure 73: Keywords approximate questions

When a search produces too many results, or indeed too few results, although the general question to be answered remains the same, the words used to search might change, perhaps several times.

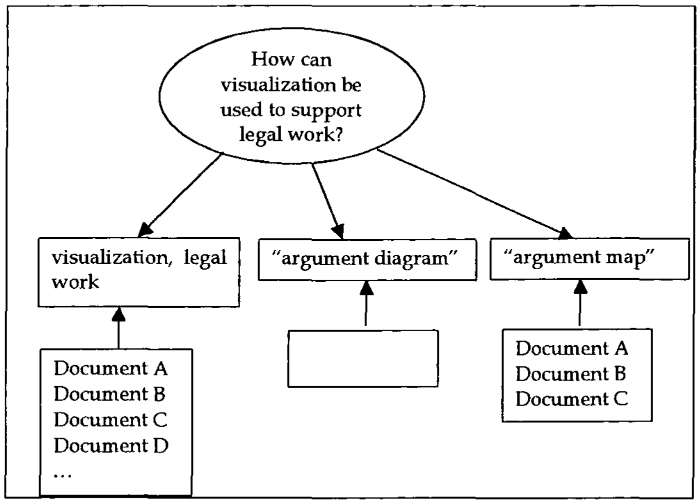

Figure 74: Reformulating searches

In the hypothetical search in figure 74, the second search did not produce any results, while the third search produced three results. However, these proved to be off-point. At this stage, the search appears to have reached an impasse and the researcher might choose to temporarily leave the search and pursue another strategy. For example, it can be imagined that after reading materials on computing and legal argument, the name Toulmin is consistently encountered. The researcher could then return to the search and try to locate documents that relate to Toulmin. As illustrated in figure 75, this search returns numerous relevant documents; the first of which appears immediately relevant. After reading this document, it is set aside for latter use and hence stored for future reference. This document might indicate that IBIS could provide an interesting approach in visualising legal work and so a new search could be performed on that. This search however, does not return any documents.

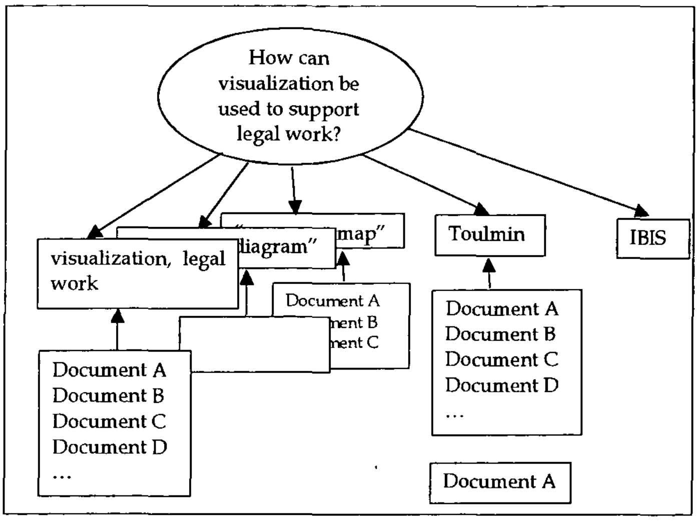

Figure 75: Successive searches

It is not that the incremental refinement of searches could only occur with a system such as above – this could clearly be done with, or without, pen and paper. Doubtless people already informally collect much such information - they remember searches they have performed or develop *ad hoc* strategies for recording them and they remember which articles they have read and where search terms came from. Rather, it is that explicit support for this and partial automation and management of the progression and evolution of a search strategy is beneficial. It allows constant review of what has been searched for and the results of those searches – information that is lost in systems where each new search presents a new list of information. A system such as the above collects all the information in one place, makes it explicit and makes it persistent so that it can be returned to days, weeks months or years latter.

More and more capabilities could be added to such a system, for example: linking search terms to the documents which first suggested them; allowing documents that are returned in multiple searches to be linked to each of those searches, hence providing and indication of their centrality; and allowing attachment of notes and annotations to searches, search results and individual documents. Moreover, as a search builds up and more and more searches are performed, more and more documents are found and more and more notes of various kinds are made, the system begins to form the skeleton for an argument construction system – although the precise support needed for each remains different. Similarly, examples of search strategies used by experts can be stored and provided to learners to help teach them both about particular areas of law and about search skills.[642]

The important point with the system sketched here is that it is only one possible outline illustrative of the diverse range of applications in which providing visual representations of argumentative and reasoning tasks could be beneficial in a legal context. It is not intended as a definitive specification of what a good system should contain. Nor has an actual system been built and tested. This outline simply illustrates that in addition to work on specifying searches visually and the visualisation of search results, visualisation of search strategy could be beneficial.

6.4 Discussion

There is abundant evidence that diagrammatic representations can benefit legal sensemaking and there is abundant evidence that computer systems could support the construction and manipulation of diagrammatic representations for legal sensemaking. Examination of diagrammatic representations however, reveals a huge diversity amongst them. The necessity is thus to find a structured way to construct useful representations. However, while a principled method is desirable for choosing amongst diagrammatic representations to support legal sensemaking, examination of theories of representation provide limited

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[642] In a similar vein, O'Day and Jeffries suggest the creation of 'retrieval mediators' which are 'small, special-purpose packagings of the retrieval expertise necessary to handle a prototypical information question in a particular domain': ibid. 438. It is unclear however, precisely what role is envisaged for retrieval mediators. Tißen appears to propose a similar idea, to be used however, as the basis for automated guidance in information retrieval. As she notes however, one 'of the main problems is to find a set of base cases of information seeking strategies.': Tißen, above n. 637, 161.

guidance. Similarly while work on diagrammatic reasoning reinforces the usefulness of diagrammatic representations it says little about how to systematically construct the best representation for a given task. The study of diagrammatic reasoning is relatively new and little consensus exists as to how reasoning with diagrams operates. Indeed, it is a matter of argument as to what actually amounts to a diagram.[643] According to Gurr:

> there does not exist the fully fledged foundation to a theory of diagrammatic communication

that could determine what makes for effective diagrammatic communication.[644]

However, while theories of representation do not determine choice or design of representations, the use, link, practical and visualisation criteria do provide general guidelines for the choice and design of diagrammatic representations. Primary amongst these is the use criteria – representations must be tailored to support the specific task that it is sought to perform.

According to Halasz, two generations of hypermedia systems are observable. The first generation is based on large computers, focused on text nodes with little graphics, and for use by large groups. The second generation is similar to the first but has more advanced user interfaces with graphics and animation, and are generally for single users or small groups.[645] To this can be added a third generation of systems – systems tailored for specific tasks. This third generation of hypermedia system can be used to augment legal sensemaking. Mapping this third generation of systems is problematic however. There is a huge diversity of legal tasks that could be supported with diagrammatic representations. Without a systematic breakdown of legal tasks, it is difficult to comprehensively predict, or predict in detail, systems that might be

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643 E.g. see: Shimojima, above n. 254.

644 Gurr, above n. 253, 317.

645 Halasz, above n. 404, 840.

constructed. As Nunamaker concludes, there is no overarching theory that enables prediction about how a system:

> should appear, what features and functions it should have, how it should be developed and what specific impacts it will have on organizations, teams and individuals that use it.[646]

Suffice to say that in such a situation, advancement comes not from global analysis of tasks but from implementation and iterative refinement in specific situations.[647] Only a long stream of future research can determine whether systems actually work and how they can best be designed.[648]

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[646] Nunamaker, above n. 623, 363.

[647] Interestingly, numerous common technologies have had a slow evolution. Technological evolution appears ubiquitous: Petroski, H., The Evolution of Useful Things (1994) Vintage Books.

[648] Hua and Kimborough, above n. 85, 268.

7 Conclusion

The best way to get something done is to begin.
Anonymous

In an environment in which the nature of work is changing, a shift in the pattern of work and the composition of the workforce is observable. Knowledge work, performed by knowledge workers, predominates. The efficient performance of new forms of work, however, requires new tools.

Legal work is a paradigm of knowledge work and exemplifies the need for new tools for its efficient performance. However, despite computers having been used for decades in law, legal workers are currently suffering a 'knowledge processing lag'. Research on using computers to aid legal knowledge work has been dominated by a paradigm based around automation. Research seeks to automate legal knowledge work. In contrast to the currently prevalent conception of legal knowledge-based systems automating legal work, this thesis has proposed an alternative, wider, conception of legal knowledge-based systems. This is a conception of legal knowledge-based systems augmenting legal knowledge work. Investigating computer systems that augment legal knowledge work has been the central concern of this thesis. In particular, this work has proposed a new class of legal knowledge-based systems - systems which augment legal knowledge work through supporting the visualisation of processes of legal reasoning.

7.1 The automation of legal knowledge work

While computers exist to support processing of legal information, computers are ineffective in processing legal knowledge. Chapter two of this work examined research on the creation of legal knowledge-based systems which seek to address this knowledge processing lag. It was argued that the dominant conception of legal knowledge-based systems is based on the use of artificial intelligence to create computer systems that automate legal reasoning. However, the creation of computer systems to automate legal reasoning has had limited success. The intractability of legal problems and the lack of precise knowledge about how processes of legal reasoning operate confound attempts at automation. It is not currently possible to automate legal reasoning to any significant degree or to automatically solve legal problems in anything but the most controlled and artificial of situations.

In contrast to this paradigm of automation chapter two introduced the concept of augmentation. The notion of computers augmenting human competencies is a potent one and holds promise for developing new tools to support legal knowledge work.

Research in artificial intelligence and law is founded on a particular conception of legal knowledge work – a conception which ignores central aspects of legal knowledge work. Research in artificial intelligence and law draws on legal theory which represents law as composed of rules, cases and principles and which represents legal reasoning as simply a matter of applying those rules, cases and principles. Through the application of techniques developed in artificial intelligence, the field of artificial intelligence and law seeks to create legal knowledge-based systems that automatically apply legal rules, legal precedents and legal principles. However, focusing exclusively on the rules, precedents and principles which are evident in law – the objects that constitute the law – misrepresents central aspects of legal reasoning. Rather than viewing it as a process determined by these legal objects, legal reasoning can be productively viewed as a process of sensemaking. Chapter three argued for a sensemaking perspective and outlined what such a perspective looks like. With a sensemaking perspective on law and legal reasoning, the legal problem solver becomes central and the perception of the legal environment by that problem solver becomes all important. In particular, the manner in which the problem solver represents legal problems, quite literally, the manner in which the problem solver visualises a problem, is determinative of the resolution of such problems. In chapter three it was argued that information visualisation is an important element in sensemaking and that techniques for visualising processes of reasoning are highly valuable. A sensemaking perspective on legal reasoning suggests an avenue for the construction of legal knowledge-based systems that augment legal work. Legal knowledge-based systems can support legal knowledge work by supporting the visualisation of processes of legal sensemaking.

7.2 Augmenting legal knowledge work - representation and computer tools to augment legal knowledge work

With a focus on augmentation rather than automation, the central question becomes how to create knowledge-based systems that augment legal work. Chapter four of this work examined techniques for diagramming processes of argument and reasoning that are integral to legal sensemaking. This chapter attempted to apply these diagramming techniques to the diagramming of legal judgments. Numerous problems were encountered however. In particular it was found very difficult to 'massage' the representation of legal judgments into the forms required by the diagrammatic representations examined.

An inherent aspect of diagrammatic representations, and representations more generally, is that they filter the view of the domain that they are being used to represent. Representations highlight aspects of a domain and occlude others. As such, diagrams and other representations mould reasoning. In order to augment legal sensemaking it is thus centrally important to make use of appropriate representations.

Chapter five of this work reviewed numerous computer systems that have been constructed in attempts to augment knowledge work through the provision of support for diagramming. Striking amongst these systems is the diversity of representations upon which they are founded and the diversity of uses to which they have been put. This diversity of existing systems not only highlights the diverse uses of diagrammatic representations for augmenting sensemaking but also the diversity of representations on which those systems are based. This diversity again highlights the necessity of using a representation appropriate to the task at hand and raises the question as to what amounts to an appropriate representation. In particular it raises the question of what amounts to appropriate representations to augment legal work.

In an attempt to determine what representations are appropriate for legal work, chapter six examined theories of representation provided in philosophy and cognitive science. This chapter argued that such theories of representation are not capable of specifying what amounts to a good, an appropriate, representation for a given use. Theories of representation do indicate however, that representational appropriateness can be assessed according to task, link and practical criteria. Primary amongst these are the task criteria which require representations to be appropriate to the task they are being used to support. In examining representations to support legal knowledge work however, no definitive specification of legal tasks is available. Hence designing representations to support legal knowledge work remains imprecise. Moreover, theory does not definitively specify how representations should be visualised. Representation and visualisation thus retain an element of art.

The dependence of representations on the task that they are being used to support does however, indicate the existence of a new class of legal knowledge-based system. This class of legal knowledge-based system is based on the use of diagrammatic techniques to support the sensemaking that is inherent in legal reasoning. Chapter six provided two hypothetical examples of computer systems that exist within this class of legal knowledge-based system.

Thus, while the automation of legal work remains problematic and whilst augmentation provides an alternative paradigm for the creation of legal knowledge-based systems, much remains to be explored. Whilst a sensemaking perspective on legal reasoning provides a basis for the creation of legal knowledge-based systems, whilst there is much evidence that argument and reasoning diagramming are useful and that computer support for such diagramming is useful, determinate methods for the creation of legal knowledge-based systems remain elusive. Although currently available criteria can guide work, the creation of legal knowledge-based systems remains largely uncharted.

7.3 Future work

While this work has argued the benefit of systems to augment legal knowledge work and the benefit of diagrammatic representations for this, much remains unexplored.

Primary questions raised by this work concern representations themselves. Current theories of representation provide limited guidance for the actual creation of representations. While theories of representation indicate that representations must be tailored for use, how this is to be achieved remains unclear. In this context, more work is needed to inform how the tasks, the performance of which representations support, can be usefully decomposed. In particular, how legal tasks can be usefully decomposed and classified, and how different conceptions of legal tasks can be integrated, remains unclear and in need of further examination. Research is needed into legal task classifications.

Representations can also be examined according to their user group. In law for example, it is uncertain whether, and if so how, representations might differ for judicial applications, for legal practice, or for non-expert use amongst others. Moreover, the analysis of tasks needs to be integrated with this analysis of use. Research is needed on the use of representations, how different representations are used by different groups and for different tasks, and their effects on reasoning. It would be productive to explore how to systematically map legal tasks so as to explore the class of legal sensemaking support systems.

Associated work is required on the visualisation of representations and specifically visualisation to support legal sensemaking. It is unclear if there is any most 'natural' way to visually represent legal sensemaking relationships. More broadly, it is unclear whether visualisation is more useful for certain groups or for particular tasks than others. Generally, investigating such questions would contribute to the further development of general theories of representation and visualisation.

In the absence of systematic and detailed theory classifying legal tasks, work can productively be conducted on the actual construction of systems to support legal sensemaking. Such construction will itself contribute to theoretical understanding of legal tasks and representations to support legal sensemaking. It remains to be seen whether augmentation through diagramming proves more useful for particular tasks or particular users than for others. The construction of systems will begin to answer such questions. The effectiveness of systems that are constructed needs verification. While the literature reports tentative experimental results showing that users have better recall of arguments constructed as diagrams than as texts, empirical testing is needed to ensure such benefit is transferred to representations other than those tested and to different tasks and groups of users.

It is unlikely that diagramming could completely replace textual presentation, and indeed this is not the aim. Hence it remains to be explored how legal sensemaking support systems can integrate with 'traditional' uses for computers in law, such as information retrieval and document management, and how they can advance aims such as knowledge management and organisational learning. In the absence of determinative criteria for the construction of systems, iterative creation, testing and refinement points the fruitful way forward.

The class of legal knowledge-based systems to augment legal knowledge work through visualisation remains fertile ground for research. Although a handful of systems have been constructed to support evidence analysis, legal argument construction, and legal education, the range of legal tasks that constitute legal work and the specificity of representations that support legal tasks indicates a broad space of potential but as yet unexplored systems.

It is hoped that this work contributes to future research in the use of computers in law, and particularly future research in legal knowledge-based systems, by pointing a way to construct useful legal knowledge-based systems that augment legal work. It is hoped that this work will motivate construction of legal knowledge-based systems designed to augment legal work and to the testing and iterative refinement of such systems. More generally, it is hoped that the creation of systems will inform how systems can advance augmentation of knowledge work and how systems can support knowledge workers faced with a changing work environment.

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