ITB Journal

Issue Number 4, December 2001

Contents

The academic journal of the Institute of Technology Blanchardstown

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Editorial

I am delighted to introduce the fourth edition of the ITB Journal, the academic journal of the Institute of Technology Blanchardstown. The aim and purpose of the journal is to provide a forum whereby the members of ITB, visitors and guest contributors from other third level colleges can publish an article on their research in a multidisciplinary journal. The hope is that by offering the chance to bring their work out of their specialised area into a wider forum, they will share their work with the broader community at ITB and other academic institutions.

In this issue we have again a diverse selection of topics. Thomas O'Loughlin of the Univesity of Wales examines some Latin evidence for the idea of one island, one people, and one nation in Ireland. Stephen Sheridan of ITB, working within the domain of artifical intelligence, delivers a review of parallel mappings for feed forward neural networks via the backpropagation learning algorithm. Brian Nolan of ITB discusses the many spaces theory of Fauconnier in his paper on mental spaces and examines how the theory may be applied in cognitive semantics. Róisín Faherty of the Institute of Technology, Tallaght discusses many issues of concern in the development of Internet applications and highlights a number of important strategic considerations. Finally, an interesting paper by Kevin Martin of ITB looks at some historical and media perspectives on representations of the West of Ireland within popular culture.

With the publication of this edition we have reached our second birthday, a milestone of sorts, and hope that you enjoy the papers in this ITB Journal.

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One Island, One People, One Nation:
Early Latin Evidence for this Motif in Ireland

Thomas O'Loughlin

An Island Home

That the island of Ireland is the home of the Irish, and consequently that 'the nation' and the territory of the island mutually define one another, has been one of the central assumptions of Irish nationalism. Just as an island is a single discrete entity -- the very icon for something well marked off from other things by 'clear blue water' -- so the people on it have been assumed to be a distinct group. More than just a collection of individuals or families, they have been assumed to form a 'nation' with a separate identity and destiny from their neighbours. This distinction has been elaborated in several modes: culturally, linguistically, religiously, and most frequently politically; but the underlying theme is that Ireland (the island) is identical with Ireland (a cultural entity generated in the imagination: 'the place we call home'), and can be identified with its nation, the Irish (an ethnic concept/entity) and with a political expression, 'Ireland' when this is the label placed before an ambassador. This identification of the geologically distinct entity, the island, with the human structures upon it, is at the heart both of Irish nationalist argument -- the 1937 Constitution of Ireland is a pristine example -- and the great sense among many of the island's inhabitants that 'Ireland' is somehow a very identifiable entity -- there is an Irish music, an Irish sense of humour, an Irish character -- and so, consequently, that the Irish are a very homogeneous collection of people.

Here lies a can worms. For if the people are that homogeneous -- as a human entity they have a similar definable unity to that which the island they inhabit has as a physical entity -- then that group must share a common imagination about their origins, loyalties, and aspirations. And, more menacingly, those who fail to share these cultural values must be seen as invaders who, if they continue to hold these views and remain on the island, are enemies. The overlaps of ethnic and political boundaries are always, once the notion of the nation figures large in peoples' world-view, sources of struggle (witness the problems of the Albanians in the Balkans outside the state of Albania), but they become extreme in the case of islands -- for an

island state's geographical boundaries can only be re-drawn with difficulty if an area is already imagined as a unity as an island. Moreover, if the idea exists that the unity of the island is directly linked to the cultural unity of its inhabitants, then even the idea that one can draw borders within the island is tantamount to splitting up a body, cutting-off a limb, sundering an organic unity, and brings with it the mental anguish that accompanies the notion of amputation. This sense of one island, one people, and by extension that there should be one memory and one future, is well exhibited in much of the rhetoric which has been used in Ireland by 'nationalists' (i.e. those who hold Ireland is home to one nation) about those who have a different cultural affinity, the 'loyalists' (i.e. those who hold that Ireland is a place where British people live) and about the border between the Republic of Ireland and Northern Ireland. It has been expressed in many ways over the years, and is by no means dead as an idea latent within many Irish minds, in both official and unofficial ways. For example, it can be seen in official mythology in 'the definitive series' postage stamps used from the 1920s to the late 1960s where Saorstad Éireann or Éire was identified by a map of the whole island, surrounded by sea, without any internal divisions; while it can be seen, unofficially, in the appeals to the notion of 'four green fields' which are imagined as forming a unity. If today we hear much of 'valuing diverse traditions' and 'reconciling memories', we still hear rumblings about 'not abandoning long term nationalist goals.' The appropriateness or not of such cultural/political attitudes is not my concern, rather I wish to focus on the earliest recorded expressions of that attitude of one island = one people = one nation, the reasons behind its origins as a cultural myth, and to suggest that it was transforme through its long-lived influence in Ireland.

The Island Problem: Naming From Outside

Before looking at the question of Irish self-perception as a nation we must note that while every society has an ethnic sense of identity, this question is more complicated in the case of island peoples than those who live on mainlands / continents. Almost by definition more people live on the continent than the island: the island is defined by being a 'bit' of island

separated from the land mass by sea. Thus while a geographer might tell us both Greenland and Australia are islands, this seems to offend our sense of how things are: if Australia is an island, then so is every piece of land, and the term has no meaning. We are much happier to think of Australia as a continent and it has the island of Tasmania near it. Thus the island is named by those outside it, on the continent, and its inhabitants are identified collectively as those who come from that place. Thus the Tasmanians are a sub-set of the Australians and are distinct as they come from that island marked-off by water, equally, the Tory islanders form a group for they come from a place marked-off by sea from Ireland. Islanders, because they live on a separated 'bit', are always more liable to have their identity imposed from outside on the basis of their geographical home than those who live on mainlands who are more likely to give themselves an identity on the basis of language, culture, or political allegiance. So from the continental viewpoint the Irish are simply those people who come from that distinct bit of land called Ireland. But if the inhabitants of that island do not equally identify with that externally given identity, it can lead to some funny situations, as anyone from the Republic of Ireland will know who has been grouped in Britain with non-nationalists from Northern Ireland under the term "Irish." Those from Northern Ireland often feel that their identity is threatened -- for they know that they do not share the 'one island = one nation' world-view of a nationalist -- and so they fell they must point-out that they are not-Irish, but British, and so should not be seen as a distinct group simply because they come from 'the island' not the 'mainland.'

We see this fate of islanders being thought of as single groups down through history. Virgil wrote of the Cretans: *centum urbes habitant magnas uberrima regna*[1]; simultaneously recognising that the 'Cretans' were divided a hundred ways politically, but for him they formed a communality. However, the Cretans were aware that if they were internally divided on their island home, then externally they were a unity. Hence, they became the paradigm for combining their forces in the face of external threads: on Crete they fought one another; but

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[1] *Aeneid* 3, 106: they inhabit one hundred great and most fruitful city kingdoms.

when anyone challenged their island home, they fought as one people. The legacy of this paradigm of unity in the face of external threat -- something the city states of mainland Greece found so difficult to achieve -- lives on in the word 'syncretism.'[2] And this notion that they are one people for they inhabit one island is even witnessed in the early Christian document known as 'Paul's Letter to Titus' where the it cites the Cretan-Liar-Paradox in this form: 'One of themselves, a prophet of their own, said, "Cretans are always liars, evil beasts, lazy gluttons"' (1:12). While we may never decide whether this proposition is true or false, we can note that for both Cretans and non-Cretans the notion is assumed that for one island, their is one people with one culture and even a single character and set of ethical values. Around the same time, another early Christian writer, Luke in Acts, viewed the Cretans in the same manner when he noted that at the first Christian Pentecost there were representatives from 'every nation (*natio*) under heaven' (2:5) gathered in Jerusalem to hear the preaching of the apostles, and among these national groups was some Cretans (2:11). We shall have to return to this early Christian image later, but for now we should simply note that for Luke Crete, the island, held one distinct *nation*, the Cretans.

Naming 'The Irish'

This process also occurred in the case of Ireland in ancient Greek and Latin writings: geographers and generals described the island's location, sometimes some features of its geography, and named its inhabitants as a single group: the Irish (*Hibernici* or *Scotti*).[3] But while Ptolemy noted that there were several different tribes on the island, he was equally assertive that they collectively formed a single ethnic group.[4] This external identification of the island's inhabitants as a single people is also central to those texts with which Irish history begins. Prosper of Aquitaine recorded an instance of papal interest in the fate of Irish

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[2] Our noun is borrowed from the Late Latin *syncretismus* based, ultimately, on the Greek verb *suncretizein* = to join forces in the way the Cretans do.

[3] All the classical reference to Ireland and its inhabitants have recently been gathered together and analysed by P. Freeman in *Ireland and the Classical World* (University of Texas Press, Austin TX 2001).

[4] Freeman, op. cit., pp. 64-84 for the text of Ptolemy and a study of its evidence.

Christians from 431 and the island's inhabitants are seen as a single group: the *Scotti*; and he adds elsewhere that they -- he treats the Irish as a race with a single character -- were barbarians.[5] Moreover, it has recently been argued that there was concern with this people (referred to as a single entity: a *gens*) beyond the fringe of the Roman empire as a part of papal policy in the fifth century, that all the nations (*gentes*) might hear the gospel first preached to a gathering on nations at Pentecost (Acts 2) and thus every nation throughout the whole earth might find its appointed place in the divine plan of history.[6] Even if Pope Leo the Great did not have Ireland in mind in that sermon, it is at least clear that he thought of peoples by region: one geographical area, one nation.

This same manner of thinking is found in our greatest fifth-century source: the writings of Patrick. While modern readers may think of Patrick as synonymous with all things Irish, he not only thought of himself as a Roman from Britain, but as someone dwelling as a stranger in an alien land suffering the loss of his family and people.[7] Despite knowing the people, and appreciating that there was no political unity on the island (see *Confessio* 52[8]), he thinks of Ireland as one island with one people. In his vocation dream he hears 'the voice of the Irish' (*Hiberionacum*) calling him back to them (*Confessio* 23) and he considers his Christians as being Irish (*Hiberionaci* -- *Epistola* 16). Elsewhere he refers to the people as *Scotti*: a woman from the island is a *Scotta* (*Confessio* 42), and they have children (*Confessio* 41) and allies (*Epistola* 2 and 12). But if he, as an outsider writing in the ecumenical-language, thinks collectively as the island's inhabitants as 'Irish', he does not, significantly, think of them as a nation, a *gens*, i.e. as one of the ethnic unities which Christians of the time believed were scattered over the earth. Patrick, while he saw himself as the preacher on the earth's bounds, did not believe he was sent to 'the Irish nation' but to preach to the Irish nations: *ego*

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[5] See T. O'Loughlin, *Celtic Theology: Humanity, World, and God in the Earliest Irish Writings* (London 2000), pp. 25-6.
[6] Cf. T. Charles-Edwards, 'Palladius, Prosper, and Leo the Great: Mission and Primatial Authority' in D.N. Dumville, *et al*., eds, *Saint Patrick, A.D. 493-1993* (Woodbridge 1993), pp. 1-12.
[7] This theme is explored in detail in T. O'Loughlin, 'Patrick on the Margins of Space and Time' in K. McGroarty ed., *Eklogai: Studies in Honour of Thomas Finan and Gerard Watson* (Maynooth 2001), pp. 44-58.
[8] The translation is am using is my own: *St Patrick: the Man and his Works* (London 1999).

ueneram as Hibernas gentes euangelium praedicare (*Confessio* 37).[9] There were several peoples on the island -- each (presumably) led by one of the 'petty kings' (*reguli*) he mentions[10] -- and since he believed Christ commanded that each nation had to hear the gospel (Mt 28:19), Patrick had to move from nation to nation within the island to carry out his task. The minimum we should take from Patrick's evidence is this: while from outside the Irish were a single nation, in there own perception -- and Patrick would have learned this as he moved from group to group -- they were not. To the outsider, any island population forms a unity and there is little need for further precision: they can be viewed as a nation without further ado; only those who live on the island know that it is more complex.

The Irish Naming Themselves

So, can we determine when the inhabitants of Ireland began to think of themselves as a single nation? The most obvious answer is to assume that as Irish people travelled abroad they adopted the identity given them, and this in turn led to a unified identity as the islanders from that island. We know that when abroad they were so identified with the label: *Scottus*. And, from the ninth century we have the sparkling linguistic game played by the theologian Iohannes Scottus Eriugena to refer to his homeland. Named John (Iohannes), when he went abroad he got the designation Scottus -- which had undertones of inferiority when used in some Frankish circles. He, probably in reply, took the Irish name for Ireland, *Ériu*, and used it to imitate Virgil's *Graiugena*[11] creating *Eriugena* (literally: born of Ireland): thus putting classical Greece and contemporary Ireland on par! However, we can locate a far more deliberate attempt to present the Irish to themselves as a single nation in a work from the last decades of the seventh century: Muirchú's *Vita Patricii*.[12]

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[9] See the comments on this verse's significance within Patrick's text in my translation and in 'Patrick on the Margins of Space and Time'.

[10] *Confessio* 41 and *Epistola* 12.

[11] See *Aeneid* 3, 550: 'born of Greece'.

[12] I am using the edition by L. Bieler in *The Patrician Texts in the Book of Armagh* (Dublin 1979), pp. 62-123;

The background to Muirchú's understanding is the notion of the 'nation' (*gens*) as Christians in the period read of 'nations' in their scriptures. As they read them, the history of the period awaiting Christ, and the time of redemption (the Christian era) could be seen in terms of the history of units called 'nations.' After the Flood, God had scattered the descendants of Noah by nations and given each an appointed place on the earth (Gen 10). For Muirchú, all the nations in Europe were ultimately descended from Japheth (Gen 10:5). From these, God chose one nation, Israel, as his own which would act as an 'advance party' for the coming of the Christ. This 'chosen nation' would be set in the midst of the nations (Ezek 5:5) who did not yet knew the true God and his plans (e.g. Deut 18:9). When the chosen people were unfaithful they were punished by these nations and scattered among them (e.g. Lev 26:33). Yet it would be from Jerusalem, the centre-point and capital of the nation, that the full message would go forth to the nations (Mic 4:2), and eventually all the nations would be gathered to Jerusalem to recognise the final purposes of God (Joel 3:2). Now this period of preparation was over, and the story of the nations was taking a new, definitive, turn: the gospel which Christ said had to be witnessed before the nations (Mt 24:14), and preached to every nation (Mt 28:19), was spreading out from Jerusalem, to the territory of the Jewish nation, and then to the lands of all nations out to the ends of the earth (Acts 1:8). The nations were going to be gathered into one (Mt 25:32) and the baptised, collectively, would form one 'chosen holy race and people' (*genus electum ... gens sancta*: 1 Pet 2:9). It is with this Christian identity -- focused on a notion of nations as God-given realities in the whole plan of the universe -- that Muirchú approaches the story of the conversion of his own nation: the Irish.[13]

When Muirchú looked back on Irish history he had few sources (Prosper's references to Ireland and Patrick's own writings), but several certainties: first, the island had been converted to Christianity; and second, the spread of the gospel did not occur in any haphazard way, but according to a definite historical blueprint ('divine providence') visible in the

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[13] To set Muirchú in context, see T. O'Loughlin, *Celtic Theology*, ch. 5: 'Muirchú: Dramatist or Theologian?'

scriptures. Upon these certainties he built his picture of Patrick with his historical sources providing the incidental colour. The missionary plan he envisaged operated like this. Each nation received the gospel from an apostle for they were charged to go out to the nations situated right out to the very ends of the earth. At this point, he either considered that this land, Ireland, was a unity, so requiring just one apostle; or, his knowledge of the history was such that he believed the Patrick was alone in bringing Christianity to Ireland. Either way, the lynch-pin of his argument was this: Ireland received only one apostle, therefore it is a single land with a single people. The long tradition that Patrick is 'the apostle of Ireland' who single-handedly converted the island is a direct legacy of Muirchú's work. If Ireland had one apostle, then the preparation for the reception of the gospel on the island (this Christians saw as the hidden work of the Holy Spirit working among the nations to dispose them to receive the message of Christ) must have been on a island-wide basis implying that the island had only one nation dwelling upon it. This is exactly what Muirchú then demonstrates to his audience. They were a single people with a single king (whom he refers to as the *imperator barbarorum*), with a unified nobility stretching over the whole country (how far this is from reality can be seen in that for the list of nobility he borrows from the Book of Daniel[14] rather than attempting to find equivalents to Irish terms), and they have a single priesthood (again borrowed from scripture[15]). This united empire made up of provinces share a single language -- this is the first use of the Irish language as a marker of national identity -- and as a people had a unified body of prophesy written in that language which foretold the coming of Christ to their island. This collection of books is explicitly invoked by Muirchú an analogue of the scriptures which the Jewish priesthood working at Herod's court could consult on the coming of Christ in their land (Mt 2:1-6). Muirchú's message is plane: just as the Jews were *par excellence* a single nation with a divinely-appointed place in the divine providence God

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[14] I have examined Muirchú's use of Daniel in 'Reading Muirchú's Tara-event within it background as a biblical "trial of divinities"' in J. Cartwright ed., *Celtic Hagiography and Saints' Cults*, forthcoming.

[15] This fact is so annoying to those with a 'New age' interest in things 'Celtic' who wish for a great system of 'druids' that they usually ignore the fact that Muirchú has no information on pre-Christian religion in Ireland, and his whole picture of Ireland before Patrick is based on a Christian reading of a late Jewish caricature of the nature of paganism in Babylon. On the historical silliness of those who pursue 'ancient Celtic druids', see D.E. Meek, *The Quest for Celtic Christianity* (Edinburgh 2000).

leading to the Christ, so the Irish *as a nation* had a place in that same providence.

This nation, the Irish, had a single destiny in the future as it had a single origin in the past, and single king and capital -- Tara -- in the present (i.e. in Patrick's time which Muirchú dates as 432[16]). The advent of Patrick would change -- so the pagan priesthood prophesy -- Ireland and its people (one identified with the other) forever. So unified is this nation that they have a island-wide liturgy (each year the king lights a single fire from which all the households derive their fire) which although pagan is part of the divine plan for it takes place on exactly the same night as the Christians light the fire for the liturgy of Christ that is at the very centre of all Christian worship: the Easter Vigil. Then comes the moment, which in Muirchú's perspective, his nation's whole ancient history was leading to: when his nation would be baptised in the first Christian night of baptism 'in our land' -- Patrick's Easter Vigil. Then in a great contest between the priesthood of the Irish nation and the priesthood of the Christian nation, the fate of Ireland was decided: the king accepted baptism and his *gens* joined the *gens sancta* of the baptised.[17] In effect, the notion of one island, one nation was created by Muirchú to fit his Christian theological vision of the place of 'nations' within the providential spread of God's message.

Muirchú's Influence

These theological themes of the baptism of 'nations' and of 'nations in God's providence' are strange to our ears because -- rhetorical references to 'Christendom' or 'the Christian nations' apart -- they no longer form part of mainstream Christian theology. Indeed, they have not been part of Latin academic theology since the scholastics and, consequently, most readers of Muirchú have not even noticed their presence, much less recognised their centrality to his argument. However, in Muirchú's time the place he ascribed to 'nations' in the providence of evangelisation was a standard element within Christian theology -- one can find it earlier in

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[16] This classic date in Irish tradition is another legacy of Muirchú.

[17] For a study of Muirchú's theology of baptism, see my 'Mission in Early Ireland: the example of Muirchú's Life of Patrick' in M. Atherton ed., *Celts and Christians*, forthcoming.

Gregory of Tours' account of the conversion of the Franks and later in Bede's account of the conversion of the Anglo-Saxons.

But if Muirchú's theological vision has disappeared, the vision which he produced, in its light, of Patrick has become a fixed element in Irish portrayals of their own identity. By adopting Patrick as their great patron, a process in which Muirchú played a central role, they adopted Patrick as 'the apostle of the nation,' and the nation's self-identity is that of the people of the whole island destined to have their future transformed by Patrick's baptism. But for these later readers of Muirchú, the entity of 'the Irish nation' perdured through that baptism, being simply altered to 'the Christian Irish nation.' Although the providential aspect was forgotten, the notion that Patrick was the converter of the whole island remained. So whenever Patrick was invoked as an element of Irish self-identification in umpteen rituals, processions, parades, and re-tellings of the Patrick-storyline,[18] at the same time the notion that the island is home to a single nation was *de facto* invoked and renewed. Muirchú wrote to create a sense of a baptised people who, as such, had a place in the history of salvation. In this action one 'of the nations' scattered over the earth ceased to be a isolated, distinct body stemming from the beginning of the 'Second Age' (after Noah's Flood),[19] and became part of the universal 'elect nation' (i.e. the Christian Church) of the Last Days, the Final Age. Yet, in being the major originator of the later Patrick legend in Ireland, Muirchú contributed to the creation of an image of the Irish nation as indestructible in its distinctiveness in any age, and to the creation of that potent simplicity of one island, one nation, one identity. Can one think of another Irish writer whose historical impact is so much at variance with his original intention!

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[18] Muirchú's *uita* forms the basis for the whole later legend of Patrick, and was used even in scholarly writings on Patrick until the c. 1960, see D.A. Binchy, 'Patrick and his Biographers, Ancient and Modern,' *Studia Hibernica* 2(1962)7-173; and T. O'Loughlin, 'St Patrick and an Irish Theology,' *Doctrine and Life* 44(1994)153-9.

[19] On the consciousness of the 'Ages' of Creation as developed by Augustine of Hippo in early Christian Ireland, see D. Ó Cróinín, *The Irish Sex Aetates Mundi* (Dublin 1983), pp. 1-11.

A Review of Parallel Mappings for Feed Forward Neural Networks using the Backpropagation Learning Algorithm

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1.1 Introduction

The Back-Propagation (BP) Neural Network (NN) is probably the most well known of all neural networks. Many mappings of the BP NN have been implemented for both special purpose and general-purpose computers. This mapping process can fall into one of two categories: *heuristic* mapping and *algorithmic* mapping. Heuristic mapping concentrates on the architecture and behaviour of the network as it trains whereas algorithmic mapping concentrates on the parallelization of the learning algorithm. Mappings in the heuristic category tend to take a trial and error approach based on the understanding of the network and of the target machine. In comparison mappings in the algorithmic category tend to take a more theoretical approach to the parallelization process. A number of heuristic mapping schemes exist for BP networks so it is worthwhile to investigate their strengths and weaknesses.

1.2 Useful terminology

The following is a brief introduction to some useful terminology that can be used in describing the different parallel implementations of BP networks.

Training Set

Consists of a number of training patterns, each given by an input vector and the corresponding output vector.

Network Size

The Network Size for a network of N_i input units, N_h hidden units, and N_o output units, can be written as N_i x N_h x N_o.

Training Iteration

Denotes one complete presentation of the training data.

Weight Update Strategy

Three different approaches can be used:

- *Learning by pattern (lbp)*: updates the weights after each training pattern has been presented.

- *Learning by block (lbb)*: updates the weights after a subset of the training data has been presented.

- *Learning by epoch (lbe)*: updates the weights after each training iteration.

Weight update interval

The number of training patterns that are presented between weight updates is termed μ. For *lbp,* $\mu = 1$, whereas for *lbe* $\mu = P$, where *P* is the number of training patterns in the training set.

1.3 Possible parallel implementations for the BP algorithm

Research into the BP network has revealed three possible parallel implementations as described below.

Training set parallelism

This approach splits the training set across the processing elements. Each element has a local copy of the complete weight matrix and accumulates weight changes for the given input patterns. The weights can be updated using *lbe/lbb*.

Pipelining

This approach allows the training patterns to be "pipelined" between the layers of the network. This means that the output and hidden layers are computed on different processors. So while the output layer calculates error values for the present pattern the input and hidden layers processors can process the next pattern. Pipelining requires a delayed weight update scheme, *lbb* or *lbe*.

Node parallelism

Node parallelism computes the neurons within a layer in parallel (Neuron Parallelism). Furthermore the computation within each node can also run in parallel. This method is also referred to as *synapse* or *weight* parallelism, *Nordström* [1].

2.1 Partitioning computation for each type of BP Parallelism

This section describes ways in which each type of BP parallelism can be distributed across a number of processors.

2.2 Training Set Parallelism

Training set parallelism is often referred to as data set parallelism as the training set data is distributed across a number of processors. An example is this type of distribution can be seen in Figure 2.1.
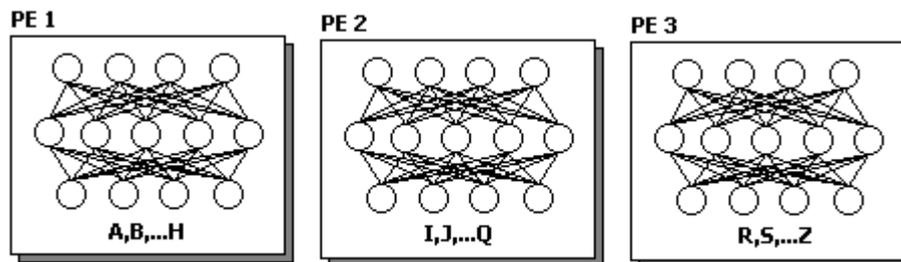
Figure 2.1. Training set parallelism for english alphabet

Each processing element (PE) has a local copy of the complete weight matrix and makes weights changes based on its range of input patterns. A global weight change operation is performed when each copy of the network has processed its current input pattern. This ensures that the weights remain consistent across each copy of the network. Therefore the global weight change operation must employ *lbb* or *lbe*. Each local copy of the weight matrix is updated by summing the weight change values for each PE.

So for example:

> PE1 processes the letter A, and computes weight change $PE1\Delta w_i$
> PE2 processes the letter I, and computes weight change $PE2\Delta w_i$
> PE3 processes the letter R, and computes weight change $PE3\Delta w_i$

> where $_i$ is the current training set iteration for that copy of the network.

Therefore each local weight matrix must be updated with a weight change value of

$$\Delta w = \sum_{j=0}^{i=0} PE_{j+1}\Delta_{i+1}$$

> where (0>=j<= *Num_Processors*) and (0>=i<=*Training_set_size*).

2.3 Pipelining

In pipelining the computation for each layer is carried out by a separate PE. Figure 2.2 shows a pipelining example for a network with one hidden layer. NOTE: A separate PE is not required for the input layer as it merely presents patterns and does little computation.
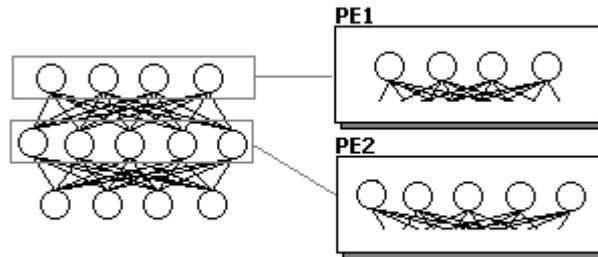
Figure 2.2. Mapping weight matrices for pipelining

Using this approach processing interleaves between the forward and backward passes of the BP learning algorithm. Figure 2.3 shows how this interleaving occurs.
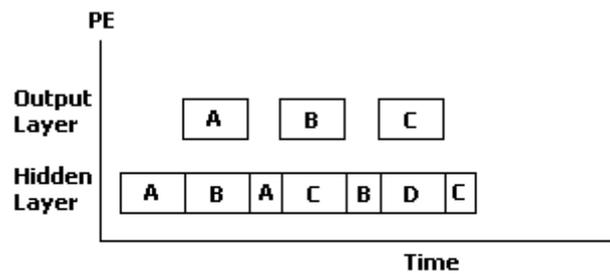
Figure 2.3. Interleaving of forward and backward pass in pipelined BP learning

So for example Figure 2.3 represents the following processing sequence:

1. Hidden layer computes output for letter A
2. Output layer reads values for letter A and computes error values
3. Hidden layer concurrently computes values for the next input pattern, B.
4. Hidden layer reads weight change for letter A and both processors accumulate weight change values for A.
5. Output layer reads values for letter B and computes error values.
6. Hidden layer concurrently computes values for the next input pattern, C.

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2.4 Node Parallelism

Node parallelism can be split into two subclasses, neuron parallelism, and synapse parallelism.

2.4.1 Neuron Parallelism (Vertical Slicing)

Using this approach all incoming weights to one hidden and one output neuron are mapped to a PE. This vertical slicing corresponds to storing one row of the weight matrix in each PE. A matrix-vector product can be used to calculate the output of the neurons:

$$
\begin{bmatrix} y_L,1 \\ y_L,2 \\ y_L,3 \end{bmatrix} = \begin{bmatrix} w_L 1,1 & w_L 1,2 & w_L 1,3 \\ w_L 2,1 & w_L 2,2 & w_L 2,3 \\ w_L 3,1 & w_L 3,2 & w_L 3,3 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}
$$

Figure 2.4 shows how a network with one hidden layer containing three nodes can be mapped onto three different PE's.
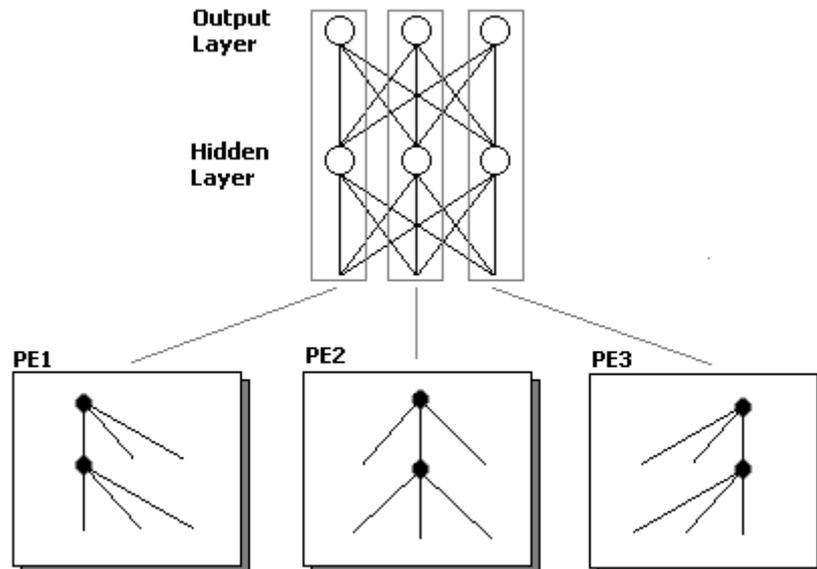
Figure 2.4. Neuron Parallelism (Vertical Slicing)

Each PE computes the value of a hidden node. Then each PE exchanges its value over a communications channel, and continues to calculate a value to be passed to the output layer. Once the output layer has received a complete set of inputs from the hidden layer it can calculate its error weight changes that are used to update the hidden layer weights. The output layer error can be calculated using a vector-matrix product:

$$
\begin{bmatrix} \varepsilon' h,1 | \varepsilon' h,2 | \varepsilon' h,3 \end{bmatrix} = \begin{bmatrix} \varepsilon'_{o,1} \\ \varepsilon'_{o,2} \\ \varepsilon'_{o,3} \end{bmatrix} \begin{bmatrix} wo,11 & wo,12 & wo,13 \\ wo,21 & wo,22 & wo,23 \\ wo,31 & wo,32 & wo,33 \end{bmatrix}
$$

As the weight matrix is stored in row order the error must be calculated by summing partial products. Some networks actually store a copy of the weight matrix in column order so that the summation is optimised for the backward pass. Weight updates can be duplicated [2,3] or communicated [4] to the other weight matrix. Communication of weight updates has been shown to be faster [4].

2.4.2 Synapse Parallelism

Synapse parallelism takes the opposite approach to *Neuron Parallelism* in that it takes columns of nodes and maps them onto separate PE's. In this case each PE computes a partial sum of a neurons output as shown in Figure 2.5. Synapse parallelism uses a more fined grained approach as each PE must broadcast its partial result to all other PE's before the next layer can compute.
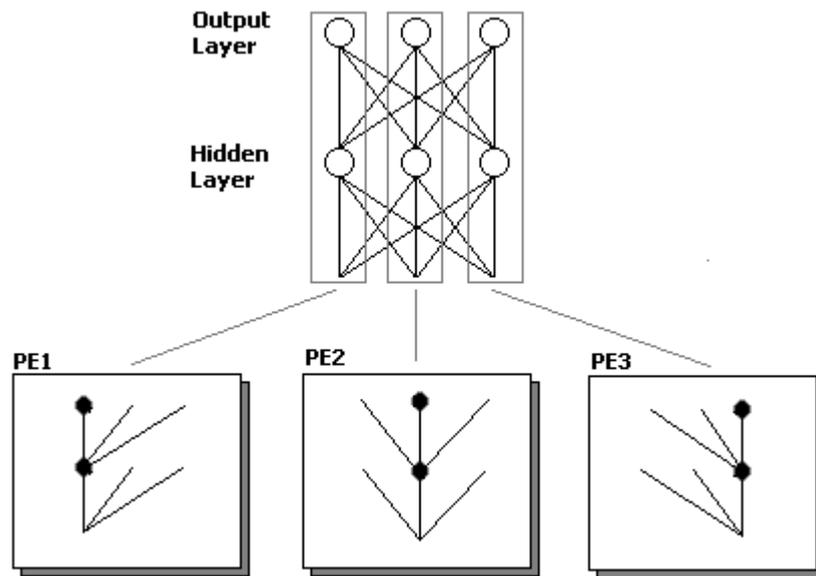
Figure 2.5. Synapse Parallelism

Synapse parallelism does have one advantage over neuron parallelism as the hidden layer error can be computed without communication:

$$
\begin{bmatrix} \delta'_{h,1} & \delta'_{h,2} & \delta'_{h,3} \end{bmatrix} = \begin{bmatrix} \delta'_{o,1} \\ \delta'_{o,2} \\ \delta'_{o,3} \end{bmatrix} \begin{bmatrix} w_{o,11} & w_{o,12} & w_{o,13} \\ w_{o,21} & w_{o,22} & w_{o,23} \\ w_{o,31} & w_{o,32} & w_{o,33} \end{bmatrix}
$$

2.5 Concluding remarks

Each implementation has inherent limitations given by the following:

- Training set parallelism: The number of patterns in the training set

- Pipelining: The number of weights layers

- Neuron parallelism: The number of hidden units and output units

- Synapse parallelism: The number of input units and hidden units

These limitations indicate the maximum amount of PE's that can be assigned to each implementation. Only a few networks and training sets will run optimally on fixed parallel mappings. What should be considered is this: What degree of parallelism should be included and how many PE's should be assigned to each of them in order to reduce the total training time?

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Mental Spaces: Processes for Establishing and Linking Spaces

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1. Introduction

This paper reviews the theory of mental spaces as expounded by Fauconnier (1994). In this work he posits a theory in which reference has a structural dimension. Within the theory, this structure is represented using spaces, connectors across the spaces and some general principles that are found to apply. The complexity lies in the interaction between the principles and in the contextual structures that feed into the principles for interpretation. Brugman, in her 1996 paper, makes use of insights from mental spaces theory to conduct an analysis of HAVE-constructions. She notes that Fauconnier has "*elaborated a theory of partial possible worlds which speakers construct when talking/hearing about the entities and relations of perceived or imagined worlds. These partial models, called Mental Spaces, are not specifically linguistic in nature. Rather they are a manifestation of general cognitive abilities. Mental spaces may be representations of the speaker's reality, or may be fictional or intensional, or may reflect past or future states of the 'real' world.*"

Possibly because of the mathematical background of Fauconnier, the notation used in the 1994 work is very similar to that used by formal semanticists and more readily associated with predicate and propositional calculus. The mental space theory of Fauconnier deals directly with quantifier scope, referential opacity, presuppositional projection, counterfactuals and many other phenomena. In conjunction with Turner, Fauconnier (1995) expanded and enriched the original theory to include specific multiple spaces. The later theory is now known as the many-space theory of mental spaces, or for convenience, the many spaces model. The revised many-spaces theory has greater applicability and utility and can, for instance, be used in analysis of metaphor and related phenomena.

In this paper we review both the initial theory of mental spaces and the later, revised, many-spaces model. Examples to illustrate the theories are taken primarily from the world of linguistics but we introduce some examples from mathematics to support the contention that mental spaces are cognitive by their nature, and are therefore found to apply to cognitive modalities outside of language.

The structure of paper is as follows: after this introduction we explore, in section 2, the theory behind the mental spaces. Here we ask what exactly are mental spaces; what do they contain and how may they be related, and provide responses to these questions based on Fauconnier's 1994 work. In section 3, we examine more recent work in the theory (Fauconnier & Turner 1994). We see that the theory is enriched in a valuable way that leads to greater applicability and utility. In addition, we see how multiple spaces are constructed and populated. Numerous examples are explored in order to demonstrate of how the theory is applied. In section 4, the concluding remarks, we deliver a very brief review of the material covered, along with some thoughts by Fauconnier on where he himself see the mental spaces theory developing. In addition, we comment on areas of usage, highlighting areas of research potential.

2.   Mental Spaces

Within cognitive semantics, referential structure is indicated by mental spaces, whereas conceptual structure is indicated by Idealised Cognitive Models (ICMs) and Frames. These structure the mental spaces. The entities in the mental spaces are:

(1)   a.   The roles defined by the ICMs and frames.

         b.   The values for those roles.

The ICMs themselves are not entities in the mental spaces. They provide relational structure linking the roles, that is, are entities in the spaces. What Fauconnier accomplished was to show how the full set of recognised problems of reference could be handled with ideas and principles that make sense from a cognitive perspective via:

(2)   a. Mental Spaces - separate domains of referential structure.

         b. Connectors between referents, within and across spaces.

         b. Roles and Individuals and the distinction between them.

         c. The ability to extend spaces in a discourse.

As an introductory example of what this entails, we can consider the well-known example from Jackendoff (1975):

(3)   *In this painting, the girl with the brown eyes has green eyes.*

In the terminology of Fauconnier, the phrase *in this painting* is a <u>space-builder.</u> The space builder sets up the mental space of the painting, which we will call P, as distinct from the mental space of the real world which we will call R. The girl who has brown eyes in R has a counter part in P who has green eyes. Fauconnier posits a number of principles to explain this phenomena, one of which is the Identification Principle. This principle permits the description of the girl in R to be used to name the girl's counterpart in P. The description "the girl with the brown eyes," which holds in R, can be applied to the girl in the painting. The clause *the girl with brown eyes has green eyes* is not contradictory because the two descriptions hold in different mental spaces.

Fauconnier's theory unifies the treatment of reference and the treatment of presupposition.

(4)   Brian's children are blond

(5)   If Brian has children, Brian's children are blond.

The sentence (4) presupposes that Brian has children, whereas (5) does not presuppose that Brian has children. Placing the presupposition in an *if*-clause has the effect of cancelling it. In Fauconnier's theory, *if* sets up a conditional mental space C, separate from the reality space R. Brian has children holds in C, but not necessarily in R. *Brian's children are blond*, as the second clause of the conditional construction, holds in an extension of C, but again not necessarily in R. Therefore, the presupposition that Brian has children holds in C, but not in R. Where there is no conditional construction setting up a separate mental space, *Brian's children are blond* will be taken as holding in R and as presupposing that Brian has children in R.

Mental spaces, including the connections linking them and the linguistic, pragmatic, cultural strategies for constructing them, are a significant part of what is happening in the cognitive background of everyday speaking and reasoning. The principles governing the operations are simple, general and appear to be universal across languages and cultures. When combined and applied to rich pragmatic situations, the principles are able to yield unlimited numbers of meaning constructions and unlimited nesting. As Fauconnier says in his preface to Mental Spaces: "*Generativity is fundamentally a property of meaning, only derivately one of syntax.*" In order for thinking and communicating to take place, elaborate constructions must occur that draw on conceptual capacities, highly structured background and contextual

knowledge, schema-induction, and mapping capabilities. Languages are designed to prompt us into making the constructions appropriate for a given context with the minimum of grammatical structure. Language itself does not do the cognitive building. It simply gives us minimal and sufficient clues for finding the domains and principles appropriate for building in a given situation. Once these clues are combined with existing configurations, available cognitive principles, and background framing, the appropriate construction takes place. The result exceeds any explicit and overt information.

We are not aware of the constructions we perform and we generally do not suspect the extent to which vast amounts of pre-structured knowledge, selected implicitly by context, are necessary to form any interpretations of anything. The common fiction is that we notice only the words and attribute all the rest to common sense. The theory of mental spaces was developed, by Fauconnier, in reaction to mainstream views of meaning. While placing doubt on the semantic foundations, analytical tools and empirical methods that had been in routine use, it recognised the importance of phenomena such as:

(6)   a   Quantifier scope

        b.   Referential opacity

        c.   Presupposition projection

        d.   Counterfactuals

Language does not carry meaning, it guides it. Fauconnier quotes Turner (1991): "*Expressions do not mean; they are prompts for us to construct meanings by working with processes we already know. In no sense is the meaning of [an] ... utterance 'right there in the words'. When we understand an utterance, we in no sense are understanding 'just what the words say'; the words themselves say nothing independent of the rich detailed knowledge and powerful cognitive processes we bring to bear*".

Fauconnier himself says, "*Language, as we use it, is but the tip of the iceberg of cognitive construction. As discourse unfolds, much is going on behind the scenes: New domains appear, links are forged, abstract mappings operate, internal structure emerges and spreads, viewpoint and focus keep shifting. Everyday talk and common-sense reasoning are supported by invisible, highly abstract, mental creations, which grammar helps to guide, but does not by itself define.*" A sentence that appears at some stage of the discourse construction will contain several kinds of information. These are indicated by various grammatical devices (7).

(7)   a.   Information as to what new spaces are being set up, expressed by means of space builders.

           b.   Clues as to what space is currently in focus, what its connection to the base is, and how accessible it is; this information is expressed by means of grammatical tenses and moods.

           c.   Descriptions that introduce new elements and counterparts, if appropriate, into spaces.

           d.   Descriptions, anaphors or names that identify existing elements and counterparts, if appropriate.

           e.   Syntactic information that sets up generic level schemas and frames.

           f.   Lexical information that connects the mental space elements to frames and cognitive models from background knowledge. This information structures the spaces internally by taking advantage of available pre-structured background schemas. Such pre-structured schemas can be altered or elaborated within the constructions.

           g.   Presuppositional markings that allow some of the structure to be instantly propagated through the space configuration.

           h.   Pragmatic and rhetoric information conveyed by words like *even, but, already*, which signal implicit scales for reasoning and argumentation.

A natural language sentence is cognitively complex. This is because it incorporates information and building instructions at all the different levels noted above. The meaning that will be produced depends on the mental space configuration, generated by earlier discourse, that the sentence applies to. Access to meaning through conceptual connections is a powerful component of meaning construction that language reflects in general, regular and systematic ways, independently of its particular domains of application. Fauconnier finds the same language and interpretation mechanisms at work in (8):

(8)   a.   Mappings between source and target domains in literary, conceptual and conventional metaphor.

           b.   Reasoning and talking about images, pictures, and representations.

           c.   The use of pragmatic functions of reference, with the special cases of metonymy and synecdoche.

           d.   Talk about propositional attitudes, beliefs and desires.

           e.   Discourse involving time, viewpoint, and reference points.

           f.   The construction of hypothetical and counterfactual situations.

In all these cases, cognitive domains are set up and connected. Uniform linguistic operations for access can apply (9).

(9)   a.   The Identification Principle (also called the Access Principle by
                 Fauconnier).

        b.   Cross-space, or trans-spatial, connection signalled by a copula such as *be* in
                 English.

        c.   Multiple connecting paths giving rise to surface ambiguities of the isolated
                 forms.

        d.   Grammatical markings such as tense, mood, anaphora and space builders for
                 keeping track of the dynamic progression through spaces as discourse
                 unfolds.

        e.   General default optimisation strategies for structuring these domains and
                 grammatically marked ones such as presupposition "float".

The generalisations bring together many types of data that are widely considered in traditional treatments to differ not just analytically, but in their nature (10).

(10)   a.   The subset of mental space phenomena involving propositional
                 attitudes, time, and hypotheticals in prototypical "minimal context", single-
                 sentence situations is classically assumed to be in the realm of core
                 semantics (literal, truth conditional, and model theoretic interpretations).

        b.   Metonymy, novel metaphor, synecdoche are consigned to rhetorical, literary
                 embellishment.

        c.   Conventional metaphor is largely ignored and is attributed to the vagaries of
                 language change.

        d.   Pragmatic functions are in pragmatics.

        e.   Analogical mappings are viewed as higher level reasoning processes and not
                 at the core of direct language interpretation.

        f.   The difficulties with reference in pictures and representations are considered
                 (if at all) as pragmatic and not relevant to truth conditional semantics.

Once we start paying attention in everyday life to instantiations of connectors, frames, induced schemas, conceptual connections, and metaphor, counterfactual mental spaces, the real world discloses far richer and more revealing configurations than our efforts as linguists

so far have been able to produce. There is an abundance of data that goes unnoticed mainly because it does not fit the established categories. "Discovering" bodies of data is a common feature of the evolution of scientific inquiry.

Fauconnier makes some interesting observations on the work of Chomsky. Chomsky, he believes, offered a general framework for asking questions relating to form that was elegant and conceptually simple. Just as mathematical well-formedness had become a scientifically tractable problem this century through the detailed study of recursive algorithms, linguistic well formedness could be approached with the same techniques and with the same goals. This knowledge is equivalent to the procedural mastery of a complex recursive algorithm. The puzzling aspect of the algorithmic approach was its lack of concern for meaning. This is the view articulated as the *autonomy of syntax* and which was inherited from American structuralism. After Chomsky, Montague, the father of formal truth conditional semantics, assumed that sentences, with their grammatical structure, were the sort of object that lends itself to literal truth conditional interpretation. It can only be said that his work encountered the same difficulties that plagued sentence oriented semantics before him.

The cognitive linguistics framework that was first elaborated in the 1970s abandoned many of the Chomskian and Montague assumptions, in particular, the algorithmic approach to syntactic form and the literal meaning, truth conditional, sentence oriented view of semantics. The work on mental spaces is part of that reassessment. Mental spaces and related notions are theoretical constructs devised to model high-level cognitive organisation.

Because generative grammars are formally axiomatic systems, it was in many ways inevitable that accounts of syntax would be formalised in the fashion of 20th century mathematics. This was also true of model theoretic accounts. It does not follow that this type of formalisation is intrinsically preferable, useful or desirable. Any formalisation is only as good as the theory it formalises. Formalisations of unsatisfactory analyses are harmful and do not support genuine understanding. In the work on mental spaces, some aspects are easy in principle to formalise for a particular purpose, others less so. For example, mental spaces are set up not just by explicit space builders, but by other more indirect grammatical means, and also by non-linguistic pragmatic, cultural, and contextual factors. It follows that there is no complete algorithm yielding a mental space configuration on the basis of available discourse only.

2.1   Partitioning: Worlds, Spaces and Domains

In traditional approaches to the study of reference, it is usual to introduce some form of partitioning into semantic analysis, in which to distinguish domains. These domains show up in the form of possible worlds, which contain all referents and their properties. They are fully specified, non-linguistic and non-cognitive. Frameworks that employ these view semantics as being the study of links between linguistic forms and universes of possible worlds. The only thing that possible-worlds semantics has in common with mental spaces is that they both use partitioning. In the possible-worlds semantics, the partitioning is metaphysical and not cognitive. Mental space configurations are only very partially specified models of discourse understanding which undergo continuous modification. Some of their structure is specified as defeasible, that is, obtained by defaults and optimisation mechanisms, and revisable. The spaces do not, in principle, have to be logically consistent. The mental space constructions are cognitive and are not something that is being referred to. They are instead something that can be used to refer to real, or imaginary, worlds and include elements or roles that do not, and cannot, have direct reference in the real world.

2.2   Cross-Domain Functions

When we engage in any form of thought, typically mediated by language, domains are set up, structured and connected. The process is local. Many such domains, mental spaces, are constructed for any stretch of thought. Language, through the grammar and the lexicon, is a powerful means of specifying or retrieving key aspects of this cognitive construction. Reference, inference, and structure projection of various sorts operate by using the connections available to link the constructed mental spaces. Such connections are cross-domain functions in that they specify counterparts and projected structure from one space to another. In a simple case, two spaces are connected by only one function and this function reflects some form of identity of the connected counterpart. A literary example of this might be taken from Oscar Wilde and the Picture of Dorian Gray. Here we build two mental spaces, one for "reality" and one for the "picture". There is a Dorian Gray in each space, one a counterpart of the other and the connection type is identity. Realistically we are referring, in the context of the novel, to a person versus oil paint - there is no identity. Subjectively, the model and man in the picture can differ as much as we want. The point of partitioning is therefore to keep distinct properties, frames, and structures in distinct domains.

It should be noted that there may be several functions linking two given mental spaces in discourse, and also that the connecting competing counterparts are not restricted to a one-to-one mapping. This aspect of mental spaces is more clearly visible in Fauconnier's more recent work, in conjunction with Turner (see Fauconnier and Turner, 1995) in which he elaborated his many space, or n-space, model within the context of conceptual blending.

2.3   Discourse Representation and Mental Models

From the cognitive semantics perspective, identity is only one of many conceptual connections across spaces. While being perhaps the most obvious and typical type of connection, it is only a special case of the connections that undertake major work, along with others such as analogical and metaphorical projection, role to value functions and pragmatic metonymy functions. What is important is the under-specification of cognitive mental space configurations by language. There is no algorithm that would deliver the space configuration that corresponds to some linguistic forms. Instead the linguistic form will constrain the dynamic construction of the spaces. That construction is itself highly dependent on the previous constructions already effected at that point in discourse. These may be:

(11)   a.   Available cross-space mappings,

        b.   Available frames and cognitive models,

        c.   Local features of the social framing in which the construction takes place,

        d.   Real properties of the surrounding world.

Framing and point of view are of major importance. Space building is also frame building. The frames provide the abstract-induced schemas that drive mappings across mental spaces. The power of grammar is to invoke suitable generic frames that will serve in context to manipulate more specific ones. This construction process implies that the speakers, hearers, and any other participants must keep track of the maze of spaces and connections being built. One way to achieve this is by use of the *point of view* and *point of view shifts*, which are grammatically encoded by means of tenses, moods, space builders, anaphors, and other cognitive operators. In this extended sense, mental space configurations are mental models, but they are mental models of discourse, not mental models of the world.

2.4 Time, Tense, and Aspect

The reference point for time reflected by language is a consequence of general principles of mental space tracking and organisation. Grammatical tenses and aspects, and their combinations, serve to indicate relative relations between spaces and to keep track of the discourse "position" of the participants, i.e. which space is in focus (dynamic), which serves as base and what shifts are taking place. Like focus, viewpoint will shift as the discourse builds up and grammatical tense, in addition to space builders and other devices, will guide speakers and hearers through the maze of connected mental spaces. Grammar provides fine-grained tense and aspect combinations that reflect motion through the space configuration during discourse, shifts of focus, abstract viewpoint, and sometimes base.

2.5 Mood and Epistemic Stance

Fauconnier's work on mental spaces highlights the importance of assessing and marking various types of mental space incompatibilities and the status of structure in one space with respect to the structure in another, be it real, hypothetical, counterfactual, shared prepositions, shared beliefs. Grammar, often in the form of tense and mood combinations, will give clues as to such status. This is called the generalised relative epistemic stance. Many surface features of grammatical distribution, such as presence or absence of tense concord, reveal elaborate and subtle aspects of the hidden mental space configurations and the epistemic stances they entail. Mood can reflect the accessibility of one space from another.

2.6 Pragmatic Ambiguity

A very significant consequence of the mental space approach has been to recast many scopal and logical phenomena. Ambiguities and multiple readings, which were previously thought to stem from underlying structural characteristics of sentences, now follow more generally from the under-specified nature of the linguistic forms. Any such form is compatible with a potentially unlimited array of space configurations, but in practice is limited by a number of factors including default principles, the current state of a construction in a particular discourse, and contextual constraints as to the conceptual domains under consideration.

The space building instructions are the same for all uses, but the domain type for the mental spaces and the mappings linking the spaces can vary over a wide pragmatic range. This allows a uniform treatment of multiple readings for "donkey" sentences (*If a man owns a donkey, he beats it*), which keeps the semantic interpretation of indefinites maximally simple and invariant, but lets the space type vary.

2.7 Cognitive Mappings

Turner and Fauconnier (1995) discovered that space constructions and mappings exist which do not seem to include explicit space builders or mapping operators. These constructions which involve analogy, metaphor, and hedges, set up multispace configurations with source, target, generic, and blended spaces that project onto each other in several directions. The syntactic construction is deceptively simple:

(12)   NP *be* NP *of* NP
         X   Y   Z

as in *Vanity is the quicksand of reason*. This construction has a complex semantic/pragmatic interpretation. Construct a metaphorical mapping such that X in the target is the counterpart of Y in the source, and Z in the target is the counterpart of a fourth element, W, in the source, and use this construction to project appropriate inferences into the target. Fauconnier interprets W as the traveller, who should reach a goal. As quicksand destroys the traveller, vanity destroys reason. The grammatical information is minimal and abstract. Find a mapping and a missing element; the rest is left to the cognitive competence of the user. An implicit generic space is constructed. A different syntactic construction example is "NP be N NP" and again, this triggers a multispace configuration with source, target, generic and blend, and it leads to the introduction of elements and structures. The emergent view is that of language guiding the space construction process through space building, space blending and projection of generic spaces.

Cognitive mappings and blendings are at the heart of meaning construction. Syntactic constructions represent high-level generic spaces. Together with lexical items, which are themselves constructions, they can be mapped and blended into progressively more specific spaces. This general scheme allows multiple levels of organisation to be simultaneously projected into one given mental space configuration.

2.8 Pragmatic Functions

In the research work on mental spaces, metaphor, and metonymy are taken to be central and widespread. Simple grammatical structures give instructions to space construction in context. This construction is often under-specified by the grammatical instructions. Simple construction principles and simple linguistic structures may yield multiple space configurations. This creates the illusion of structural complexity. Recent studies have shifted the focus of attention from language forms to other structures and networks upon which they depend. Examples of these would include:

(13)   a.   Frames and scenarios

        b.   Metaphor as an elaborate structuring of conceptual networks via partial correspondences underlying semantic-pragmatic organisation and its expression through language

        c.   The account of presupposition in terms of discourse worlds linked to each other

        d.   The treatment of "scopal" phenomena, like opacity and transparency, as referential correspondence between concrete or mental images.

A key idea related to such correspondences is the notion of pragmatic function. We establish links between objects of a different nature for psychological, cultural, or locally pragmatic reasons and the links thus established allow reference to one object in terms of another appropriately linked to it. The general principle of this is contained within what Fauconnier calls the Identification Principle.

(14)   Identification Principle

        If two objects, a and b, are linked by a pragmatic function $F(b=F(a))$, a description of a, d_a, may be used to identify its counterpart b.

By way of example consider the following:

(15)   {authors} → {books}

$$F_1$$

The function, F_1, links authors with the books containing their works. Taking a = "Plato", b = $F_1(a)$ = "books by Plato", the ID Principle allows "Plato is on the top shelf" to mean "The books by Plato are on the top shelf". Other pragmatic functions are also available to interpret

"Plato is on the top shelf", for example, functions from person to representations, from persons to information about them, from persons to bodies, from persons to names (= words), etc. Using one of these instead of F_1, the example sentence quoted could be interpreted to mean that a bust or portrait of Plato is on the top shelf, that Plato's body is on the top shelf, or that the sign with the word *Plato* on it is on the top shelf. F may simply be the identity function, in which case b will be described in terms of itself and its own properties.

One area where the possibility of "indirect" reference by means of pragmatic functions and the ID Principle has linguistic relevance is pronominalisation. Consider the situation in which b is linked to a by a pragmatic function F and may be referred to by means of a description of a, via the ID Principle.

(16)   a   →   b
        {trigger} $F_{connector}$ {target}

        Where
                a   is the reference *trigger*,
                b   is the reference *target* and
                F   is the *connector.*

The ID Principle states that in a connected situation, a description of the trigger may be used to identify the target. This allows reference to the target b and this reference target becomes a potential antecedent for pronouns and other anaphors:

(17)   Plato is on the top shelf. *It* is bound in leather.

The trigger a is also a potential antecedent in such situations:

(18)   Plato is on the top shelf. You'll find that *he* is a very interesting author.

Both the reference trigger (the author Plato) and the reference target (books by Plato) can be pronominal antecedents of discourse. It is not simply a matter of choosing one over the other as the antecedent for pronominalisation as both may simultaneously warrant anaphors in the same discourse.

(19) a → b

{trigger} $F_{connector}$ {target}

food customer

Consider the connector linking food and customers induced by the restaurant frame that allows statements like:

(20) The mushroom omelette left without paying the bill.

This is understood to mean that the customer who had ordered the mushroom omelette left without paying. The target may then serve as a pronominal antecedent.

(21) The mushroom omelette left without paying the bill. He jumped into a taxi.

Reflexivisation shows that:

(22) The mushroom omelette was using chopsticks.

Or

(23) Norman Mailer likes to read himself before going to sleep.

In the Norman Mailer example, we find the masculine pronoun *himself* agreeing with the trigger (Norman Mailer) in gender, but referring to the target (books by Mailer). Since the NP Norman Mailer described and refers to the author, its involvement does not involve the connector. The reflexive pronoun *himself*, on the other hand, while anaphoric to Norman Mailer, refers to the books and its interpretation does involve application of the connector. This application must follow the reflexive rule:

(24)   Linguistic expression   <u>Norman Mailer</u> likes to read <u>himself</u>
                                                              | |

        interpretation   a |
                                                                                |

        Reflexive interpretation   a
                                                                                |

        Connector F$_1$ applied to trigger a   b

If the connector applied to the first instance of a, corresponding to the noun phrase Norman Mailer, giving b, then b can serve as an antecedent for the reflexive *itself*.

(25)   a. Linguistic   <u>Norman Mailer</u> is not, in <u>itself</u>,   a great discussion topic.
            expression | |
        b. interpretation   a |
                                   | |
        c. Connector F$_2$ b |

        d. Reflexive   b
            interpretation

We can say that a connector is <u>open</u>, when it sets up both target and trigger as potential antecedents and may apply to the output of pronoun interpretation, and <u>closed</u>, when it sets up the target as foremost potential antecedent and cannot apply to the output of pronoun interpretation. In the examples we used above:

(26)   F1 (authors → books) is *open* and

        F (food → customers) is *closed*.

An observation regarding open and closed connectors is that open connectors relate, in the first instance, to people (i.e. authors) and that closed connectors relate to inanimate objects or things (i.e. food). Whether this universally generalises is not clear. It may be simply a side effect of the particular examples used by Fauconnier.

What makes connectors available, and when are they open or closed are questions that are posed by Fauconnier. He responds to these by stating that they are central and fascinating questions involving psychological, cultural and sociological conditions that bear directly on the linguistic data. However, the connectors themselves are   part of idealised cognitive

models (ICMs) in the sense of Lakoff (1978). Speakers are able to set up new connectors by settings up new ICMs. The more familiar and useful a connector becomes, the more open it tends to be. The connectors that link mental spaces tend, according to Fauconnier, to be mostly open.

The properties of open connectors include:

(27)   a.. the ID Principle,

        b.   the capacity to set up target and trigger as potential antecedents,

        c.   the applicability to anaphoric elements.

Images, pictorial representations, photographs etc. are linked to their models by pragmatic connectors.

(28) $a \rightarrow b$

      {trigger} $F_{connector}$ {target}

        model   image

Examples of pronominalisation data show that image connectors are open. They set up target and trigger as potential antecedent and may apply to the output of pronoun interpretation.

(29)   a. Lisa is smiling in the picture, but she has been depressed for months.
            (Trigger antecedent of *she*)

        b. Lisa has been depressed for months, but in the picture she is smiling.

        c. (connector applies to interpretation of pronoun *she*)

        d. Lisa, who has been depressed for months, is smiling in the picture.

        e. (Trigger antecedents *who*, target is smiling)

        f. Lisa, who is smiling in the picture, has been depressed for months.

        g. (Lisa (model) antecedes *who*; connector applies to *who*)

        h. *Lisa* saw herself in Len's picture.

        i. (Connector applies to the output of reflexive interpretation, so that *herself*=image)

        j. In that drawing, *Lisa* appealed to *herself*.

        k. (connector applies to the reflexive interpretation of Lisa as a person, giving the image (drawing); the reflexive interpretation is with respect to the trigger, *herself* referring to the person)

There is a pragmatic relation between a model and its representation. Something is a picture of something else by virtue of psychological perception, social convention, how it was actually produced, or any combination of all three. This pragmatic relation meets the criteria for being a pragmatic reference function, a connector. Therefore, the ID Principle will apply and allow a description of the trigger (the model) to identify the target (the image). Image functions are open connectors.

Adverbial phrases can set up an image situation, as in "*In Len's painting*". Reality is quite different from images. There are real, essential referents on the one hand and various representations of those referents on the other. Under this view, the triggers will be real referents while the targets may be concrete or mental representations of them. This asymmetrical view is not reflected by the linguistic data. The triggers may be in the pictures, beliefs, etc., and the targets in the real world.

(30)   *In reality, the girl with brown eyes* has blue eyes.

Instead of going from the real world, we go from the picture to reality. Instead of mapping reality onto the picture, it maps the picture onto reality. It is also an open connector. The direction of the mapping is indicated by the adverbial phrase. Similar connector inversions are possible in the context of "mental" images such as beliefs.

While we use the terms reality and real object in the above discussion, it is important to realise that the connectors are not actually linking real objects and representations. The speaker who uses the example above (In reality....) need not be right about the properties that he assigns to entities, including whether or not they exist. What we have been calling reality must be itself a mental representation - the speakers mental representation of reality. We end up with then, with links between mental representations, that is, a mental representation of a mental representation. This embedding is often reflected in the syntactic embedding:

(31)   Max believes that Len wants to leave the country.

Real objects are, of course, real, but their interpretation as images is mental. Fauconnier introduces the notion of space builders as part of a more precise model of mental spaces. Mental spaces are constructs distinct from linguistic structures and built up in any discourse according to guidelines provided by the linguistic expressions. In the model, mental spaces
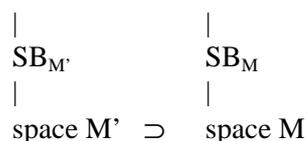
will be represented as structured, incremental sets with elements (a, b, c, ...) and relations that hold between them (R_1ab, R_2a, R_3cbf, ...), where an incremental set is an ordered sequence of ordinary sets, such that new elements can be added to them and new relations established between their elements. Expressions like (Ra_1a_2..an holds in mental space M" will be taken to mean that a_1, a_2, ...a_n are elements of M and that the relation R holds of (a_1, a_2, ..., a_n). A partial ordering relation is defined on spaces and this is called *inclusion*. Fauconnier expresses inclusion via the notational symbol of $\subset$. However, unlike set inclusion, it is important to note that, in this context, inclusion carries <u>no</u> entailments for the elements within the spaces: $a \in M$ and $M \subset N$ does not entail $a \in N$. All spaces are assumed to be distinct with no elements in common.

Linguistic expressions will typically establish new spaces, elements within them, and relations holding between the elements. Expressions that establish a new space, or refer back to one already introduced in the discourse, are called *space-builders*. Space-builders may be:

(32)   a.   Prepositional phrases (In Len's picture, at the factory, from her point of view),

b.   Adverbs (really, probably, possibly, theoretically),

c.   Connectives (if A then ___, either ___ or ___),

d.   Certain subject-verb combinations (Max believes ___, Mary hopes ___, Sorcha claims ___).

Space-builders usually come with linguistic clauses that predicate relations holding between space elements. The space-builder SB_M establishing M will always establish M as included in some other space M' (its parent space). This inclusion may either be inferred pragmatically from previous discourse or be indicated explicitly by syntactic embedding of the space-builders for M' and M as in the example following:

(33)   <u>Max believed</u> that <u>in Len's picture</u>, the flowers are yellow.

```
        |               |
        SB_M'           SB_M
        |               |
        space M'  ⊃   space M
```

Discourse D starts relative to space R (origin (= "speakers reality"))

(34)   a.   <u>Susan likes Harry</u>.
                |
                establishes relation between Susan and Harry in R

         b.   <u>Max believes</u> that <u>Susan hates Harry</u>.
                | |
                | establishes relation between Susan' and Harry' in M
                space-builder for M

No parent space is explicitly specified for M. R is inferred as the parent space: $M \subset R$. When space M is introduced in discourse by a space-builder SB_M, it must be pragmatically connected to its parent space. There must be a connector capable of connecting triggers and targets in the parent and daughter spaces. M and M' may be linked by more than one connector. Many linguistic reference phenomena do not depend on which particular connectors are involved, but rather on general properties of open connectors and the trigger-target configurations they set up.

We have discussed how spaces are built by space-builders, how they fit into other spaces by syntactically or pragmatically conditioned inclusion and how pragmatic connectors keep them in touch with their parents. We now need to discuss the related topic of how do spaces acquire elements. How are they filled and internally structured? Fauconnier outlines several strategies to achieve this. One device that does this explicitly is the *indefinite article*.

(35)   In Len's picture, *a witch* is riding *a unicorn*.

The space-builder *in Len's picture* sets up space M. The noun phrase *a witch* sets up element *w* in M with the property indicated by *witch* and transcribed as WITCH(*w*). Similarly, the noun phrase *a unicorn* sets up a new element *u* in M such that UNICORN(*u*). The verb form indicates that a relation holds between *u* and *w*: RIDES(*w*, *u*). Taking N to be a common noun, either simple or complex (*witch, wicked witch who came from the west*) and "N" the property it denotes, the indefinite article can be partially characterised as follows:

(36)   Indefinite Interpretation
         The noun phrase *a* N in a linguistic expression sets up a new element *w* in <u>some</u> space, such that "N"(*w*) holds in that space.

In contrast to indefinite descriptions that set up new elements, the direct function of definite descriptions is to point out elements already there. This may also indirectly result in setting up elements.

(37)   Definite Interpretation

        a.   The noun phrase *the* N in a linguistic expression points to an element a already in some space M, such that "N"(a) holds in that space.

        b.   If N is a proper name, the noun phrase N points to an element a already in some space M, such that N is a name for a in M.

Definites and indefinites can also set up roles rather than "mere" elements. Targets do not require explicit introduction. The system, instead of explicitly introducing targets in M', lets the ID Principle apply freely to trigger elements in M with the implicit, "sensible" instruction, "If the ID Principle applies, assume there was a target for its application".

(38)   ID Principle on Spaces

        Given two spaces M, M', linked by a connector F and a noun phrase NP, introducing or pointing to an element x in M,

        a.   If x has a counterpart x' ($x = F(x')$) in M', NP may identify x';

        b.   If x has no established counterpart in M', NP may be set up and identify a new element x' in M such that $x' = F(x)$.

In virtue of the Indefinite Interpretation Principle, an indefinite noun phrase *a* N will introduce a new element w into space M. If M is connected to M; by F, then the ID Principle may apply to this noun phrase, so that *a* N will identify a target of w, w'. If w has no target (typically the case, since w is itself a new element) then by the ID Principle on Spaces, the noun phrase also sets up the target w'.

If two spaces M and M' are relevant in the discourse and NP is an indefinite noun phrase in the companion clause, as in {SB$_M$, S} where S is the companion clause, the characterisation of indefinites via the Indefinite Interpretation Principle and the ID Principle on Spaces Principle allow NP to set up a new element either in M or in M'. This accounts for the scope ambiguity of indefinites. If discourse involves more that two spaces, say *n*-spaces, the possibility arises that the element corresponding to the indefinite will be introduced in any one of the *n* spaces, giving rise, in a sense, to *n*-contextual readings for the utterance of the

sentence. Perhaps Bob Dylan was the first to notice this phenomena in the mid-to-late sixties when he penned the line "*... you can be in my dream if I can be your dream*" in the song *Subterranean Homesick Blues.* Ontological reality is not an issue, nor "existence" whether "real" or "imaginary".

Earlier we have noted how simple opaque-transparent ambiguities associated with verbs of propositional attitude follow directly from natural language trigger-target identification under the operation of the ID Principle. The availability of two interpretations for a sentence is purely a consequence of the discourse processing involved (construction of spaces, connectors, etc.). It is important to realise that this is <u>not</u> linked to any structural ambiguity of the linguistic form at deep, semantic, or logical levels.

Time adverbials such as *in the late-to-mid sixties, last night, next time you're here* are space-builders. Informally, the counterpart of an element in some space corresponding to time *t* is "that element at time *t*".

(39)   In 1929, *the lady with white hair* was blond.

In 1929 sets up space M. Assume that the parent space R corresponds to "now". The noun phrase *the lady with white hair* may set up x_1 in R and identify its counterpart x_2 in M (x_1 "is" the old lady today, x2 the "same" person when she was young, in 1929). The noun phrase *the lady with white hair* could also be a direct description of the target x_2, giving the somewhat contradictory reading that the lady was a blond with white hair. Another example is:

(40)   Today, *that young woman* is an old lady with white hair.

This time, the origin space is "1929". The space-builder *today* sets up a space corresponding to the present. The non-contradictory reading of the previous example is obtained by letting *that young woman* point to an element in R_{1929} and identify its target counterpart in M_{today}. Geographical spaces are also linguistic spaces and are treated in the standard manner within the model of mental spaces. A domain of activity (game, field of science, sport, type of literature, etc.,) can be processed linguistically as a mental space. The usual ambiguities can be observed. Consider the following examples:

(41)   a.   In Canadian football, the 50-yard line is 55 yards away.

b. In the Phoenix Park, the Fifteen Acres playing fields are twice that size.

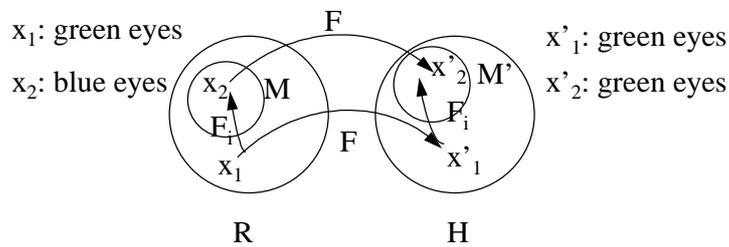c. In the monetarist religion, greed is good.

Linguistic forms such as *if p, then q* set up a new space H in which *p* and *q* hold. *If p* is a space-builder. Again, we find non-contradictory "transparent" readings and contradictory opaque ones, as in:

(42)   If I were a millionaire, my VW would be a Jag.

x_1: VW $\qquad$ x_2: Jag

x_1 $\qquad\qquad$ x_2

R $\qquad$ H ("If I were a millionaire ___")
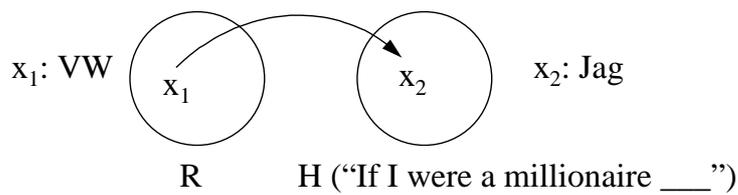
In (43) following, four spaces are involved.

(43)   If you were a good painter, the girl with blue eyes would have green eyes

x_1: green eyes $\qquad$ F $\qquad$ x'_1: green eyes
x_2: blue eyes $\qquad\qquad$ x'_2: green eyes

x_2 M $\qquad$ x'_2 M'

F_i $\qquad$ F_i

F

x_1 $\qquad$ x'_1

R $\qquad\qquad$ H

R ("reality"),

M (the painting),

H (the counterfactual hypothetical space), and

M' (the counterpart of M within H).

The girl with the green eyes points to a trigger in R ("the model") and identifies a target in M' after successive applications of the ID Principle. The properties of hypothetical spaces are important also in relation to presuppositions and indefinites. Counterfactual spaces can be set up by *otherwise*, or sometimes directly, after a negative utterance.

(44)   I don't have a car. Otherwise I would have to drive it to work.

These hypothetical spaces are to be found in abundance in the world and language of consumer advertising. Tenses and moods do not by themselves explicitly set up spaces, but they give grammatical clues concerning the spaces relevant for the sentence being processed. For example, using the sentences from earlier, *In 1929, the lady with the white hair was blond* and followed by a past tense means that we stay in M (1929); with a present tense, it signals a shift back to R, the "conditionals" (*could, would*) signal the counterfactual space M. When they appear within a description (inside a relative clause), tenses and moods can signal explicitly what kind of space the description is relative to, thereby removing some or all of the indeterminacy of the ID Principle on Spaces.

2.9 Pronouns across Spaces

Because the connectors that link elements in different spaces are open, a pronoun with an antecedent in one space can identify its counterpart in another connected space.

(45)   Vivien saw herself in *Gone with the wind.*

The relevant cases can be subdivided into three main categories; multiple connectors, multiple counterparts, and multiple descriptions. We will examine each of this in turn.

2.10 Multiple connectors

Suppose a film was to be made about the life and times of Charles J. Haughey and the main role ("Charley") to be played by Niall Tobin. Suppose also that in the film, Charley himself plays a minor role, perhaps as the man shopping in his local Dunnes Stores supermarket. In this imaginary scenario, R, the speakers reality and M, the movie, are linked by two connectors - the drama connector F_d from actors to characters and an image connector F_i from real-life people to their film counterparts. Haughey (x_1) happens to be linked to two elements of M, by two different connectors, which is confirmed by the ambiguity of the example sentences following:

(46)   a.   Haughey saw himself in the film

        b.   Haughey liked himself in the film.

        i.e.

        c.   He liked the man in the supermarket,   [= a.] or alternatively

        d.   He liked the character played by Niall Tobin.   [= b.]

x_1: Charles Haughey

x_2: The man shopping in Dunnes Stores

y_1: Niall Tobin

x_3: Charles Haughey

A single connector can also produce more than one counterpart per element. For example, if Vincent Brown doesn't know that his new neighbour is Eamonn Dunphy, one element in R (a = Dunphy = Brown's new neighbour) has two counterparts in M (SB_M = Vincent Brown thinks). We assume that the following hold:

(47) a'_1 lives in CloudRadioLand ("Vincent Brown thinks Eamonn Dunphy lives in CloudRadioLand")

        a. a'_2 makes too much noise ("Vincent Brown thinks his new neighbour makes too much noise")

The following utterances can be true under the interpretation in which the ID Principle applies to the single trigger a and to either one of the targets a'_1, a'_2.

(48)   a: Dunphy, a'_1: Dunphy

Browns new neighbour

a'_2: Brown's new neighbour

        a. Vincent Brown thinks Eamonn Dunphy makes too much noise.

        b. Vincent Brown thinks his new neighbour lives in CloudRadioLand.

2.11 Multiple Descriptions

An example of multiple descriptions can be seen from the example given by Fauconnier relating to a dancing competition for women, at which a speaker makes the utterance:

(49)   The winner will get a new toaster, but George thinks she will go to Hong

 Kong.

We can read this to take *the winner* as identifying someone in R and *she* as identifying its counterpart in the space "George thinks". However, if we suppose that the winner has just been announced and that the speaker and George disagree about who won: for the speaker it's Rose and for George it's Olive. If we allow Olive to have red hair and Rose to have blond hair, and George and the speaker to agree on this, then the speaker can truthfully say:

(50)   George thinks *the winner* has red hair.
(51)   *The winner* is blond, but George thinks *she's* a redhead.

We can easily see that there is an over-abundance of counterparts but only one connector linking R to M ("George thinks").

2.12 Roles

Earlier we took noun phrases to point to elements (objects, individuals, etc.) and examined this in the context of the ID Principle, and the Indefinite Interpretation and Definite Interpretation Principles. However, definite descriptions have many features which suggest a treatment in terms of functions ("roles") rather than in terms of direct reference (Fauconnier 1988). We can notice this from some examples.

(52)   The president changes every seven years.
(53)   Your car is always different.

In these examples, the noun phrase refers to a single element. For example, the person who happens to be president (Mary Robinson) changes every seven years (becomes weary, bored, grey or insane). Equally we can say that there a reading which involves a variable denotation for the noun phrase: there is a new president every seven years. The readings cannot be taken as generic or universal. There is no universally qualified equivalent:

(54) ≠ ∀x , x = president • x changes every seven years

Compare:

(55) ∀x , x = president • x lives in Áras an Uachtarán

This data confirms an approach by which definite descriptions are primarily role functions and secondarily the values taken by such roles. The <u>domain</u> of the role may include times, places, situations, contexts, etc. Its <u>range</u> will consist of elements having the particular property "N" indicated by *the* N, in the corresponding setting.

Intuitively this should not present any problem, if we look "behind" the notation and terminology. We all know and understand that the president changes at the end of term of office, that they change as people during that seven years. The president, as a role, will be different in different countries at different times. The president of the USA, for instance, has certain executive powers according to that particular definition of the role, whereas the president of Ireland does not have identical powers.

Quantification contexts highlight the functional value of a definite description and the multiple values at hand:

(56) Every man build himself a house. In Lowry's case, *the house* was a two-story Georgian brick structure. In Ben's case, *the house* was a neo-classical design; in most cases, *the house* was conceived for five to eight people.

The <u>role</u> *the house* takes the men as its <u>domain</u> and the houses built as its <u>range</u>. By specifying sub-domains, expressions like *in Ben's case* assign the corresponding role value to the definite description, i.e. "the house built by Ben".

Returning to the presidential examples, *the president* corresponds to a role, the first reading (= Mary McAleese) gives us a property of the value of that role in some particular context, and the second reading delivers a property of the role itself.

Therefore let:

(57)   P represent the prediction involved ("___ changes every seven years")

r represent the definite description role function ("the president")

m represent the relevant contextual parameters in the domain of *r*

(time, place, etc.)

Linguistic forms will be found to correspond to two fundamental readings:

(58)   a   P(r)   the property of a role.

b.   p($r(m)$) the property of a value of that role.

Where:

($r(m)$) is the value of role r for the contextual parameters *m*).

A unified view suggests itself. The elements we have discussed up to now have had a fixed identity, but their other properties can change. Roles are also elements, but such that identity, or role value, can change, while one particular property (i.e. president) is fixed. For such elements, identity is a variable property. This view has the advantage of giving a unified analysis of verbs like *change*: if "X" changes" entails that some property of X is added, or modified, then that property can be identity in the case of roles, but will be a property other than identity for values. The fact that a linguistic description may identify a role or its value may itself be considered a case of transferred trigger reference, since the link between a role and its value for some setting of parameter m is itself a pragmatic function, F:

(59)   F(m,r) = $r(m)$

Mental spaces belong to the domains of role functions. A role, perhaps in the form of a definite description such as *the president*, will take on different values in different spaces, and these values need not be images of one another. Typical space-building utterances have the structure:

(60) M[P(a)]

Where:

P is a property,

M, corresponding to the linguistic space-builder SB_M, indicates that the

property holds in space M.

a is an element.

If *a* is in R, then P holds of the counterpart of a in M, F(*a*).

If *a* is in M then P holds of *a*.

Therefore, if *a* is in R,

then $M[P(a)]$ expresses that *a*'s counterpart in M has property P.

This itself is a property of *a*

- to have a counterpart in M with property P (= property $M\,{}^oP$)

This equivalence follows from the ID Principle and can be expressed as:

(61)   Property Equivalence Theorem

   If   F is the relevant connector linking space M and its parent space R, and

      a is an element of R,

   then

      $M[P(a)] \leftrightarrow P[F(a)]$

   or,

      $M\,{}^oP(a) \leftrightarrow P[F(a)]$

   Where:

   "$M\,{}^oP$" is the property of having a counterpart in space M with property P.

Under the Indefinite Interpretation Principle, the indefinite article was taken to be simply an explicit means of introducing new elements in spaces. When combined with the standard properties of trigger-target configurations, it accounted directly for the basic scope properties of indefinites. Data examined later made it apparent that the space elements include not only individuals but also roles, and furthermore that a linguistic description may identify a function or its value. Indefinite descriptions are similar in this respect to definite ones in that they can set up roles as new elements and identify the role itself, or its value, in some space.


2.13 Names and Roles

The meaning of a definite description explicitly indicates a corresponding role (president, man shopping in Dunnes Stores, etc.). A proper name does not, unless specific pragmatic conventions apply. If there happens to be such conventions in force, then the corresponding proper names will behave like other roles. There is a very interesting analogy between the way we talk about situations in general and the way in which we talk about "theatrical" situations (plays, films, make-believe, etc.) Such situations have been assumed to have two spaces. However, a complete theatrical situation can involve at least four spaces.

(62)   a. The origin R, which includes the actors in their real. everyday life and, if
the play is non-fictional, some of the real people that the play is meant to
represent.

        b. The "play", for example as written by the author (with characters,
events, dialogues, etc. unspecified as to which actors will play the parts. We can
call this space Pl.

        c. The "performance", Pe, as viewed by the audience, with real people on
stage who "are" the characters of Pl and say and do what these characters say and
do (in Pl).

        d. The "real" situation on stage - what the actors, as persons of R, are doing.
This is a subspace of R, T.

All the connectors are image ("identity") connectors except for F_d which links Pe to T and
what Fauconnier calls a *drama connector*. If we make the assumption that Ingrid Bergman is
playing the part of Golda Meir in a biographical play, we can arrive at the corresponding
space configuration diagram:

(63)

name Golda Meir: a, b, c
name Ingrid Bergman: d, e

$T (\subset R)$
(situation involving real
 people putting on a show)
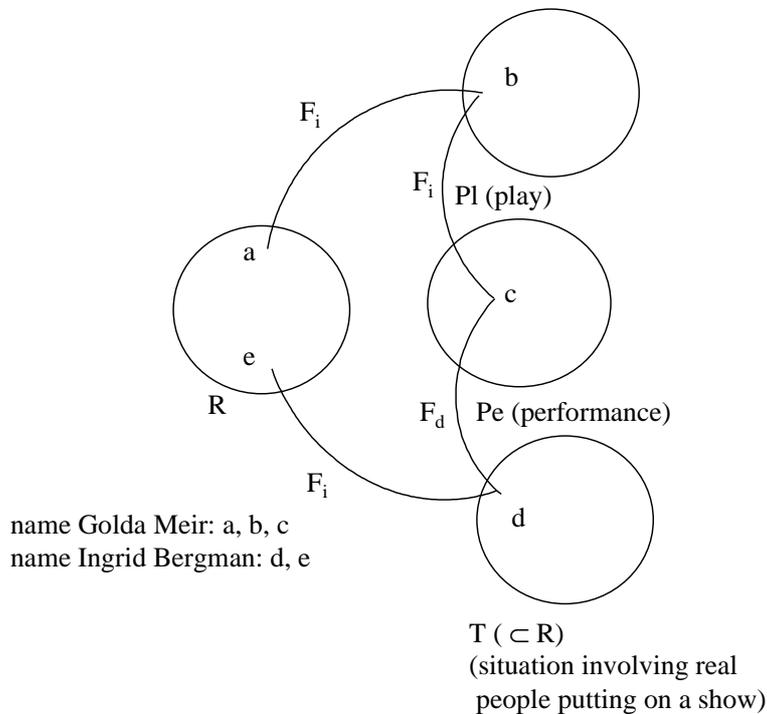
Fauconnier makes some useful mention of the connection between spaces in the linguistic
sense and frames. Actions and situations are framed in various "realms of being", such as

make-believe, ritual, contests, dramas, and "everyday life". The same objective events could take on different meanings depending on the frame (which allows for fabrication, deceptions, jokes, theatre, etc.). One may differentiate frames in speech by constructing corresponding frames: "they are pretending to fight", "they are not really fighting". By choosing descriptions of an object or event that are good in one frame but not in another, one may select a certain frame, switch frames, or mix them.

A frequent method of reporting, or political speech, consists in using the ID Principle to give, in one frame for some event or action, a description satisfied in another frame. Fauconnier (1994), quoting a passage by Goodman (1974), elegantly illustrates the role and frame ambiguities with respect to the theatrical audience: *"The difference between theatregoers and onlooker is nicely illustrated in regard to laughter, demonstrating again the need to be very clear about the syntax of response. Laughter by members of the audience in sympathetic response to an effective bit of buffoonery by a staged character is clearly distinguished on both sides of the stage line from audience laughter that can greet an actor who flubs, trips, or breaks up in some unscripted way. In the first case the individual laughs as onlooker, in the second as theatregoer... And, of course, both kinds of laughter are radically from the kind enacted by a character; that kind of laughter is heard officially by the other characters."*

This type of situation can of course be clearly noticed during comedy sessions with stand-up comics. In particular, the local (and loud and lewd) comedian Brendan Carroll exhibits all of the qualities mentioned in the quoted passage, but in a controlled way as part of his act. Related to comedy but in a different context, such events are captured (typically as "classic movie moments") and viewed on television as "movie out-takes" where the incidents shown can in fact be quite funny. In a TV program such as Fr. Ted, it may actually be difficult to distinguish between what was intended and what actually happened on set. This suggests that mental spaces provide a linguistic and cognitive means for setting up and distinguishing frames.

2.14 Presupposition

There is, as Fauconnier (1994) notes, no agreement among presuppositionists with regard to any precise definitional characterisation of presupposition, and indeed given such characterisations, where proposed, have so far proven inadequate. What is surprising, however, is that there is a widespread consensus about which grammatical constructions are

relevant in regard to the projection problem. Fauconnier (1994) outlines three main approaches to the projection problem, that is, the problem of determining the presuppositions of complex sentences on the basic of the presuppositions of simple ones. The approaches are:

(64)   a. The **combinatorial approach** seeks to provide explicit algorithms for
            computing presuppositions of complex constructions on the basis of the simple
            clause presuppositions and projection properties of the higher verbs, connectives,
            adverbs, etc. of the complex construction.

        b. The **cancellation approach** defines potential presuppositions grammatically and
            allows them to emerge as actual presuppositions, but only if they are not
            superseded by an incompatible implicature or implication.

        c. **Procedural approaches** view discourse as "creating" worlds to which
            presuppositions attach. Here the projection problem amounts to determining
            which presuppositions are transferred to the "actual" world.

The mental space approach of Fauconnier is essentially procedural. From his perspective, "*the combinatorial or cancellation methods, although sometimes descriptively adequate, are at best artefacts of a misconceived conceptualisation of presuppositional phenomena.*" The main feature of his analysis is that it sets up hardly any principles meant to deal specifically with presupposition. The strategic principles are general.

An utterance can be considered to consist of both a space-builder SB_M and a "propositional" part which we will denote as *Prop*. We divide *Prop* into an asserted part A and a presupposed part P. A and P express that certain relations hold between certain elements in the spaces. We say that Q (=Q'(a, b, c, ...)) is satisfied in space H if the relation Q' holds of the counterparts of a, b, c, ... in space H. The notation is:

(65)   Q/H   Q is satisfied in space H
        ~Q/H   Q is not satisfied in space H

We say the Q is determined in space H if it is either satisfied or not satisfied, even thought the actual value may not be accessible at that point in the discourse.

(66)   Q!H   Q is determined in H

Q is *undetermined* in H if it not determined in H, that is, if Q and ~Q are both possible with respect to H.

(67)   Q?H   Q is undetermined in H

Given an utterance and calling R the parent space for M, the following rules operate:

(68)   Rules

    a. R_1: A/M   ("asserted part A is satisfied in space M")

    b. R_2: P/M   ("presupposed part P is satisfied in space M")

    c. R_3: P/R   ("presupposed part P is satisfied in parent space R")

    d. *optional*   (R3 applied only as part of strategy SP_2)

(69)   Definition

    D_1:   If Q/M is established at discourse time *t*, then the accessible consequences of Q are *explicit presuppositions in* M after *t.*

(70)   Strategic Principles

    a. SP_1:   Avoid contradiction within a space (e.g. avoid Q/H and ~Q/H).

    b. SP_2:   Structure space M and its parent space R as closely as possible with respect to background assumptions and *implicit* presuppositions.

    c. (SP_1 has precedence over SP_2)

(71)   Obvious Corollaries

    a. C_1: If P/R then P/R, M   (by R_2)

    b. C_2: If ~P/R, then do not apply R_3 (by SP_1)

    c. C_3: If P!R, then apply R_3 (by SP_2)

    d. (i.e. assume P satisfied in R to maximise implicit presupposition correlation)

    e. C_4: If P?R, then do not apply R_3 (by SP_1)

    f. (because P?R implies the possibility of ~p in R and so is incompatible with P)

Informally, D_1 defines an explicit presupposition in M at discourse time *t* as background information established before *t*. An implicit presupposition (at *t* in M) is that of a presupposition set up in M at *t* by virtue of some grammatical construction, and not established in M independently before *t*.

For example, in a discourse that starts at *t* with *Harry believes my car is red* (SB_M = Harry believes ____), "I have a car" is an implicit presupposition in M at *t*. In a discourse that starts at time t_0 with *Harry believes I have a car*, "I have a car" is an explicit presupposition in M at *t* later that t_0. Notice that implicit presuppositions established in M at t_i are explicit presuppositions in M at any time after t_i.

The general character of these principles is such that R_1 and R_2 simply follow from the general definition of space-builders that "*Prop* holds in space M". D_1 corresponds to the "intuition" that new information once expressed becomes old information. SP_1 (non-contradiction) is demoted from "law" to discourse strategy, since contradictory spaces cannot be ruled out, e.g. contradictory beliefs, desires, etc., may be reported. SP_2 is a general strategy for "filling in" spaces. In fiction beliefs etc., we typically take the world to be as we know it unless explicitly specified otherwise. SP_2 plays an important role in the analysis of counterfactuals. The only rule that specifically and technically applies to presupposition is the optional rule R_3, allowing grammatical presupposition (as opposed to assertions) to be attached to more than one space by a single utterance. R_3 is furthermore taken to apply recursively. If R itself has a parent space R', then P/R' *optionally*, subject to D_1, SP_1, SP_2.

The standard projection problem of whether a complex sentence inherits the presuppositions of its simple parts amounts in procedural terms to whether a presupposition satisfied in M can, or must, be satisfied in parent space R. There is a very general strategy for filling in spaces, characterised as Space Optimisation.

(72) Space Optimisation

When a daughter space M is set up within a parent space R, structure M implicitly so as to maximise similarity within R. In particular, in the absence of explicit contrary stipulation, assume that:

a. elements in R have counterparts in M,

b. the relations holding in R hold for the counterparts in M and

c. background assumptions in R hold in M.

The effect of the Space Optimisation is that when an "if" space "If S, ____" is set up within a parent space R, the background assumptions and explicit relations satisfied in R can be assumed to hold in the "if" space M, insofar as they are compatible with S. Looking at some test cases:

(73) a. Maybe

Maybe is a space-builder that sets up a possibility space M within R.

     b. If S then ___.

If S is a space-builder that sets up a space M in which S is satisfied.

     c. Either ____ or ____

Either S_1 or S_2 is a "double" space-builder. It sets up two possible spaces at once, M_1 and M_2. In M_1, S_1 is satisfied. In M_2, S_2 is satisfied. Both spaces, M_1 and M_2 are compatible with parent space R.

     d. Believe, Hope

Some spaces are linked in special ways. For instance, one's hopes depend on ones beliefs. Call the space upon which another depends its mentor. Space Optimisation applies to spaces and their mentors.

     e. Factives

Factives are viewed as strong presupposition triggers, i.e. words like *regret*.

     f. Possible

Possible is a space-builder. In discourse, a second occurrence of possible can refer back to the first possibility space, or it may set up a second possibility space different from the first.

     g. Negation

Negatives set up corresponding counterfactual spaces in which the positive version of the sentence is satisfied.

The unifying semantic property of presuppositions is that they are able to *float* from space to space under optimisation strategies. From this perspective, the standard "projection" problem is just one special case of floating. The obvious question to ask is: under what circumstances do presuppositions introduced into "lower" spaces float all the way up to the parent space R for the entire utterance. Implicit presuppositions float up until or unless they are blocked by incompatibility in a higher space (SP_2 followed by SP_1).

From the viewpoint of Fauconnier's mental space theory, presuppositions are linguistically efficient because through SP_2 they allow for a quick (implicit) filling in of spaces. They are often difficult in the sense of making the hearer feel they are already know something which is given, and therefore not in a position to refute, or question, in any way.

2.16 Counterfactuals

Counterfactuality is a case of forced incompatibility between spaces. A space M_1 is incompatible with another space M_2 if some relation explicitly in M_1 is not satisfied for the corresponding elements in M_2. Counterfactuality may be lexically imposed, as it is for "strong" negatives such as *not* and *prevent*. The strong lexical entailment automatically cancels the optimisation implicature, without *buts* or *although's*.

(74)   If men had wings, they would fly

The are two dimensions of counterfactuality. The first is the lexical dimension, on which negatives are strongest, followed by verbs like *wish*, which is typically counterfactual. Lower on the lexical dimension we find conditionals (*If ____*) and modals like *could, might*. These space-builders impose counterfactuality in some grammatical constructions, suggest it in others, and also set up ordinary, non-counterfactual hypothetical situations.

The second formal dimension along which counterfactuality varies is grammatical. In cases where the time reference is past, the weak and strong counterfactual readings merge for purely grammatical reasons. The same phenomena occur with modals.

2.17 Transspatial Operators

Many verbs establish relations within spaces. Others, such as *believe, paint, look for, wish*, set up new spaces. The verb, or copula, *be* has special properties. It can be used very generally to link a trigger and its target, when the relevant pragmatic function is known:

(75)   a.   Plato is the red book; Homer is the black book.

(connector: "writers $\rightarrow$ books")

b.   The gastric ulcer is Keith Richards

(connector: "illnesses $\rightarrow$ patients" (in a hospital))

c.   We are the first house on the right.

(connector: "people $\rightarrow$ houses they live in")

A pragmatic function can operate within a space (extended metonymy), as in the examples above. In this case *be* stands grammatically for the metonymic link. A pragmatic function(connector) can also operate from one space to another. In this case, *be* links elements that are counterparts in different spaces, as in the two examples following:

(76)   a.   In that picture, Lisa is the girl with the blue eyes.

              (Image connector: "models → representations")

       b.   In that movie, Cleopatra is Liz Taylor.

              (Drama connector: "characters → actors")

Consider conditionals, "If A, then B". We have seen that they set up a hypothetical space H in which the relations expressed by A, and by B, are satisfied. As it stands, this formulation is not sufficient in some cases involving the copula *be*.

(77)   If <u>Jerry was Napoleon,</u> <u>he wouldn't make so many mistakes</u>
            | |
            A   B

The counterpart of element a (Jerry) of space R is element a' (Napoleon) of hypothetical space H. If A expressed an internal relation within space H, its noun phrases would identify elements of H, possibly via the ID Principle. Napoleon identifies a' directly, Jerry points to a and identifies its counterpart a'. The relation expressed by A would be "a is a' ", which is a tautology! However, A does not express a relation within H as described in the previous paragraph. It sets up the link between a and a', that is, between an element of R and an element of H. This is the sense in which *be* is transspatial. When the pragmatic connector is known, *be* can be used to link elements of different spaces. The transspatial property of *be* can be formulated as follows:

(78)   Given a configuration SB_M S

        where

                SB_M is a space-builder

        and   S a grammatical clause of the form S = NP1 be NP2

        and   given the connector F linking space M to its parent space R,

                if   NP1 (or NP2) points to *a* in R

                and   NP2 (or NP1) points to *a'* in M,

                then   S may express that *a' in M is the counterpart of a in R*, that is , *a'* = F(*a*).

In other words, even thought a simple clause usually established relations within a space, those of the form NP be NP may establish a counterpart relation between elements of

different spaces. As opposed to many other verbs, *be* may express transspatial links. This is a consequence of its general metonymic function and of the metonymic nature of pragmatic connectors in general, and of interspatial ones in particular.

In the same configurations, there is another interpretation of *be* that is not transspatial. Earlier we saw that the link between a role and its value is itself a pragmatic function (a connector) F, defined as follows:

(79)   F(m,r) = $r(m)$

>   where *m* represents the relevant contextual parameters and
>   the space in which *r* takes its value.

There is a metonymic link between a role and its value and this link can be expressed grammatically with the copula *be*:

(80)   Eamonn *is* my brother.
         | |
          a → r
         value   role

(81)   Mary *is* the queen of Scotland
         | |
          a ← r

         The winner *is* John Doe
         | |
          r → a

The pragmatic function F, which *be* stands for, is :

(82)   "the attribution of a value to a role", →.

This means that there will be configurations in which:

(83) SB_M S   with S = NP_1 be NP_2
         where
                 S will express a relation internal to space M, namely the
         attribution of a value to a role, and not a transspatial link.

The copula *be* can explicitly link two elements of different spaces. Other verbs or verbal expressions also operate on several spaces, but start with only one element and one effect of this is to set up for this element of space M, a counterpart in space M'.

An example of this type of verb is *exists*, as in *the house exists on paper*. Another series of verbs has the effect of copying the relations or elements from the speakers reality R to the reality space of the grammatical subject if the verb R_s. The verb *find* is yet again another interesting case. Find involves two spaces: reality with objects, relations etc "versus" the perception space of the subject, R_s, which may correspond to what the person can see, touch, apprehend, understand etc.

3. The Many Space Model

More recently, Fauconnier has developed the ideas behind Mental Spaces Theory and enriched it by positing the existence of not just two spaces, but many spaces. Conceptual projection from one mental space to another involves projection to middle spaces. These are abstract "generic" middle spaces or richer "blended" spaces. In his words, (Fauconnier and Turner 1994), "*Projection to a middle space is a general cognitive process, operating uniformly at different levels of abstraction and under superficially divergent contextual circumstances. Middle spaces are indispensable sites for central mental and linguistic work*". The process of blending is viewed in this new expanded theory as a fundamental and general cognitive process, running over many, and possibly all, cognitive phenomena, including categorisation, hypothesis making, inference, the origin and combining of grammatical constructions, analogy, metaphor and compounding (Fauconnier 1995). Blending is a prerequisite to these phenomena.

A guiding idea within the cognitive sciences, including cognitive linguistics, is that the same cognitive principles apply generally within all people over different cognitive processes and functions. An important finding has been that key notions, principles, and analyses are valid across all of the cognitive sciences from psychology to linguistics, including, of course, many domains which are non-linguistic. Some of these ideas are:

(84) a. Frames
      b. Analogical mapping
   c. Reference points, focus and viewpoints
      d. Connected mental spaces

e. Connectors and conceptual connections
f. Figure and ground organisation
g. Profiling
h. Pragmatic scales

Fauconnier places his new theory of mental and middle spaces in this context as it is held to operate uniformly at different levels of abstraction. The general process is that of the conceptual projection of two mental spaces into a third, "middle" spaces giving rise to either a more abstract "generic" space or to a richer "blended" space. The cognitive importance of middle spaces allows him to propose a generalised four-space model of conceptual projection that subsumes a variety of analogical and metaphorical mappings. Blending is motivated independently of metaphor and analogy, and is not restricted to language phenomena.

The projection of conceptual structure is an essential instrument of thought. All conceptual projections involve middle spaces that are indispensable sites for central mental and linguistic work. The existence of these middle spaces entails that conceptual projection is not direct, except perhaps as a limiting case within the full range of cognitive possibilities. Middle spaces provide key inferences not derivable in metaphoric source or target but can project to source or target.

In the model, a conceptual projection occurs, two mental spaces are set up, one for a source and one for a target. Such spaces do not represent entire domains, but represent relevant partial structure, as highlighted from, say, a particular point of view. As with mental spaces in general, these may inherit additional structures by default from context, culture and background. There will be a projection from source to target and the mental spaces will be linked by counterpart functions. Middle spaces will be constructed. The more abstract is called GENERIC and reflects the roles, frames, and schemas common to the source and target spaces. A fourth type of space called BLEND is also available which gives the impression of richer, often counterfactual or seemingly "impossible" structure. The process of blending follows a logic but its output cannot be predicted because subjects avail of a broad range of knowledge in the process and because the blend routinely contains emergent structure not simply inherited from either input concept. Middle spaces also fall on a gradient, with the most abstract generics at one end and the richest blends at the other. The four-space model briefly described is simply an instantiation of a more general many space, or n-space, model.

(85)
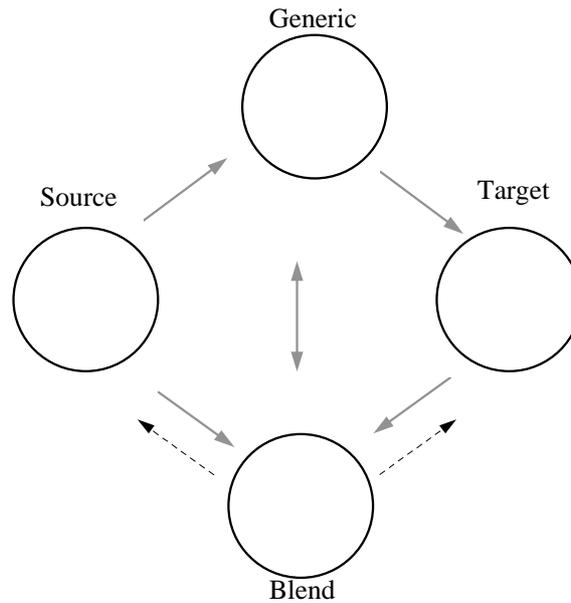
In conventional projection a certain amount of abstract information is projected from the source to a generic space and then from the generic space to the target. Such a generic space is available to be projected to a great range of different target spaces. This mental process of projecting "skeletal" information to a generic space, which is then available for infinitely many projections to specific target domains is, for instance, the standard procedure, of Fauconnier and Turner (1994), for interpreting proverbs. Lakoff (1987) makes use of a generic space to understand the structure and behaviour of the metaphor GENERIC IS SPECIFIC. These generic spaces are one kind of middle space. The blended space contains the generic space projected from the source and contains additional specific information from the source and target. Blending is pervasive to all modes of thinking (and talking) and while not tied specifically to language appears to be a phenomenon of cognition. Blends can be constructed if there is abstract structure shared by the two input spaces. This abstract structure is found in the fourth space, the generic space. The construction of blended spaces has the following characteristics:

(86)   a. Mental spaces, in general, only have very partial explicit structure that typically includes roles, values and relations.

        a. To blend two spaces is to project them onto a third space, also partially structured, in such a way that the first two partial structures map coherently onto the third.

        b. A blend is neither a union nor a blur. It is a space structured in its own right, onto which the two initial spaces are projected. The blended space typically has structure absent from the input and generic spaces.

c. A blended space may (or may not) give rise to a new conceptual domain.

d. A blended space may be used for local cognitive purposes only, or it may lead to more permanent re-conceptualisation and category extension.

Conceptual projection enables us to extend categories to cover new provisional members. The blended space that develops during such a projection merges the original category with its new extension. When categories are extended permanently, it is the structure of this blend that defines the new category structure.

Fauconnier and Turner (1994) make the interesting point in support of their arguments that the history of science, mathematics and physics is rich is conceptual shifts and that it is usual for us to speak of (new) models replacing or extending previous models. In support of the notion that blended spaces are not just a phenomena visible through language, they consider the example of the stage of mathematical conceptual development at which complex numbers, in some sense, became respectable. The square roots of negative numbers had shown up in formulas of 16th century mathematicians and the operation of these numbers had been correctly formulated but these same mathematicians (including Descartes) were of the opinion that they were "useless" or "imaginary". Leibniz said no harm would come from using them! Euler thought them impossible but possibly useful (and even fun).

The square roots of negative numbers has the strange property of lending themselves to formal manipulations without fitting into a mathematical conceptual system. A genuine concept of complex numbers took time to develop and the development took the lines of analogical connections and blending. It was eventually observed that if negative numbers could be mapped onto a directed line, complex numbers could be mapped onto points in a two-dimensional plane. Geometrical constructions were devised for standard quadratic equations (of the form $ax^2 + bx + c = 0$). This is a standard case of extending analogical connections. Geometric space is a source domain partially mapped onto the target of numbers. The mapping from a single axis is extended to mapping from the whole plane. Some geometric constructions are mapped onto operations on numbers. For many years this insight was ignored. It shows that mapping a coherent source onto a conceptually incoherent target is not enough to give the target new conceptual structure. It also follows that coherent abstract structure is not enough to produce satisfactory conceptual structure. The source metric geometry provided abstract schemas for a unified interpretation of real and imaginary numbers, but this was insufficiently cognitively for mathematicians to revise their target domain accordingly.

A similar process can be observed today in the light of discoveries in physics. The three dimension physical world that we inhabit is considered by all theoretical physicists as a "convenient fiction" or folk theory. While the jury is still out on the actual numbers of dimensions in existence and in use within contemporary models in physics, it is very definitely now an *n*-dimensional space, where *n* is quite a large number (Michio Kaku 1995). The only way to understand these sophisticated models is, or must be, by a process of conceptual blending.

In the analysis developed in relation to complex numbers, the novel conceptual structure in the mathematical case of numbers is first established within a middle blended space. In the blend, but not in the original source and target, it is possible for an element to be simultaneously a number and a geometric point, with Cartesian co-ordinates (a ,b) and polar co-ordinates (r, q). In the blend, they hold general properties of numbers, such as:

(87) $(a, b) + (a' + b')$ = $(a + a', b + b')$

$(\rho, \theta) \times (\rho', \theta')$ = $(\rho\rho', \theta + \theta')$

Every number in this extended sense has a real part, an imaginary part, an argument and a magnitude. By virtue of the link of the blend to the source (two-dimensional plane), the numbers can be manipulated geometrically. By virtue of the link of the blend to the target (real numbers), the new numbers in the blend are immediately conceptualised as an extension of the old numbers, which they include, by way of the mapping. The mapping from points on a line to numbers has been extended to a mapping from points in a plane to numbers. This mapping is partial from source to target. Only one line of the plane is mapped onto the numbers of the target domain. It is total from source to blend. All the points of the plane have counterpart complex numbers.

When a rich blended space of this sort is built, an abstract generic space will come along with it. Having the three spaces containing points (source), numbers (target), complex numbers/point (blend) entails a fourth space with abstract elements having the properties "common" to the points and numbers. The relevant abstract notions in this case are those of the "operations" on the pairs of elements. For numbers, the specific operations (in the target domain) are addition and multiplication. For points in the plane, the operations are vector transformations and include vector addition and vector composition by adding angles and multiplying magnitudes. In the blended space of complex numbers, vector addition and

number addition are the same operation because they deliver the same result. Vector transformation and number multiplication are conceptually a single operation. Such an operation can, however, be instantiated algorithmically in different ways depending on which geometric blend and algebraic properties of the blend are exploited.

In the generic space, specific geometric or number properties are absent. All that is left is the more abstract notion of two operations on pairs of elements, such that each operation is associative, commutative, and has an identity element; each element has under each operation an inverse element; and one of the two operations is distributive, with respect to the other. This structure is called a "commutative ring" by mathematicians. The evolution and extension of the concept of number includes a four-space stage at which the concept of complex number is constructed in a blended middle-space, on the basis of a generic middle space structured as a commutative ring.

The abstract and mathematical example of complex numbers is only different in a superficial manner from other phenomena such as discourse, metaphors or jokes, and confirms that we are dealing with an aspect of thought that is not purely linguistic or verbal. It highlights the deep difference between naming and conceptualising (adding expressions like $\sqrt{-1}$ to the target domain of numbers, and calling them numbers, is not enough to make them numbers conceptually, even when they fit a consistent source model). The example of a boat race is also used by Fauconnier and Turner (1994):

(88)   *As we went to press, Rich Wilson and Bill Biewenga were barely maintaining a 4.5 day lead over the ghost of the clipper Northern Light, whose record run from San Francisco to Boston they're trying to beat. In 1853, the clipper made the passage in 76 days, 8 hours. - "Great America II. " [Latitude 38,* volume 190, April 1993: p100.]

In this example a comparison is made with the performance of a boat racing in 1993 and one, in 1853, which took the same route. In this particular example, the blended spaces inherits the dates of 1993 and the 1853 race days are mapped onto corresponding 1993 days by using a date role (d_1) for the first, i.e. in the blend, the two boats are assumed to start together on the first day of the 1993 passage. Notice that this appears to be an instance of foregrounding in that the 1993 structure is more "prominent". The boats in the blend retain their characteristics (clipper as 1853 boat, catamaran as the actual 1993 boat). Positions and days for each boat are then mapped: identity for the catamaran, sequence from day 1 for the clipper.

The two boats were counterparts with respect to the generic framing, but they are no longer with respect to the blend. At the same time, the blend fits the generic in a many-to-one map. New relational structure is created automatically by the projection. There are "now" relative positions between the two moving boats, distance between them at any point, difference in time to reach the same position, etc. The additional structure is not specified in the blend itself. It just follows topologically from that projection. The next step is to fit the blended structure into the pre-existing cognitive model. In the boat race example, the blended structure does not contain any notion of "race", but it fits the richer "race" model which we are familiar with, of two or more moving vehicles driven by people and moving in the same path with the same goal.

The generic space is a structural intersection of the input spaces but the blend creates new structure by allowing counterparts to be mapped to distinct elements, with distinct attributes, and by allowing importation of specific structures in the inputs. The key constraint is that we don't just have a union of the input spaces; only selected structure in the inputs is exported to the blend, but the overall projection will contain more structure than is available from the inputs. The "whole" that we find in the blend is therefore greater and smaller than the sum of the "parts". Through projection of partial structures, and embedding into background frames, we get a novel structure which is not compositionally derived from the inputs.

We can perhaps *simply* look at blending in the following manner as denoted in the diagram below, which makes use of the terminology and notation of sets. The generic set/space is populated with what is common to both input sets/spaces. The blended set/space is populated with what is unique in each of the input sets. The generic set/space provides the background context to the blended set/space and, as such, becomes an enriching input to it. Such spaces are now available as potential inputs to other sets/spaces to provide additional layers of meaning, or frames of context reference(s), as required.

The creative power of conceptual blends lies in this ability. New actions, new concepts, new emotions and understandings emerge. Margaret Boden, the eminent cognitive/computational psychologist and AI researcher, attempts in her work "The Creative Mind", to understand human creativity and makes the point that creativity involves the exploration of conceptual spaces in the mind. She describes these spaces in her own terms and discusses ways of transforming them to produce new ones. In support of her argument she quotes a very apt and interesting passage from Koestler (1990): "*the moment of truth, the sudden emergence of a*

new insight, is an act of intuition. Such intuitions give the appearance of miraculous flashes, or short-circuits of reasoning. In fact they may be likened to an immersed chain, of which only the beginning and the end are visible above the surface of consciousness. The diver vanishes at one end of the chain and comes up at the other end, guided by invisible links."

(89)
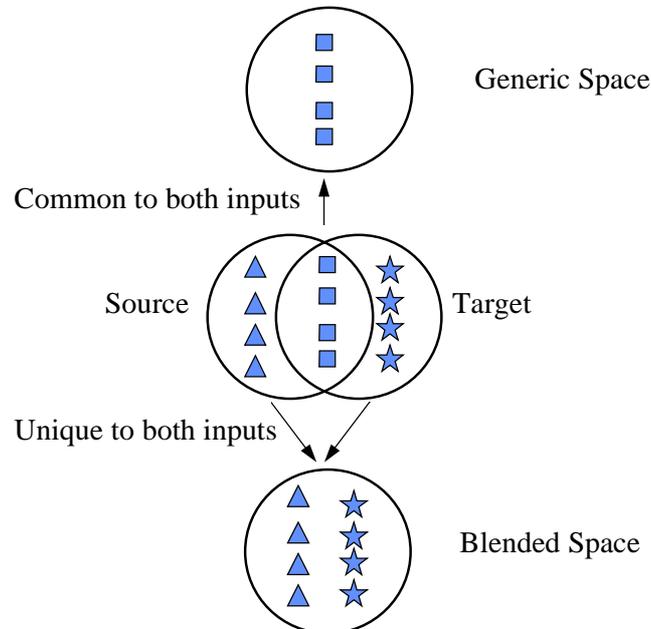
It may be that our creative ability is linked in some way to our ability to create multiple blended mental spaces. With respect to grammar, Fauconnier holds that the same formal merging operations show up at the more schematic level of blended grammatical constructions and functional assemblies. The full interpretation of any sentence in a particular context is a sequence of successive blends meeting more and more specific local constraints. Blending is a general phenomenon that traverses all varieties of cognition. In a manner similar to categorisation, inference, metaphor and hypothesis making, blending is routinely employed. These phenomena depend on the existence of the general cognitive for blending.

Additional evidence for conceptual blending into a blended space can be taken from a variety of sources. Fauconnier suggests that important cognitive work is performed in middle spaces, generic and blended spaces. A blended space had its own structure and organisation, not reducible to an amalgamation of structure from the source and target. Blending could manifest itself in many ways, verbal or non-verbal, imaged or hidden from consciousness, in poetic invention, everyday language, or scientific enquiry. We have already had examples of conceptual blending in the realm of mathematics. Literary examples abound also. A

particularly rich literary example is to be found throughout the work of Tolkien in which, having invented "Middle Earth", he proceeded to develop its language, history, peoples and cultures. His readers are invited to enter literary conceptual spaces, and do so willingly to great reward. Works such as Tolkien's, jokes, poetry or idioms often provide useful data for analysis because they make certain cognitive processes highly visible.

Fauconnier and Turner (1994) discuss metaphor, personification and category extension in terms of mental and blended spaces. While it interesting to read and understand these analysis for the insights they deliver to these phenomena, it occurs to me that they may actually be missing something fairly important. Lakoff (1987) uses the idea of an Invariance Principle to guide the structural compabilities of connecting source and target metaphors under the TARGET IS SOURCE metaphor. To use a metaphor to explain the operation of this principle, the Invariance Principle guides the correct (structural) plug to the correct socket. This is all very well and necessary, but Lakoff devotes not a lot of time to explain how it actually works beyond explaining why it is needed. The many space model may provide the technology to explain how the Invariance Principle actually works, through its use of generic and blended spaces. The operation of the many space model may actually be the operation of the Invariance Principle. We can see a clue to this by considering the utilisation of the metaphor used by Lakoff (1987) to enrich his theory of metaphor: GENERIC IS SPECIFIC. The topology of this simple, but rich, metaphor can be reflected very easily within the many spaces model. The generic space, of course, is available to be applied to an infinite number of specific targets, within the sense of the metaphor.

What is also interesting about the many space model, is its use of many spaces. This may sound trite but it is actually a valuable enrichment to the two-space mental space model of Fauconnier's earlier work, which serves to make it more accessible and more plausible. The many-spaces provided for within the model, as available working spaces, also creates a striking resonance when one considers the current thinking on mental representation and more particularly, the facts concerning the distribution of cognitive memory within cognitive psychology. In, for instance, the work of Eysenck and Keane (1996), memory is held to be broadly distributed by type and function. The idea of memory as a big block no longer holds. Memory, particularly short term or episodic memory, is more accurately considered as working buffers spaces. At this level, this idea of memory as buffered working spaces is almost isomorphic with the use of generic and blended working spaces within the many spaces model. There may potentially be a point of connection here, between the two domains of cognitive studies.

As we have seen the conceptual projection scheme that is considered by Fauconnier and Turner (1994) involves a dynamic construction of multiple spaces: source, target, middle including generic and blended. In the full scheme of the model, everything is maximally differentiated and activated. From this general schema, typical sub-schemas can be derived by considering special or limiting cases. The parameters that need to be considered are:

(90)   a.   The number and type of spaces involved.

            b.   The degree to which the space is active as a working space.

            c.   The degree of blending and of abstraction.

            d.   The vocabulary transfer.

            e.   The category relationship between source and target, and the potential for category extension triggered by the blend.

            f.   The number of conceptual domains involved.

            g.   Whether (or not) the conceptual domain involved is consciously focused upon.

            h.   The extent to which the blended space gives birth to new conceptual domains.

4. Concluding Remarks

This paper has looked at Fauconnier's theory of mental spaces and the more recent and enriched many spaces model. We have discussed how mental spaces are constructed, populated, related to each other and how they acquire structure. We have also explored how they are used by people in everyday life and in everyday speech. In Fauconnier's (1988) own words:

> *"mental spaces has been concerned with one general aspect of semantic/pragmatic organisation: the construction of domains, and the principles whereby domains are linked, implicitly or explicitly structured, incremented, altered or merged.*

> *Simplifying somewhat, the overall scheme might be summed up as follows: language does not link up directly with a real or metaphysical world; in between takes place an extensive process or mental construction, which does not mirror either the expressions of language responsible for setting it up, or the real world target situations to which it maybe intended to follow. Following current fashion, this intermediate level may be cognitive; it is distinct from objective content, and distinct from linguistic structure. The construction takes place when language is used, and is*

> *determined jointly by the linguistic forms which make up a discourse, and by a wide array of extra-linguistic cues, which include background information, assessable schemata, pragmatic manifestations, expectations, etc."*

Fauconnier (1994) notes that the study of mental spaces does not make for a theory of reference. The space elements are not referred to by elements of language; they are set up and identified and may then be used for referential purposes. Theories of language based on reference cannot bypass mental spaces and must abandon the notion of a direct link between linguistic structures and referents and take account of intermediate process of space construction.

Many of the issues raised in Fauconnier (1994) are of concern to the philosophy of language but are also of concern to the practitioners of formal semantics. The general thesis of Fauconnier's work is that mental space construction is an important part of natural language semantics and pragmatics. Theories of truth based on paradoxes of direct truth and reference assignment arise from the failure to take into account the relevant properties of the intermediate space constructions.

In addition to the "standard" theory (shades of Chomsky!) of mental spaces we have also explored the revised theory of the many-spaces model. We have explored in detail how these many spaces are constructed, populated, related etc., and how they find utility in common usage by people. We used examples from language, mathematics and humour to support and expand the detail of the arguments.

The many-space model is substantially enriched compared to the earlier model and therefore lends itself to a wider application in both cognitive studies in general, and linguistics, in particular. The many-spaces theory is psychologically more plausible and shows great potential for direct connection to areas of research in the wider cognitive domains. We noted the uncanny similarity between the dynamic use of the many typed, functional and mental working spaces in the many-space theory and the model of typed, functional and dynamic working memory which now represents current thinking in cognitive psychology (Eysenck & Keane 1996). This is highly suggestive of bridges being enabled between the two research areas. In addition, the many-spaces model suggests itself as the "enabling technology" behind the Invariance Principle posited by Lakoff (1987). Again, while this would require more detailed research, it does appear to provide many of the necessary insights into how the structural coherence is managed in metaphor mapping from source to target.

Having completed our review, we may ask if this theoretical work is being applied in linguistic analysis. A review of the literature revealed a number of worthwhile studies relating to mental spaces which provide some evidence that the theory of mental spaces is delivering benefits to research in a number of fields.

Earlier we made passing mention to the work of Brugman (1996) and her use of the theory of mental spaces in understanding a series of HAVE-constructions. While not repeating the analysis here, she strongly holds the view that research has been facilitated in a positive way by the insights made available by Fauconnier. She summarises her analysis as follows: *"...shown the following: that an apparently distinct construction, headed by HAVE, whose semantics is in the business of expressing a prediction or depiction, actually is an unremarkable conjunction of independent sets of interpretative principles. For the examples discussed ... the principles exist at two levels; first is the lexical level in which one of the four readings of the polysemous lexeme HAVE is invoked and the other is at a much higher level of conceptual-semantic organisation, that of mental space construction. The apparent idiosyncrasy of using HAVE as a verb of prediction dissolves when one realises that a daughter space may be set up, with or without an explicit signal to the hearer to do so."* Later she continues *"The moral of the story for the students of mental space phenomena is that a mostly skeletal construction such as HAVE-extraposition may criterally include a space builder. We should investigate further the question of how common it is for a sentential skeleton to require that one of its complements be a space builder."*

An analysis by Dirven (1996) is motivated to *"show that the structuring of our experience of physical space by means of prepositions to a large extent determines the language specific concepts built up in mental space"*. He raises the question: how similar or how different are the various concepts in mental space, e.g. the various concepts of circumstance or cause denoted by the different prepositions. Dirven tests his hypotheses on a sample of twelve prepositions selected at random. These include *"the three basic space prepositions at, on, in: the two 'proximity' prepositions by and with; the two 'path' prepositions through and about, the two 'vertical space' prepositions under and over, and the three separations or 'source' prepositions from, off, out of."* Dirven develops his analysis through the use of radial categories, or as he calls them, radial networks of extensions, while exploring differences of manner versus means within various phrases. He concludes *"The most striking phenomenon is the relationship between the way physical space is divided up in English and the way mental space is structured. It is due to the very specific way prepositions are geared to*

denote relationships in the domain of spatial experience that English has made differentiation in the domains of mental experience such as area, manner or cause..... we can conclude that languages, even the most related ones, have conceptualised the links between spatial and mental domains of experience in slightly or markedly different ways. The basis of it all is the conception of physical space. The structurings that have taken place here also determine the later extensions of those spatial concepts into the mental domains."

The concluding paragraph of Fauconnier (1994), notes that *"sign language seems to have ways of setting up spaces and elements (i.e. abstract referential domains) using body shift and three-dimensionality. The mental construction, which remains the same regardless of the modality involved, can be reflected concretely by very different codes, adapted to that modality"*. It is still early days for the theory of mental spaces but clearly the theory has delivered many insights of value to cognitive linguistics. Its domain of applicability will also most likely broaden into such areas as deaf sign language. In addition, the notation used within the theory may lend itself to use as a specification language for computational modelling of mental space phenomena by our more computationally oriented colleagues in the cognitive sciences. Clearly Fauconnier's mental spaces and, in particular, the many-space model, are an area of research with large potential.

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Internet Applications Development Issues and Strategic Considerations.

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Abstract

This paper examines the development issues and strategic considerations involved in Internet Applications Development. The prevalent development environments are discussed highlighting their advantages and disadvantages. Issues regarding the development of Internet applications are viewed under the headings of human resource, organizational, technological, investment and Legal Issues. Lastly the paper gives an overview of the strategic implications for an organization considering the development of Internet Applications. These include security, quality and the look & feel of the application. This paper is not intended as a definitive resource on the area of Internet Applications Development, its aim is to highlight the areas of interest and concern for organizations considering a move into the area of Internet Applications Development.

Keywords: development issues, strategic considerations, Internet Applications Development, human resource issues, organizational issues, technological issues, investment issues, legal issues, security, quality, the look & feel.

1. Introduction

The aim of this paper is to highlight the issues that an organization needs to consider before entering the realm of Internet Applications Development. The research for this paper was conducted by referencing text books as well as journal articles and web resources. It is the authors' opinion that too many organizations enter into development of Internet applications without fully considering what is involved. This has lead to a plethora of applications, which are lacking in a number of key areas such as security, quality and look & feel. According to the Gartner Group, 1999, through 2002, there is a 0.8 probability that e-commerce software vendors will fail to prosper by reducing web security risks unless they also address users feelings of insecurity about web commerce.

The paper is divided into four main sections. Second 2 outlines the development tools available to organizations examining the benefits and drawbacks of these tools. Section 3 examines the issues facing an organization when choosing to develop an Internet based application, concentrating on the issues faced by the people, the organization, the technological issues, the cost and the legal issues. Section 4 then explores the strategic

considerations of importance for an organization involved in the development of Internet applications.

Development Tools

There are a number of development tools available for applications development on the Internet. It is beyond the scope of this paper to examine them all, therefore the most prominent tools, on the market at present, are considered.

Java

Java was introduced by Sun Microsystems in 1995 and instantly created a new sense of the interactive possibilities on the Web. Both of the major Web browsers include a Java virtual machine. Almost all major operating system developers (IBM, Microsoft, and others) have added Java compilers as part of their product offerings. Java is a programming language expressly designed for use in the distributed environment of the Internet. (Dietel & Dietel, 1999). It was designed to have the "look and feel" of the C++ language, but it is simpler to use than C++ and enforces an Object Oriented model. Java can be used to create complete applications that may run on a single computer or be distributed among servers and clients in a network. It can also be used to build a small application module or applet for use as part of a Web page. Applets make it possible for a Web page user to interact with the page because it is a tiny java program, that is dynamically downloaded across the network, and it can contain images, sound files and video clips. (Dietel & Dietel, 1999).The following is a diagram is a typical architecture for an existing PC environment using Java:
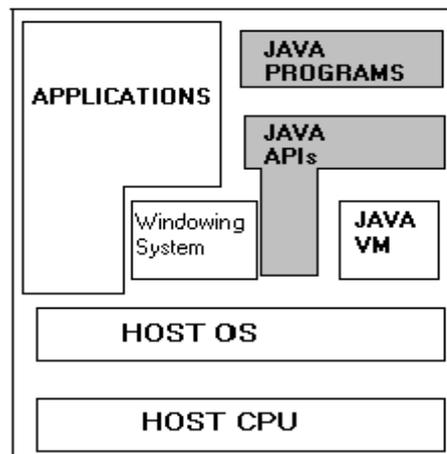
FIGURE 1: (Revett, M.C.,*et al.*, BT Technology Journal, 1997)

This diagram represents the typical systems architecture of a PC. The areas in white are the native elements of the system. The greyed sections are the java elements. In order to successfully implement Java on a host machine the Java VM must be part of the native element on the machine. The bottom two layers of this diagram are the host Central Processing Unit and the Operating System. To the left is the windowing system on top of which sits the native application programs. To the right sits the Java VM on top of which sits the Java API's and the Java Programs. Java is a widely used programming language for Internet Development. However there are other languages that are used to develop Internet Applications. These languages are known as scripting languages and it is important to understand how these work.

Scripting

In computer programming, a script is a program or sequence of instructions that is interpreted or executed by another program rather than by the computer processor. Scripting is an interpreted language, in other words it does not need to be compiled in order for the computer to understand it. There are a large number of scripting languages available. The paper will briefly describe four of the more commonly used scripting languages, Dynamic HTML (DHTML), Extensible Markup Language (XML), Extendable HTML (XHTML) and Javascript.

DHTML

"DHTML is the interaction of existing web technologies, primarily HTML, Style Sheets and scripting, to create web pages that can interact with the reader without depending on the Web server." (Darnell, et al., 1998) Dynamic HTML is a collective term for a combination of the new Hypertext Markup Language (HTML) tags and options, and programming that will allow users create Web pages that are more animated and more responsive to user interaction than previous versions of HTML. Much of dynamic HTML is specified in HTML 4.0. Simple examples of dynamic HTML pages would include, having the color of a text heading change when a user passes a mouse over it or allowing a user to "drag and drop" an image to another place on a Web page. In essence DHTML is about creating mini applications that run on the users computer instead of the traditional static Web Page that depends on the web server for it's updates. DHTML is a quicker and easier way to implement dynamic Web Pages (Darnell, *et al.*, 1998).

XML

"XML is a set of rules for forming semantic tags that break a document into parts and identify the different parts of the document." (Harold, 1998). XML is a meta markup language, in which users can make up the tags as they are required. These tags must be organized according to some general principals, but they are quite flexible in their meaning. Previously in HTML if the tags needed did not exist there was nothing to do but wait for the next version in the hope it would contain what was needed. XML (Extensible Markup Language) is a flexible way to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere. For example, computer makers might agree on a standard or common way to describe the information about a computer product (processor speed, memory size) and then describe the product information format with XML. Such a standard way of describing data would enable a user to send an intelligent agent (a program) to each computer maker's Web site, gather data, and then make a valid comparison. XML can be used by any individual or group of individuals or companies that wants to share information in a consistent way (Harold, 1998). The benefits of XML include :

- XML has the ability to work with HTML for data display and presentation (Harold, 1998).

- XML is a smaller language then Standard General Markup Language (SGML), the designers of XML tried to cut out everything in SGML that was not needed for web delivery, the result being a much simpler and slimmed down language (Harold, 1998).

- XML includes a specification for a hyperlinking scheme which is described as a separate language called Extensible Linking Language (ELL). It supports the basic hyperlinking in HTML but takes it further to extending linking (Harold, 1998).

- XML includes a specification for a style language called extensible stylesheet language (XSL) (Harold, 1998).

XHTML

As the World Wide Web Consortium describes it, XHTML (Extensible Hypertext Markup Language) is:"a reformulation of HTML 4.0 as an application of the Extensible Markup Language". XML is a structured set of rules for how developers might define any kind of data to be shared on the Web. It's called an "extensible" markup language because anyone can invent a particular set of markup for a particular purpose and provided everyone uses it (the writer and an application program at the receiver's end), it can be adapted and used for many purposes - including, as it happens, describing the appearance of a Web page. That being the

case, it seemed desirable to reframe HTML in terms of XML. The result is XHTML, a particular application of XML for "expressing" Web pages (www.whatis.com).

XHTML offers some advantages to the user, especially over the previous version HTML 4.0. According to the W3C again, the advantages are "*extensibility and portability."* Extensibility means that as new ideas for Web communication and presentation emerge, they can be implemented without having to wait for the nextmajor version of HTML and browser support. New tags or attributes can be defined to express the new possibilities and, assuming some program at the receiving end can understand and act on them, new things may happen on the Web page that never happened before. Specific sets of extensions for XHTML are planned for mathematical expressions, vector graphics, and multimedia applications (www.whatis.com).

If extensibility is likely to lead to more complicated pages and larger programs, the portability advantage means that Web pages can now be made simpler than they were before so that small devices can handle them. This is important for mobile devices and possibly household devices that contain microprocessors with embedded programming and smaller memories. XHTML defines several levels of possible markup complexity and each document states its level of complexity at the beginning. Programs in micro devices might expect XHTML-coded files that state the simplest level of complexity so that they could be handled by a small program and memory.

Javascript

In a Press release from Netscape Communications and Sun Microsystems on the launch of Javascript, they are quoted as describing Javascript as follows:*"Javascript is an easy to use object scripting language designed for creating live online applications that link together objects and resources on both clients and servers. Javascript is designed for use by HTML page authors and enterprise applications developers to dynamically script the behavior of objects running on either client or server."(Danesh et al., 1996).* JavaScript is a lightweight interpreted programming language with Object Oriented capabilities. The general-purpose core of the language has been embedded in Netscape Navigator, Internet Explorer and other web browsers embellished for web programming. The client side version of Javascript allows executable content to be included in Web pages, this means that web pages can include programs that interact with the user, control the browser and dynamically create HTML content (O'Reilly, 1998).

Javascript is touted as a scripting language, the implication being that scripting languages are simpler then programming languages. At first glance Javascript appears to be relatively straightforward, it does have a number of features designed to make it more forgiving and easier to use for new programmers.

However Javascript is a full-featured programming language as complex as any. Programmers can use Javascript for non-trivial tasks and need a solid understanding of the language to do this. There are two main types of Javascript, Client-Side Javascript and Server-side Javascript

Client-side Javascript – this is the more common variant of Javascript. It is when the Javascript interpreter is embedded in a web browser.

Server-side Javascript – This provides an alternative to CGI scripts. It goes beyond the CGI model because server-side Javascript is embedded directly within HTML pages. This allows executable server side scripts to be directly intermixed with web content (O'Reilly, 1998).

Many organizations have given into the fact that they cannot keep up with the pace of change and have begun to purchase Internet solutions from service providers, independent software vendors and value added resellers as part of IT outsourcing. This can lead to successful projects, but can also lead to increased dependency on the external provider and the tools selected (O'Reilly, 1998). Having looked at what the tools are offering to suppliers, it is pressing to consider the issues regarding Internet Applications Development that face the supplier.

Comparison Table:

	DHTML	XML	XHTML	JAVASCRIPT
Dynamic Content	X	X	X	X
Style-sheet Language		X		
Extensible		X	X	X
Portable		X	X	X
OO Capabilites				X

TABLE 1: Róisín Faherty, 2001.

Internet Applications Development Issues

There are a number of issues involved in choosing a development tool for Internet applications development. The main areas of strategic interest are:

- Human Resource Issues

- Organizational Issues

- Technology Issues

- Investment Issues

- Legal Issues

The Human Resource Issues

According to IOS/IEE 12207 1998 there are two groups of people involved in this section. The supplier i.e. those delivering the application and the acquirer i.e. those getting the application. Both of these groups need to be considered.

The supplier - The key aspects for the supplier's consideration include:

- Deciding whether to develop the application from scratch or to perform expensive custom back-end integration to legacy systems.

- Deciding on whether to face proprietary and vendor focused solutions which may lead to costly external business process integration difficulties.

- Trying to support open standards for example, Java, CORBA and IIOP in an environment where the Gartner group predict little or no support for these interoperable, open applications until after 2003.

- Dealing with problems and issues involved in integrating web applications.

- A realization that few suppliers have provided complete end-to-end e-commerce applications (Gartner Group, 1999).

The acquirer – The acquirer of the product needs to be considered by the organization the following key issues need to be addressed:

- Will the acquirer require retraining in the new application?

- Technology would need to be addressed, how would the supplier ensure that all of its acquirers would have sufficient software and hardware to enable the new application.

- Versioning Problems: the ability to transmit small applications and applets, over the network, together with the HTML pages of the Internet, allows the code to be run where it is needed and then be discarded after use.

The Organization

"IT has become a strategic resource as it brings about or facilitates major changes in industry sectors, in competitive behavior and in organizations' own strategy structure and functioning" (Earl, 1989).

In order for organizations to get applications implemented as quickly and effectively as they would like, there has been a shift in the way the organizations do their work. The organisational areas that need to change are:

Work units change: Groups of people will work together in order to perform an entire process. In terms of developing applications for the Internet teams comprise of groups of developers, graphic artists and technical writers.

Jobs change: This could be as simple as moving from writing code in C++ to writing code in Java or a scripting language.

People's Roles change: The structure of the employees' roles may change the organization may have to become "flatter" in order to accommodate the speed needed to produce the application. Managers need to have a more hands on role in the development process in order to outline the needs of the acquirer.

Job Preparation Changes: The employees will have to understand why the organization is changing in order to fully facilitate the change. People tend to find changes threatening, if proper communication is set up the change should be smoother and faster. The faster the change the faster the organisation can get stuck into the new business at hand i.e. developing Internet Applications.

Executives need to change: Flatter organizations move the senior management closer to the customers and to the people performing the companies value added work (Hammer, 1993).

Technology

In order to run and develop applications for the Internet there are some basic requirements:

Hardware – The acquirer will need a PC with at least 32MB of RAM and at least 8 MB hard drive. A sound card and speakers would also be required depending on the application. The PC processor should be a minimum of a Pentium 486, a modem will be needed and the cable

that connects the modem needs to be hardware handshake compatible, so that the modem can enunciate clearly when it talks to the Internet. As for the supplier they would need higher specification machine because they will also have to run the programming environments and possible hold large amounts of code. Here a PC with at least 64MB of RAM would be required and a minimum of a Pentium chip processor, especially where speed is essential in delivery of the product.

Software – Java:

- Java allows platform independence, this means that once the supplier provides an implementation of the Java VM and APIs for their host architecture the Java bytecode will run without modification on any platform (BT Technology Journal, 1997).

- Java is dynamic, due to the speed of adoption and the association with the Internet, the progression of Java has been very fast. There are new API's and tools being announced on a regular basis, and the power and flexibility of the Java capabilities are increasing rapidly (BT Technology Journal, 1997).

- Java provides a full and rich set of APIs. It provides all the basic feature sets required for a wide range of applications and has the ability to use more extensive systems on a dynamic basis (BT Technology Journal, 1997).

- Java allows users to incorporate new elements into a web page. However Java is not suited to working with the HTML contents of a web page itself.

Software – Scripting:

- Both Microsoft and Netscape browsers support JavaScript, but sometimes in slightly different ways.

- The writer of the interpreted program need not be concerned by low-level storage management considerations. On the other hand, an interpreted program cannot be as efficient as a *compiled* program, which has been processed by a language compiler. A language compiler converts source statements into something close to the strings of 0's and 1's that a processor ultimately is given to work on. Because this work is already done before a compiled program is run, it runs much more quickly.

- Interpreted programs are ideal for small tasks and for "gluing together" a succession of compiled programs that are run from the interpreted program (www.whatis.com).

- Interpreted Languages can allow the developer to generate scripts with errors and deploy them on a website, so it is vitally important that any interpreted language program be fully tested before it is deployed (Danesh, 1996).

- With most interpreted languages users need to revalidate any data submitted with a form on the server side in order to protect against the transmission of corrupt data (Danesh, 1996).

- Scripting allows users to work with the HTML contents of a web page directly, however if it was necessary to build an Internet based graphical pace invaders game then scripting would be an inappropriate tool for this job. (Danesh, 1996)

Another software issue other than the development tools involves the software required by the acquirer in order for the application to run. The acquirer would need a browser that works with the PC. The acquirer would also need a browser to load the application in a reasonable amount of time and with a view of all the components i.e. if the application had dynamic content then the required browser would have to be able to interpret this and display it to the user. Internet TCP/IP software would also be needed. Helper applications may also be required along with some sort of media player.

Investment

A major task to be performed during project planning is to estimate the cost of the system to be delivered. This paper will look at some of the cost issues that need to be considered by management before deciding which tools are appropriate to use. According to Ince *et al*.,1993, in general the cost of the project can be divided into:

- Staff costs, this includes the cost of development staff as well as any support staff that may be required.

- External sub-contractor costs, for example, the cost associated with subcontracting hardware development or security assurance to an outside company.

- Physical facilities cost this can include office space and furniture but in this case in would include purchase of development tool licences and hardware to run project.

- Consumable costs such as paper and disks that will be needed when developing the project.

- Traveling cost if members of staff need to travel in order to be trained for the project. (Ince *et al*., 1993)

- Acquirer Costs the acquirer will have considerable costs in setting up on the Internet if this is not already in place. There are also cost for the acquirer in relation to maintenance of any new technologies.

Legal Issues

Legislators have been slow to institute laws regarding the rapidly growing electronic commerce market. The government would prefer to allow the industry to regulate itself, so as not to slow down progress. For the most part existing laws on commerce can be applied to Internet commerce also. However when developing an Internet Applications there are some important legal issues that need to be highlighted. (Computer Weekly, 1997).

Jurisdiction on the WWW – This issue relates to where a person will be held responsible for any breach of the Law on the Web and also what law is to be applied to the person? (www.componentsonline.com/ecommerce.htm)

Copyright – A party is guilty of copyright infringement if they violate on of the five exclusive rights given to copyright owners under the Copyright Act. There are main areas that need to be considered here: obtaining images and text and developing code. Obtaining images the simple rule here is do not steal someone else's images, if an image is needed users will have to create it themselves, starting from scratch. Text issues are the same as those for images. Truly original text is fine to use but anything else may be subject to copyright laws. As with text and images it is usually a violation of copyright law to appropriate scripting or programming from someone else without permission. If a party makes it's scripts and programs available to the public then this can be used as long as any requirements set down by the developer are adhered to. (www.bitlaw.com/internet/webpage.html)

Domain Name – The selection and protection of a domain name may be the most important detail in the creation of a web site or application. Domain name function as the address for the site, and disputes over domain names have become more frequent as the Internet has grown. In order to protect a Domain name and to avoid loosing the domain name under the InterNIC domain name dispute policy, a domain name owner should obtain a trademark registration on their domain name. In order to get a domain name the name must first be available and then a registration can be filed with InterNIC.
(www.bitlaw.com/internet/webpage.html)

Trademark – A trademark is a word, image, slogan or other device designed to identify the goods or services of a particular party. Trademark infringement occurs when one party utilizes the mark of another in such a way as to create the likelihood of confusion, mistake and/or deception with the consuming public. When developing web sites it is important to

ensure that any trademark that does appear on the site cannot be misinterpreted or confused by the consumers in such a case there may be trademark infringement. (www.bitlaw.com/internet/webpage.html)

Defamation – The term defamation refers to a false statement made about someone or some organization that is damaging to their reputation. For a statement to be defamatory, the statement must be published to a third party, and the person publishing the statement must have known or should have know that the statement was false. While the Internet provides a new context in which a defaming statement can be made and published, there is little new law relating to Internet defamation other then the Liability for service providers. Nonetheless it is important to ensure that web development does not infringe on this law. (www.bitlaw.com/internet/webpage.html)

Linking and Framing – Links between pages are what makes the Internet what it is. Without widespread linking, the web as it's now known wouldn't exist. However there are questions about the legality of such connections. A person could pass off someone else's work as their own. Defamation can occur by linking to another person's page, for example, "Some http://www.badman.com idiot killed my cat, stole my invention and threatened to destroy the Internet." The person is not identified but the link itself provides the context that turns the statement into defamation. A link could lead to Trademark infringement if a consumer was lead to believe that the original page was in some way connected to the linked Trademark. (www.bitlaw.com/internet/webpage.html)

The development issues are important and need to be thoroughly assessed before embarking on Internet Applications Development. However there are other strategic considerations that are of concern to the organization. These are discussed next.

Strategic Considerations

The areas of strategic consideration in this paper are the areas of security on the Internet, the quality of the Internet application and finally the Look & feel of the application for the users.

Security

When developing applications for the web the security is of primary importance. "*The advent of the Internet has put corporate networks on a permanent state of alert against hacking attacks, e-mail viruses and other security infringements"(Irish Computer, May 2000).*

There is such pressure for companies to get applications on line that smaller companies are not giving the same amount of thought and resources to protecting their systems (Irish Computer, September 1999). In a report from the Gartner group, the following statistics on the perception of security are eye opening:

- 70 percent cited security as the main reason they are reluctant to purchase over the Internet.

- 45 percent were very concerned about the level of security on the Internet.

Rits (2000) information security recently revealed the finding of its information security survey 2000, which details the Irish companies that have prepared themselves for the rapid emergence of Internet applications in terms of technology security. The survey found the following:

- Lack of Data Protection Act compliance reviews

- No confidence in internal IT and IT security expertise to secure the organizations IT assets.

- A high percentage of companies with no authentication procedures for remote access.

- Over 50 percent had identified a security breach from external sources

- Poor third party controls (Irish computer, May 2000).

The most commonly used attacks by a hacker include:

- Contacting the helpdesk posing as an authorized user to extract passwords.

- IP address Spoofing, this is where the hacker sends data packets with a spoofed IP address from a remote site and bypass a filtering router if the firewall is not configured properly.

- A syn attack, where a server is flooded with a large number of open requests.

- War-dialing, where all numbers within a PSTN number range are dialed in order to establish a connection with a modem, which may be connected to the internal network.

Within the organization the security specialist must ensure that all avenues of attack are identified and safe guarded (Gartner Group, 1999). Most network level attacks can be clocked using a firewall, however most firewalls do not provide sufficient protection against "inband" attacks (Gartner Group, 1999). By manipulating parameters placed in forms, or the parameters passed to server CGI scripts, the security of the web server can be compromised (Gartner Group, 1999).

CGI scripts were designed so that almost anyone could initiate their execution with any input parameters and still ensure their safe operation. The problem with this lies with the unexpected input. Often, the web server or CGI scripts run with privileges beyond what is required to execute the services the user needs, and hackers could exploit these. It is unfortunate that even though it may be possible to avoid design and configuration errors the track record shows that secure design and configuration rarely occurs (Gartner Group, 1999).

There are companies who offer vulnerability assessments. Vulnerability assessments involve finding a weakness in a network and network hardening. A security consultant will go on site to patch up any soft spots, but one of the most frequently used test is known as penetration testing. This type of testing is carried out by a team of workers who try to compromise the network by any means possible (Irish Computer, April 2000). The team will use procedures and techniques that real hackers do, automated tools, live penetration attempts as well as a variety of conventional and unconventional access methods. The purpose of this testing is to find the problems and solve them before the application goes live on the Internet (Irish Computer, April 2000).

Security is a very important issue for Internet based applications, it needs to be fully considered and implemented in order to guaranteed the acquirer a safe environment.

Having discussed the issues around security, the next issues lie with the Quality of the application.

Quality

Quality is an issue in Internet Applications because of the speed required to build the application, is due consideration given to the quality of what is being produced? *"Software Quality concerns are quite broad, including, for example, correctness, robustness, readability and evolvability."(ACM Computer Surveys, December 1996).* By 2001 Application Development organizations that do not include specialists in art, public communications, emotional content, and sociology on their teams will produce applications whose poor quality will fail their e-business strategies in excess of 85 percent (0.9) (Gartner Group, 1999). Software quality is difficult to define, since the characteristics of quality contain a large subjective element, and often depend on the application being considered (Ince *et al.*, 1993). Certain characteristics may be determined by the user for example the ease-of-use and others may be determined by the developer for example maintainability. However high quality software can be characterized by the following:

Efficiency – this refers to the behavior of the system in relation to the resources of the computer system on which it executes. Most often the efficiency of a system is described in terms of its execution speed and storage use (Ince *et al.*, 1993). The efficiency of the Internet based product must at least match that of its predecessor.

Reliability – This refers to the number of errors in the piece of software, and hence is simply a measure of the number of times a software system fails to perform correctly (Ince *et al.*, 1993). This is important if an Internet application is being developed using one of the scripting languages detailed in section 3. As mentioned there it is possible to develop and deploy a scripted application with bugs and errors still in it. This is because there is no complier for these languages to catch these errors.

Testability - This refers to the ease with which a software system can be tested. For example if a system contains program units with large amounts of logic then it will be difficult to test and if it is difficult to test this may indicate bad design or implementation (Ince *et al.*, 1993). In relation to an Internet application testing would have to also include network tests to ensure the reliablility and speed of the network for users.

Maintainability – This refers to the ease with which a system can be changed once it is in operation (Ince *et al.*, 1993).

Usability – This refers to the ease with which the system can be used (Ince *et al.*, 1993). The users will expect to be able to use the product as easily as it's predecessor, if there are major changes to it's look and feel users may become frustrated.

Look & Feel

"The application front end must make a striking point why the application deserves the consumers' attention. If it fails to do so, the consumer might not try to explore the value of the offer hidden behind the interface" (Gartner Group, 1999). An application must have a unique face, it is important that organizations address new disciplines in application development for aesthetic appeal, ergonomic rationale, clearly communicated business messages and emotional content (Gartner Group, 2000).

Throughout their history application development organizations have employed professionals whose primary goal was to program business logic and data access. As a result of this many

web applications are poorly designed, difficult to navigate and visually unappealing (Gartner Group, 2000).

The Internet offers such a wide variety of choices that customers who feel unsatisfied with an application can simply look elsewhere. This threatens the Application development organizations with possible permanent loss of this customer (Gartner Group, 2000).

The following are important when designing a Web Application:

- **Personalization** – Applications must address customers according to their social status, profession, education, culture, individual needs and tastes. Applications should simulate a web counterpart for the consumer and establish a one –to- one dialog with them. There is a tool available to assist in this process know as Broadvision (see glossary).

- **Client Care** –Customer's should not be abandoned in any situation, they should be shepparded through to a satisfactory end.

- **Applications behavior** should accommodate all possible client site platforms – all brands and versions of browsers, computer types, operating systems and access devices. Applications should recognize the platform and appropriately adapt their interface.

There are a number of web authoring tools available now too, the most popular of which are by Adobe and Dreamweaver by Macromedia. Dreamweaver the Macromedia tools have excellent template and library facilities. This allows entire sites to be updated rapidly, if for example an address, logo or image has to be changed in every page of a site. Dreamweavers approach to page design is probably the best of all wysiwyg editors (Irish Computer, March 2000). The big drawback of this editor is the steep learning curve associated with it. On the other hand there is GoLive Adobes authoring tool. GoLive incorporates the Adobe approach to making programs easier to use. There are at least two ways of doing anything in GoLive but the program is biased to Drag and Drop.

With these and so many other web authoring tools on the market, while it would mean investment by organizations, there is no reason for web applications to have poorly presented front ends (Irish Computer, March 2000). In summary individuality, personalization and client care are the new criteria that together with the traditional application development criteria determine the success of Internet applications (Gartner Group, 2000).

Conclusion

This paper has looked at the history of applications development and the Internet. It has examined the Internet applications development issues facing an organization and finally it discussed the strategic considerations involved in building an Internet application. There are two main development tool categories that were discussed. Java and Scripting Tools. The scripting tools included

- DHTML
- XML
- XHTML
- Javascript

Java is best for large applications development for deployment over distributed environment like the Web. The Scripting tools are best for smaller applications. The scripting tools had a number of different features summarized in Table 2.

Comparison Table :

	DHTML	XML	XHTML	JAVASCRIPT
Dynamic Content	X	X	X	X
Style-sheet Language		X		
Extensible		X	X	X
Portable		X	X	X
OO Capabilites				X

TABLE 2: Róisín Faherty, 2000.

There are five main categories that organizations need to consider when deciding on Internet Development:

- People Issues

- Organizational Issues

- Technological Issues

- Cost Issues

- Legal Issues.

If an organization adequately addresses these issues before embarking on an Internet Development project many of the major problems that arise during these types of projects

will be already addressed or be planned for. However the organization must also consider some key strategic considerations:

- Security

- Quality

- Look and Feel

These considerations relate to the consumer, if the organization does not meet the needs of the consumer in these areas then the project is likely to fail regardless of how well it is implemented.

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How the west was wonderful; some historical perspectives on representations of the West of Ireland in popular culture

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The idealisation of life in the west of Ireland was central to the mission of the Irish Literary revival. The images of life in the west served as an idealised counterpoint to the grubby, urban, materialistic and valueless society that could be viewed a short distance across the Irish Sea. The romantic mythologising of the west of Ireland peasant was a key tenet of the 'Celtic Twilight'.

Arguably it was the work of one of the most self consciously inclusive and intellectually honest writers that opened the floodgates for the romantic view of what Daniel O Connell had termed the 'greatest peasantry in the world'. In 1893 Douglas Hyde, the future first President of the new Irish Republic, published his bilingual collection of Irish poetry entitled *Love songs of Connacht* or *Abhrain ghra chuige Chonnactha.* In his beautifully realised text, complete with hand drawn engravings, Hyde set about recording the native poems and songs that he heard the local people singing in the fields while they worked near his native Frenchpark in County Roscommon. He printed the Irish text on one side of the page and his translation into Hiberno-English on the other. It has consistently been argued that his achievement was a double-edged sword. While on the one hand he managed to popularise Irish literature it made the creation of a national literature in English seem all the more feasible. He was the leader of the movement to save Irish -being the founder of the Gaelic League -but he was also the founder of the Anglo-Irish Literary Revival.

William Butler Yeats was to the forefront of this movement. His Fisherman is 'a wise and simple man'. James Joyce, who had grave reservations about the mission of what he jokingly and lewdly termed the 'Cultic Twalette', similarly engaged with the notion of the mythical west. In his story *The Dead* the protagonist Gabriel Byrne is called a 'West Briton' by another party guest who attempts to persuade him to take a holiday in the west of his own country. Gabriel's wife Gretta is from Galway and after hearing her account of the dead young boy from Oughterard he decides to make his own journey westward, a journey rich in implication.

The Irish Free State was to give Yeats vision a firm Ideological footing within the straitjacket of a narrowly defined Irish Ireland. Post-colonial Ireland- as defined by the powerbrokers- was to be a bulwark against the pernicious modernising forces of urban, Anglo-American and heathen European Civilisations. The west, and more specifically the western Islands, became part of the creation myth of the Irish State. For the young state the western Islands had an aura of pre-history. Michael Collins, after a visit to Achill Island, County Mayo outlined his vision of the future in words eerily prescient of his political foe Eamon De Valera.

In the island of Achill, impoverished as the people are, hard as their lives are, difficult as the struggle for existence is, the outward aspect is a pageant. One may see processions of young women riding down on the Island ponies to collect sand from the seashore, or gathering in the turf, dressed in the shawls and their brilliantly coloured skirts…They remain simple and pisturesque. It is only in such places that one gets a glimpse of what Ireland may become again. (O Toole; 1996.p.34)

John Wilson Foster puts it succinctly thus-

> *The Western Isles came to represent Ireland's mythic unity before the chaos of conquest…at once the vestige and the symbolic entirety of an undivided nation.* (O Toole; 1996.p.36)

Their supposed historical isolation had rendered them untarnished from the poison of foreign rule and as such represented the embodiment of what the new state could once again become. They had been preserved from corruption and kept their aboriginal Irishness intact through being unsullied by foreign rule. George Thompson, a renowned Greek scholar, who spent a great deal of time on the Blasket Islands and edited Maurice O Sullivans account of his early life there *Twenty years a growin'* wrote of

> *The Homeric qualities in the life of the Blasket Island; the island of Ithaca had little to offer besides mountain pasture. 'It is a rough place but a fine nurse of man' said Odysseus. One might* say the same of the Blasket Island.

Famously Yeats on meeting John Millington Synge in Paris urged him to travel to the Aran Islands to get in touch with the essential Ireland. Synge accepted the advice and, repudiating the art of the decadents (he had brought himself to Paris in an effort to become an art critic in the French language), he made a return to nature, in his view, as fresh and sincere in its courage and originality as the previous return had been of Coleridge and Wordsworth to the

simple standards of truth and beauty. The product of the time he spent there was his one act tragedy *Riders to the sea* (1904) and his prose narrative *The Aran Islands* (1907). Interviews with exiled Aran Islanders in America on reading Synges prose account make for interesting reading. Many thought that it would have been a better book if he had written more of the sea and the birds and the storms and less of the people who they thought were invested with spiritual and quasimystical qualities which were undeserved. Having firsthand experiences of the harsh socio-economic realities many of these expatriates expressed no desire to return.

> *I'd like to be going back and seeing the old lady and the Islands too, especially after reading this book. But I'm thinking two or three weeks would be enough, unless I was a rich man, and then maybe I'd like to stay for a year or so.*

Notwithstanding the worldly wisdom of Sean Mac Donnacha and his ilk it was in the ideological interest of the emerging state to brush over the cracks and develop the image of an unsullied, God-fearing peasantry making a humble living on the edge of Europe.

This pastoral idyll was given legal sanction with the state imposed revival of the Irish Language; the 'special position' accorded to the teachings of the Catholic Church in the 1937 Constitution and the Censorship of Publications act of 1929. The most frequently quoted expression of this Ideology is the, by now infamous, St. Patricks Day Speech by Eamon De Valera in 1943.

That Ireland which we dreamed of would be the home of a people who valued material wealth only as a basis of right living, of a people who were satisfied witth frugal comfort and devoted their leisure to things of the spirit; a land whose countryside would be bright with cosy homesteads, whose fields and villages would be joyous with sounds of industry, the romping of sturdy of sturdy children, the contests of athletic youth, the laughter of comely maidens; whose firesides would be the forums of wisdom and serene old age.

The reception given the various accounts of life on the Blasket Islands- Tomas O Criomhtain's *An tOileanach (The Islander)* (1929), Maurice O Sullivan's *Fiche Blian Ag Fas (Twenty Years A-Growing)* (1933) and Peig Sayer's *Peig* (1936)- reinforced the virtues of an Irish Ireland as promulgated by the fathers of the fledgling state. These books were placed on the school curriculum as a valid record of a culture that had been –and would be once again- emblematic of Gaelic Ireland in its purest form.

In retrospect it is the death throes of a fast vanishing civilisation that we are reading about. While E. M. Forster might have correctly viewed the work of O Sullivan as 'an account of neolithic civilisation from the inside' the reality is that the society was crumbling from the inside starved of any tangible state support. It is ironic then that they were placed on the Irish school Curriculum as a record of a Gaelic Ireland that could be once again realised in the future.

It was little wonder that De Valera and W.B. Yeats graced the opening night of Robert Flaherty's *Man of Aran* with their presence. The seventy-five minute film depicted the ongoing struggle of an island family against the sea. It is clear that Flaherty imagined them as a people ennobled by stoicism in the face of inevitable hardships and, perhaps, ultimately defeat. It has achieved canonical status principally for the vivid depiction of the ferocious seascapes and the impressive cinematography deployed. Fintan O Toole has convincingly argued that the opening inscription of Flaherty's ethnographic documentary could be read as a party political broadcast on behalf of De Valera's political party Fianna Fail.

In this desperate environment, the Man of Aran, because his Independence is the most precious gift he can win from life, fights for his existence, bare though it may be…it is a fight from which he will have no respite until the ends of his indomitable days or until he meets his master, the sea.

The arguments which have centred on whether the work of O' Flaherty represents true documentary or fiction are apposite in relation to representations of the west. The founding myth of documentary had been- particularly through the 1930's when the film was shot- that the documentary maker spontaneously caught real events and screened these back to the audience in an unmediated fashion. Although the family are native islanders, they are nonetheless acting roles, carrying out actions and performing lines written by Flaherty and his wife Frances. Claims for this film being a Documentary are undermined by Flahertys request to the islanders to re-learn the long dead art of sharkhunting to allow him to film the climactic sharkhunting sequence. While the cinematography brilliantly represented the harshness of the climate and the sea it did nothing to explore the socio-economic realities of the Aran Islands. Shark hunting had become a distant memory in reality and the fabric of the society was being rent asunder with the complicit aid of a political establishment that had not the will or the ways to remediate the situation. Many Aran Islanders were more familiar with the operations of the transport system in downtown Boston than the ferocious beauty of the local seascapes. That the official indifference from the state is fact can be evidenced by the

death of many Island communities at this time. Economies of scale and scarce resources for additional development meant a move to the mainland would better suit the powers that were.

> *Now I'll begin at the beginnin'. A fine soft day in the spring it was when the train pulled into Castletown three hours late as usual, and he got off. He didn't have the look of an American tourist at all about him. Not a camera on him. And what was worse, not even a fishing rod.*

So begins the narrative voiceover in John Fordes classic *The Quiet Man*.

It is a tribute to the enduring legacy of this work that a substantial proportion of the tourism revenue for parts of Mayo and Galway are still derived from elderly Americans visiting the sites where the action was filmed. The picturesque village of Cong in south Mayo boasts a Quiet man Hostel, Coffee Shop, restaurant and bus tour at last count. The film immortalised Ashford Castle on the shores of Lough Corrib and ensures a constant flow of well-heeled affluent Americans seeking a little of the fairytale Idyll portrayed in the film.

The film was an ambitious pet project of Ford's who had previously directed a host of award winning films including *The Informer* (1935), *The Grapes of Wrath* (1940) and *How Green was my Valley* (1941). Because of the nature of the film Forde was unable to source funding from any of the major Hollywood studios and turned to Republic Pictures, a smaller studio regarded as the studio for B-Pictures and low budget westerns. The project was an unmitigated success and formed a template for the representation of Ireland in Hollywood.

For Ford it was a loving, sentimental and nostalgic tribute to his Irish ancestry and homeland. Based on Maurice Walsh's short story *Green Rushes* it was shot in beautifully textured Technicolor which won an Oscar for cinematography as well as Ford's fourth Oscar as Best Director.

It was his first 'romantic love story' and featured his stock company of actors in John Wayne, Victor Mc Laglen and Maureen O Hara. The story charts the collision between the anti-materialistic, Irish American boxer Sean Thornton (Wayne) in the town of Inisfree (his birthplace) and an archetypal local bully 'Red' Will Danaher (Mc Laglen). The plot is further entangled when he falls in love with the bully's feisty, red-haired and materialistic sister Mary Kate (O' Hara). The trials of life and love that follow for Sean and Mary Kate are

played out against a pastiche of all the stereotypical elements of stage Irish representation. It was little wonder that the film was openly welcomed by the conservative Irish censor.

This article has attempted to provide a brief analysis of some of the ways in which the West of Ireland has been represented in popular culture historically. The central thesis posited is that the idealisation of the west was an ideological construct. It provided a legitimisation for the powerbrokers of the newly created Irish state in their narrowly defined vision of what an Irish Ireland should be.

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