

**The ANU
Undergraduate Research Journal
Volume One 2009**



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FOREWORD



The Australian National University (ANU) is an education-intensive research institute of international distinction.

A high proportion of our resources are directed towards maintaining research and research training of exceptional quality and our research concentration leads to a unique environment within an Australian university. Our academic profile is not driven by what, in the end, are ‘profitable’ student study choices and patterns—our profile is driven by what are important issues, topics and disciplines on which to conduct research—strategically and for the long-term as necessary. This form of ‘learning’ feeds our educational programs; our students are educated in a unique research-intensive environment by researchers amongst the world’s leaders in their fields.

The benefits of this experience are evidenced by the ANU Undergraduate Research Journal. The breadth and depth of the articles chosen for publication by the editorial team and reviewed by leading ANU academics demonstrates the quality and research potential of the undergraduate talent being nurtured at ANU across a diverse range of fields. The culture of discovery that pervades our students’ educational experience helps us to foster future generations of researchers and the ANU Undergraduate Research Journal harnesses some of the best work of this emerging community of scholars.

A handwritten signature in black ink, which appears to read 'Ian Chubb'.

Ian Chubb AC
Vice-Chancellor and President
The Australian National University

EDITORS' NOTE

We would like to present the ANU community with the inaugural *ANU Undergraduate Research Journal*. We were privileged in selecting thirteen outstanding essays from numerous ANU undergraduate essay submissions. All were of an exceptional quality and variety. Future editions of the Journal will certainly not be at a loss for quality material.

We have attempted to create a flow for the reader of this journal. The journal opens and concludes with an analysis of questions about life itself. It consecutively explores divergent academic fields; commencing with essays in physical and natural sciences, moving into social sciences, through humanities and into legal studies. The articles were chosen in a way that highlights their interdisciplinary character. As such they will be of interest to a wide audience, regardless of the reader's academic background.

Given the interdisciplinary nature of the essays, we chose not to use a uniform referencing system. We found that enforcing a discipline-specific referencing system on all essays took away from the integrity of a student's article. As such, each article is referenced according to the general norms of the relevant discipline. This enables readers to approach these essays as examples of "best practice" scholarship in their field of study.

Happy perusing,

The Editorial Team:

Maurits Evers

Elizabeth Humphries

Saskia Vervoorn

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About the cover page

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School of Art, The Australian National University, Acton ACT 0200, Canberra, Australia

STACKS AND STACKS AND STACKS

STACKS (wood) (performance documentation), 2008

Screen-print on cardboard

Dimensions variable

Hundreds of blocks are piled in the centre of a large gallery space. Participants are invited to build and innovate with these blocks, creating forms that are structurally sound or precariously balanced. Some participants construct by mimicking something they are familiar with, such as a building, an igloo or a work of art, while others make a form up. The process finishes with the form's destruction—the creators of the form are invited to knock it down and start again.

This process was documented as a part of a series of works surrounding the installation STACKS (wood).

The work itself sits statically but its weightlessness and its superficial character offer the participant endless opportunities of creation. The structure as it is seen in the Journal's cover image is merely one of infinite arrangements.

The blocks are manufactured representation of wood. In fact, they are made out of cardboard and screen-printed with a wood-grain pattern. It is the surprising lightweight quality of the "wood" blocks that allows the participation in the installation.

The artwork intends to intersect different realities of the world we live in; the spaces we inhabit, the environments we build, and the architecture of virtual reality that we create and which is infinite. The work challenges ideas of representation by attempting to embody the superficiality of an object in a world that is increasingly being shaped by virtual realities.

This project has been documented further at:

<http://theflatcity.com/>

<http://richardblackwell.net/>

What is life made of?

A. Chopra

Planetary Science Institute, Research School of Astronomy and Astrophysics & Research School of Earth Sciences, The Australian National University, Acton ACT 0200, Canberra, Australia

As we begin to understand the origin and evolution of terrestrial life and investigate the possibility of extraterrestrial life, the need to scientifically approach fundamental questions such as ‘What is life?’ increases. In beginning to answer such questions we can look at the ingredients of terrestrial life. Here we present an overview of our understanding of the composition of terrestrial life. At the level of chemical elements, the major ingredients are carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus along with trace amounts of elements like sodium, potassium, iron and copper.

Why terrestrial life is made of this particular set of elements is not clear. Here we present the correlation between the elemental composition of life (humans and bacteria) and sea water. Elements essential to life (e.g. carbon and sodium) are more abundant in sea water than non-essential elements (e.g. tungsten or lead) suggesting that life utilises elements that are easily obtained from its environment.

We quantify differences in elemental abundances in life, relative to sea water, and attempt to interpret them in terms of chemical constraints on metabolic activities and harnessing energy. We discuss how future investigations could further our understanding of the origins and evolution of life on Earth.

While natural philosophers¹ believed all matter to be made of four elements: fire, air, water and earth, we now recognise that all matter in the universe is made of atoms of chemical elements.²

The first chapter of [1] is titled: “A chemical analysis of the elements which are found to exist in the human frame - thus showing the natural origin of man.” It is perhaps one of the earliest records where one has examined the composition of life in terms of chemical elements. De Courcay mentions that vegetable and animal matter are essentially composed of carbon, hydrogen, oxygen and nitrogen in addition to sulphur, phosphorus, iron and small quantities of “saline matter” (for example sodium and potassium).

He goes on to give us relative proportions of these elements in “fibrin - the lean part of animals, which is composed of 18 parts of carbon, 14 of hydrogen, 5 of oxygen and 3 of nitrogen.” Upon examining the elements that make up the environment of the vegetables and animals, he concludes that the

atmosphere, water and vegetables are composed of the “same elementary principles” and that “the Earth and the animal organization of the human frame is composed of the same agencies.”

Today we have a much better knowledge of the composition of life and its environment, primarily due the suite of analytical techniques available to accurately measure the concentrations of elements in a sample.

The ‘bulk’ elements oxygen, carbon, hydrogen and nitrogen make up $96.8 (\pm 0.1) \%$ ³ of the mass of living matter and the remaining $3.2 (\pm 0.1) \%$ ³ of the mass consists primarily of phosphorus and sulphur with $2.2 (\pm 0.2) \%$ ³ of the mass attributed to ‘trace’ elements like potassium, sodium, calcium, magnesium and other metals such as iron, copper and cobalt. Many of these trace elements are known to play a variety of biological roles as electrolytes and as enzyme cofactors and often the amounts and proportions of these elements are important in achieving successful functioning of the metabolic pathways in an organism. [5] have noted that “of the 90 kinetically stable elements that occur in nature,

¹Empedocles proposed *circa* 450 BC that the four classical “roots” known to pre-Socratic philosophers, made all the structures in the world. The term “elements (stoicheia)” was first used by Plato *circa* 360 BC in his dialogue *Timaeus*.

²Excluding the case of dark matter, whose nature and composition is still in question.

³Values were derived from averaged elemental abundances in humans and bacteria, as presented by [3] and [4] respectively. The uncertainties reflect the deviation between the abundances in humans and bacteria.

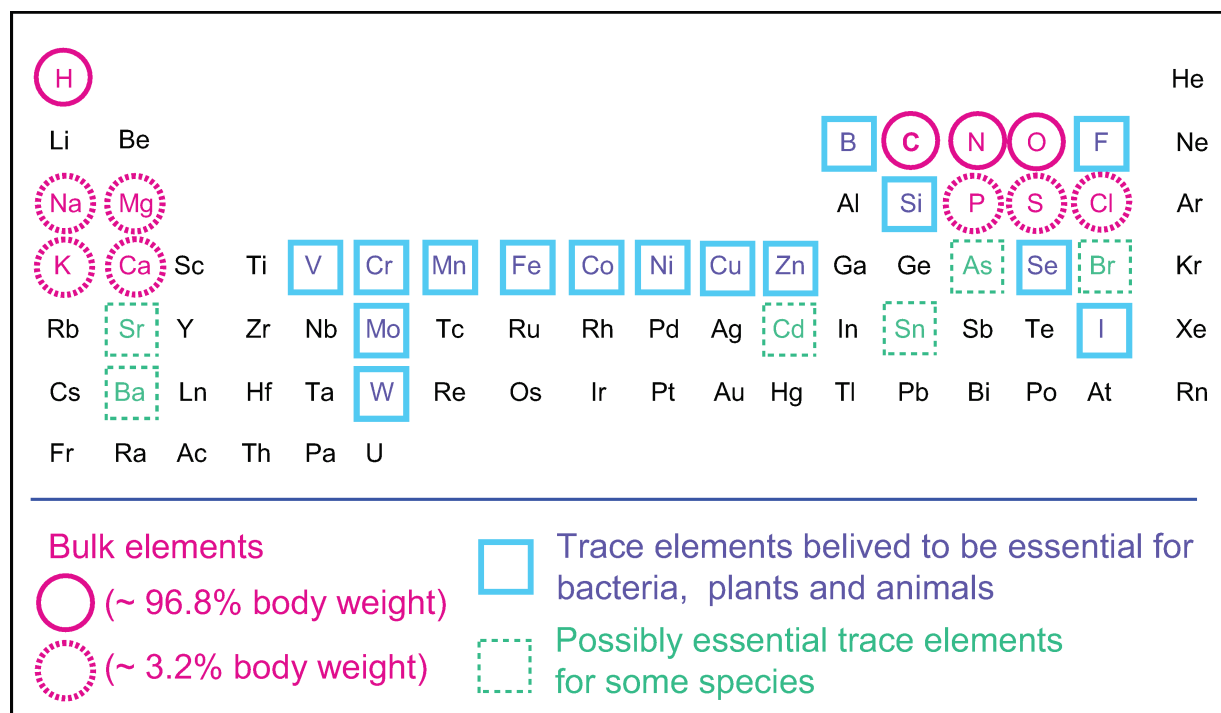


Fig. 1: The distribution of elements considered 'essential' for life in the periodic table. Adapted from [2].

about 36 are essential to some form of life (see Fig. 1)."

A number of authors including [5] and [6] have presented the relative proportions of the chemical elements in organisms like humans⁴ and bacteria⁵ and noted the similarity in their compositions. [6] has also noted that the elemental abundances in these species show strong correlation with the elemental abundances of sea water⁶. We have graphically illustrated the tabulated data from [6] in Fig. 2.

Life forms show many commonalities but also differ in their composition and usage of elements because of the different environments they live in. It is clear that any life form can only be made of the elements available to it from its environment. If element X is non-existent in an environment then any life in that environment will not be composed of element X. It is interesting to examine to what extent

the ingredients of life reflect the relative proportions of the elements in its environment. If we take sea water as an approximation to our diet then from Fig. 2 we can infer that 'we are what we eat' but also that 'we are not *exactly* what we eat.'

Although humans do not currently live in the oceans or drink sea water, the composition of our diet is much more similar to sea water than it is to the Earth's crust. This is probably because the first 90% of our evolution, approximately 4 billion years ago to 400 million years ago, took place in sea water.

The relatively high abundance of hydrogen and oxygen in life is primarily due to the water (H₂O) that makes up about 65.9% (by number of atoms) of humans⁷ and about 83.6% (by number of atoms) for bacteria such as *Escherichia coli* [4]. The fewer number of data points for bacteria (25 elements) than for humans (58 elements) in Fig. 2 relates to the fact that bacteria have not been analysed to the same extent as humans have been for their elemental composition.

Unlike humans and bacteria, sea water is almost entirely composed of hydrogen and oxygen (hydrogen and oxygen in H₂O makes up 99.1% of

⁴Human abundances from [3]. The study involved about 150 individuals.

⁵Bacteria abundances are from [4] and the values are representative of 7-40 species depending on the element.

⁶Sea water abundances are from [7] and based on empirical models that estimate the composition of normal surface sea water with a chlorinity of 19, which corresponds to approximately 34.5g of salt per litre of solution.

⁷[8] suggests that human body water content can range from 56% for obese persons to 70% for a lean person and here we have used the mid-point value of 63% by mass.

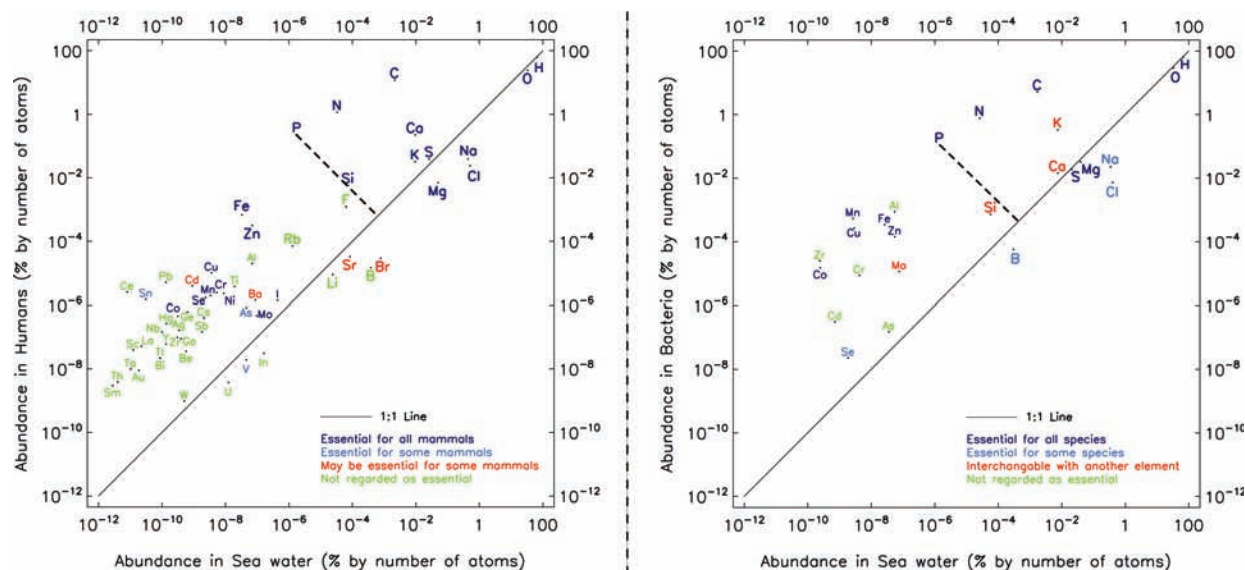


Fig. 2: Life vs. Sea water—The positive correlation between elemental abundances (by number of atoms) in humans and bacteria relative to ‘boiled’ sea water, which contains the same percentage of water (by number of atoms) as in the life form. Note the logarithmic scale and that although elements like sodium and boron appear to have similar deviations from the equilibrium value (as indicated by the 1:1 line), the absolute deviations are much greater. ‘Essentiality’ of elements for mammals and bacteria are colour coded as suggested by [6].

the atoms in normal surface sea water) with relatively negligible amounts of other elements that make up the ‘sea salts’. To allow valid comparisons of the relative elemental abundances in life forms and the sea, we have reduced the quantity of H_2O in sea water such that the percentage of water (by number of atoms) was equivalent in the life form and sea water. The treatment is analogous to ‘boiling’ sea water and concentrating the salts in sea water.

Due to the logarithmic axes used in Fig. 2, hydrogen and oxygen appear to have the least magnitude of deviation from the equilibrium value (as indicated by the 1:1 line) compared to other elements. However, the absolute deviations are much greater and account for the apparently large deviations in the opposite direction exhibited by the low concentration elements like cerium and lead.

It was surprising to find that if we ‘boiled’ sea water to the extent that no hydrogen and oxygen was present as H_2O , and similarly ‘boiled’ the life form (humans or bacteria) by reducing the water content to 0%, we would still have a higher proportion of hydrogen and oxygen in seawater than in the life form. That is, there are more atoms of hydrogen and oxygen present as salts (such as bicarbonates and sulphates) and gases dissolved in sea water, than there are hydrogen and oxygen atoms in the non-water component of humans and bacteria.

As expected, the most abundant elements in sea water after hydrogen and oxygen are chlorine and sodium that upon evaporation of sea water yield sodium chloride crystals that constitute common salt. Sea water is not just a solution of sodium chloride and water, but rather is a mixture of virtually every element on Earth. Anything that can be washed downstream eventually finds its way to the seas, and is incorporated into the solution of the oceans [9].

The relatively high abundance of ‘essential’ elements in humans, bacteria and sea water in Fig. 2 suggests that terrestrial life does not have elemental preferences and is based on the most abundant elements in the environment. Additionally we observe that the composition of life is not exactly the same as its environment. Some elements like carbon, nitrogen and phosphorus are more abundant in life than in sea water while other elements like chlorine and sodium are more abundant in seawater than in life. An increased abundance of an element in life, relative to its abundance in sea water (for example carbon and phosphorus in Fig. 2), is a measure of life’s concentration of the element from the environment. Elements like tungsten or uranium, which are not regarded as ‘essential’ to life appear to have similar abundances in life and in sea water and appear along the diagonal line in Fig. 2. It is tempting to suggest that life concentrates ‘essential’ elements from its environment while ‘non-essential’ elements occur in equilibrium abundances in life and its environment. However, a number of elements not

regarded as 'essential,' like aluminium, germanium and cerium, are also in high abundance in life relative to sea water.

We also observe that elements recognised as 'essential' are not necessarily concentrated in life like sodium and magnesium which are more abundant in sea water. Some elements may not be 'essential' for an organism but are concentrated in the organism as a consequence of sequestration of another element. For example, Pb^{2+} ions have similar binding preferences to Ca^{2+} and Zn^{2+} ions in the metal centres of proteins as they all have similar effective ionic charge to radius ratios. It is difficult for metabolic pathways to distinguish between ions of these elements and the toxic effects of lead poisoning are attributed to displacement of Ca^{2+} and Zn^{2+} ions by Pb^{2+} ions in metalloenzymes [10,11]. In humans, lead is found incorporated into the mineral matrix of calcium rich bones.

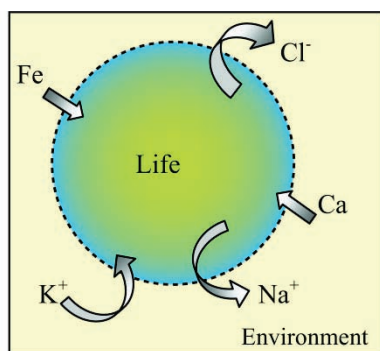


Fig. 3: Life pulls in some elements like iron and calcium from the environment while it pushes out elements like sodium and chlorine.

These observations lend support to the idea that life is a system which manipulates elemental abundances away from their equilibrium abundances in its environment, to perform its metabolic activities, ultimately to harness energy. Imagine that life begins as a bag containing the same elements in the same proportion as in the external environment. Then life somehow learns to pull in some elements from the outside world and concentrates them inside the bag and push out other elements as illustrated in Fig. 3. We can now define life as a chemical system away from equilibrium with its environment. The disequilibrium established by the unequal abundance of an element in life, relative to its environment is used by life to perform its metabolic activities.

We are not suggesting that organisms are bags of independent elements. Organisms are chemical entities and are produced, maintained, and propagated by chemical reactions, in the form of

highly complex coupled networks, which are the product of evolution over the past approximately 3.5-4 billion years.

We plan to perform elemental analyses of various species using the analytical techniques that offer much higher precision than ever before and hope to remedy the lack of quality data for other species (not just humans and bacteria). Widespread studies looking at all forms of life on Earth would be required to work towards our ultimate goal of understanding the origins and evolution of life. However, given that our approach is at an early stage, we must have a modest realisable target that will eventually help us assemble the 'big picture'. This will be achieved by focusing on the root of the phylogenetic tree commonly described as the Tree of Life illustrated in Fig. 4. We plan to study the elemental composition of the archaean and bacterial species that have been the dominant life form for most of life's existence on the Earth⁸ and are more closely related to the Last Universal Common Ancestor (LUCA) than eucaryotes. Many of the extant archaean and bacterial species were present on the early Earth and are found today in extremely acidic or hot environments.

The chemical composition of an organism may be a highly conserved feature of terrestrial life allowing us to relate deeply branched extant species by their elemental composition and in turn infer the composition of the Last Universal Common Ancestor and its environment. Such knowledge will further our understanding of the possible sites for the origin and early evolution of life on Earth.

Using branch lengths as a proxy for time, analyses of the elemental composition of species with various branch lengths across the phylogenetic tree will be used to determine if there is any identifiable trend of life using a larger suite of elements as a function of time. This approach also lends itself to identifying evolutionary steps linked to changes in the bioavailability of elements. For example, oxygenation of the atmosphere approximately 2.34 billion years ago caused substantial decrease in

⁸ Although controversial isotopic evidence by [13] suggests the presence of autotrophic organisms 3.7 billion years ago, bacteria have existed for at least 3.4 billion years, as indicated by stromatolite fossils [14] and microbial life was the only form of life until 2 billion years ago. Animals appeared 600 million years ago and the *Homo* genus that includes modern humans has existed for 2.5 million years.

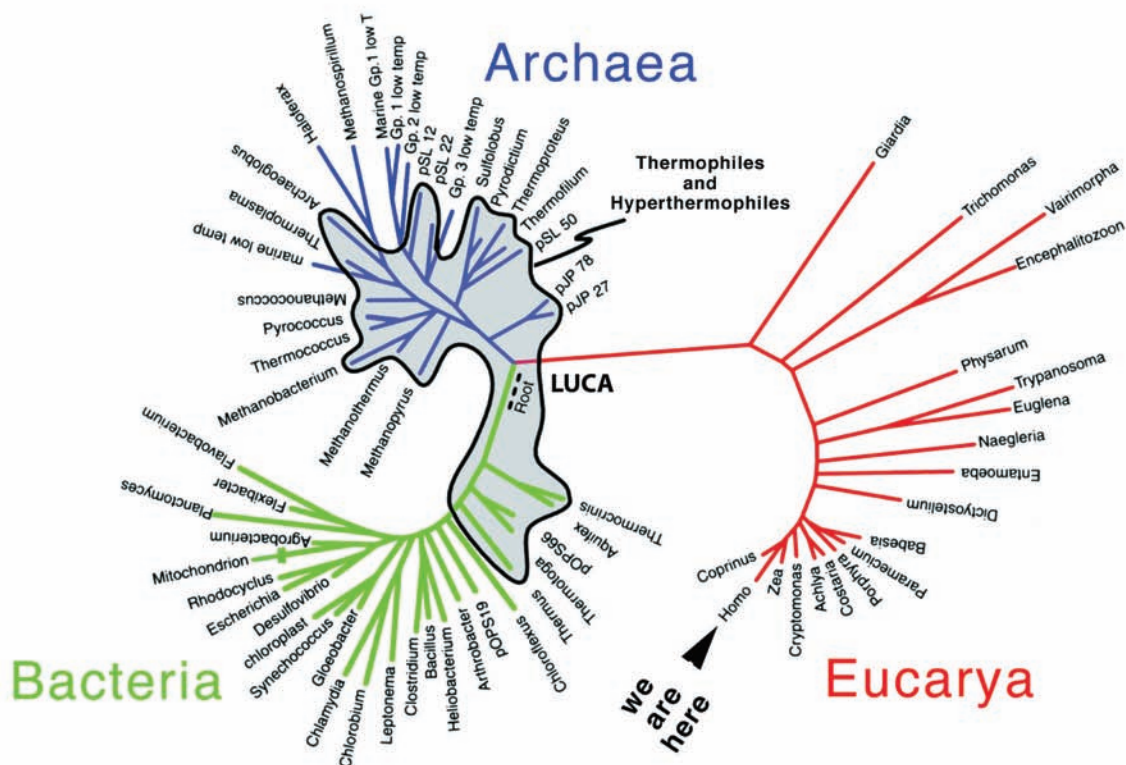


Fig. 4: The Phylogenetic Tree of Life based on comparisons of 16s rRNA sequence of extant organisms [12].

the availability of the biologically active form of iron in the oceans (from soluble Fe^{2+} to Fe^{3+} which forms insoluble precipitates of $\text{Fe}(\text{OH})_3$). The oxygenation also oxidised another biologically active metal, copper from its Cu^+ to Cu^{2+} state [15]. [16] have suggested that this change in the environment may have triggered the development of new metabolic pathways which harnessed the electrochemical potential of the higher oxidation state of copper often in roles previously performed by iron.

Advancements in molecular biology, bioinformatics and elemental analysis over the last decade means that we now have the tools to perform our investigations successfully. [1] observed the similarities in the elements that make up life and its

environment and reasoned that “... man was created from the dust of the Earth.” 150 years on, we are examining both the similarities and the differences in the elements that make up life and its environment and our interpretations will allow us to better understand the origins and the evolution of life. Answering questions like ‘*What is life made of?*’ will help us answer one of man’s most fundamental questions: ‘*What is life?*’

ACKNOWLEDGMENTS

This article is a shortened version intended for a university-wide audience, of a more detailed conference proceedings article [17].

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Selective infiltration of photonic crystal fibres for waveguide arrays

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Photonic crystal fibres (PCFs) can be used as a platform for the study of periodic photonic structures as well as the novel linear and nonlinear physical effects associated with them. The cladding holes in these micro-structured fibres can be infiltrated with a liquid utilising capillary action. This can be prevented in selected holes through the prior blocking of one end, producing periodic photonic arrays in the shape of the infiltration, providing a customised array shape within a low defect, high quality PCF. The coupling pattern of guided light in an input hole redistributing to neighbouring infiltrated holes can be modified through thermo-optic relationships, which, together with non-linear effects resulting from high light intensity, enables the study of novel physical phenomena of both periodicity and non-linearity.

We developed a blocking procedure which, when applied to hexagonal ring Large Mode Area (LMA) PCFs, allowed a single row of holes to be infiltrated by an index matching oil with a well-defined thermal-optic relationship. With laser light guided into a single infiltrated hole and the sample maintained at $55 \pm 0.1^\circ\text{C}$, a linear discrete diffraction pattern was observed in the output intensity distribution, indicative of a one dimensional periodic photonic array.

The investigation of non-linear self trapping at a constant temperature produced results obscured by asymmetric linear coupling. Proposed alterations to the blocking procedure could allow for the formation of more complex infiltration patterns with novel coupling relationships and non-linear effects. Further development can lead to applications in bio-sensing and beam manipulation.

I. INTRODUCTION

Optical fibres have been almost universally deployed in the telecommunications industry for data transmission to take advantage of the bandwidth and low signal degradation that optical transmissions provide. However, the ability to manipulate these beams in a purely optical form has been limited, requiring a conversion of the optical signal to an electrical signal for manipulation, before becoming an optical signal again [1]. This has promoted research into optical beam control and manipulation. The novel effects of materials with periodic optical characteristics provide for such beam control possibilities.

A new type of optical fibre, known as photonic crystal fibre (PCF) has been recently developed [2]. These fibres are formed from a pre-form bundle of silica capillary tubes drawn out under heat. The resultant fibre is fused silica with a micro-structured array of holes as cladding around a core (core defect). There are many structural forms of PCFs

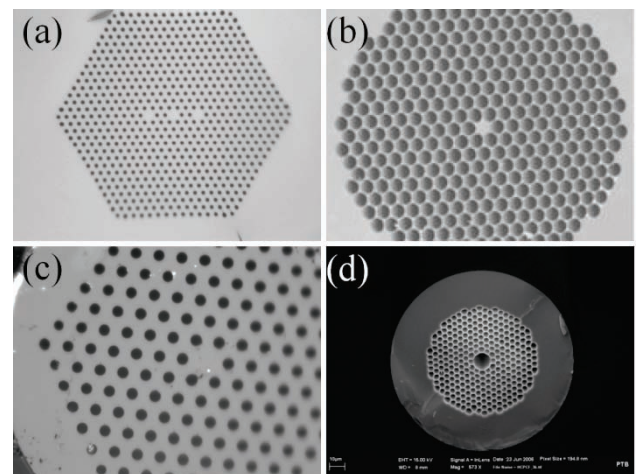


Fig. 1: Structures of photonic crystal fibres with (a) multiple cores, (b) close packed holes, (c) a hexagonal array and (d) a hollow core. Images adapted from [3].

[Fig. 1], and the type used in this experiment is a Large Mode Area (LMA) with a single solid core [Fig. 1(c)]. The holes are continuous through the length of the fibre and are open on each end, thus the holes generally contain air. The holes can be infiltrated with a liquid by immersing one end,

allowing the capillary force to draw up a column of liquid, displacing the air [3].

PCFs can function in a similar way to standard optical fibres, transmitting a signal through the core; however, most of the beam control possibilities come about from the effect of coupling. When light is injected into one of the infiltrated holes, the liquid, being of a higher refractive index than the surrounding glass, allows the hole to act as a waveguide, channelling the light along the length of the fibre [4].

At a glass-liquid boundary, light propagating in the liquid requires a field to extend into the glass to preserve the continuity of the electric and magnetic fields [3]. This is referred to as an evanescent field and decays exponentially with the transverse distance [Fig 2(a), x-axis] from the infiltrated hole. The rate of decay is dependent on the difference between the two refractive indices, the 'refractive index step'.

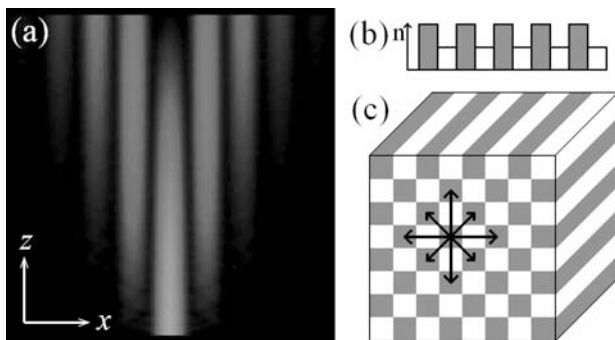


Fig. 2: (a) Coupling effect viewed along the propagation axis of (b) one dimensional, periodic array. (c) The transfer of light (arrows) only occurs between regions of similar refractive indices. Images adapted from [5].

The evanescent field reaches the next liquid channel, so the light field continuously couples to the surrounding waveguides along the length of the fibre [Fig. 2(a) z-axis]. With a small glass section between the holes and a small refractive index step, the transfer of power from one infiltrated hole to adjacent holes can be significant enough to distribute the input light throughout the waveguides, resulting in coupled channels. This is known as discrete diffraction.

Due to the light coupling only between the guiding regions of the fibre, PCFs with different cladding patterns will display different coupling patterns [6] [Fig. 2(c)].

Applications of PCFs

In terms of applications for PCF arrays, it is worthy to mention their potential use in light beam control and as compact bio-sensing devices.

Beam Control

When multiple strands of standard optical fibres are packed together for data transmission, separating material is added to prevent the signal from one strand impacting on the other. In PCFs, this ability to modify a signal by having other waveguides in close proximity can allow for beam routing, duplication and switching, enabling greater throughput, finer control or 'hardwired' passive controls compared with existing systems.

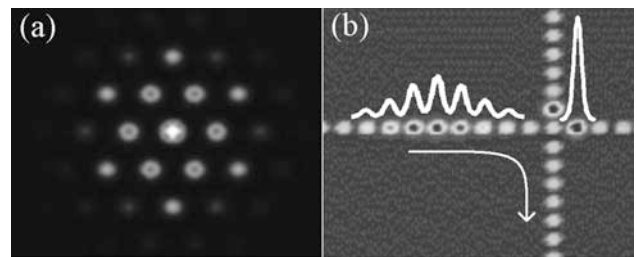


Fig. 3: (a) Theoretical coupling in a hexagonal array enabling beam splitting. (b) Simulation of optical logic gate using a linear network array, enabling beam routing (white intensity profiles added). Images adapted from [7,8].

Beam duplication or splitting can be achieved with an array. The coupling in a symmetrical array provides for identical outputs in holes the same distance from the input hole [Fig. 3(a)]. Under some refractive index step conditions, there is no residual light in the input hole and different array configurations can provide for various division ratios. Relative thermal expansion properties of liquids and silica allow for temperature tuning of the refractive index step, which in turn affects the splitting ratios. This fine control and ability to integrate a beam splitter into a fibre strand is more versatile than conventional, table mounted beam splitters.

These infiltrated arrays show two main properties allowing for sensing or switching possibilities; the expansion of the coupling effect under high temperatures and the contraction under high intensity light. These properties will be explained in-depth later, however they provide for ways of modifying the direction of a beam based on either external conditions (temperature) or the properties of the beam (intensity). A simple linear array could transmit light in the external holes for recombination, however at high intensities, the coupling contracts to

the input hole and the light is rerouted, providing a passive optical power limiter e.g. for laser surgery.

A possibility that requires a variety of cladding patterns is optical logic gates [Fig. 3(b)]. A laser beam incident at an angle over a number of holes in an array can cause the signal to transfer fully from one hole to an adjacent one, travelling across the network of holes. The path at junctions can be affected by the presence of other high intensity beams which impact on the optical properties of the array and decouple sections from the network. Thus the final beam path is affected by interactions with other beams, and a basic logic gate can be constructed. The theory behind these has already been developed with simulations [8] [Fig. 3(b)], and this could be matched by applications.

Bio-sensing

Bio-sensing possibilities for PCFs allow for the optical detection of biological or chemical traces in a compact sensor fibre package.

In standard spectroscopy, the volume of sample required is usually on the same order of magnitude as the optical path length [Fig 4(a), 1cm to 1mL]. An infiltrated PCF enables spectroscopic detection over a longer path length, allowing for more photon-liquid interaction and a higher absorption signal using far less liquid [Fig 4(b), 10km to 0.2mL]. This could be expanded to using coupling relationships for sample identification. A limited array PCF would benefit identification as theoretical models for two dimensional coupling assume a perfectly isotropic and infinite array with no core defect [7]. However, experimentally, these two dimensional arrays can lead to highly asymmetric coupling, which can lead to a greater variation between otherwise identical arrays. This should be lessened in a one dimensional array due to a more limited scope for impact of spacing irregularities and simpler coupling relationships with only two waveguides directly coupled to any third. This would make the distinction between the impact of normal structural irregularities and the identifying signal of the sample liquid.

PCFs are already being applied in bio-sensing applications [9] [Fig. 4(c)], with the use of a PCF for continuous flow, DNA specific capture and optical detection. DNA capture was provided by pre-treating a fibre with various polymers and chemicals. The optical detection utilises absorption from the central hollow core, however investigation could provide for a linked network with specific molecules

captured in each hole, allowing detection of many components though the changes to the coupling relationship. With more PCF structural options, more bio-sensing applications should become available.

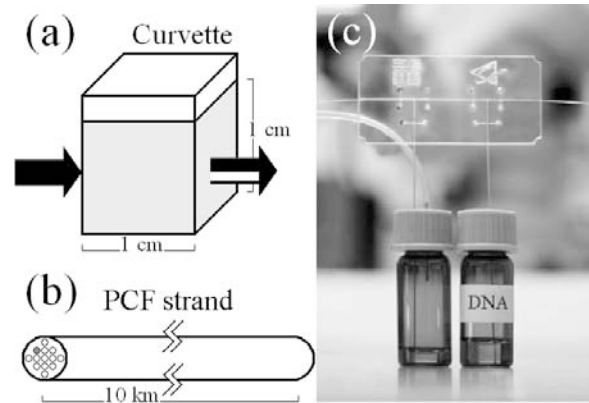


Fig. 4: Bio-sensing applications of PCFs, such as absorption spectroscopy with a longer path length and decrease sample volume in (b) an infiltrated PCF compared to (a) a standard cuvette. (c) Lab-On-Chip DNA sensor using a fully infiltrated PCF. Images adapted from [9].

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Selective Infiltration

Although various designs of PCF can be created for specific applications, these often have a higher defect rate than commercially available fibres with high production volumes, have long lead times and are expensive. These defects can mask the identifying changes for sensing or can distort the signal in beam manipulation. If a waveguide pattern could be produced within the structure of a common PCF, both the low defect rate and array shape customisation can be achieved.

A method to achieve this is the infiltration of only selected cladding holes within the PCF. The selective infiltration of a single row, a network of

holes [Fig. 5] or any desired geometry within a fibre has similar coupling properties to a fully infiltrated fibre in that custom shape; the un-infiltrated holes do not affect the overall liquid to liquid coupling relationship.

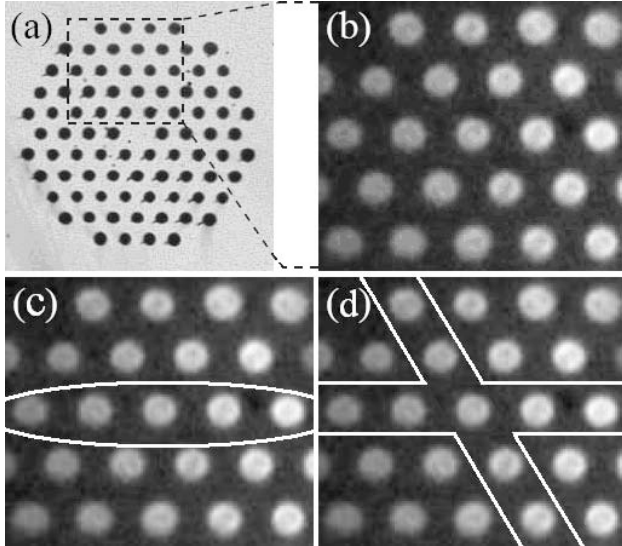


Fig. 5: The un-infiltrated face of a PCF (a) is completely infiltrated (b) creating an array of waveguides. Single line (c) or network (d) infiltrations provide for more application possibilities. Images adapted from [3].

A single line infiltration will act as a proof of concept of the procedure. This simple shape has been produced in structurally manufactured arrays, so provides well defined, expected, experimental coupling patterns. The selective infiltration array can be imaged under various input intensities and temperatures and compared with responses found by groups using other types of arrays. This serves as allows a method of judging the success of infiltrated structures in comparison to the fabricated arrays.

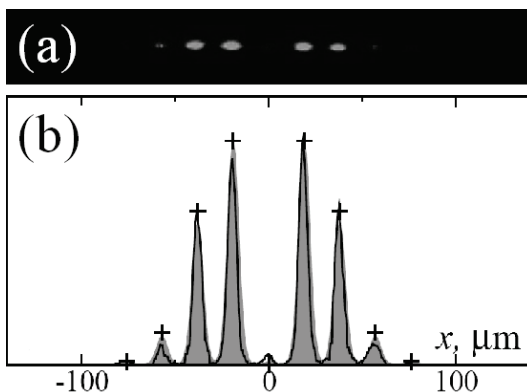


Fig. 6: Linear discrete diffraction through a 1D periodic array, (a) final output and (b) intensity profile. Images adapted from [5].

The primary identifying response of a manufactured line array, e.g. LiNbO_3 waveguide

array [5], is linear discrete diffraction [Fig 6(a), (b)]. At a critical, temperature dependent, propagation length, the central input waveguide is no-longer the peak intensity output. A symmetrical linear array will display two maximum peaks in the channels adjacent to the input hole, which contains an intensity minimum [10]. This is a distinctive and identifying feature of linear arrays, to be used for comparison with the coupling in selectively infiltrated PCFs while the non-linear expected result is dealt with in Section 4.

II. EXPERIMENTAL ARRANGEMENTS

Blocking

During infiltration, one end of the photonic crystal fibre is immersed in the sample liquid and the air contained within the cladding holes is displaced by the infiltrating column of liquid. Selective infiltration is achieved by the application of a viscous blocking liquid to one end of selected holes prior to immersion of the opposing end, thereby preventing the displacement of the contained air by liquid. The infiltration pattern produced is then the inverse of the pattern of blocked holes, the ‘blocking pattern’ [Fig. 7, setup].

The PCFs used consist of seven hexagonal rings of holes layered around a fused silica solid core (Crystal Fibre A/S LMA-15 and LMA-20) [Fig. 7, inset]. The cladding holes are approximately $4.8 \mu\text{m}$ and $6.3 \mu\text{m}$ in diameter with a periodicity (hole spacing) of approx. $9.8 \mu\text{m}$ and $13.2 \mu\text{m}$ for LMA-15 and LMA-20 respectively. Samples were cleaved by a fibre cutter to approx. four centimetres long to match the length of the fibre holder, although the process is applicable to various fibre lengths.

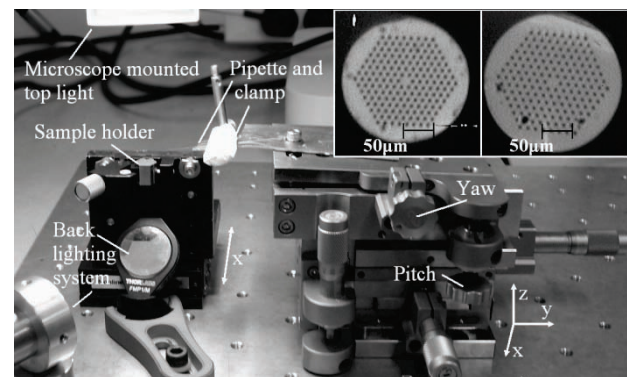


Fig. 7: Experimental arrangements for blocking. Inset of LMA-15 (left) and LMA-20 (right) samples used. The fibre samples are held vertically on a single axis translational stage. A 5x zoom microscope with

a long focal length and a camera is used to image the exposed face of the sample and the blocking process. Additional illumination to highlight the different optical properties of the blocked and unblocked holes allows the blocking pattern to be confirmed. The light is incident on the lower face of the sample, ‘back lighting’, and/or incident on the exposed sample face, ‘top lighting’. A ‘micropipette’ formed from a conventional optical fibre drawn through under heat and snapped is used for applying the blocking liquid. It is clamped onto a five axis translational stage to allow for fine spatial positioning of the pipette respective to the sample.

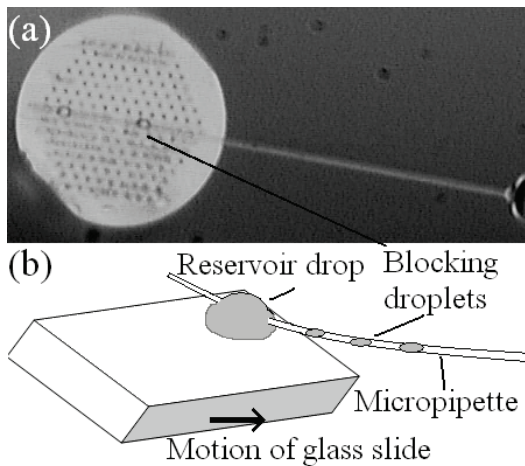


Fig. 8: Blocking procedure including (a) drop application and (b) drop formation

The blocking liquid was transferred from a drop on a glass slide to the micropipette, in a manner that produced a string of well-separated, small drops near the pipette tip [Fig. 8(a)]. The pipette is drawn through a drop of liquid, located at the edge of the glass slide, while the tip is bent upwards due to the angle the slide is held at [Fig. 8(b)].

The blocking process involved the pipette being aligned parallel to a line of cladding holes and then lowered onto the fibre face, covering a partial line per application. To prevent covered holes reopening, the blocking liquid must not readily infiltrate into the cladding holes while still forming suitably sized drops. Castor oil was found to be suitable. A red dye suspension was added to provide additional absorbance and scattering, further distinguishing the blocked and unblocked areas.

Infiltration

For infiltration, <0.1mL of infiltrating liquid is drawn into a 3 mL syringe, which is then positioned upside down. The unblocked end of the fibre sample is inserted into the liquid reservoir in the syringe tip and left to stand for approx. 20 minutes. In the blocked holes, the liquid rises a short distance before the pressure of the air being compressed within the hole prevents further capillary rise. After infiltration, the fibre is cleaved at both ends to remove the blocking tip and the immersed tip, resulting in a 2cm long selectively infiltrated sample.

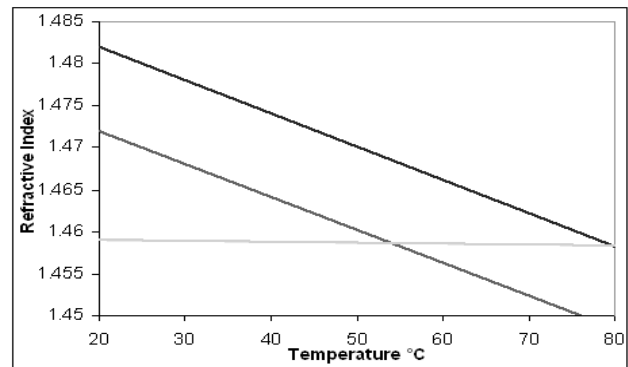


Fig. 9: Temperature dependence for index matching oils, $n=1.47$ (grey) and $n=1.48$ (black) with a reference line of fused silica (light grey) [11].

The infiltrating liquids used are index matching oil $n=1.4700\pm0.0002$ and $n=1.4800\pm0.0002$, (Cargille Labs Series A-certified refractive index liquids) which have a well defined, linear relationship between the refractive index and temperature [11], as shown in Fig. 9.

The higher refractive index of the liquids allows the infiltrated holes to act as waveguides, and the different thermo-optic coefficients of the liquid and glass [Fig 9, slopes] allows the refractive index step to be decreased by increasing the temperature of the fibre. This promotes the coupling of light between the holes and is utilised in the following section.

Coupling

The infiltrated samples are mounted in two grooved brass plates within an oven, temperature controlled to $\pm 0.1^\circ\text{C}$ [Fig. 10, inset]. Light of 532nm wavelength from a Verdi V-5 laser is injected into a single hole in the PCF sample via a single mode, polarisation maintaining input fibre, with a mode of approx. $5\mu\text{m}$. The input fibre can be moved independently of the infiltrated samples, which allows the incident light to be injected in a single hole, given the comparable mode and cladding hole sizes. Covering this is a thermally insulated oven

cover with a glass window pressed on the output end of the samples [Fig 10, inset]. A drop of the infiltrated liquid is placed on the input-sample butt-couple and on the sample-glass contact to ensure minimum imaging and coupling losses.

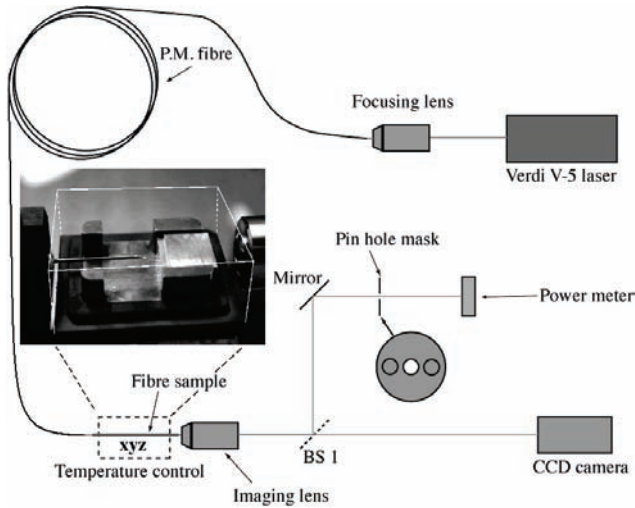


Fig. 10: Experimental arrangements for coupling measurements. The inset displays the oven covering as white lines with the input fibre tube (left) and PCF sample (right). Images adapted from [3].

The output light is collected by an imaging lens and then split into beams to both a CCD camera and through a pin-hole mask to a power meter. The imaging lens was adjusted so the pin-hole mask exclusively transmitted light from the input channel to be measured by the power meter. Sequential images of the coupling intensity distribution were taken at various temperatures and laser power levels to investigate the linear and non-linear effects. The input hole was also varied to minimise the impact of edge effects and lattice defects.

III. RESULTS

Blocking technique

The blocking technique was successfully developed to allow for the formation of a one dimensional infiltration pattern within the cladding hole lattice of photonic crystal fibres. This method is repeatable and scales from larger (LMA-20) to smaller (LMA-15) fibre samples.

The reliability with which the blocking pattern was replicated in the infiltration is high, although additional, undesired infiltrations do occur [Fig 11(d), bottom left]. These were usually sufficiently displaced from the infiltrated line to

produce only a negligible impact on the coupling pattern.

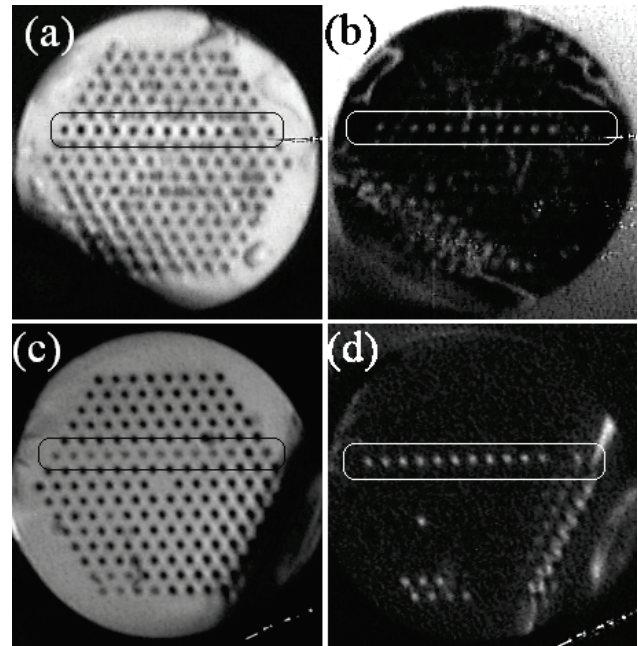


Fig. 11: LMA-20 sample. Fibre blocked with red dyed castor oil for single line infiltration, shown (a) top lit and (b) back lit. The same fibre infiltrated with $n=1.48$ oil is shown (c) top lit and (d) back lit.

A visual inspection of the infiltration pattern under a microscope produced false positives, when excess liquid on the cleaved face partially infiltrates a hole, and false negatives, when the infiltrated liquid receded too far back into the hole to be identified. This resulted in different infiltration patterns when each end is viewed under a microscope. As the coupling process is less affected by these end effects, it was necessary for each sample to be put through the coupling setup to determine the successful blocking of a sample and the validity of new patterns or techniques.

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More complex blocking geometries may also be formed using this blocking method. Multiple parallel

infiltrated lines; either adjacent or separated by blocked regions is a trivial extension of the single line process. Closed, hollow shapes, such as rings or boxes, have been attempted but were not successful due to it being energetically unfavourable for a drop to be situated on the very tip of the micropipette. As the blocking liquid spreads along the length of the pipette where it touches the fibre, fine control is lost. This is not an issue when a whole line is to be blocked but prevents controlled, partial line blocking. This same problem exists for two dimensional networks. The formation of simple solid shapes, such as solid triangles or trapezoids should avoid this problem and be feasible with minor modifications to the procedure. Multiple rotations of the sample in the fibre holder would be required to bring the next flat edge into a region the pipette can reach without crossing the shape.

Temperature response

For the successful formation of periodic arrays within PCFs, utilising selective infiltration, the coupling output must match that produced by similar, fabricated arrays. In this case, the single line infiltration should display similar linear discrete diffraction as seen in LiNbO_3 waveguides [5] [Fig. 6(a)]. This coupling is indicative of an extended, symmetrical, one dimensional array with a small refractive index step and a single input site excitation.

At temperature up to 53°C , the refractive index step between the glass and the infiltrated liquid keeps the input beam contained to the input hole [Fig. 12, 53°C]. From an initial refractive index step of $\Delta n = 0.011$ ($n_{\text{oil}} = 1.470$, $n_{\text{glass}} = 1.459$) at 25°C , the refractive index step decreases by approx. $-3.83 \cdot 10^{-4}^\circ\text{C}^{-1}$ for every degree above 25°C due to the disparity in thermo optic coefficients; $-3.95 \cdot 10^{-4}^\circ\text{C}^{-1}$ for oil [4] and $-1.2 \cdot 10^{-5}^\circ\text{C}^{-1}$ for glass [9].

As the temperature is elevated, the lower refractive index step reduces the rate at which the evanescent field between the infiltrated holes decays and allows more energy to be coupled outwards; however the peak intensity remains at the input site [Fig. 12, 54°C]. It is worth noting that the size of the cladding holes in the LMA-20 allows the propagation of non-fundamental modes. These modes couple ‘faster’ than the fundamental mode, resulting in two or more intensity lobes per infiltrated hole at the edge of the fundamental mode coupling.

At $55.0 \pm 0.1^\circ\text{C}$, a symmetrical intensity distribution with two peak intensity lobes adjacent to the input hole is produced. This is indicative of linear discrete diffraction [Fig. 12, 55°C]. The low refractive index step allows almost all of the light to be coupled away from the central, input channel. This clearly matches the output of fabricated linear arrays from other groups [Fig. 6(a)].

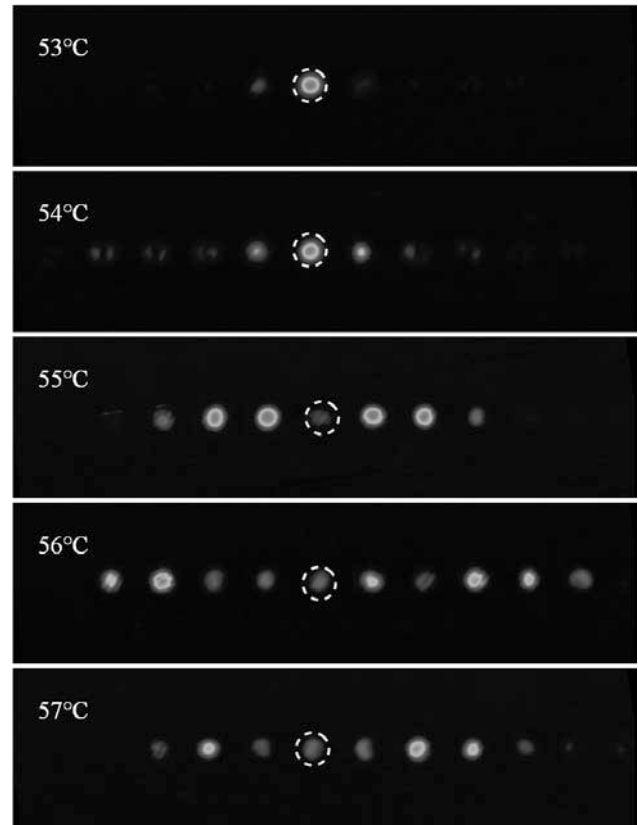


Fig. 12: Coupling intensity distribution for a single line infiltration of $n=1.47$ in a LMA-20 sample over a 53°C to 57°C temperature range at constant input power. Input hole circled.

As the temperature is increased further, the beam continues to spread through the array [Fig. 12, 56°C and 57°C]; however the symmetry is quickly lost due to the edge effects of the array extending further to the left than to the right.

A single line infiltration within a photonic crystal fibre has been shown to display linear discrete diffraction in a manner characteristic of a one dimensional periodic photonic array. The irregularity and edge effects in the array mainly affect the symmetry at higher temperatures when the refractive index step is smaller. This allows the beam to spread out further through the array, leading to more coupling relationships and a greater potential for irregularities to cause asymmetrical coupling. However, the general validity of this

approach for small array extensions is supported by the results.

IV. NONLINEARITY

Optical systems dealing with low light intensity are considered to be linear to a first order approximation and to follow the principle of superposition [12]. The system response at any intensity can then be broken down into a sum of response seen at lower levels. Necessarily, the optical properties of the propagation medium are independent of the input power, so a transmitted beam has no effect on the transmission material, hence it does not affect light propagating through the same region.

However, when light of a high intensity propagates through a medium, the large scale interactions between photons and the atoms of the material causes localised changes to the optical properties of the media [4]. In this way, the first order approximation falls down and the system is considered to be non-linear; the act of transmitting light impacts on light propagating through the same region, allowing a sustained beam to self-modulate.

The optical Kerr effect, whereby the local refractive index of the propagation medium becomes a function of light intensity at high input levels, is of particular interest in this experiment. In most liquids, the effect is ‘negative’ [4], an inverse relationship between refractive index and intensity [Fig. 13(a)]. This occurs due to the localised heating effect from the absorbance of energy from transmitted light. The thermal expansion of the liquid decreases the refractive index at a rate given by the thermo-optic coefficient.

As the laser beams have a non-homogenous intensity profile, the refractive index encountered will vary across the beam. The speed of light propagation varies inversely with refractive index so a plane wavefront will be distorted by the different speeds. For a Gaussian cross-sectional beam, the central, peak intensity light is sped up relative to the edges, resulting in the ‘self-defocusing’ of a plane wavefront [Fig 13(b)]. A wave peak thus broadens faster from nonlinearity than occurs due to linear diffraction.

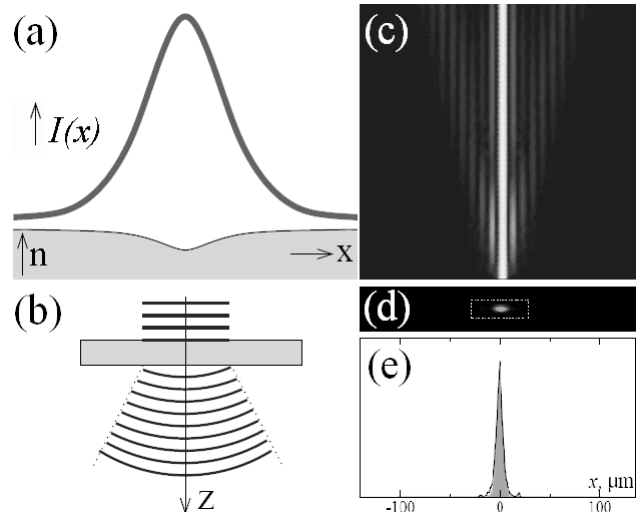


Fig. 13: (a) Kerr effect causing the refractive index of the propagating medium (grey) to change and (b) a self-defocusing effect on plane waves in a bulk nonlinear medium. A spatial soliton is formed from nonlinear self-trapping in a periodic structure, shown along (c) the propagation axis with (d) the final output and (e) intensity profile. Images adapted from [3,5].

However, when high intensity light is transmitted through material with a negative thermo-optic coefficient in a periodic photonic array, a distinct phenomenon is displayed, whereby the wavefront is prevented from dispersing, see Fig. 13(c-e) in contrast to Fig. 6. This occurs when the refractive index of the input hole is reduced by the Kerr effect, leaving the waveguide surrounded by higher refractive index regions. These act as Bragg reflectors, confining the beam to the input channel and preventing the light coupling out. The ‘self-trapping’ effect produces a spatial soliton [6] which, due to their non-dispersing, self-reinforcing propagation, are highly applicable for signalling, transmission, and beam control.

In PCFs, the confinement of the input light to small cladding holes allows high light intensities to be achieved with moderate laser power levels. The coupling relationship in these fibres can be ‘tuned’ both thermally through linear discrete diffraction and optically through non-linear self trapping.

The relatively high thermo-optic coefficient of the infiltrating liquid [11] and the sensitivity of the coupling to a small change in temperature, [Fig 12, 54°C-55°C] made a strong thermal non-linear response expected for moderate input power. However, investigations into self-trapping were hindered by difficulties in re-producing a selectively infiltrated fibre with reasonably symmetrical coupling. Asymmetrical coupling relationships

obscure the contraction of the wavefront in the move from linear discrete diffraction to self-trapping. Refinement of the blocking and infiltration procedure should allow for further investigation of nonlinear effects in such infiltrated fibres.

V. CONCLUSIONS

Photonic crystal fibres provide a low cost, 'tuneable' platform for the study of multiple aspects of periodicity. Liquid infiltration allows for simple modification of the refractive index step as well as investigation of sample liquids. Non-linear responses can be achieved using lasers of moderate power levels. The key to the investigation is determining the relationship between thermal or optical inputs and expected intensity outputs. Although commercially available PCFs are low in defects, the impact of slight variations in hole positions, as well as the core and edge effects, results in complicated coupling relationships in fully infiltrated fibres. Limited infiltration can reduce the impact of lattice irregularities, simplifying the determination of particular cause for small changes to the coupling output.

Selective infiltration was achieved for a single line of holes within hexagonal ring, solid core PCFs (LMA-15, LMA-20). Thermal tuning produced the one-dimensional linear discrete diffraction seen in individually fabricated waveguide arrays. Identification of a nonlinear self trapping response through a contraction of the coupling at elevated input levels was made problematic by asymmetric linear coupling. A 1D array contained within an optical fibre package with a liquid medium that can be varied provides for greater bio-sensing and beam control applications than standalone, fabricated arrays with a defined transmission medium.

The blocking methodology developed provides a basis from which other non-trivial infiltration patterns can be produced after slight modifications to the process. Geometries with novel coupling relationships can be investigated in the linear and non-linear input regions utilising the test bed developed for this report. The ability to modify the shape, composition and refractive index step of periodic arrays, within a standard PCF structure, should encourage the development of further applications.

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Fluency - Friend or foe for learners? An examination of whether the perceptual fluency effect occurs for complex text material

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The perceptual fluency effect refers to the finding that people base their judgments about future memory performance on the ease with which material is comprehended during learning. Under some conditions, an illusion of comprehension may occur, leading to an overestimate of ability to recollect studied information. This experiment tested 95 participants to examine whether the perceptual fluency effect can lead to an illusion of knowing about complex text material. In Experiment 1, 80 participants studied six text extracts. Fluency was manipulated via inclusion of familiar but only tangentially-related material aimed at fostering a level of ease which might lead to an illusion of knowing. There were three presentation conditions, manipulated between-subjects: In the control condition, extraneous material was absent, and participants studied only baseline texts; in the separated condition, extraneous material was presented in a paragraph preceding the baseline texts; in the integrated condition, extraneous material was incorporated into baseline texts. Prior to study, participants provided ease-of-learning judgments (EOLs), estimating how easy they believed the material would be to learn. Following study, participants provided judgments of learning (JOLs) either immediately or following a 24-hour delay, estimating how they thought they would perform on subsequent tests of the material. Participants then took comprehension tests to measure their accuracy. Experiment 2 was identical but used a within-subjects design: 15 participants studied six texts, two from each of the three fluency conditions. Results showed that the presence of extraneous information misled learners about their level of understanding, with poor calibration between JOLs and accuracy in both experiments, but particularly where the extraneous information was interleaved or integrated with the basic text. Further analyses revealed that participants not exposed to extraneous information were able to answer more high-level inference questions than those who were exposed to such material. These results have implications for educators, particularly in the design of psychologically-appropriate coursework for students, and in instructing students to recognise textual cues which can mislead metamnemonic monitoring.

When studying for exams, many students experience difficulty predicting their likely performance (Benjamin, Bjork & Schwartz, 1998). Students often get frustrated: They believe they have studied effectively and expect to perform well, make a judgment that their memory of the material is sufficient to cease revision, and are disappointed when they perform more poorly than anticipated on the subsequent test (Shaddock & Carroll, 1997). Laboratory studies corroborate these observations: Evidence suggests most students stop self-paced study too soon, and consequently attain test results which are both inadequate *and* inconsistent with initial predictions about their likely performance (Mazzoni, Cornoldi & Marchitelli, 1990). Evidently, then, the reading an individual takes of his or her capacity to recall studied material can be as

important as his or her actual comprehension of that information (Benjamin & Bjork, 1996).

If learners are to perform effectively in testing situations, they need a range of monitoring strategies to assess their cognitive *competence*, in addition to the cognitive strategies used to facilitate learning and task completion (Flavell, 1979). These monitoring strategies—termed ‘metacognitive skills’—include activities such as planning and regulating one’s cognitive processes during learning, setting goals and selecting study strategies, and monitoring comprehension (Brown, Bransford, Ferrara & Campione, 1983). Arguably the most important metacognitive skill, however, is making accurate mnemonic judgments about the objective state of one’s memory (King, 1991). Because metamnemonic judgments about learning and future

performance are linked to the amount of cognitive effort a student will employ when studying a particular topic, the accuracy of such predictions is inextricably related to a student's likelihood of success on a subsequent test (Nelson & Narens, 1992). Ultimately, the effective monitoring of memory is critical for achieving optimal control of subsequent study, affecting the strategic regulation of learning and remembering processes and, therefore, memory performance itself (Koriat & Goldsmith, 1994). Accordingly, understanding the variables which influence effective memory monitoring is of prime importance in designing psychologically-appropriate coursework and study strategies for students (Benjamin, 2003). If a relationship exists between metamnemonic monitoring and later recall, then improving students' ability to assess their mnemonic capacity should enhance students' actual performance.

This research aims to examine whether text-based cues can influence and mislead metamnemonic monitoring, and consequently affect learning and performance. It will investigate whether perceptual fluency—or the familiarity or ease with which text can be comprehended during learning—can lead students to misdiagnose what they know about complex text. Hitherto, fluency's pervasive misleading influence has largely been studied using list-learning and cue-pair associates paradigms. Investigation of whether the perceptual fluency effect persists for complex text material will be carried out using a methodology developed specifically for this study. The research seeks to answer the question: does the presence of familiar extraneous material *aid* learners in helping them comprehend, or does it *mislead* them by inducing an illusory belief about comprehension?

INVESTIGATING METAMNEMONIC MONITORING

To date, judgments of learning (JOLs) have been the index most commonly used to investigate metamnemonic monitoring. JOLs are metacognitive judgments in which one predicts the likelihood of remembering an item on a criterion test (see, for example, Nelson & Narens, 1992). Several extraneous variables influence JOL accuracy. Research indicates that delaying JOLs for 30 seconds after study increases their accuracy relative to JOLs made immediately after study (Hertzog et al., 2003); this effect persists even when JOLs are delayed for 24-hours (Dunlosky & Nelson, 1994; Shaddock & Carroll, 1997). When JOL is delayed,

the information used to make such estimates involves a target retrieval attempt that is highly diagnostic of their subsequent target retrieval attempt at the time of test (Finn & Metcalfe, 2007; Koriat & Ma'ayan, 2005). However, there is less agreement about what information people use to make immediate JOLs. Information in short-term memory (Rawson & Dunlosky, 1992), an ease of processing evaluation based on ease of encoding (Begg, Duft, Lalonde, Melnick & Sanvito, 1989), or normative difficulty of the items (Koriat, 1997) have been proposed as candidates.

Most research favours the view that JOLs are heuristics which are inferential in nature (e.g. Koriat, 1997), and that they are based on a variety of cues pertaining to the task, and on an individual's belief about how these cues relate to subsequent test performance (Matvey, Dunlosky & Guttentag, 2001). Some cues are information-based, mediated by deliberate, analytic inferences that rely on retrieved memories. Other cues are experience-based, relying on a variety of internal, mnemonic cues which operate below full consciousness to influence and shape subjective experience (Koriat, 1997). One high impact cue is the ease or fluency of processing of a presented item (Begg et al., 1989). Because the inferential view holds that metamnemonic judgments are not based directly on memory traces, it predicts that JOLs may be systematically erroneous in some cases. Hence, it envisages situations in which judgments of memorability and later performance may be correlated negatively (Schwartz et al., 1997). Indeed, evidence supporting this view comes from observations documenting dissociations between subjective and objective indices of memory performance, such as poor JOL and accuracy calibration (Koriat & Ma'ayan, 2005).

The current study focuses on the notion of perceptual fluency as a mnemonic cue underlying metamnemonic judgments (Kelley & Jacoby, 1998; Koriat & Bjork, 2005). Perceptual fluency—the experience of fluent or facile processing—gives rise to predictions of future performance that are somewhat inflated (Benjamin et al., 1998). In some circumstances, using perceptual fluency as a heuristic for predicting future retention is sensible because more well-known material will tend to be recallable in the future. However, it is sometimes a poor predictor: For instance, Benjamin et al. (1998) have shown that more familiar studied material is processed with greater ease or speed. Learners use this speed as a heuristic to predict that the material is more likely to be recallable on a future test.

Consequently, they devote less study time to learning such material, misjudging their understanding of the relevant material (Koriat & Bjork, 2006). The same is true of the bias arising from word frequency (Begg et al., 1989; Greene & Thapar, 1994).

This body of research suggests that individuals predict mnemonic success for items that are easiest to process in the manner demanded by the task. Overcoming the influence of perceptual fluency requires a shift to an analytic mode of reasoning, and a correct attribution of the feeling of fluency to its cause (e.g. speed of processing). The drawback of using such heuristic judgments is that their correctness arises from associations that are correlational rather than causal. Specifically, differences in perceptual fluency do not *cause* items to be differentially memorable, though students studying for an exam may believe so. In fact, students' claims that they have studied sufficiently for exams should be treated with scepticism; the design of lecture and textbook materials which are initially easy to understand may actually hinder student learning. There are reliable findings suggesting that perceptual factors that *impede* fluency such as increasing difficulty or cognitive effort (Butler, Marsh, Goode & Roediger, 2006; Alter, Oppenheimer, Epley and Eyre, 2007) improve memory accuracy, by activating more analytic forms of reasoning during initial processing. Conceptual factors, too, such as varying the coherence of prose so as to increase readers' processing effort (Harten, 1999) improves the accuracy of assessment of their text comprehension.

The current studies investigate the generalisation of these findings to more naturalistic material: text extracts that might be used in the classroom. Currently, it is unclear whether the perceptual fluency effect persists with the complex text material that is routinely used in educational settings. Empirical studies supporting the fluency effect's existence have been readily applied to education, notwithstanding hefty criticisms launched over the ecological validity of the research paradigms employed (Koriat & Goldsmith, 1994). Principally, this criticism pertains to the use of list-learning and paired-associate tasks to investigate perceptual fluency, using simple, common, and impoverished material compared to text-based materials (Robinson, Johnson & Robertson, 2000). Generalisation to educational contexts requires the use of appropriate materials.

To date, the most common methodology psychologists have used to manipulate fluency within text is to degrade the grammatical structure, logical coherence, or physical presentation of the material. For instance, Hertzog et al. (2003), across four experiments, had participants read texts, predict their performance for each one, and take tests. Fluency was manipulated by having participants read texts that varied in coherence; the authors altered either: the causal relatedness across sentence pairs, the structure of sentences within paragraphs, or the structure of paragraphs by deleting letters from some words. Results showed that prediction magnitudes increased as coherence increased, suggesting that predictions were based on processing ease and fluency. Similarly, Harten's (1999) study manipulated the logical coherence of history texts, and found that JOL prediction magnitudes increased as the text's lucidity increased. Memory performance, however, was not consistent with the memory predictions in either of these experiments. In Harten's study, degrading textual coherence activated a more analytic form of reasoning and improved metamnemonic monitoring.

The approach adopted in the current study investigates the effect of perceptual fluency caused by a different kind of facility of processing from the structural ease studies described above. It is based on the notion that pre-existing knowledge, i.e. familiar material such as tangentially-related examples and anecdotes, can also lead to a misleading fluency about one's understanding of newly learned material. When people have to learn new technical information, of some degree of difficulty, extracted from high-quality tertiary-level textbooks, the presence of irrelevant but familiar material may lead them to believe they *understand* the key technical concepts in the text. Does old but irrelevant information lead to greater miscalibration of judgments and performance on newly learned material than the absence of such irrelevant information? Further, if such miscalibration occurs, is it more likely to occur when the irrelevant material is embedded within the new information, or when it is presented *en bloc* separately from it?

We expect, then, that if perceptual fluency caused by familiar but irrelevant material occurs, there will be poorer calibration between JOLs and subsequent memory accuracy for the exposed conditions, relative to a condition in which participants are not exposed to such material. Furthermore, when material can be more easily discounted, as when the irrelevant material is separated from the new

material, calibration may be less impaired than when the material is integrated with the to-be-learned information.

We also examine the effect of delayed or immediate JOLs. Consistent with previous research, we expect that when JOLs are made *immediately* after study, miscalibration will be more marked than when JOLs are provided after a 24-hour delay.

Finally, we also look at the depth of understanding of the new material, by comparing memory accuracy for more superficial aspects of the text, compared to deeper, more inferential understanding. Conditions that lead to fluency and thus to memory illusions may affect only deeper aspects of understanding, leaving memory intact where verbatim information is assessed.

EXPERIMENT 1

Method

Participants

Eighty English-speaking individuals (47 female; 33 male) took part in the experiment. Over half were undergraduate psychology students from The Australian National University who participated for course credit; the remaining 37 were recruited via advertisement on university community notice boards. Due to the textual complexity of experimental materials, the results of non-native English speakers were excluded from final analysis. Mean age was 23.3 years ($SD=7.506$), with a minimum age of 17 years, and a maximum of 61 years. 60 (75%) were currently studying at a tertiary level, 15 (18.8%) had completed a tertiary undergraduate degree, and 5 (6.2%) had completed only secondary level studies.

Materials

A set of six technical difficulty- and length-matched 'baseline' texts was compiled, adapted from introductory-level tertiary textbooks. The texts covered a range of different topics, including euthanasia, drug abuse, terrorism, nuclear energy, tsunamis, and climate change. Six corresponding comprehension tests were created, containing 10

questions each; tests consisted of 4 questions which could be answered verbatim by remembering words in the text; 4 comprehension questions whose answers could be found in the text, but which required a level of understanding of the material; and 2 high-level inference questions whose answers were not directly stated but required deductions to be drawn from the text. Participants were randomly allocated to one of three experimental conditions – control, integrated, and separated. The control group studied *only* base texts; the separated and integrated group studied texts which included the whole of the base texts plus extraneous information. This information consisted of easy-to-read familiar material, designed to elicit the perceptual fluency effect, gathered from magazines and popular websites, and was identical across experimental conditions. It included well-known topical examples of the text's issues, which would not, however, aid understanding of the text that was to be learned. For instance, in the text on Nuclear Energy and Radiation, the following anecdotal material was inserted: *Stories like 'Sadako and her Thousand Paper Cranes' show that the bomb's radiation still causes leukaemia almost 60 years after the bomb was dropped.* In the integrated condition, the extraneous material appeared interleaved appropriately among the sentences in the base text. In the separated condition, the extraneous material was presented in an isolated paragraph which preceded the base text.

Design and Procedure

This experiment was a 3 (perceptual fluency condition) x 2 (immediate or delayed JOL) between-subjects design. Participants were tested individually or in small groups. Prior to the experiment, participants were instructed that they were engaging in an experiment about students' learning strategies, which would involve studying six texts, making judgments about their likely performance on a subsequent test of the materials, and completing associated comprehension tests. Participants were informed that they could be tested on any of the material presented, to ensure that those in the separated condition did not discount or ignore the extraneous material. Text order was counterbalanced across conditions, to eliminate text or fatigue effects.

Condition		Immediate JOL		Delayed JOL	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	EOL	58.14	19.35	62.55	12.35
	JOL	63.93	15.08	52.77	10.69
	Accuracy	68.15	9.61	52.62	8.03
	Calibration	-4.23	14.70	-0.15	7.27
Separated	EOL	59.12	16.70	55.06	11.64
	JOL	60.90	10.12	37.24	18.81
	Accuracy	45.10	15.18	34.62	13.54
	Calibration	15.79	13.39	2.63	10.46
Integrated	EOL	60.51	6.48	63.29	16.62
	JOL	63.91	9.83	52.74	17.15
	Accuracy	54.04	10.56	34.29	14.08
	Calibration	9.87	8.83	18.45	13.76

Table 1: Mean percentage and standard deviations for EOLs, JOLs, accuracy and calibration scores for the three perceptual fluency conditions, calculated in both the immediate and delayed JOL conditions

Pilot testing revealed ten minutes of allocated study time was sufficient for participants to achieve approximately 50-60% accuracy on the subsequent test; hence, across conditions, participants were given ten minutes to study the base texts. Because of the extra material to be read in the integrated and separated conditions, these participants were given an additional three minutes' study duration, for a total of 13 minutes' study time.

Participants were allowed 30 seconds to scan each text, presented on a separate page of a booklet, before making an ease of learning judgment (EOL) on a scale of 0-100%, indicating how easy they believed the material would be to learn. They then studied the first text in the condition to which they had been assigned. Following this, half the participants (Immediate JOL group) provided an immediate judgment of learning (JOL), indicating on a scale of 0-100% how well they thought they would perform on an upcoming test of the material. After studying and providing EOLs and JOLs for three texts, participants completed the three associated comprehension tests, presented on separate pieces of paper with separate headings. Thereafter, they repeated the process with the remaining three texts. A maximum of ten minutes was allowed to complete each test. The remaining half of participants (Delayed JOL group) studied and made EOLs for the six texts consecutively, returning 24-hours later to provide delayed JOLs and complete comprehension tests.

Results

Completed tests were graded for accuracy according to a standard marking rubric; half marks

were awarded for answers which envisaged a clear understanding but were nonetheless incomplete.

A between-groups 2 x 3 factor *ANOVA* was conducted to explore the impact of perceptual fluency condition and retention interval (immediate or delayed JOL) on average EOL and JOL estimates, accuracy, and calibration.

Judgments of Learning: There was a statistically significant main effect for both perceptual fluency condition [$F(2, 77)=3.819, p=.026$, partial $h^2=.94$] and retention interval [$F(1, 79)=23.77, p=.000$, partial $h^2=.243$] on JOLs. Post-hoc comparisons indicated that the control group's mean JOL ($M=58.35, SD=14.03$) was significantly greater than the separated group's ($M=49.07, SD=19.09$), whilst the integrated group's mean JOL ($M=58.33, SD=14.83$) did not differ significantly from either the control or separated groups. Across the three fluency conditions, JOLs were greater when provided immediately ($M=62.91$) than when provided after a 24-hour delay ($M=47.58$).

Accuracy: Similarly, a statistically significant main effect for perceptual fluency condition [$F(2, 77)=22.041, p=.000$, partial $h^2=.373$] and retention interval [$F(1, 79)=32.093, p=.000$, partial $h^2=.303$] on accuracy scores was found. As might be expected, accuracy was poorer when 24 hours had elapsed ($M=40.51$) than when participants were tested within the same experimental session ($M=55.76$). Post-hoc tests revealed that mean accuracy for the control group ($M=60.39, SD=11.75$) was significantly greater than the separated group ($M=39.86, SD=15.07$) and the integrated group ($M=44.17, SD=15.81$).

Calibration: Of greater importance were the calibration scores. Calibration was calculated by subtracting accuracy scores from JOL estimates: perfect calibration was reflected by a score of zero, overconfidence by a positive score, and underconfidence by a negative score.

There was a statistically significant effect of fluency condition on calibration scores [$F(2, 77)=13.633$, $p=.000$, partial $h^2=.269$]. Post-hoc tests indicated that mean calibration for the control group ($M=2.04$, $SD=11.59$) was significantly better (closer to zero) than the separated group ($M=9.21$, $SD=13.55$) and the integrated group ($M=14.16$, $SD=12.14$), supporting our expectations.

A further analysis examined the difference in accuracy among the different types of test questions: verbatim, comprehension and inferential. There was a statistically significant difference for the proportion of high-level inference questions answered correctly across both the immediate and delayed JOL conditions [$F(2, 77)=19.588$, $p=.000$, partial $h^2=.34$]. Post-hoc comparisons indicated that the mean percentage of high-level inference questions answered by the control group ($M=59.96$) was significantly greater than in both the separated ($M=34.81$) and integrated groups ($M=43.00$, $SD=14.60$). The separated and integrated groups did not differ.

On verbatim questions, the control group ($M=66.21$, $SD=10.94$) also performed better than both the separated ($M=44.62$, $SD=15.86$) and integrated groups ($M=52.12$, $SD=11.96$) [$F(2, 77)=19.193$, $p=.000$, partial $h^2=.33$], which did not differ from each other.

Discussion

The results of this study failed to confirm the hypothesis that students exposed to tangentially-related information would exhibit higher JOL estimates relative to students *not* exposed to such material. No significant difference was found between the three fluency manipulations for mean JOLs, either in the immediate or delayed JOL conditions. This result contradicts findings from list-learning and paired-associates tasks, which generally indicate that participants exposed to perceptually fluent information make more inflated metamnemonic estimates than control subjects. One explanation for this finding is Vernon and Usher's (2003) anchoring hypothesis, which suggests that the

magnitude of metamnemonic judgments did not differ across the fluency manipulations because *initial* JOL estimates were used as an anchor point for *subsequent* judgments. Specifically, once participants provided an initial estimate—typically at an intermediate point on the scale between 0-100%—they used it as an anchor point, and adjusted their JOLs around this central position when making successive metamnemonic assessments (Serra & Dunlosky, 2005).

Importantly, the results of this study supported the hypothesis that students exposed to tangentially-related information would exhibit impaired calibration scores relative to students not exposed to such material. When participants provided JOLs immediately after study, those in the separated and integrated conditions exhibited poorer calibration (overconfidence) relative to the control group. This result demonstrates that the perceptual fluency effect *does* occur for complex text material, and that fluency is in fact *foe*, not *friend*, to learners. The outcome also strengthens previous evidence documenting the fluency effect in list-learning and paired-associates paradigms.

When JOLs were delayed by 24-hours, calibration improved markedly: although accuracy scores were naturally lower, there was a corresponding drop in JOL magnitude. Only individuals in the *integrated* condition exhibited significant overconfidence; by contrast, the control and separated conditions both exhibited near perfect calibration. The misleading influence of perceptual fluency effect persists only when the extraneous information is embedded within the to-be-learned text. Why should participants be misled in both integrated and separated conditions when JOLs are provided immediately after study, but misled only in the integrated condition when they are provided after a 24-hour delay? One possibility is that a 24-hour delay allowed subjects to 'filter out' superfluous information when *separated* from the baseline text, whilst the subtle, persistent nature of the *integrated* extraneous material made it more difficult to disregard. What subjects remember could well be a text that is inferred to be more coherent in retrospect, leading to overconfident JOLs (Harten, 1999).

The finding that the control group correctly answered significantly more verbatim *and* high-level inference questions than either the separated or integrated conditions implies that the linking of new, technical information into a familiar context is only helpful and enhancing to memory when the familiar

Perceptual Fluency Condition		Experiment 2: Delayed JOL		Experiment 1: Delayed JOL	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	EOL	59.03	21.24	62.55	12.35
	JOL	48.00	20.75	52.77	10.69
	Accuracy	50.50	10.23	52.62	8.03
	Calibration	-2.50	15.53	-0.15	7.27
Separated	EOL	52.33	17.61	55.06	11.64
	JOL	46.67	19.70	37.24	18.81
	Accuracy	38.00	13.07	34.62	13.54
	Calibration	8.67	16.98	2.63	10.46
Integrated	EOL	57.40	18.67	63.29	16.62
	JOL	50.33	20.37	52.74	17.15
	Accuracy	38.50	8.33	34.29	14.08
	Calibration	11.83	16.92	18.45	13.76

Table 2: Mean percentage and standard deviations for average EOLs, JOLs, accuracy and calibration scores across the three perceptual fluency manipulations after a 24-hour delay

context is *relevant* and helps students *understand* the material at hand (Shaddock & Carroll, 1997). If the examples are not helpful in comprehension of new material they serve only as a vehicle to mislead the learner with respect to the degree of his or her comprehension. Genuine “deep” learning of a text means that individuals can infer new facts, and use the information in novel ways (Kintsch, 1994). Control subjects in both the immediate and delayed conditions accurately assessed what they knew; they were able to both infer and remember the surface forms of the texts. Those misled by fluency were not only misled about their deep understanding of the texts but had not even achieved sufficient memory for the superficial aspects.

EXPERIMENT 2

Research indicates that within-subjects designs are more sensitive to differences in metamemory measures than between-subjects designs (Shaddock & Carroll, 1997). Nelson (see Carroll and Nelson, 1993) used a metaphor to describe the different encoding strategies participants in the two designs might use: within-groups subjects ‘turn the microscope to low power’ to focus on large, salient differences between conditions, whilst between-groups subjects ‘turn the microscope to high power’ so smaller differences between items become more salient than larger, contextual ones. In Experiment 1, no differences in JOL between conditions were evident, even though miscalibration occurred in the experimental groups. Differences in the influence on JOLs of perceptual fluency may be magnified when people have an opportunity to learn under all three conditions of Experiment 1. Thus Experiment 2 seeks to confirm the miscalibration found in that

experiment, but also investigates whether the differences in memory monitoring judgements can be detected in the more sensitive paradigm in which an individual can make judgments under all three conditions.

Method

Participants

Fifteen English-speaking individuals who had not taken part in Experiment 1 participated (8 female; 7 male). All participants completed pre-tests measuring age, level of education, gender, and first language; results of non-native English speakers were excluded from final analysis. Mean age was 27.3 years ($SD=9.208$), with a minimum age of 19 years, and a maximum of 57 years. Six (40%) were currently studying at a tertiary level, 9 (60%) had completed a tertiary undergraduate degree.

Design and Procedure

This experiment employed a within-subjects design: each participant studied two texts under each of the three fluency conditions of Experiment 1: control, integrated and separated. Because Experiment 1 results indicated that delayed JOLs yielded better calibration rates than immediate JOLs in two of the three conditions, Experiment 2 was a delayed-only JOL experiment.

Participants were tested individually or in small groups, and were provided with initial instructions identical to Experiment 1. Text order and condition were counterbalanced, eliminating text or fatigue effects. As in Experiment 1, participants were given ten minutes to study each baseline text, and an additional 3 minutes to study the additional material, in the integrated and separated conditions.

Participants were given each text, allowed 30 seconds to ‘cast their eyes’ over the materials, and then instructed to make an EOL, before studying the text for the appropriate duration depending on the condition presented. This process was repeated for six texts; two from each of the control, integrated and separate conditions. Participants returned 24 hours later to provide JOLs and complete comprehension tests. Participants were allowed a maximum of ten minutes to complete the tests, in which they were denied access to the studied materials.

Results

One-way repeated measures ANOVAs were conducted on EOLs, JOLs, accuracy and calibration. The mean and standard deviations for EOL, JOL, accuracy and calibration are presented in the left half of Table 2, with corresponding means for Experiment 1 provided for comparison.

JOL: There was no statistically significant difference between the three conditions in mean JOLs.

Accuracy: The control condition’s mean accuracy score ($M=50.50$, $SD=10.23$) was greater than both the separated ($M=38.00$, $SD=13.07$) and integrated conditions ($M=38.50$, $SD=8.33$). [Wilks’ $\Lambda=.30$, $F(2, 13)=15.141$, $p=.000$, partial $\eta^2=.70$].

Calibration: As in Experiment 1, when participants studied the control text, they exhibited near perfect calibration after a 24-hour delay, with slight underconfidence. However, calibration scores showed that overconfidence was exhibited by participants in *both* the separated and integrated conditions after a 24-hour delay. F statistics confirmed a significant effect at the $p<.001$ level for fluency condition on mean calibration scores, [Wilks’ $\Lambda=.352$, $F(2, 13)=11.951$, $p=.001$, partial $\eta^2=.65$]. This latter finding differs from Experiment 1 results, which suggested that after 24-hours, poor calibration persisted, and overconfidence even *increased*, for the integrated group, whilst the separated group’s calibration improved to near perfect levels.

Discussion

Contrary to expectations, Experiment 2 showed that the memory monitoring measures did not differ among the three conditions even when a more sensitive within-subjects design was used. When

participants made judgments under conditions of perceptual fluency that were designed to mislead them into believing they had understood the texts, they failed to make judgments of higher magnitude than those given to the base texts. Thus, fluency apparently does not increase the metamemorial judgements above the rate of texts that do not contain fluency-inducing material. The magnitude of these judgments was also comparable to those of Experiment 1. As in Experiment 1, it appears that the use of an anchor is employed in both the within and between subject designs: it appears that participants in Experiment 2 made EOL and JOL estimates by choosing an initial anchor point on the scale between 0-100%, and based all subsequent judgments around that value (Serra & Dunlosky, 2005). Given that, in both experiments, judgments were made on the basis of whole texts, it may be that the within subject design is more sensitive to conditions only when individuals make item by item judgments.

As in Experiment 1, accuracy scores in the two experimental conditions were poorer than for the control, leading to significant miscalibration. Surprisingly, however, Experiment 2 participants exhibited significant negative calibration in *both* the separated and integrated fluency conditions after a 24-hour delay. This suggests that participants in the within-subjects design were affected differently by the 24-hour delay than those in the between-subjects design. Perhaps participants in the between-subjects design were able to disregard the irrelevant information in the separated condition over the 24-hour delay, whilst those in the within-subjects design were unable to engage in such a filtering process, because, having been exposed to all three fluency conditions, they were not as certain about which information would be redundant for testing.

An alternative explanation for the finding of generally poor accuracy in the experimental conditions in both experiments is that there was more material to remember overall in these two conditions than in the control conditions. The addition of extra study time for the two experimental conditions was designed to rule out any simple explanation for poorer accuracy based on sheer memory load. Nor did participants appear to perceive any extra memory demands compared to the control texts when they made their EOL judgments prior to study. These judgements would presumably have taken into account any readily perceived differences in the lengths of text, along with differences in comprehensibility.

GENERAL DISCUSSION

This research demonstrates that the perceptual fluency effect *does* occur for complex, real-world text material, implying that fluency, when it consists of familiar but irrelevant material, is *foe*—not *friend*—to learners who are attempting to understand new technical material. Students in real-life learning situations may be unable effectively to filter out such irrelevant information; instead, the fluency engendered by the extraneous material misleads them to believe that they have mastered the new information to the same extent as when such extraneous information is absent. They are misled because their memory accuracy is significantly poorer than when only the new information is presented.

We find support for earlier research (Koriat, Bjork, Sheffer & Bar, 2004; Benjamin & Bjork, 1996; Benjamin, Bjork & Schwartz, 1998) that ease of access effected by certain variables leads learners to rely on the implicit heuristic that what is easy to process *now* will be well recalled *later*. The variable manipulated here is familiarity, operationalised as already known irrelevant material that is either embedded in, or that precedes, complex new to-be-learned material. Because this study suggests that fluency's effects persist for 24-hours, and that the presence of this irrelevant material reduces a learner's ability to answer correctly *both* verbatim and inference-style questions, it is important that educators pay particular attention to the *type* of

examples they use in their course material. Although much research remains to be done concerning beneficial or detrimental elements of fluency in real-life contexts, it is clear that the inclusion of some material such as that used here may lead to an illusion of knowing. Further research might investigate, for instance, whether other extraneous material, such as the use of jokes and irrelevant anecdotes during lectures, devices designed to capture attention and to engage students, have the same effect. Clearly, the inclusion of *relevant* examples, which induce deeper elaborative understanding, may lead to a feeling of fluency that is entirely justified and which leads to accurate memory outcomes.

Other avenues for future research concern a potentially educable component of metacognition. Providing students with a rudimentary understanding of how fluency can hinder memory has the potential to prevent the kinds of generalisations that mislead metamnemonic predictions (Benjamin, Bjork & Hirshman, 1998). Whilst research overcoming illusions of knowing is in its infancy, training learners to identify misleading metamnemonic cues in list-learning and paired-associates paradigms can prompt them to develop and use metacognitive skills to assess their knowledge more accurately (Renner & Renner, 2001). This research should now be extended to cover real-world text-based material, particularly since training for these skills has practical value in the classroom (Koriat & Bjork, 2006).

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Extended investigations in the physics of oligonucleotide microarrays

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Gene expression technology is commonly used in molecular biology and medicine to evaluate parallel expression levels of a large number of genes. The technology relies on the hybridisation of fluorescently labelled DNA/RNA fragments to oligonucleotide probes. Existing algorithms available to biologists for converting fluorescence intensities to target concentrations are statistically sophisticated, but fail to take proper account of the physical chemistry involved in the experiment. Recently Burden has developed a physico-chemical model which has been tested on the U95 and U133 Affymetrix Latin Square spike-in data sets. The model fits well to the U95 data set but fails to fit accurately to the U133 data set at low spike-in concentrations. In order to remedy this, the current study considers two new physical effects not included in the original model, namely incomplete probe synthesis and target depletion. In general, we find that including incomplete probe synthesis provides little improvement. On the other hand, statistical test shows that inclusion of target depletion improves the fit, though some problems remain.

1. INTRODUCTION

DNA is a polymeric molecule which contains genetic instructions for the development and functioning of all known living cells. A gene is a region on the DNA and encodes for a specific protein. The information on the gene is transcribed to an RNA molecule *via* a process called *transcription*. The RNA molecule is subsequently involved in the synthesis of the corresponding protein [1].

A microarray consists of tens of thousands of microscopic spots of oligonucleotides arranged in an arrayed series. Each spot is called a *feature* and contains a specific short sequence of DNA chosen to match part of a human gene. Each expressed gene is present in a cell as its complementary RNA sequence, called *target*, in concentrations of the order of picomoles per litre [2]. The experiment consists of two main steps: *hybridization* between the targets and the probes and the *detection* of the specific sequences by some form of labeling techniques. The probes are supported on a solid surface made of glass or silicon chip by covalent interactions with a chemical matrix. Microarrays originated from Southern blotting, where DNA fragments are attached to a substrate, and then duplexed with a known gene [3, 4]. The processes can also be used for the detection of RNA as cDNA obtained after reverse transcription.

They have many applications in biological sciences. For instance, they are used in comparative genomic hybridization where the gene contents from different cells or organisms are compared to examine the evolutionary relationship [5] or in the identification of single nucleotide polymorphisms that may cause genetic defects including potentially cancer-causing mutations, known as *SNP microarrays* [6]. They are also useful in the detection of the protein binding site (active site) in protein binding genes, known as *Chromatin immunoprecipitation* (ChIP) on Chip [7]. The oligonucleotide microarrays considered in this study are involved in one of the most significant applications, *gene expression profiling* where they allow the simultaneous expression of a large number of genes in prepared target RNA samples to be evaluated [8]. This is particularly useful in studies of diseases by the comparison of gene expression levels between abnormal and normal cells.

The oligonucleotide microarray experiment involves the hybridization between the target RNA and the oligonucleotide sequences on the microarrays *via* complementary base pairing. The aim is to find the gene expression level from the concentration of the target RNA in the loaded solution, which is related to the density of hybridized probe-target duplexes formed. Different labeling techniques applied to the target RNA such as fluorescent dye, radionucleotide markers and quantum dots allow the detection of the duplexes

to be made *via* some intensity measurements of the observed signals.

There are a number of designs for DNA microarrays. *Affymetrix GeneChip* arrays are the subject of this study [10]. An array of this type contains a probeset of 11-16 pairs of features, whose lengths are all 25 bases. Each pair contains an element with a perfect match sequence (PM) and another element with a mismatch sequence (MM), which is the same as the PM but the middle 13th base being replaced by its complementary base. The PM sequences are selected so that they are non-overlapping subsequences of the target gene and based on their ability to specifically hybridize with the gene. Fluorescent dye is used to label the target cRNA molecules.

Given the intensity measurements from the experiment, an efficient functional relationship based on logical considerations of physical chemistry principles relating them and the absolute target RNA concentration is necessary instead of the empirical approach involving the use of expression indices obtained by the subtraction of the PM intensity by the background data estimated by the MM intensity. The *Langmuir* adsorption theory was initially proved to be a reasonable model for the description of surface hybridization processes [11, 12]. The probe-target hybridization is, however, influenced by a number of other factors such as thermodynamic stability of the duplexes, surface chemical adsorption, side reactions in bulk solution, electrostatics of the fragmentation of the DNA, washing step etc [13, 14, 15]. Consequently, the initial *Langmuir* adsorption model has to be modified by taking these factors into considerations.

2. STATEMENT OF THE PROBLEM

A physico-chemical model of the functioning of oligonucleotide microarrays was previously developed by considering a set of hybridisation reactions at the microarray surface, in the supernatant solution (Eqs. 1-5) and partial dissociation of hybrid duplexes during post-hybridisation washing phase (Eq. 6) [12, 14, 16].

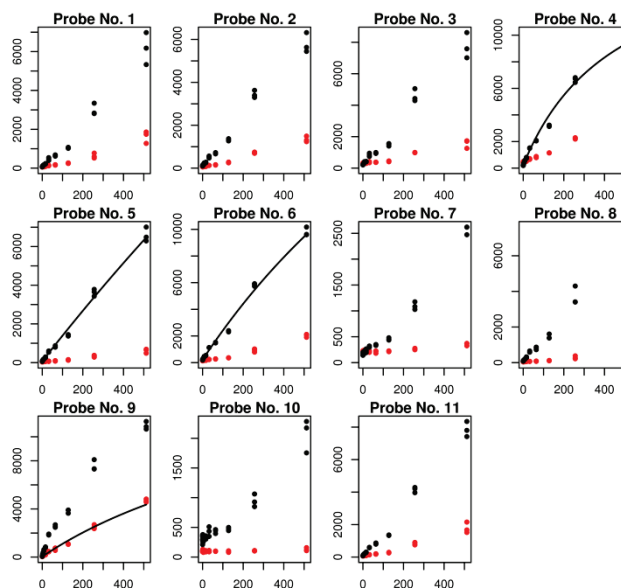
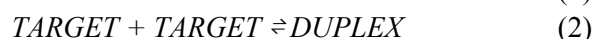


Fig. 1: Typical fits to observed fluorescence intensities in spike-in U95 experiments.

According to the model, the duplex coverage fraction q for each feature can be described in terms of the specific target concentration x at washing time t_w as

$$q(x, t_w) = a(t_w) + b(t_w) \frac{Kx}{1 + Kx}, \quad (7)$$

where the parameters a , b and K are dependent on binding energies of probe-target duplexes; target-target duplexes; folded probes and targets; and non-specific target concentrations. The model predicts a hyperbolic response function for the measured fluorescence intensities.

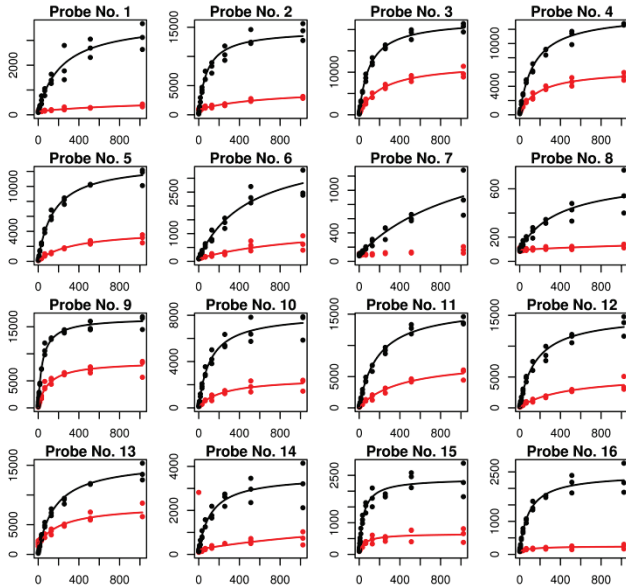
$$I(x) = a + bq(x, t_w) = A + B \frac{Kx}{1 + Kx}, \quad (8)$$

where a and b are constant across the microarray, and $A = a + ba$, $B = bb$.

The Affymetrix U95 and U133 spike-in experiments were used to examine the model, which allowed A , B and K to be estimated for each feature of each spiked-in gene. The model fits particularly well in the datasets of U95 with and without the complex human pancreas background (Fig. 1) (Table 1 from ref. [16]). On the other hand, many examples from the U133 dataset displayed a sigmoidal rather than hyperbolic shape (Fig. 2). The aim of this study is to improve the current chemical adsorption model for U133 by

considering two possible physical effects: incomplete synthesis of the oligonucleotide probes [13] and target depletion [16].

Fig. 2: An example of the sigmoidal behavior for the



fluorescence intensities in spike-in U133 experiments.

Sections 3 and 4 describe how each of these effects will change the current model and evaluate the validity of the two resulting physico-chemical models by considering their behaviors asymptotically and their fits to the dataset.

3. INCOMPLETE SYNTHESIS OF OLIGONUCLEOTIDE PROBES

Oligonucleotide microarrays are produced *via* photolithography, which involves the use of light and light masking agent adding one nucleotide at a time on the whole array in a selective manner [9]. The “mask” is only added to the end of the growing probes at certain locations on the array each time. The chemically unreactive protecting groups on these applicable probes are removed prior to exposure to a solution of a specific nucleoside (A, T, G or C). This process is called “unmasking”. The deprotected end of the probe can undergo reaction to incorporate this next nucleotide to the chain. The masking reaction then takes place again, the next set of selected probes are unmasked and coupled to the next nucleotide. The entire process is repeated until the probes reach the desired length with specific sequences.

The model described in Section 2 assumes that all these reactions are 100% efficient, which is, in

reality, not the case [18]. The yield of the deprotection process was reported previously to be $p_{synt} = 82 - 98\%$ [13]. Those probes at which the “unmasking” process fails can no longer be extended. Consequently, it is expected that the microarrays contain probes with various lengths.

Assuming that L be the ideal length of the probe and p_{synt} be the synthetic yield of each nucleotide on the probe. L for the Spike-in experiments is 25. The probability distribution of the length of the probe, a , is

$$f_{synt}(a, L) = \begin{cases} p_{synt}^{a-1}(1 - p_{synt}) & \text{for } a = 1, \dots, L - 1 \\ p_{synt}^{a-1} & \text{for } a = L \end{cases} \quad (9)$$

where $0 \leq p_{synt} \leq 1$. When $p_{synt} = 1$, all the probes are L in length.

From this distribution, we aim to find an expression for the overall surface coverage of the microarray, q . Section 3.1 will show the derivation of a simple model without probe folding on the microarray surface. The model is further extended with the effects of probe folding in Section 3.2. Sections 3.3 and 3.4 investigate in the behavior of the model.

3.1 Initial simplified model

For an initial simplistic model, the two main chemical reactions at the microarray surface are considered for probes with a definite length a . Specific hybridization:

$$P_a + S \rightleftharpoons P_a \cdot S \quad \text{with } K_a^S = \frac{[P_a \cdot S]}{[S] \cdot [P_a]}. \quad (10)$$

Non-specific hybridization:

$$P_a + NS_i \rightleftharpoons P_a \cdot NS_i \quad \text{with } K_a^{NS_i} = \frac{[P_a \cdot NS_i]}{[NS_i] \cdot [P_a]}, \quad (11)$$

where the species NS_i is any target RNA molecule with a subsequence complementary to the i th subsequence of the specific target sequence. Let the coverage for probes with a length a be q_a . This is the sum of the coverage of these probes by both specific and non-specific target mRNA, expressed as:

$$q_a = q_a^S + \sum_i q_a^{NS_i}. \quad (12)$$

The total concentration of probes of length a is

$$[P_a]_{total} = [P_a] + [P_a \cdot S] + [P_a \cdot NS_i]. \quad (13)$$

Therefore,

$$\begin{aligned} \frac{[P_a]}{[P_a]_{total}} &= 1 - q_a, \\ \frac{[P_a \cdot S]}{[P_a]_{total}} &= q_a^S, \\ \frac{[P_a \cdot NS_i]}{[P_a]_{total}} &= q_a^{NS_i}. \end{aligned} \quad (14)$$

From (10), (11) and (14) one obtains after some working

$$\begin{aligned} q_a^S &= K_a^S \cdot [S] \cdot (1 - q_a), \\ q_a^{NS_i} &= K_a^{NS_i} \cdot [NS_i] \cdot (1 - q_a). \end{aligned} \quad (15)$$

Substituting (15) into (12) to obtain an expression for q_a in terms of $[S]$ and $\mathring{a}_i [NS_i]$.

$$q_a = \frac{X_a}{1 + X_a}, \quad (16)$$

where

$$\begin{aligned} X_a &= X_a^S + X_a^{NS} \\ \text{with } X_a^S &= K_a^S [S] \\ \text{and } X_a^{NS} &= \mathring{a}_i K_a^{NS_i} [NS_i]. \end{aligned} \quad (17)$$

The overall hybridization isotherm can be expressed as

$$q = \mathring{a}_{a=1}^L f_{synt}(a, L) \cdot q_a. \quad (18)$$

Probe folding, target-target hybridisation in bulk solution and the post-hybridisation washing step have not been taken into account. Hybridisation in bulk solution has the effect of reducing spike-in concentration x to a free target concentration, $[S] = x / (1 + K^{S \cdot fold} + \mathring{a}_i K_i^{bulk} [S_i^{bulk}])$, which is common for all probes on the microarrays. The washing step will scale each q_a by a factor that reduces the asymptote of each q_a to less than 1, but does not otherwise change the shape of the function.

3.2 A more complex model with probe folding

In addition to the two reactions described by (10) and (11), probe folding is considered.

$$P_a \rightleftharpoons P_a^{\phi} \quad \text{with} \quad K_a^{Pfold} = \frac{[P_a^{\phi}]}{[P_a]}. \quad (19)$$

This gives

$$\begin{aligned} q_a^S &= \frac{X_a^S \cdot (1 - q_a)}{1 + K_a^{Pfold}}, \\ q_a^{NS} &= \mathring{a}_i q_a^{NS_i} = \frac{X_a^{NS} \cdot (1 - q_a)}{1 + K_a^{Pfold}}. \end{aligned} \quad (20)$$

Let m be the constant $1/(1 + K_a^{Pfold})$. The hybridization isotherm for probes with length a is

$$q_a = \frac{m X_a}{1 + m X_a}. \quad (21)$$

The overall q is still expressed in terms of these q_a 's as in Eq. (18). The consideration of probe folding in this model does not introduce any extra parameter other than a reducing factor m to the binding strength in the expression for q_a . As a result, the simplified model built in section 3.1 is used for assessing whether the case of incomplete synthesis will give the sigmoidal behavior of the total coverage at low specific target concentrations as observed in the plots of Fig. 2. This is covered in section 3.3.

3.3 Prediction of the behavior of the model

The model for q described in Eq. (18) is a superposition of the individual isotherms of probes of length a . As suggested in Eq. (16), each contributing isotherm behaves in a *Langmuir* manner. It is expected that the binding strength increases with probe lengths, suggesting that at low target concentrations, longer probes hybridize more efficiently than shorter ones [13]. Therefore, q_a values for larger a 's contribute a much more significant portion to the mean value q than those of smaller a at low $[S]$. The resultant shape of the total coverage is predicted to be similar to that of the coverage of longer probes. This indicates that q will be likely to still show a *Langmuir*-type behavior and hence will not give the desired sigmoidal shape at low target mRNA concentrations.

3.4 Qualitative analysis of the model

The model described in Eq. (18) can be fully written as

$$q = \prod_{a=1}^L f_{\text{synt}}(a, L) \cdot \frac{X_a}{1 + X_a}, \quad (22)$$

where $p_{\text{synt}}(a, L)$ is defined in Eq. (9) and only dependent on the synthetic yield p_{synt} for each nucleotide on the probe and the ideal length of the probe. For this study, $L = 25$.

We aim to investigate how the relationship between q and the target concentration will vary upon changing the extra parameter, p_{synt} . It is necessary to firstly express X_a in terms of $[S]$. X_a is the sum of X_a^S and X_a^{NS} . However, as the model involving target depletion does not take non-specific hybridization into account, X_a^{NS} is not considered for this model for consistency. On the other hand, X_a^S was defined as $K_a^S[S]$. The specific equilibrium constant K_a^S needs to be evaluated. From ref. [16], the constant can be expressed as

$$K_a^S = e^{I_S(m_S - \frac{DG(a)}{RT})}, \quad (23)$$

where the parameters I_S and m_S have been estimated as 0.00677 and -688.9 respectively in that study.

The main difference between our model and that in the previous study is that the effective binding free energy DG is no longer a constant, but depends on the length of the probe, a . Based on physical study done by Sugimoto *et al.* [20] together with a few steps of manipulations, the dimensionless relationship between DG and a is approximated as

$$\frac{DG(a)}{RT} = 5.478 + (-2.274) \cdot a. \quad (24)$$

Having estimated all the involved parameters, q can then be plotted in terms of $[S]$ for different p_{synt} values as shown in Fig. 3. The plot of q does not deviate strongly from the hyperbolic shape of the *Langmuir*-isotherm model. The sigmoid behavior at low target concentration can not be obtained. In addition, the curve for q shifts downwards by a small amount with decreasing p_{synt} , showing that the behavior of q does not change significantly upon changing p_{synt} .

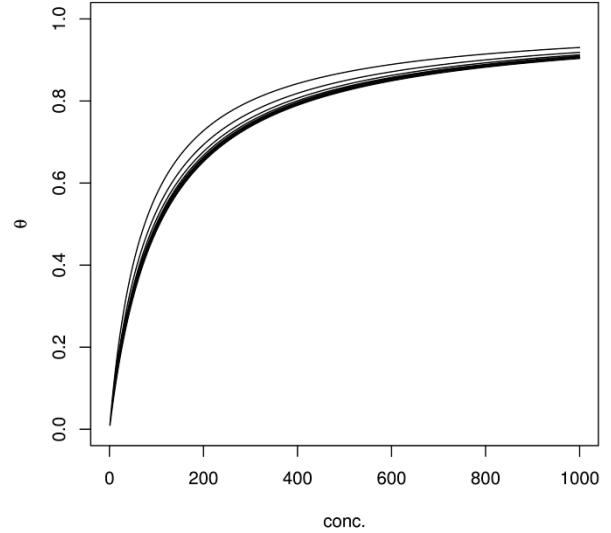


Fig. 3: Plot of the overall coverage of the microarrays against the mRNA target concentration $[S]$ for various values of p_{synt} range from 0.5 (bottom curve) to 1.0 (top curve).

4. TARGET DEPLETION

Another physical effect that may cause the deviation of the hybridization isotherms of microarrays from a *Langmuir*-type behavior is target depletion. In the previous derivation of q [16], when considering chemical reactions at the microarray surface, it was assumed that the spike-in concentration of specific target mRNA was sufficiently large compared to that of bound target mRNA in forms of $P.S$ duplexes. As a consequence, the concentration of free targets, $[S]$ was treated as if it were a constant and the same as the total spike-in concentration. Nonetheless, at low spike-in concentrations, target depletion by $P.S$ duplex formation is likely to cause the actual concentration of free target, $[S]$ to deviate from that of the spike-in concentration by a greater proportion. The previously made assumption no longer holds and $[S]$ needs to be considered as a function of both the spike-in target concentration and duplex concentration $[P.S]$ [21]. This section aims to construct a model resulting from the effects of target depletion.

4.1 The initial simplified model

In this model, only the chemical reaction for probe-target binding is considered.

$$P + S \rightleftharpoons P.S, \quad \text{with } K^S = \frac{[P.S]}{[S].[P]}. \quad (25)$$

Let P_{total} and x be the total probe concentration and the target mRNA spike-in concentration respectively. In this case, P_{total} is the sum of the concentrations of free probes, $[P]$ and duplexed probes, $[P.S]$. On the other hand, x is the sum of the free-target concentration, $[S]$ and duplexed target, $[P.S]$. Explicitly,

$$P_{total} = [P] + [P.S], \quad (26)$$

$$x = [S] + [P.S]. \quad (27)$$

From (26), the relationship between q and the probe concentrations can be obtained.

$$q = \frac{[P.S]}{P_{total}}, \quad 1 - q = \frac{[P]}{P_{total}}. \quad (28)$$

Hence, one obtains the isotherm

$$q = K^S (1 - q)(x - qI), \quad \text{where } I = P_{total}. \quad (29)$$

An explicit expression of q can then be obtained by solving the quadratic equation (29).

$$q(x) = \frac{x + I + \frac{1}{K^S} - \sqrt{(x + I + \frac{1}{K^S})^2 - 4Ix}}{2I}. \quad (30)$$

There are, in fact, two solutions to the obtained solution. The asymptotic behaviour of q eliminates the other solution. This is the first simplest model of q with target depletion. It involves only one extra parameter I compared to the *Langmuir*-type model. The simple model of Eq. (30) will be used for computational purposes to enable comparisons between fits to the U33 data with and without the assumption of target depletion in Section 4.4. A more complex version of the model including reactions in bulk solution and non-specific hybridization is given in the Appendix.

4.2 Prediction of the behaviour of the model

The simple model described in Eq. (30) will be firstly used for the purpose of prediction and further computational work. There are three basic tests that can be applied to the model.

- When there is no target mRNA in the reaction mixture, $q(x = 0) = 0$.

- As I approaches 0, the model will be expected to return the hyperbolic function with *Langmuir*-type behaviour as before the effects of target depletion were introduced.

$$\begin{aligned} q(x) &= \frac{x + I + \frac{1}{K^S} - \sqrt{(x + I + \frac{1}{K^S})^2 - 4Ix}}{2I} \\ &= \frac{x + I + \frac{1}{K^S} - \frac{2Ix}{x + I + \frac{1}{K^S}} + O(I^2)}{2I} \\ &= \frac{x}{x + \frac{1}{K^S}} + O(I) \\ &\approx \frac{K^S x}{1 + K^S x} \end{aligned} \quad (31)$$

- The slope of q at $x = 0$,

$$\begin{aligned} \left. \frac{dq}{dx} \right|_{x=0} &= \frac{1}{2I} \left[1 - \frac{2(x + I + \frac{1}{K^S}) - 4I}{2[(x + I + \frac{1}{K^S})^2 - 4Ix]^{\frac{1}{2}}} \right] \Big|_{x=0} \\ &= \frac{K^S}{1 + K^S I}. \end{aligned} \quad (32)$$

The slope at $x = 0$ is smaller than K when $I > 0$, which may give a behaviour closer to the sigmoidal behaviour observed for the U133 dataset.

Initial investigations carried out on the model suggest that the model has some possibility of fitting in the U133 intensity data. The next section will examine the model qualitatively.

4.3 Qualitative analysis of the model

To analyse the qualitative behaviour of the family of isotherm solutions Eq. (30), we introduce a dimensionless concentration $X = Kx$ and dimensionless parameter $L = K/I$, giving

$$q = \frac{X + L + 1 - \sqrt{(X + L + 1)^2 - 4LX}}{2L}, \quad (33)$$

where the dimensionless quantities, X and L are Kx and Kl respectively.

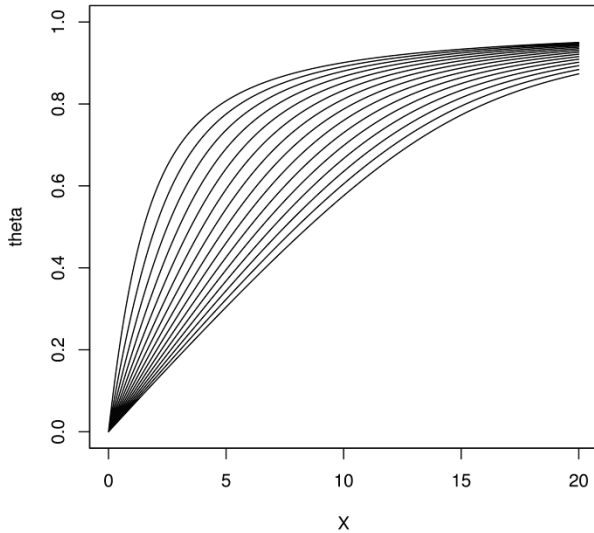


Fig. 4: Plot of the overall coverage of the microarrays against X for various values of L range from 0 to 15.

The results of plotting q against X for different L parameter values are shown in Fig. 4. At $L = 0$, q is identical with that of the *Langmuir*-isotherm model (see Eq. (33)). A more significant downward shift of the curve for q with increasing L is observed compared to the previous q plot with changing p_{syn} values. The curve appears more linear rather than sigmoidal as L increases.

4.4 Statistical Analysis for the model with target depletion

To examine the statistical significance of the model described in Eq. (30), we consider the relationship between the coverage q and the fluorescence intensity at a feature for a given concentration, x of a mRNA transcript

$$I(x) = A + Bq(x), \quad (34)$$

where A is the background intensity resulting from sources such as reflection, components of non-specific hybridization etc. and B corresponds to the maximum fluorescence by the hybridized features on the microarray [11].

Our aim is to make a comparison between the original *Langmuir* model (Model 1) and the model with target depletion (Model 2) via a χ^2 -squared test of the scaled change in deviance as described

in ref. [12], where model 1 is nested within model 2. The test will ultimately illustrate whether the extra parameter l improves the fits significantly.

$$I(x) = A + B \cdot \frac{K^s x}{1 + K^s x} \quad (\text{Model 1}), \quad (35)$$

$$I(x) = A + B \cdot \frac{x + l + \frac{1}{K^s} - \sqrt{(x + l + \frac{1}{K^s})^2 - 4lx}}{2l} \quad (\text{Model 2}). \quad (36)$$

Let r_1 and r_2 be the residual degrees of freedom, D_1 and D_2 be the deviances of models 1 and 2 respectively. The tested object is given in ref. [12] as

$$DD_{\text{scaled}} = (D_1 - D_2) \frac{r_2}{D_2}. \quad (37)$$

Throughout the process of fitting the two generalized linear models to the U133 dataset of Affymetrix Latin Square experiment, it is assumed that the measured fluorescence intensity I is a gamma random variable with mean m and shape parameter n . The probability density and unscaled deviance are given by McCullagh and Nelder [19] respectively as follows

$$\text{Probability density} = \frac{1}{\Gamma(n)} \left(\frac{n}{m} \right)^n e^{-\frac{n}{m} I} I^{n-1} \quad (38)$$

$$D(I; m) = -2 \ln \left(\frac{1}{\Gamma(n)} \left(\frac{n}{m} \right)^n e^{-\frac{n}{m} I} I^{n-1} \right) \quad (39)$$

A number of defective probes and outliers from the U133 dataset are omitted from the analysis (see Table 1). The results of fitting the two generalised linear models to the the U133 data set are shown in Fig. 2.

Gene	Data omitted
203508_at	Probe 2
207777_s	Probe 10
207968_s	Probe 6
207968_s	Probe 7
209606_	Datapoint # 2, MM, Probe 9
206060_s	Datapoint # 8, PM, Probe 31

Table 1: A list of the omitted data from the analysis of both models.

The results of the fitting the two generalized linear models to the U133 dataset can be summarized as followed

	Model 1	Model 2
Total deviance, D	391.3462	377.5971
Degree of freedom	18174	17708

Table 2: The total deviances and degrees of freedom from fitting the two models to the U133 dataset.

The DD_{scaled} is found to be 647.2146, which gives a p -value of $5.0 \cdot 10^{-8}$. This small p -value indicates statistically that the introduction of the extra parameter makes a significantly better fit to the dataset.

The plots of the fits of the fluorescence intensity data to the response curve given by the new model are also done for the dataset of 38 genes. There exist some abnormalities in a number of the response curves where at some points in the high target concentration range, a sharp-cornered transition is observed (Fig. 5). This indicates a discontinuity in the gradient of the curve. A physical explanation for this behavior is required. A suggested idea is the limits imposed on the values of the parameters, I and K in the programming process.

5. CONCLUSION

In conclusion, the study has considered two possible physical effects suggested in ref. [16] for the aim of finding a physical explanation for the deviation of the response curve for Affymetrix U133 dataset from the hyperbolic form. Our investigation suggests that the incomplete synthesis of probes does not significantly alter the hyperbolic behavior. The case of target depletion has positive results from the initial statistical test. Further work is required to find a physically meaningful explanation on the abnormalities in the plots obtained.

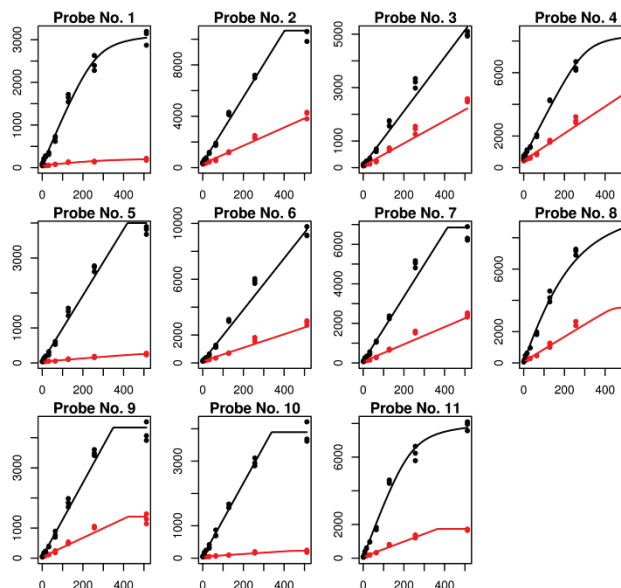


Fig. 5: Examples of the mentioned abnormal behavior of the fits.

6. ACKNOWLEDGEMENT

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APPENDIX

More complex model with reactions in bulk solution

The chemical reactions in bulk solutions arise by two main types of interactions:

- Intramolecular folding of the specific target mRNA molecules (S-fold), which disables duplex formation for a portion of the target molecules. (ref. [13])

$$S \rightleftharpoons S\phi \quad \text{with } K^{Sfold} = \frac{[S\phi]}{[S]}. \quad (40)$$

- Non-specific hybridization which involves the duplex formation between between the specific mRNA targets and the non-specific RNA fragments present in the bulk solution.

$$S + NS_i \rightleftharpoons S.NS_i \quad \text{with } K_i^{bulk} = \frac{[S.NS_i]}{[NS_i].[S]}. \quad (41)$$

At the microarray surface, not only specific hybridization (as in (25)) but also non-specific hybridisation are considered. The additional reaction can be expressed as

$$P + NS_i \rightleftharpoons P.NS_i \quad \text{with } K^{NS_i} = \frac{[P.NS_i]}{[NS_i].[P]}. \quad (42)$$

The total spike-in concentration of the target mRNA, x can be rewritten as

$$x = [S] + [P.S] + \sum_i \mathring{a}_i [NS_i] + [S\phi]. \quad (43)$$

From (40), (41) and (43),

$$\begin{aligned} x - [P.S] &= [S] + \sum_i \mathring{a}_i K_i^{bulk} [NS_i] [S] + K^{Sfold} [S] \\ x - [P.S] &= [S] (1 + \sum_i \mathring{a}_i K_i^{bulk} [NS_i] + K^{Sfold}). \end{aligned} \quad (44)$$

Hence,

$$[S] = \frac{x - [P.S]}{(1 + X^{bulk}[NS] + K^{Sfold})}, \quad (45)$$

$$\text{with } X^{bulk}[NS] = \sum_i \mathring{a}_i K_i^{bulk} [NS_i].$$

The total probe coverage consists of two components, specific and non-specific coverages.

$$\begin{aligned} q &= q^S + q^{NS} \\ &= \frac{[P.S]}{P_{total}} + \sum_i \mathring{a}_i \frac{[P.NS_i]}{P_{total}} \\ &= K^S [S] \frac{[P]}{P_{total}} + \sum_i \mathring{a}_i K_i^{NS} [NS_i] \frac{[P]}{P_{total}} \\ &= (1 - q)(K^S [S] + \sum_i \mathring{a}_i K_i^{NS} [NS_i]) \\ &= (1 - q)(K^S [S] + X^{P-NS}). \end{aligned} \quad (46)$$

The aim is to find an expression of $[S]$ in terms of q and other constants.

$$\begin{aligned} [S] &= x - [P.S] \\ &= x - q^S P_{total} \\ &= x - (q - q^{NS}) P_{total} \\ &= x - q P_{total} + P_{total} (1 - q) X^{NS}. \end{aligned} \quad (47)$$

Substituting (47) into (46) to obtain a quadratic equation for q

$$a q^2 + b q + c = 0, \quad (48)$$

with

$$a = \frac{K^S}{g} P_{total} (1 + X^{NS}) \quad (49)$$

$$b = - \left[\frac{K^S}{g} P_{total} (1 + X^{NS} + x + P_{total} X^{NS}) + X^{P-NS} + 1 \right] \quad (50)$$

$$c = \frac{K^S}{g} (x + P_{total} X^{NS}) + X^{P-NS} \quad (51)$$

$$g = 1 + K^{Sfold} + X^{bulk}. \quad (52)$$

q can be written in terms of a , b and c as a solution to the quadratic equation (48). Similar to in the previous case, asymptotic behaviour of q allows one of the solutions to be eliminated

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From subsistence to nuisance?: Rice and the process of demographic transformation and adaptation in the village of East Laguna, Philippines

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The Green Revolution and the wave of political reforms it inspired during the 1970s significantly contributed to increases in rice supply in the Philippines, where at the time, modernisation logically established agricultural intensification as a means to rice stability for the country. This period of growth in Philippine history would, on face-value, seem to demonstrate Ester Boserup's classic expectation that population pressures lead to agricultural innovation and intensification so as to elevate food production. Three decades have since passed, and it becomes of great interest to explore and qualify how Boserup's model stands in the face of modernisation, and in turn, how population and intensification are ultimately shaping rural lives in the Philippines. This essay will take as its case study the rice village of East Laguna, a "rural" community located south of Laguna de Bay, the country's largest lake. An examination of the village's demographic history as it has undergone transformation and adaptation indicates several limits to Boserupian modes of growth while at the same time emphasising the role of agency and practicality in determining smallholder outcomes in the face of socio-economic change.

I. INTRODUCTION

Rice maintains its status as the most important staple crop in the Philippines (Van der Eng 2004: 347). Its production delicately holds together the country's agricultural sector and is hence central to the overall well-being of the nation's growing rural population. The experience of the Green Revolution and the wave of political reforms it inspired during the 1970s significantly contributed to increases in rice supply in the Philippines, where at the time, modernisation logically established agricultural intensification as a means to rice stability for the country. This period of growth in Philippine history would, on face-value, seem to demonstrate Ester Boserup's classic assumption that population pressures inevitably lead to agricultural innovation and intensification so as to elevate food production to feed growing households. Three decades have since passed, and it becomes of great interest to explore and qualify how Boserup's model has stood in the face of modernisation in the country, and in turn, how population and intensification are ultimately shaping rural lives in the Philippines.

This essay will take as its case study the rice village of East Laguna, a "rural" community located south of Laguna de Bay, the country's largest lake.

As will be examined through a reading of the village's demographic history, the process of demographic transformation and adaptation in the village demonstrates several limits to Boserupian modes of growth while at the same time emphasising the role of agency and practicality in determining smallholder outcomes in the face of socio-economic change.

This essay will begin by identifying its key theoretical premise as framed against Netting's concept of the smallholder and Boserup's theory of agricultural intensification. A brief overview of the socio-economic history and situation of East Laguna Village will follow. How demographic change and adaptation in East Laguna Village qualify Boserupian modes of growth will then be examined, after which brief analysis will ultimately seek to explain how smallholders interact with limits to agricultural intensification, and what such interactions might imply for Philippine rural futures.

II. NETTING'S CONCEPT OF THE SMALLHOLDER & BOSERUP'S THEORY OF AGRICULTURAL INTENSIFICATION

It has long been commonplace to associate agriculture in developing settings with subsistence farming and likewise to perceive resource-poor farmers as totally dependent on their crops for their survival (Hill 1998: 1). While such a predicament may still apply in some settings, the contemporary situation of resource-poor farmers needs to be understood against the backdrop of constant social change and dynamic adaptation. Framing Filipino agriculturalists according to Robert Netting's (1993) concept of the "smallholder" is particularly appropriate.

Netting defines smallholders as "rural cultivators practicing intensive, permanent, diversified agriculture on relatively small farms in areas of dense population," (Netting 1993: 2). His concept suggests that smallholders have the family household as the major corporate social unit responsible for mobilising agricultural labour, managing productive resources, and organising consumption. Smallholders produce a significant part of their household's subsistence by participating in the market to sell some of their agricultural goods while also carrying on cottage industries or other off-farm employment for added income (Netting 1993: 2). Worth noting also are the following key traits which Netting emphasises as facilitating for the enduring social and economic nature of smallholders:

- they are members of communities with common property and of established institutions for sharing, monitoring, and protecting resources;
- they have ownership or well-defined tenure rights over heritable land; and
- they make daily decisions regarding the allocation of time and effort, tools, land, and capital in the context of changing climates, resource availability, and fluctuating markets (Netting 1993: 2-3).

Indeed, in response to the historical stereotyping of smallholders as backward and socio-politically inert, Netting considers the survival (and success) of smallholders as due in great part to their wealth of social relationships and their tendency to frame everyday situations and decisions in rationalistic and utilitarian terms. With smallholder practicality and versatility in mind, it then follows that smallholders

are assumed to be capable of perpetuating themselves into the future even under stressed circumstances. Such an assumption begs the question—how do smallholders adapt to increasing population pressures and declining resources, given that both greatly constrain the ability of smallholders to continue subsisting on the land which, in turn, provides their purpose and survival? Ester Boserup's attempt to address the same question had resulted in the formulation of her now classic theory of agricultural intensification.

Boserup's theory of agricultural intensification is essentially premised on the assumption that population growth induces a need for increased food production so as to satisfy a growing population (Boserup 1965). In this way, intensification functions to increase not only the amount of food produced from a limited area, but also the predictability of an area's food supply (Darity 1980). The following sequence describes the augmentative process of agricultural intensification as suggested by Boserup (in Darity 1980: 139 and Stone 2002: 330)

- 1) Where a human population is unable to move out of its existing niche and into areas of richer resources (as in shifting cultivation), rising population density and land scarcity in the same land-base would necessarily require fallow periods to shorten and food production to rise so as to ensure adequate yields.
- 2) As a result of more intense land-use, plots are likely to become increasingly less fertile.
- 3) Mandates are then created to expand human efforts for better field preparation, fertilisation, irrigation, and weed control.
- 4) Such mandates would necessarily lead to a rise in marginal labour costs, which in turn, induce agricultural innovation and the adoption of improved technology so as to facilitate better returns.
- 5) Increased food production is realised, and population growth is supported temporarily.
- 6) The renewed experience of population density and land scarcity would once again spur a need for greater intensification and further innovation.

Boserup also notes that agricultural innovation is closely associated with the type of intensification undertaken. She identifies two types of agricultural intensification:

- Capital-based intensification—referring to investments into labourers, machinery, fertilisers, and/or improved crop varieties; and
- Infrastructure or “landesque”-based intensification—referring to investments into on-site structures such as terraces, irrigation canals, ridged paddies, etc (Stone 2002: 331).

In sum, agricultural intensification via innovation and technology serve to enhance and extend food production beyond normal cropping cycles, where Boserup implicitly argues that intensification and its associated growth can be supported indefinitely for as long as capital and infrastructure-related inputs are maintained (Stone 2002: 330).

Both Netting’s concept of the smallholder and Boserup’s theory of agricultural intensification raise important propositions about smallholder situations and behaviour. Thanks to the work of Hayami and Kikuchi (2000), a comprehensive set of demographic data is available for East Laguna Village against which these propositions can be tested. The next sections of this essay will now explore the following case-study questions: to what extent can the *smallholder-Boserupian growth* model explain demographic and agrarian change in East Laguna Village? Are there limits to Boserupian modes of growth?

III. EAST LAGUNA VILLAGE: A BRIEF OVERVIEW

East Laguna Village (ELV) lies along the southern coast of the country’s largest lake, Laguna de Bay, some 50 kilometres south of Manila (Fig. 1). Unlike the rapidly urbanising west coast, ELV maintains its traditional position as a “rural village” because the strip of irrigated lowland along which the village is situated has historically been one of the most productive rice-growing areas in the country (Hayami and Kikuchi 2000: 3). Such recognition is also due in part to the fact that prior to the Green Revolution, ELV had a primarily farm-oriented population with 70% of its economically-active inhabitants engaging in farm activities (Hayami and Kikuchi 2000: 54).

As there is little difference in the elevation between the rice fields and Laguna de Bay, wet rice fields are abundant in ELV and are often flooded during the rainy season. Villagers live on slightly higher ground in thatched roofed houses hidden under coconut groves. Since 1996, a local primary school and a small Catholic church have been operating at the centre of the village (Fig. 2). As of 1997, the village held 266 households and had a population of 1,209 (Hayami and Kikuchi 2000: 3-5).

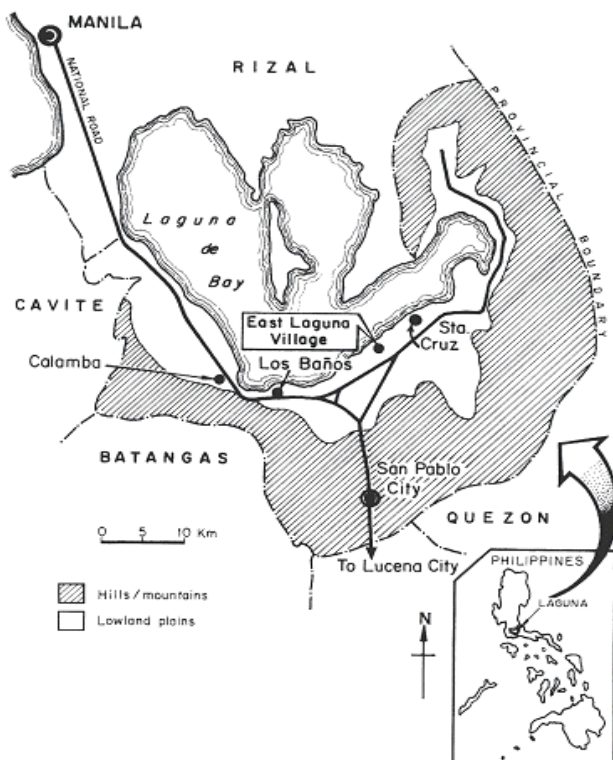


Fig. 1: Laguna Province: referring to area within the provincial boundary (Hayami and Kikuchi 2000: 3).

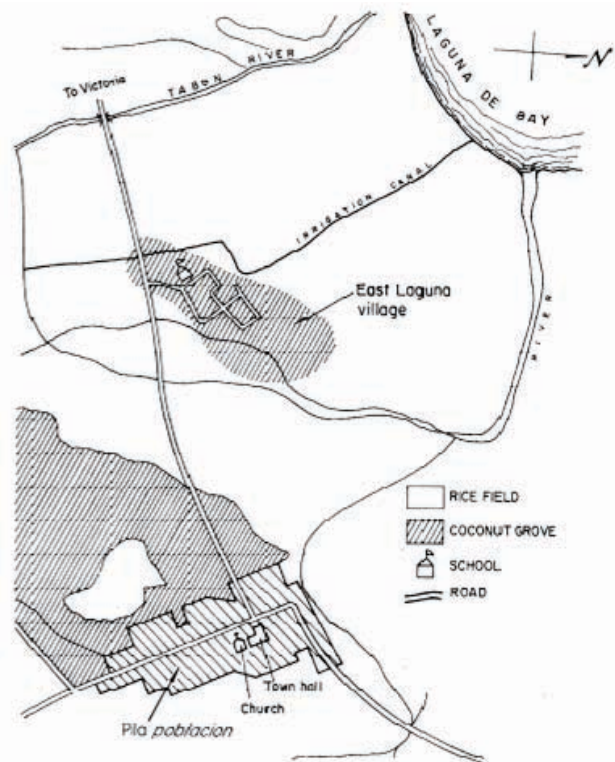


Fig. 2: Map of East Laguna (Hayami and Kikuchi 2000: 4)

Pila, the closest *poblacion* or urban municipality, is located 3 kilometres southeast of ELV. Pila was developed during the early Spanish period (16th Century) but is thought to have been a coastal settlement before Spanish colonisation. As the coastline of Laguna de Bay receded, it is presumed that population and resource pressures on Pila and surrounding elevated areas would have influenced the establishment of rice-cultivating settlements on the newly-emerged marshes by the coastline. ELV is speculated to have originated from this phenomenon (Hayami and Kikuchi 2000: 23-24).

From Pila, Spanish landlords established legal claims over ELV, and subdivided its lands progressively through inheritance. During the first several years of “land opening”, neighbouring communities as well as locals already living in ELV were enticed by legal landowners to manage their property via sharecropping agreements. Under such an agreement, an absentee landlord provided the necessary capital needed for a tenant to set-up, operate, and maintain a rice farm on the property. Without any formal documentation, the tenant’s family was also allowed to build a home on the paddock and to raise poultry and vegetables for household consumption. In return, 50% of seasonal yields were surrendered to the landowner at the end of harvest time (Hayami and Kikuchi 2000: 24-25). Sharecropping would remain the norm in Philippine agriculture until the 1970 agrarian reforms.

IV. AGRICULTURAL INTENSIFICATION IN EAST LAGUNA VILLAGE : MAJOR DEVELOPMENTS 1950-1997

The closure of the Laguna land frontier in the early 1950s shifted the momentum of economic growth in ELV from a focus on land expansion to a focus on increasing land productivity (Hayami and Kikuchi 2000: 27)—conditions which, as Boserup argued, make agricultural intensification the logical next step. On the surface, it would seem intensification in ELV took on the form of modern rice varieties, infrastructure and technological improvements, and the transfer of wealth from landowners to tenants.

Introduction of modern varieties, technology, and infrastructure

Prior to the Green Revolution, rice yield per season in ELV matched the national average of 2-3 tonnes per hectare. This doubled to 4-5 tonnes per hectare with the introduction of modern rice

varieties (MVs) to ELV in 1966 (Hayami and Kikuchi 2000: 31). It is to be noted, however, that the introduction of MVs—specifically the landmark IR8 variety—to the village was spearheaded by the International Rice Research Institute (IRRI), located in Los Banos a few kilometers west of ELV. In this case, ELV was chosen (for logistical convenience and appropriate agroecology) by IRRI to be the first community in the world to test IR8 (Hayami and Kikuchi 2000: 33). This particular agricultural innovation, therefore, had come from *outside* ELV and not from within, materialising regardless of pre-existing population and agricultural regimes.

An irrigation system was set-up in 1958 by the national government which irrigated 4000 hectares of paddy fields and allowed ELV to shift from rainfed farming to complete double cropping (Hayami and Kikuchi 2000: 27). Straight row planting and regulated paddy draining were then locally implemented alongside the use of rotary weeders, threshers, hand tractors, and the intensified application of fertilisers (Hayami and Kikuchi 2000: 30)—all of which demonstrated forms of capital and infrastructure-based intensification leading to enhanced farm productivity and returns.

A country road to Pila was established in 1965; while in 1978, a major highway was created linking Manila to Laguna and to ELV. In 1967, an elementary school was built to provide up to 4th grade education, extending to 6th grade in 1995 (Hayami and Kikuchi 2000: 27, 41).

Land reform

In an attempt to enhance the benefits of the Green Revolution and promote the diffusion of new rice technologies (such as MVs, chemical fertilisers, and machinery), a major land reform program, initiated under the Marcos government, sought to undermine the position and power of elite absentee landlords. From 1973, shared tenancy (sharecropping) arrangements were formally required to convert to leasehold tenancy, whereby former share tenants would now legally “own” the plot of land they cultivate and be free of any obligation to landlords for as long as a uniform rent rate was paid (Hayami and Kikuchi 2000: 34). Under this new regulation, rent was fixed at a lower rate of 25% of seasonal yields, with some credit being made available through local extension units. For a period of time, the land reform program was able to transfer landholder wealth to tenants, ease the financial situation of some farmers, and channel farmer credit

for purchase of modern agricultural inputs supporting intensification (Hayami and Kikuchi 2000: 35). However, with the collapse of the credit system as a result of very low repayments, farmers were left with the sole responsibility and burden of purchasing all their inputs (Hayami and Kikuchi 2000: 99). ELV was no exception in respect to the experience of land reform.

V. DEMOGRAPHIC TRANSFORMATION AND ADAPTATION IN EAST LAGUNA VILLAGE

Agricultural intensification and its associated developments had therefore set ELV upon a path towards rapid modernisation, where change, development and how both influenced for demographic transformation and adaptation in the village can be broken down into three themes:

- 1) Continued population pressure on declining land resources;
- 2) Land reform and its role in deepening class segmentation;
- 3) Infrastructure, migration, and alternative livelihoods.

Continued population pressure on declining land resources

Despite the closure of the cultivation frontier before 1960, the population of ELV increased by as much as 3.7% per year from 1966 (MVs introduced) to 1997, well above the national rate of 2.7% (Table 1) (Hayami and Kikuchi 2000: 47). This extraordinary growth in ELV can be attributed to high rates of natural increase and to extraordinarily high net immigration—an issue which will be tackled shortly.

With high population growth, the availability of

rice fields per capita in ELV decreased rapidly, from about a quarter of a hectare in 1966 to less than a tenth of a hectare in 1995 (Hayami and Kikuchi 2000: 14). The increase in crop area and rice yields through the years as a result of irrigation, MVs, and other agricultural innovations had no power to prevent population and resource pressures from increasing *landlessness* in the village. This problem of landlessness in ELV is demonstrated by the dynamic shown on Table 2 (see next page), where an increasing proportion of the economically-active population (13-65+ years old) are having, and would have in the future, less or no cultivable land to inherit and subsist on. Indeed, land scarcity is clearly reflected by the sudden drop in the proportion of farmers' households from 70% to 15% during the period of 1966-1997, and by the increase in proportion of agricultural labourers' (landless) households from 30% to 60% (Table 3) (Hayami and Kikuchi 2000: 54)—changes, which shall be discussed, were as much facilitated by land reform.

Though ELV can be considered as undergoing demographic transition—demonstrated by the gradual decline in birth rates and the stabilisation of death rates—it is arguable that agricultural intensification and its associated developments have limited, if not fallen behind in, the provision of adequate agricultural resources across the village's population. This is particularly demonstrated by how ELV's land-base continues to decline and how rice farming is becoming less accessible and profitable for younger generations.

Land reform and its role in deepening class segmentation

Before land reform took place in the 1970s, two recognisable class groups existed in ELV—that of landowners and leaseholders (Hayami and Kikuchi

	Natural Increase			Social Increase			Total population growth
	Birth	Death	Net	In	Out	Net	
1918-40	4.6	2.4	2.2 (44) ^a	3.2	0.4	2.8 (56)	5.0 (100)
1940-60	5.2	1.4	3.8 (86)	1.9	1.3	0.6 (14)	4.4 (100)
1960-70	4.7	1.4	3.3 (79)	2	1.1	0.9 (21)	4.2 (100)
1970-80	4.6	0.8	3.8 (83)	3.5	2.8	0.7 (17)	4.5 (100)
1980-90	3.1	0.7	2.4 (74)	4.2	3.4	0.8 (26)	3.2 (100)
1990-97	2.6	0.6	2.0 (60)	5.2	3.8	1.4 (40)	3.4 (100)
1918-97	4.4	1.5	2.9 (68)	3.1	1.7	1.4 (32)	4.3 (100)

Note: ^aPercentages to totals are in parenthesis

Table 1: Birth, death, and migration rates in ELV, 1918-1997 (Hayami and Kikuchi 2000: 49)

2000: 24-25). The implementation of land reform raised expectations that the distribution of wealth away from landlords and towards village smallholders would establish a fairly equitable class system whereby farmers thrived and a portion of the village's educated, non-farm workers participated in alternative livelihoods (Hayami and Kikuchi 2000: 78). However, with the failure of land reform, demographic transformation in ELV materialised in a wholly different manner.

Firstly, the failure of the local credit system made it extremely difficult for a majority of farmers to absorb the costs of intensification, despite land reform granting the farming sector considerable autonomy. This led to the polarisation of the farm community in ELV, where on one side of the spectrum were the large farmers who, as a result of the initial effects of lowered rent rates, prospered and could afford to purchase and maintain two or more hectares of farmland. While on the other end of the spectrum were the small farmers who, as a result of not being able to keep up with operational costs and market pressures, were forced to sell part of their land, or more commonly, move out of farming (Hayami and Kikuchi 2000: 57, 83).

Whereas prior to land reform, ELV ensured through the *hunun* mode of income sharing that farmers falling on hard times and landless labourers were provided with work on a neighbour's plot in exchange for one-sixth of the harvest, market pressures and an awareness of relatively low wage rate standards from urban areas served to undermine this social mechanism and therefore cut opportunities for farmers to bounce back from economic ruin (Hayami and Kikuchi 2000: 36).

Added to the increasing landlessness, the inability of most households to intensify farm operations substantially led

to the emergence of a new social class of landless agricultural labourers. As mentioned earlier, agricultural labourers' households increased from 30% to 60% during 1966-1997 (Table 3), indicating not only declining land availability and farm opportunities but also a growing young and unskilled labour force desperate for any form of work.

It also goes without saying that the income disparity in ELV has become worse since the reforms, with large farmers in 1995 earning 56% of the village's income and owning a startling 99% of the village's share of land—indicating that most, if

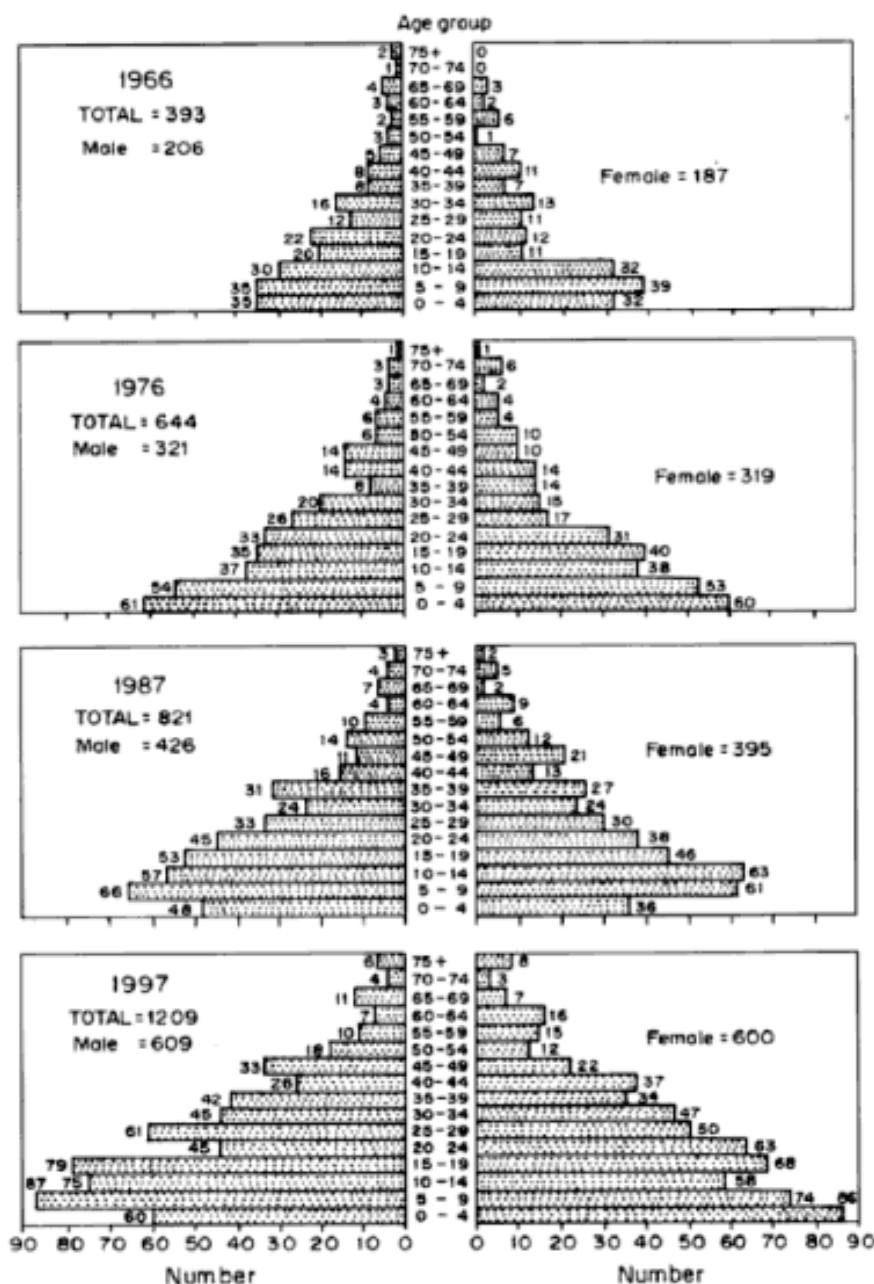


Table 2: Age distribution in ELV, 1966-1997 (Hayami and Kikuchi 2000: 52)

not all, of the remaining farming households in ELV are composed of ELV's elite (Hayami and Kikuchi 2000: 242).

Infrastructure, migration, and alternative livelihoods

The high costs of agricultural intensification coupled with the effects of land reform seem to have favoured a form of demographic transformation in ELV whereby smallholders were left with little choice but to veer away from land as the primary source of subsistence. Indeed, if it were not for developments *outside* agriculture, smallholders in ELV would truly be struggling to make ends meet.

The construction of paved roads linking Pila, Laguna, and Manila to ELV, together with the extension of the local elementary school, proved central to adaptive trends in the village. Since the

1980s, a growing proportion of village households have begun to take advantage of ELV's urban networks and education to seek off-farm employment in most especially Pila. By the early 1990s, migration and higher education (for non-farm work) were seen as the only escape from local hardships and dead-ends (Table 3, see growth rate) (Hayami and Kikuchi 2000: 61).

Teaching, secretarial and accounting work have become particularly popular amongst women in the village. Several male agricultural labourers have also entered contracts as temporary construction workers and craftsmen in Pila, while a small portion of ELV's failed farmers have also found a means for survival as, ironically, agricultural consultants to neighbouring villages (Hayami and Kikuchi 2000: 61). Such adaptive trends seem to have come full circle with the establishment of a metal craftworks industry in the village during the early 1990s as a result of a villager venturing into Manila and successfully sealing a subcontract with a major metal manufacturing company. This local industry boomed in the 1990s and played a significant role in the growth of ELV's non-farm working population (Hayami and Kikuchi 2000: 41).

The success of the metalworks industry in the 1990s, together with the improvement of infrastructure and cheap housing in ELV, made the village particularly attractive to (worse-off) upland villages whose villagers, since the construction of the irrigation system and the introduction of MVs decades earlier, had already begun emigrating into ELV for similar reasons of population and resource pressures (Hayami and Kikuchi 2000: 64-66). Migration into the village has grown faster through the years than net emigration out of the village (Table 1, social increase). This suggests that, given that most uplanders are of unskilled and uneducated backgrounds, the proportion of agricultural labourers in ELV is only likely to increase as a result of high net immigration. However, with increased market and land pressures, the non-farm section of ELV is also likely to thrive and inspire younger generations to look away from the farm for prosperity.

Year	Farmer ^a	Agricultural labourer ^b	Non-farm worker ^c	Total
1966	46 (170) ^d	20 (30)	0 (0)	66 (100)
1974	54 (57)	41 (43)	0 (0)	95 (100)
1976	54 (50)	55 (50)	0 (0)	109 (100)
1980	46 (37)	76 (60)	4 (3)	126 (100)
1983	44 (35)	76 (61)	5 (4)	125 (100)
1987	53 (34)	98 (62)	7 (4)	158 (100)
1995	51 (21)	150 (62)	41 (17)	242 (100)
1997	41 (16)	163 (61)	62 (23)	266 (100)
Growth rate (%/year)				
1966-74	2	9.4	----- ^e	4.7
1974-80	-2.6	10.8	-----	4.1
1980-3	-1.5	0	7.7	-0.3
1983-7	4.8	6.6	8.8	6
1987-97	-2.5	5.2	24.4	5.3

Notes:

^a Households cultivating paddy fields

^b Households having no land to cultivate and engaging in hired farm work

^c Households having no land to cultivate and engaging only in non-farm activities

^d Percentages to totals are shown in parenthesis

^e ----- stands for data undefined

Table 3: Number and percentage of households by type in ELV, 1966-1997 (Hayami and Kikuchi 2000: 54).

VI. CONTEXTUALISING THE SMALLHOLDER IN EAST LAGUNA VILLAGE: LIMITS TO BOSERUPIAN MODES OF GROWTH

To what extent then can the *smallholder-Boserupian growth* model explain demographic change in ELV? Are there limits to Boserupian modes of growth?

A careful reading of ELV's demographic history leads to the conclusion that, indeed, smallholders and agricultural intensification have undeniably played critical roles in the village's existence and development. However, as suggested by increasing *landlessness* in the village and the gradual shift in population composition favouring *non-farming* households in ELV, there is a need to acknowledge limits to Boserupian modes of growth and a need to revise conceptualisations of the smallholder. The following section will attempt to qualify and synthesise the limitations of both theories via ELV's experience of demographic transformation and adaptation.

1) Boserup's theory of agricultural intensification tends to be ahistorical and apolitical

As mentioned, agricultural intensification in ELV happened alongside land reform and the re-ordering of traditional society—whether the villagers liked it or not. Although agricultural intensification may have brought about increased rice productivity in ELV for a limited time, agricultural growth could not be maintained due to a lack of consistent government support and, more recently, a lack of local political will. Also, it is important to emphasise that the closure of the land frontier and the introduction of MVs, chemical fertilisers, and proper irrigation in ELV—all integral to inducing intensification—were all orchestrated by *exogenous entities*; where one cannot help but wonder if it had not been for outside influence and imposition, would we still have seen a similar transformation in ELV's demography? ELV's situation therefore demonstrates a need to integrate local history and politics in studying how agricultural intensification might be constrained and regulated by agents other than the smallholder (Stone 2002: 332).

2) Ecological and economic factors set limits to Boserupian growth

Population growth in ELV reached its peak during the period between 1960 and 1980 (Table 1), the

same time agricultural intensification was most fruitful and technological innovations were being zealously and affordably applied by farmers. After 1980, population growth in ELV gradually declined, seemingly demonstrating “demographic transition”. This decline in population growth, however, can partly be attributed to two major factors limiting further agricultural intensification in ELV.

Firstly limiting further Boserupian growth in ELV was the decreasing momentum of and returns from technological uptake. The increasing application of fertilisers and herbicides in ELV (which in the 1980s was four times more than in the 1960s), together with the cultivation of more MVs, conversely resulted in declining yields and other land-related problems like salinity and pest attacks (Hayami and Kikuchi 2000: 110-113). What this experience illustrates, therefore, is that agricultural intensification is greatly limited by the ability of an agroecosystem to sustain production (Stone 2002: 331).

Secondly, if we were to follow Boserup's line of thinking, the above problems could have been quickly remedied through the application of more inputs for more intensification. However, the failure of land reform in ELV severely undermined the income of farmers and hence reduced their ability to purchase inputs (Hayami and Kikuchi 2000: 122-123)—in turn demonstrating that Boserupian growth is significantly constrained by the income of farmers relative to the costs of intensification.

3) Smallholder survival does not necessarily have to rely on agricultural sources

Returning now to notions of smallholder “practicality” and “versatility”, the experience of increasing resource pressures and landlessness in ELV certainly confirms the prominence of both traits in the village, where through the years smallholder adaptation in ELV has tended to move away from “rural cultivation” and “permanent agriculture” as a primary basis for survival. The strong trend favouring off-farm employment amongst the non-elite section of ELV qualifies Netting's original smallholder concept, and suggests that human agency and a desire for a better life amongst rural inhabitants (including former farming families) will almost inevitably shift smallholder attention to livelihoods proven to be more lucrative and accessible—regardless of whether or not such opportunities come from agriculture or promote community values. Indeed, the combination of

increasing population pressures and decreasing land resources is likely to shift the interests of most especially poor smallholders away from food production and community interests, and towards alternative livelihoods and family interests.

4) Rural-rural migration can lead to further rural population pressures

While unusual, high net immigration into rural communities can lead to further population and resource pressures. In ELV, the migration of upland migrants into the village has intensified local competition for land and opportunities as these migrant populations add to the growing section of unskilled and landless agricultural labourers in ELV. Also, a constant influx of outside populations into the rural community might systemically upset any equilibrium and/or benefits possibly achieved through intensification or demographic transition in ELV.

VII. CONCLUSION

If rice farming has truly lost its once central relevance amongst a majority of ELV's population, then it would seem inappropriate to continue imagining ELV as a proper "rural village". Indeed, the experience of change and modernisation through ELV's dynamic demographic history has indubitably transformed the very foundations of its population, increasingly disqualifying the village from conventional "rural" standards. In particular, the

experience of landlessness, population pressure, and the growing popularity of off-farm work in ELV begs the question of whether or not it is still sensible for "rural life" to be tied down to "land" and "agriculture".

As this essay has argued, agricultural intensification in the context of the smallholder is far more than just a simple relationship of give and take or of increasing inputs and outputs. There are several limits to Boserupian modes of growth, limits which, coupled with several other political, ecological, and economic factors, compel the smallholder to rethink his/her position in the greater scheme of rural life and rationalistically approach survival in practical terms, even if this means moving away from the land for subsistence. Hence, the process of demographic transformation and adaptation in ELV, together with its lessons, not only provides us with an idea of how long-term socio-economic change is likely to interact with existing rural demographic and social regimes, but simultaneously also helps us appraise the enduring ability of smallholders to come up with appropriate strategies to further perpetuate and improve their existence.

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An environment for integration?: Climate change, sustainable development and Europe's external identity

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Sustainable Development has been evolving as a guiding principle in European politics, and Europe has demonstrated strong leadership in climate change mitigation. This essay explores the sustainable development discourse in Europe and how it has driven unified European Union action on climate change. As climate change is one of the biggest long-term problems facing humanity, Europe's proactive role in international negotiations has been of crucial importance to secure international agreements. In spite of the complexity of the European Union decision making process, member states have demonstrated a precedent of working collaboratively to achieve strong cuts in greenhouse gas emissions. Support and re-enforcement has come from many levels. Sustainable Development discourse and the urgency created by climate change has been a cohesive force in internal EU politics and a part of Europe's international agenda. As Europe leads by example in climate change mitigation, sustainable development becomes part of its external identity. The EU will play a crucial role in forming a successful outcome at the 15th Conference of the Parties of the UN Framework Convention on Climate Change. In the face of Economic Concern, the EU must re-affirm and demonstrate its commitment to unity, and ambition for a sustainable future.

INTRODUCTION

Over the last two decades, the Europe has positioned itself as a global sustainability leader. The European Union (EU) plays a significant and powerful role in international environmental policy, continuing to demonstrate leadership in climate change mitigation. In this essay, I examine how co-operation and cohesion in response to global climate change (GCC) has shaped EU external policy identity. I begin by examining the discourse of sustainable development (SD) as a cohesive force in the EU, and outline the mechanisms for the EU's solidity in the negotiation and domestic implementation of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. I then argue that EU action on GCC, grounded in a European understanding of sustainability, contributes to the external policy identity of the EU as a normative force in global affairs. Recent developments - including high level environmental diplomacy, the announcement of strong Greenhouse Gas (GHG) mitigation targets and further integration of sustainability into EU activity through the Lisbon Treaty—raise the pressure on the EU to be successful as a long-term SD leader. However, the short-term success of EU's normative power will face a critical test in negotiating a post-2012 climate agreement in challenging economic times.

SUSTAINABILITY AND SHARED VISION

Unity in European external policy identity has been facilitated by a discourse of sustainable development. Dryzek (2005: 5, 19) identifies discourse as a "shared way of apprehending the world", common sets of ontology, assumptions, agents and metaphors. The SD discourse is based on a general understanding that environmental protection can be compatible with economic and social development, and is essential to ensuring the long term viability of economic and social systems (Dryzek 2005: 16; Kronsell 1997: 118). There is no consensus on what SD and sustainability actually are, and herein lies the power of the discourse in European (and global) politics and society.

The plurality of understanding surrounding sustainable development is partly responsible for the power of the discourse; in Europe it has evolved as a political force that can gather support from a multitude of actors (Sneddon et al. 2006). Environmental protection has been a top public priority in the Eurobarometer survey¹ for over 20

¹ The Eurobarometer is co-ordinated by the Directorate General Communications on the request of the European Commission and the European Parliament. It samples individuals aged 15 and over in member countries and three candidate states.

years (Oberthür and Roche Kelly 2008; Schreurs and Tiberghien 2007). There has been a continuous and increasing level of media attention surrounding environmental issues, including GCC. This concern is reflected in the European Parliament, with Green political groups having had a significant prominence (Bainbridge 2002: 422). The plurality in understandings of SD means that these concerns and priorities can be integrated with the economic growth and integration paradigm which underlies EU activity (Sbragia and Stolfi 2008: 132). The discourse allows for political reconciliation of the assertive pro-environment stance of Finland and Sweden with the national economic development priorities of Spain and the newer EU members. It has shifted environmental regulation toward working with, rather than against industry (Kronsell 1997: 119), and has even led to the (previously unlikely) partnerships between business interest groups and environmental NGOs (Dryzek 2005: 152)².

Sustainable development was enshrined in EU's identity by the 1997 Amsterdam Treaty (Dinan 2005: 366). While the Environment Commissioner and the Directorate-General Environment takes leadership on environmental protection, integrated SD discourse has led to recognition under the Article 130r (2) that 'Environmental protection must be integrated into the definition and implementation of other community policies' (Delreux 2006). Under the 2001 Treaty of Nice, competence on most environmental issues is shared between the European Community (EC) and EU member states—meaning that most environment-related decisions can be made through qualified majority voting in the Council. (Schreurs and Tiberghien 2007). The protection of the environment has become a concern central to European identity, and SD is an overarching objective of the EU (e.g. Article 2, Treaty of the European Union) (Vogler and Stephan 2007). Global climate change presents the single largest threat to SD concerns and objectives, along with its severe social, economic and security consequences across a variety of scales (Parry et al. 2007). The 2008 Eurobarometer survey revealed that Europeans believe GCC to be the second most serious global problem after the related issue of "poverty, the lack of food and drinking water" (TNS Opinion and Social 2008: 5). Within the discourse of SD, the EU its member states and

citizens have had a continued interest in preventing dangerous climate change³.

In October 1990, the European Community (EC) Ministers of Energy and the Environment announced that GHG emissions of the EC were to be stabilised at 1990 levels by the Year 2000, mirroring the independent commitments made by the Dutch, German, Danish and Austrian governments in the preceding 12 months (Huber 1997: 143; Schreurs and Tiberghien 2007). With this collective target and sustainability discourse, the EU⁴ entered into international GCC negotiations leading up to UNFCCC, which opened for signature at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. The EC and member states were among the first signatories. The cohesive approach demonstrated in the early 1990s continues; it remains central to GCC mitigation in Europe and the role of the EU in international GCC negotiations. Alone, member states have relatively small carbon footprints and mixed capacity to mitigate emissions. The EU becomes a multiplier for the power of individual states in international negotiations—having a total impact "greater than the sum of its parts" (Peterson 2008:204). In 2004, the EU accounted for 14.7% of global GHG emissions (United Nations Statistics Division 2007). Reduction in the EU's collective emissions has a global impact. The EU also has a market of 500 million consumers, 40 percent more than the USA (Peterson 2008), and is the biggest provider of aid to developing countries (European Communities, 2008). As both an intergovernmental and supranational entity, the EU has the internal capacity to make these reductions, and a significant capacity to influence other countries to do the same.

MECHANISMS FOR COHESION

The EU has maintained a unified climate change mitigation strategy and cohesive negotiating position at the UNFCCC despite significant institutional barriers. The European policy making structures and

² The campaign partnership between the World Business Council for Sustainable Development and Environmental NGO Greenpeace at the 2002 World Summit for Sustainable Development is a prominent example

³ The EU has accepted dangerous climate change as mean global temperature increase greater than two degrees above a pre-industrial baseline (1.4 degrees above the current temperature). Stabilising atmospheric CO₂ concentration at less than 450 parts per million will reduce the probability of this occurring to 50% (Parry *et al.*, 2007)

⁴ In 1990, negotiations were carried out by the European Economic Community and its 15 member states.

mechanisms for legal personality in an international setting are complex and unique. The European Union, as an entity, does not always have a supranational legal personality—a power to represent EU member states at an international level and accede to international agreements. While the European Community “pillar” of the EU (represented by the European Commission—the EU’s multinational civil service) does have legal personality, the international agreements that the Commission negotiates have to be ratified by the European Council, which consists of ministers from member states (Delreux 2006). Furthermore, while environmental policy falls under the competence of the Commission, member states remain largely responsible for energy and transportation, sectors critical to climate change response (Lacasta et al. 2007: 215). This mixed competence means that the EU negotiation and accession to international agreements is conducted jointly by the European Communities (represented by the Commission), the Council, and individual member states (Oberthür and Roche Kelly 2008). Therefore, a cohesive position is necessary to produce a binding agreement (Delreux 2006).

Responsibility for forming cohesion between the EC/member state positions lies with the Presidency of the European Council, which consists of ministers from member countries. The president is assisted by an ad hoc Climate Working Group of environmental ministers from the council (Delreux 2006; Schreurs and Tiberghien 2007). The President has the power to add international agreements to the *aquis communautaire*, making them EU law. The SD discourse is evident in numerous aspects of this process. Delreux (2006) and Lacasta et al. (2007) note that proactive policy entrepreneurship under the 1997 Dutch presidency was critical to the advancement of the sustainability and climate change agenda, and the development and articulation of an EU position leading up to Kyoto—indicating that the EU position may have been considerably weaker under another leadership. However, Schreurs and Tiberghien (2007) argue that the multiple levels of EU leadership, unified by the SD discourse, allowed for the incorporation of a greater level of public engagement, and ultimately support, for the EU’s position on GCC. The Commission has used the environmental and climate change agenda as a focal point for integration, building consensus, unity and international leadership with much greater success than the Common Foreign and Security policy (Oberthür and Roche Kelly 2008; Schreurs and Tiberghien, 2007). In a time where confidence

has been reduced in other aspects of European integration, SD and GCC have become drivers to internally promote the power of a cohesive European response to domestic and global issues.

CLIMATE CHANGE IN THE EU’S BROADER POLICY IDENTITY

The successes of the EU’s unified and cohesive approach to GCC complement a broader foreign policy identity. The EU can be regarded as a “normative power” in global affairs, acting primarily through ideals and values rather than military force (Falkner 2006). “Leadership by example” is a critical part of this power and identity, and the EU must demonstrate that aggressive emission reductions are possible in order to maintain integrity as a GCC leader (Oberthür and Roche Kelly 2008). Under the Kyoto Protocol, the EU committed to an 8% reduction of GHG emissions from 1990 levels by 2012. The EU negotiated a unique burden-sharing approach to collectively reach this target across the 15 states that were members of the EU (EU-15) at the time of ratification, known as the “EU bubble”. Their approach has embodied the principles of Equity and Common but Differentiated Responsibilities central to the UNFCCC—that countries, based upon their historic emissions and present capabilities have different levels of mitigation responsibility (Schreurs and Tiberghien 2007; Vogler and Bretherton 2006). Under the “EU bubble”, the bulk of emissions reductions have been provided by the UK (through the transition from coal to natural gas in the energy sector) and Germany (through the de-industrialisation of the east, and investment in renewable energy), which has allowed Spain, Portugal and Greece to increase national emissions as they achieve economic development outcomes.

The EU bubble has also made exemplary use of market-based instruments for mitigation, including the Emissions Trading Scheme (ETS) (Bailey 2003: 41). While the ETS has faced extensive criticism, it provides a blueprint for national and regional schemes, and demonstrates the plausibility of a global ETS (Schreurs and Tiberghien 2007). This leadership by example has provided a regional basis for how GCC policy could be implemented at a global scale, through co-operation, cohesion and leadership. More broadly, the EU’s continued faith in the UNFCCC and Kyoto Protocol is an affirmation of its commitment to multilateralism through UN mechanisms, trade and dialogue (Vogler and Stephan 2007). The EU decision to proceed with

the Kyoto Protocol without US support was a defining moment in its external politics, and its entry into force in 2005 (following Russia's ratification) was a major victory for the EU's long term SD diplomacy.



Fig. 1: Angela Merkel has emerged as a GCC policy entrepreneur, securing a G8 agreement on climate change. Source: (Spiegel Online 2007)

According to Lacasta et al (2007: 211) the EU has taken the environment into the domain of “high politics”, with leaders engaging in direct diplomacy on climate change with countries outside the EU (Lacasta et al. 2007: 211; Oberthür and Roche Kelly 2008: 35). Angela Merkel has emerged as a key policy entrepreneur in gaining support for EU positions on GCC and SD (Figure 1) (Smith and Mix 2007). A major victory of her 2007 presidency of the G-8 was the launch of negotiations for a G-8 climate agreement, with leaders agreeing to “consider and adopt... the goal of achieving at least 50 per cent reduction of global emissions by 2050, recognising that this global challenge can only be met by a global response” (Pilling and Harvey 2008). Her direct engagement with G-8 leaders laid the foundation for consensus on a Bali roadmap at the 2007 UNFCCC Conference of the Parties. In order to match this leadership with corresponding “low diplomacy”, the Commission has launched a “Green Diplomacy Network” to integrate the environment and SD into all relevant areas of foreign policy (DG External Relations 2007). While Vogler (2007) and Oberthür and Roche Kelly (2008) question the effectiveness of this network, it has the potential to further cement the environment and SD into the EU's external policy identity.

FUTURE DIRECTIONS

In order to secure the integrity of sustainable development and global climate change leadership in the EU external policy identity, the EU must aim to meet its Kyoto targets. Yet even if it comes close, the EU will still have demonstrated its capacity to lead by example on GCC and SD (Schreurs and Tiberghien 2007). It is clear that the EU intends to remain a unified leader. In March 2009, EU environment ministers agreed to a binding target of a 20% reduction relative to 1990 levels by 2020, which will increase to a 30% reduction provided other developed countries commit to making comparable reductions. But will the EU be able to maintain its position, approach and success?

A post-2012 EU agreement will expand the “EU bubble” from 15 members to 27, with a far greater diversity in economic and technical capacity and less exposure to the sustainability discourse (Lacasta et al. 2007). This presents a challenge to cohesion and meeting mitigation targets. Should the 2007 Lisbon Treaty enter into force, the decision making process and efficacy of the EU in external relations may be greatly improved (Oberthür and Roche Kelly 2008). Article 2 (5) of the Treaty of the European Union will be updated to state that the EU shall “contribute to... the sustainable development of the earth...” internalising Europe's identity as a normative force for SD. However, many of the interest groups who tried to use their influence to “green” the treaty of Lisbon felt blocked out of the Lisbon treaty negotiation process (Vedder 2008). Such sentiment could weaken the SD discourse—threatening to make sustainability a bureaucratic ideal that loses the popular support and public participation that has given the discourse such power (Sneddon et al. 2006). However, the biggest resistance to the EU's GCC leadership and sustainability diplomacy may come from the 2008 developments in global financial markets and economies. Several EU member states have questioned whether they are capable of meeting their mitigation targets in their current economic situation, but both Yvo de Boer (UNFCCC Executive Secretary) and Ban Ki-moon (UN Secretary General) have called on all UNFCCC parties to use the current economic challenges as an opportunity to build a more sustainable economy (Copenhagen Climate Council, 2008; UN News Service, 2008). Therefore, a real test of the EU approach will be the level of unity and ambition that of Europe brings to Copenhagen in 2009, where a Post-2012 agreement

will be negotiated in a challenging economic environment.

CONCLUSION

A loosely defined principle of sustainable development has become a relatively powerful discourse in the EU's evolving identity. The most notable manifestation of the discourse has surrounded climate change, an issue that has been approached with a level of unity and cohesion lacking in other areas of EU affairs. I have demonstrated that in many ways, European cohesion and the SD discourse have been mutually reinforcing, as the discourse reconciles the interests of different actors within the EU. The EU has "led by example" in its approach to climate change mitigation by embodying key UNFCCC principles and agreeing to ambitious GHG reduction targets. These actions support Europe's power as a normative global force.

Preventing dangerous climate change remains one of the most significant, long-term global challenges. Unity around a sustainable development discourse

and success in meeting mitigation targets are critical to maintaining EU legitimacy as a global sustainability leader, and, in turn, securing a sustainable global solution to climate change. However, the long term sustainability of the European position and the EU's aggressive mitigation targets is questionable. In the face of the challenges caused by expansion and economic concern, the EU must maintain its unity and ambition for a sustainable future.

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Paradoxes and paradigms: How can the social model of disability speak to international humanitarian assistance?

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In order for a theory to be dynamic and to remain useful, it must speak to other philosophies that operate with similar goals, so that it might translate its theory into practical policy. During the exercise of International Humanitarian Assistance (IHA) where people's lives are frequently at stake, and of disability rehabilitation where issues such as livelihoods, empowerment and development are being addressed, it is extremely important that the grand ideas advocated by theories are fully utilized by practitioners. Though the two philosophies of IHA and the Social Model of Disability come from quite diverse and disparate viewpoints, with IHA primarily working amid humanitarian emergencies in developing countries and the social model of disability examining the relations between individuals with disabilities and their societies, their language reveals that they converge on many issues. By analysing the discourses of both IHA and the social model of disability, important paradigms and paradoxes on both the theoretical and practical levels are uncovered. In this way each theory, each model, and each ideology can be refined and in turn, it can better the circumstances of the people who exist in the real-world situations the theories seek to inform.

INTRODUCTION

Articulating the relationship between international humanitarian assistance (IHA) and the social model of disability is central to understanding the paradoxes and paradigms that exist within and between the two theories. Though the two philosophies come from quite diverse and disparate viewpoints, with IHA primarily working amid humanitarian emergencies in developing countries and the social model of disability examining the relations between individuals with disabilities and their societies, their language reveals that they converge on many issues. A Critical Discourse Analysis of both IHA and the social model demonstrates a number of paradoxes that exist within them on two levels: the theoretical and the practical. A key theoretical paradox central to both theories is represented by the language of 'empowerment' and 'community'. Given the centrality of these two ideas, a better understanding of this paradox would benefit both IHA and the social model, and interaction between the two. Likewise, there exist a clear set of compatible assumptions, concepts, values, and practices that constitute a way of viewing reality for both theories. The way in which IHA and the social model operate within their similar paradigms elucidates the potential for positive engagement between the two. Ultimately, illuminating the analogous paradigms and the theoretical and practical tensions in one can

help shed light on the paradigms and paradoxes inherent in the other.

For the purposes of this paper, the ongoing Palestinian/Israeli conflict will be examined in order to discover how the social model of disability can speak to IHA in order to further its work with conflict-related disability. After critically analysing the discourse of both IHA and the social model to discover the true extent of the theoretical and practical paradoxes within and between them, the practice of community-based rehabilitation (CBR) in Palestine will be used to further demonstrate the tangible effect that this discourse has on 'in the field' IHA work. This case study highlights that, in operational terms, the social model of disability has much to offer IHA practitioners in terms of presenting them with a framework through which to address the needs of disabled people during times of conflict and emergency. CBR in Palestine is thus a useful context to use in order to establish how the social model of disability can speak to IHA.

CRITICAL DISCOURSE ANALYSIS

Critical Discourse Analysis (CDA) is a way of approaching the interaction between rhetoric, politics, society and identity, that can facilitate the exploration of the way in which institutions and individuals communicate through written texts and

verbal interactions (Lupton 1995). A basic definition of discourse analysis is provided by Wetherell, Taylor & Yates (2001), who describe it as:

...the study of talk and texts. It is a set of methods and theories for investigating language in use and language in social contexts. Discourse research offers routes into the study of meanings, a way of investigating the back-and-forth dialogues which constitute social action, along with the patterns of signification and representation which constitute culture (2001: i).

CDA investigates language not as a mental, but rather as a social phenomenon. It primarily studies the way social discrimination, manipulation, inequality, power and control, are enacted, reproduced and resisted by text and talk in the social and political context (van Dijk 1993).

Wodak and Meyer (2001: 16) explain that CDA sees itself as a hermeneutic process; 'Compared to the (causal) explanations of the natural sciences, hermeneutics can be understood as the method of grasping and producing meaning relations.' CDA assumes that all discourses are historical and can therefore only be understood with reference to their context. Thus it refers to extra linguistic factors such as culture, society and ideology. They continue by linking the idea of context to CDA's 'interdisciplinary claim and its description of the object of investigation from widely differing perspectives' (2001: 16), and argue that CDA, when compared to other linguistic methods of text analysis, seems closest to sociological and socio-psychological perspectives. I suggest further development of this point and argue that the emphasis CDA puts on explaining relations of power through language, makes it a particularly useful tool with which to understand how the discourse of IHA and the social model of disability influences the way in which the two theories can speak to each other.

LOCATING DISABILITY IN IHA: WHY DOES IT MATTER?

The United Nations' International Year of Disabled Persons (UNIYDP) was held in 1981 with the goal of obtaining 'full participation and equality' for all disabled people. General Assembly resolution 36/77 stated that the member states were 'deeply concerned that no less than five hundred million persons are estimated to suffer from disability of one

form or another, of whom four hundred million are estimated to be in developing countries.' Later *The International Decade of Disabled Persons* was held between 1983 and 1993. Today the UN estimates that there are more than 650 million people and 2 billion directly affected by disability, if family members are included. This represents approximately one third of the world's population.

The 2007 World Bank Guidance Note on *Incorporating Disability-Inclusive Development into Bank-Supported Projects* recognizes that the majority of people with disabilities live in developing countries, those countries in which IHA practitioners most often find themselves. Their increasing numbers are the result of conflict, malnutrition, diseases including HIV/AIDS, aging and natural disasters.

CONFLICT IS ALWAYS INCLUSIVE

In any society, the vulnerable members are groups such as the socially, physically or mentally disabled, women and children. Emergencies such as natural disasters or conflict situations exacerbate the vulnerability of these groups. Disabled people (this group includes the elderly) are overwhelmingly represented in refugee communities (Pankhurst 1984) and are disproportionately affected by disasters and conflict. Conflicts and natural disasters are both direct and indirect causes of disabilities: directly through physical injuries, and indirectly thorough lack of quality medical care and disruption of health care services and infrastructure. Furthermore, disabled people and their relations may encounter additional problems due to the loss of mobility aids, difficulty in accessing information, food, water and/or sanitation sources. For IHA practitioners, disabled people are most certainly a vulnerable group that requires targeting. IHA practitioners must therefore consider the implications (both long and short term) of their actions.

Article 11 of the *UN Convention on the Rights of Persons with Disabilities* says that:

States Parties [sic] shall take, in accordance with their obligations under international law, including international humanitarian law and international human rights law, all necessary measures to ensure the protection and safety of persons with disabilities in situations of risk, including situations of armed conflict,

humanitarian emergencies and the occurrence of natural disasters.

Following this, disabled people must be considered a target group across all assistance processes including detection and identification, assessment and planning, delivery of support programs, monitoring, review and evaluation. Article 11 means that, in the field, aid organizations must pro-actively seek out and engage with disabled people, their family members and care-givers in order to ensure they are registered and provided with support. At home, donor agencies must include within their funding strategies designs that specifically recognize disabled people's needs. This must include both supporting disabled people in terms of them being aid-recipients (for example, reconstruction projects must ensure that there are appropriately designed shelters and camps) and also including them as active participants in the wider community's response to the crisis. Ultimately, it is imperative that disabled people do not get lost in the chaos of emergency.

THE SOCIAL MODEL OF DISABILITY

Peter Coleridge, in his book, *Disability, Liberation and Development* (1993), explains the social model of disability as follows:

The social model of disability begins from the point that integration is ultimately about removing barriers, not 'normalisation', cure or care. Rehabilitation within a comprehensive social framework is about the removal of barriers at the individual level; it is also about the removal of physical and attitudinal barriers in society at large (Coleridge 1993: 73).

The social model is an approach and an attitude to disability, whereas the 'individual model' is more prescriptive. The individual model includes both the charitable and the medical models of disability in which the disabled person is presented as the problem. Within this model there is no perception of the need to change society to better the position and circumstances of disabled people. The individual model favours institutions and promotes the segregation of disabled people. It is important to note that the social model (as practiced in its most

current, more moderate form¹) does not negate the need for appropriate medical and rehabilitative care, what it does do is seek to adapt the system to the person, rather than force the person to adapt to the system. It has thus become an emancipatory force for many disabled people worldwide.

In the Oxfam publication, *Disabled Children in a Society at War*, Hastie (1997) further explains that the social model sees beyond the specific impairment of the individual and in doing so, requires disabled people to define the services they require, and take a prominent and active role in project design, decision-making and project management. The social model recognises that disability is not just a medical problem but rather, that the actual 'disabling' of the individual person is the result of a combination of architectural, institutional and prejudicial barriers. It stresses the empowerment of disabled people and encourages them to take control of their futures by speaking up against inherently unfair and inaccessible societies, and to work to locate themselves within projects that relate to disabled people in order to make sure their voices are heard.

COMMUNITY-BASED REHABILITATION (CBR)

CBR combines the positive aspects of both the medical and social models of disability by providing physical rehabilitation and continued medical care whilst promoting empowerment and social inclusion. It returns power to both the disabled individual and the community by including them in the process of rehabilitation and management of the impairment. Furthermore, CBR facilitates cooperation between the disabled person, their family, the wider community and IHA practitioners, requiring positive engagement and understanding between all actors if it is to work successfully.

CBR is particularly compatible with the ideologies of most NGOs (such as ICRC, Oxfam and World Vision) as it focuses on the obtaining and promotion of human rights, equality and emancipation, and encourages inclusion and social integration. Its desire to create equal opportunities for employment and the way it utilizes means that are already present in the community, makes good use of scarce resources. Local knowledge is respected and a high

¹ For a discussion of the more radical, 'UK version' of the social model see Shakespeare and Watson 2002 as well as Tregaskis 2002.

value is placed on indigenous knowledge and practices, 'the key being to 'unlock' existing expertise within communities enabling them to develop their own community process that builds on and validates existing indigenous knowledge and information systems, while facilitating access to relevant information and ideas from outside the community' (World Bank Guidance Note 2007).

THE PARADOX² OF 'EMPOWERMENT' AND 'COMMUNITY'

The concept of empowerment is central to the way the social model of disability is used by IHA as a theoretical framework for aid projects. It logically features in CBR just as prominently. As WHO's Disability and Rehabilitation Team state at the outset of its explanation of CBR, 'CBR is a multi-sectoral approach and has 5 major components: health, education, livelihood, social and empowerment'. However, as recognised by many scholars (Riger 1993; Schloss, Alper and Jayne 1993; Kendall, Buys and Lerner 2000) the very idea of 'empowerment' is a paradox. The tensions that surround the way empowerment is conceptualised within the social model can speak to IHA. They are the same tensions that exist for any emergency assistance program seeking to create a solid 'empowered' foundation for later development. Arguing that giving people back their agency, or 'empowering' them, after a time of acute crisis raises similar issues to those when discussing empowering disabled people who are (or at least are seen to be) marginalised.

Empowerment relies on the assumption that there is pre-existent 'power' available to be transferred between groups or people. In this sense power is a relational construct that rather than being created or destroyed, simply exchanges hands. During a humanitarian emergency there may not be any power to transfer to the disabled population, or similarly, there may be so little power available to share that giving power to one vulnerable group necessarily subtracts power from another. Manipulating power in this way causes unequal relationships (Schloss, Alper and Jayne 1993) as well as conflict between actors, hence causing a situation that directly contradicts the tenets of the social model, CBR, and IHA. These models all champion the importance of equal relationships. Furthermore, this notion of the transferring of power

runs the risk of promoting an 'expert/client' situation. In the context of CBR, 'the idea that power can be taken by a rehabilitation worker and given to a client immediately suggests that power lies firmly with the worker' (Kendall, Buys and Lerner 2000: 437). In IHA, the idea of an aid agency (who is almost always the outsider in any humanitarian emergency) donating its power to a vulnerable group, particularly at the risk of upsetting an already fragile balance of power between groups, is unsettling and raises questions about power, control and what type of assistance is most appropriate.

Riger asserts that 'finding one's voice, controlling one's resources and becoming empowered may reduce the interdependence that produces a strong sense of community' (Riger 1993: 278). She asks if the empowerment of vulnerable groups really brings about a greater sense of community or whether it in fact promotes certain groups at the expense of others, therefore increasing competitiveness and lack of cohesion. She recognises that pure Western-liberal philosophy, such as that which so often informs IHA, emphasises individual rights over community rights (Riger 1993). This obviously runs counter to the focus on social and community participation inherent in the way IHA actors practice the social model of disability. When speaking to IHA it is important to note, as do Thomas & Thomas (1999) that 'in many developing countries, 'individual rights' as expressed in industrialised nations, do not exist. Traditionally in these countries, an individual is born in a kinship group, with a network of relationships that involve mutual obligations with regard to religious and economic factors. They warn that IHA practitioners must pay careful consideration to cultural factors when implementing programs like CBR through the social model lens because "the process of 'empowerment' of an individual in this society is more complex, irrespective of whether he is a disabled person or otherwise."

Empowerment and power relations can also be observed from a gender perspective whereby traditionally masculine notions of power, mastery and control are used to the detriment of normatively feminine ideals of cooperation, and community. However empowerment may require women to take control of their lives in a society that does not fully accept such masculine behaviour. Thus, the discourse and construct of empowerment tends to favour middle-class Western males. It thus has the potential to disempower women and, more specifically, through the framework of the social

² See Kendall, Buys and Lerne 2000 for the origins of this idea.

model and CBR, to disempower disabled women. Thomas & Thomas (1999) are critical of the fact that 'even the women's organizations in developing countries consider these women as disabled first and as women only secondarily.'

From a practicality perspective, 'buzzwords' such as empowerment and community suffer from a semantic vagueness that results in difficulty using them appropriately in applied policy. However even a brief visit to the websites of agencies such as WHO, Save the Children, Oxfam and ICRC prove that these buzzwords are regularly espoused in IHA. Riger (1993) remarks that admirable goals such as empowerment and community inclusion may hinder the achievement of the more tangible but less glamorous goals, such as physical aids. Too much rhetoric and not enough action is particularly damaging during humanitarian emergencies when what ought to come to the fore is practical action rather than ideological 'buzzwords'. In these emergency situations many of the disabled are newly disabled due to conflict-acquired injuries; they therefore predominantly require practical assistance. Kendall, Buys and Larner rightly acknowledge that 'misrepresentation of empowerment and community inclusion can lead to the provision of inadequate support services and the placement of excessive demands on family members who are already experiencing significant pressure' (2000: 438). They further comment that 'rehabilitation practices that are characterized by inadequate support and structure are disempowering and fail to acknowledge the individual's right to relinquish control' (2000: 438). Just like any person that IHA attempts to help, disabled people deserve both choice and expert assistance; these two ideas need not be mutually exclusive. Neglecting concrete assistance in favour of positive-sounding discourse also critically affects the way in which emergency relief can make the transition to longer-term development. This 'relief to development continuum' provides numerous challenges for IHA practitioners. Development demands a solid foundation from which to work, and therefore it is vital that IHA implement projects (such as CBR) appropriately and responsibly, using the right mix language and practical policy.

MOVING BEYOND WORDS: HOW IHA PRACTITIONERS ARE USING THE SOCIAL MODEL TO INFORM PALESTINIAN CBR PROJECTS

The second Palestinian *Intifada*, *Al-Aqsa*, began on 28 September 2000 due to the Palestinian

people's growing frustration with the lack of tangible progress in implementing the 1993 Oslo agreement. This *Intifada* was much more violent and resulted in many more deaths and injuries than the first (1987-1994) due to the use of tear gas and snipers firing live and rubber-coated metal bullets. According to records held by the Red Crescent Organization and the Palestinian Ministry of Health, 13.4% of the injuries were severe enough to have serious implications for disability and the need for long-term care and support (Halileh et al. 2002). The Palestinian Red Crescent reports 737 injuries in the West Bank and Gaza so far during 2008 and 32,569 deaths since the beginning of *Al-Aqsa*. Although armed conflict obviously has serious direct consequences on human lives in terms of death or injury, its effect on infrastructure and services can lead to indirect consequences, such as high numbers of disabled people, which are potentially more widespread and severe. For this reason the role of NGOs in providing health services, such as CBR is of the utmost importance.

There is solid history of rehabilitation and disability-related services in Palestine for aid agencies in the region to build on. Since the 1940s, they have primarily been carried out by local and international NGOs however until the 1970s they focused mainly on deafness and blindness (Eide, Harami and Greer 2005). In the 1980s, during the first *Intifada*, many NGOs started special programs for disabilities which included CBR projects. In 1994, the Palestinian National Authority took full responsibility for the health sector and rehabilitation and disabilities were given special support, especially in terms of institutional capacity building and staff development. In 2005, there were 23 NGOs, grouped into 5 regional subcommittees—Nablus, Jenin, Southern Region, Central Region and Gaza—the main supporters being The Norwegian Association of the Disabled and Diakonia. The importance of CBR in transforming the lives of disabled people in Palestine cannot be underestimated. Continuous promotion of community awareness and activity on the issues affecting disabled people since at least the early 1980s, when the United Nations Relief and Works Agency (UNRWA) began its first CBR programs, has led to increased integration and acceptance. After the first *Intifada* an improved CBR, based on these early programs, was able to operate beyond the political spectrum and draw on a wider variety of sources for sustainable development which has led to wide acceptance of the social model and the importance of disability-rights (Ashtan 1997: 56).

CONCLUSION

As Finkelstein (2001) asserts in his discussion of the social model:

Models are constructed so that an object can be looked at in different ways and under different conditions. Models are artificial and do not *explain* anything. Model airplanes, for example, are constructed to see how they might behave in a wind-tunnel. The model airplane will not explain the laws governing flight, although they might provide the insight from which laws of flight are inspired. A good model can enable us to see something which we do not understand because in the model it can be seen from different viewpoints (not available to us in reality) and it is this multi-dimensioned replica of reality that can trigger insights which we might not otherwise develop.

This statement about the utility of models can further be applied to theories and, I believe, this can help us to understand why looking at the way theories and models speak to each other is important. When theories interact and seek to inform each other, they open themselves up to critical evaluation from an outside source (the other theory). When IHA and the social model of disability engage, they approach each other from completely separate schools and yet their agreement on so many issues demonstrates their potential to positively influence each other, and help each develop into better and more complete theories.

By analysing the discourse of both IHA and the social model, important paradigms and paradoxes on both the theoretical and practical levels are uncovered. Using a discussion of the social model-based CBR projects in Palestine, as operated by IHA practitioners, these paradigms and paradoxes are further illuminated. In addition to this, this case study highlights that, in operational terms, the social model of disability has much to offer IHA practitioners through providing a framework which addresses the needs of disabled people during humanitarian emergencies. It has been the aim of this study to demonstrate that in order for a theory to be dynamic and to remain useful it must speak to other theories which operate with similar goals. In this way each theory, each model, and each ideology can be bettered and in turn, can better the circumstances of the people who exist in the real-world situations they seek to inform.

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Opening up the West: An examination of four core questions on China's "Western development" campaign

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The widespread unrest across the Tibetan plateau and events in Xinjiang earlier in 2008 turned international focus directly on China's west region. The overriding policy initiative that is pivotal in understanding the current dynamics of the region is the Chinese government's Campaign to "Open Up the West". Grounded on an awareness of the unique complexities of the region, this essay examines the campaign through the guidance of four core questions that are critical to any understanding of the issue: Why did the Chinese government introduce the Campaign to Open Up the West? What kinds of policy measures are being implemented? How likely is policy to succeed in reducing and reversing the rise in regional inequalities? What are the major obstacles to success?

The campaign to Open Up the West is a multifaceted drive representing economic, environmental and political agendas. It has manifested primarily as an all-out push for rapid growth through enormous subsidies and subsidised investments via Chinese corporations based mostly outside the region; an open immigration policy that facilitates the movement of Chinese from other areas into the region, drawn by the state induced boom; and an absence of protection of the employment of the local population despite acute educational lags and a severe undersupply of education infrastructure relative to the rest of China. Contrary to conventional expectation, these "development" policies and the associated rapid growth have in fact been reinforcing the underlying political and social tensions through the marginalisation of local populations which ultimately revealed themselves in the form of social unrest and resistance.

INTRODUCTION

The events in Xinjiang and the widespread uprising by tens of thousands of Tibetans across the Tibetan plateau engulfing regions in five provinces of the People's Republic of China (PRC) earlier in 2008—the year of the Beijing Olympic Games—turned international focus directly on China's west region. The events that unfolded brought to the fore the complexities of the territory, shattering the myth of the region being just another area of China albeit with the added colour of happy and grateful minorities. Indeed, the western region of what is now the PRC is very different from her eastern regions geographically, historically, ethnically and politically. The stark dissimilarity between the Uigurs living at the edges of the Taklamakan and Kumtag deserts in the Tarim Basin of Xinjiang and the Tibetans of the grassy plains of the plateau highlands and at the foothills of the great Himalayas, in comparison to the habitants of coastal cities such as Shanghai and the agricultural fields of eastern China highlight these differences. Moreover, until quite recent times many of these areas were almost solely occupied by non Chinese peoples with their own sense of distinct identity, and in the case of the

Tibetans, their own sense of national identity¹ coupled with their own Lhasa-based government and army.² Any analysis of the Chinese government's policy towards the west region must be grounded on an informed awareness of this context.

The overriding policy initiative that is pivotal in understanding the current dynamics of the region is the Chinese government's "Western Development" Strategy, also known as the Campaign to "Open Up the West" (*xibu da kaifa*)³. This campaign is a multifaceted drive representing economic, environmental and political agendas. In its most lustrous emanation, it has manifested as an all-out push for rapid growth through enormous subsidies and subsidised investments via Chinese corporations based mostly outside the region; an open immigration policy that facilitates the movement of Chinese from other areas into the region, drawn by the subsidy induced boom; an absence of protection of the employment of the local population despite acute educational lags and a severe undersupply of

¹ Tsering (2004)

² Laird (2006)

³ Goodman (2004a)

<i>Mineral, Water, and</i>			
<i>Hydropower</i>	<i>Reserves (%)</i>	<i>Land Type</i>	<i>Area (%)</i>
Potassium	97	Unused	79.6
Nickel	62	Pastoral	72.3
Natural gas	58	Water surface	39.0
Platinum	57	Forest	38.3
Coal	30	Cultivated	28.6
Petroleum	23	Transportation	24.3
Underground water	12.5	Gardens	23.3
Hydropower potential	80.3	Residential, industrial, and mining	22.7

Table 1: Natural Resources in the Western Region as % of national total. (Lai, H. H. China's Western Development Program: Its Rationale, Implementation and Prospects, *Modern China*, 2002; 28; 432)

education infrastructure relative to the rest of China; and an assimilationist agenda within education policy. Contrary to conventional expectation, these "development" policies and the associated rapid growth have in fact been reinforcing the underlying political and social tensions through the marginalisation of local populations which ultimately revealed themselves in the form of resistance and social unrest.⁴

This essay provides an examination of the campaign through the guidance of four core questions which are critical to any understanding of the issue: *Why did the Chinese government introduce the Campaign to Open Up the West? What kinds of policy measures are being implemented? How likely is policy to succeed in reducing and reversing the rise in regional inequalities? What are the major obstacles to success?*

Since the formation of the People's Republic of China in 1949 and the subsequent annexation of territories to form what is now the western region of the PRC, this region has consistently lagged behind the eastern regions of China in almost every measure of economic development and social welfare. During this period, the lag of the western region has been preserved and aggravated by the ultimate failure of Mao Tse-Tung's Interior Development Strategy due to its contradictory policies, compounded by Deng Xiaoping's explicit economic favouritism towards the eastern coastal regions which began with the open door policy in 1979. Through the Campaign to Open Up the West, the subsequent leaders Jiang Zemin and Hu Jintao, may be viewed as fulfilling Deng's vision of developing the west after the

development of the east had gained momentum. The policy shift occurred vaguely during the Eighth Five-year plan (1991-95) and became more explicit during the Ninth Five-year plan (1996-2000).⁵

WHY THE CHINESE GOVERNMENT INTRODUCED THE CAMPAIGN TO OPEN UP THE WEST

The most evident economic motive behind the Campaign to Open Up the West has been the rising level of regional inequality between the eastern and western regions. In 1952 average per capita GDP in east China was 1.3 and 1.7 times higher than that in the centre and west respectively. These ratios had increased to 1.9 and 2.5 by 2000. Provincial per capita GDP in 2002 ranged from 6,093 yuan in Gansu in the west to 40,648 yuan in the coastal municipality of Shanghai.⁶ This high and rising level of inter-regional economic disparity is of concern to the Beijing leadership not only because of the inherent inequities it represents but also because of this inequality's socio-political implications including the potential for widespread disenchantment in the region with the national leadership of the Chinese Communist Party.

This concern has been intensified with the onset of China's WTO membership and the apprehension that the long isolated officials and population of the western regions who are more accustomed to the command economy structure and state owned enterprises which have tended to dominate the western region's industrial output will be hard

⁴ Fischer (2008)

⁵ This paragraph draws on Golley (2004).

⁶ Golley (2004)

pressed to compete against internationally competitive foreign firms.

Some also view the development of the western regions as complementary to the development of the eastern regions due to the west's wealth in natural resources as illustrated in the Table 1. They believe that further exploitation of these resources will not only bring growth to the west but will also help to satisfy the east's seemingly voracious appetite for such resources as its rapid economic growth continues.⁷ However, such a simplistic analysis belies the true complexity of the issue. In fact, there is the possibility that the western region is becoming subject to the 'resource curse' where forward thinking industrial policies are neglected while resource-extraction takes centre-stage, primarily for the benefit of other regions.⁸ Another reason for the inter-regional complementarity concept is based on the idea that the western region, where the rate of household consumption of manufactured goods is still much lower than in the coastal regions, represents a large untapped potential source of domestic consumption demand for the manufactures from other parts of China

Another aspect of the Campaign to Open Up the West according to official Chinese government sources is management of environmental and ecological issues.⁹ With an estimated 70% of China's urban population exposed to air pollution, 700 million Chinese having to consume water polluted with human and animal waste¹⁰ while hundreds of cities are short of water, and with 3,400 square kilometres of land turning into desert every year,¹¹ attention to these issues is urgently due.

A further principal reason behind the recent introduction of the Campaign to Open Up the West in its current form appears to be aimed at ensuring social and political stability in the non-Han-Chinese areas of the PRC. Indeed, the current campaign by Beijing in the western regions has much in common with colonial experience elsewhere in the world,¹² highlighted by the efforts at promoting the 'Peacock

flying to the west' phenomenon. In other words, concerted government efforts at immigration of the majority Han Chinese who constitute over 1.2 billion of China's national population, into those regions. Now, many of the actual peoples of these regions are becoming shrinking minorities in their historical homelands and this undertaking seems likely to be accelerated further with explicit official policy intentions to "lower the natural growth rate of population significantly"¹³ in those regions while simultaneously introducing policies to further facilitate the movement of people from other regions into these areas supported by the lure of the government induced boom. Indeed, Li Dezhu, who until March 2008 was the head of the Ethnic Affairs Commission, a state body responsible for relations between the central government and ethnic minorities, is reported to have explicitly stated that the problem of minorities would be "definitely solved" through mass migration of Chinese into minority areas.¹⁴

The 2001 commencement of US military operations in bordering Afghanistan is also seen as having added further urgency to the perceived need for western development. This has meant that strategically, some in China feel a real need to further consolidate its hold on the west, both economically and politically.¹⁵

TYPES OF POLICY MEASURES BEING IMPLEMENTED

From a theoretical perspective on development based on Myrdal's thesis there are (at least) three types of policy options.¹⁶ They are the '*Laissez Faire*—neoclassical' approach to regional policy where the government focuses on fundamental policies that aim to allow the private sector to operate effectively and efficiently, the 'development state' approach where state intervention is prevalent, and the 'market enhancing' approach where the government complements private sector and market-based coordination, rather than substituting for it. The market enhancing approach may be the most effective¹⁷ and viable policy choice. Moreover, this approach has proved successful in China in the past

⁷ O'Donnell (2000)

⁸ Golley (2007)

⁹ Overall Plan of Western Region Development During the Tenth Five-Year Plan Period (1 and 2), accessed at <<http://www.chinawest.gov.cn/english/index.htm>>, [on 5/10/2005].

¹⁰ O'Donnell (2000)

¹¹ Li (2003)

¹² Goodman (2004a)

¹³ Overall Plan of Western Region Development During the Tenth Five-Year Plan Period (1), *op. cit.*

¹⁴ Sheridan (2008)

¹⁵ Bedeski (2004)

¹⁶ Golley (2004)

¹⁷ *ibid.*

as demonstrated by Deng Xiaoping's experiment in the east. However, the extensive involvement by the state in the many facets of the current campaign suggests that perhaps the central Chinese government is pursuing a more 'development state' type approach. Indeed in government material there seems to be much emphasis on the need to "bring into play regional comparative advantages"¹⁸ and it appears that this is to be implemented by the central government deciding which provinces and administratively-called autonomous regions are to specialise in what—which effectively translates into trying to 'pick winners'.

The central and local governments have implemented a number of specific explicit policies as part of the Campaign to Open Up the West. These policies include the objectives of promoting investment in the region, managing the region's fragile ecological balance and strengthening the economic association between eastern China and the central and western regions. As part of the policy to promote investment in the western region, favourable conditions for foreign investors in terms of the legal environment, approval procedures and tax incentives have been set up.¹⁹ The sectors in which foreigners may invest have been expanded and the joint development of natural resources is being encouraged. Concurrently, policies to boost the fiscal subsidies for regional governments and regional investment have been implemented.

There has also been an easing of the family register transfer policy in order to facilitate the movement of human resources to the west. This allows the free movement of people into the west region without transference of their family register, thus reducing the risks associated with relocating by allowing migrants to maintain their current residency status and not forego the welfare and social privileges accorded by the government to legal residents should they choose to return. A myriad of other policies were announced including the further development of general infrastructure in the region as well as the implementation of what has been called the "Five Mega-Projects"²⁰. A further policy which the central government has attempted to utilise is what is called the 'Coastal-interior Cooperation'—direct aid from rich coastal provinces to poorer western areas. These have been called

'mutually beneficial cooperation' although there is some evidence of central government arm-twisting.²¹

Likelihood of policy in succeeding to reduce and reverse the rise in regional inequalities. Some analysts have described the Open Up the West Campaign as 'soft policy',²² which is long-winded yet devoid of clarity and detail on how the objectives will be achieved. It seems likely that any impact of the campaign on reducing regional inequalities will be diminished by the number of other environmental, political and racial agendas behind the campaign.

Of the '5 Mega Projects', only the Qinghai-Tibet railway project which was completed in 2006 is entirely in the western region. Even with this project, as Lin Ling and Liu Shiqing note, a priority is the promotion of national unity, to consolidate the parameters of China's frontiers, as well as national defence²³ rather than solely economic development. Others also see this particular project as a double purposed venture which is of enormous threat to the unique culture and identity of Tibetans on the Tibetan plateau.

Although state budgetary appropriations to the western region has increased, Chinese and foreign private investors have not followed the government funds into these areas and thus growth does not appear likely to become self-sustaining. Indeed, foreign investment in the western region actually fell from 9% of the national total in 1996 to 6% in 2002.²⁴ Furthermore, empirical evidence thus far suggests that there has been no reduction in the level of regional inequality since the campaign's inception.

The central government's provision of a series of preferential policies and increased government investment in large-scale infrastructure and basic industry may help in laying a solid foundation for future economic growth driven by the private sector and therefore perhaps gradually reduce the rise in the level of regional inequalities in a sustained manner. Thus far, economic growth in much of the region has been heavily dependent on the state sector. This level of dependence is highlighted by the Tibet Autonomous Region (TAR) where 90% of the economy was government-driven in 2003.²⁵

¹⁸ Overall Plan of Western Region Development During the Tenth Five-Year Plan Period (1 and 2), *op. cit.*

¹⁹ *ibid.*

²⁰ Lin and Liu (2004)

²¹ Golley (2004)

²² *ibid.*

²³ Lin and Liu (2004)

²⁴ Jane Golley (2004)

²⁵ Kyodo News International (2003)

However, with limitations on government expenditure, there is no guarantee that the current level of support will be sustained or that it is indeed sustainable. Given the colossal dimensions of the regional inequalities problem the adequateness of even the current level of fiscal spending in the development of the western region in making the Open Up the West Campaign a success is questionable.

The nature of government expenditure in the western regions has also been a factor in reducing the effectiveness of government spending in generating self-sustaining economic development. For example, official 2003 statistics revealed that expenditure on local government administration in TAR was growing at 46% per year, ranking as the region's fastest growing industry.²⁶ Such disproportionate growth of the local government administration may reflect a focus on controlling the region rather than development. This transpires in the form of a multitude of initiatives such as the institution of the "Work Teams" in monasteries and nunneries all across Tibet that have been implementing the infamous "Patriotic Re-education" campaigns.

In the area of foreign investment, little has been achieved despite efforts to promote the region to foreign investors through various trade fairs and forums. It is doubtful whether the new preferential policies granted to the western region, such as the 15% corporate tax rate, will have the desired effects because many of the policies are not really more favourable than the ones already granted in the coastal regions. Furthermore, foreign investment is unlikely to freely flow into a region characterised by social tension, rampant corruption, and an entrenched lack of enforcement of and respect for the basic conditions necessary for the functioning of the market system such as property rights and clearly defined contractual obligations.

If the current largely state-driven economic growth is feasibly sustained over the long run, it may succeed in reducing regional inequalities, at least on an aggregated level. Indeed, it is clear that for those who fit the requisite criteria, namely those with Chinese language fluency, good connections to economic and political centers in other regions of China, and who thrive in Chinese work cultures profit considerably from the subsidy and subsidised

investment induced growth.²⁷ Moreover, with the continuation of the rapid economic growth in the eastern region where industrial agglomeration following Myrdal's theoretical notion of 'circular and cumulative causation' has taken place, theoretically there is the future potential for 'spread effects' to take place, in other words, for the trickle down of the eastern development into other regions.²⁸ Practically, when and how this might actually happen is another matter.

Furthermore, before drawing hasty welfare conclusions based on any reported economic growth in the region, it must be noted that statistical indicators of aggregated data often say very little about the distribution of welfare changes and inter-ethnic inequalities, or the people's concerns for the survival of their cultural heritage or their freedom to be in control of their lives. In fact, most in the minority populations in these regions have hardly derived any even purely economic benefits from the rapid growth. Thus, in some of these regions, the current development strategies have led to rapidly rising inequalities which are much higher than even that observed anywhere else in China. Additionally, these ethnic inequalities are occurring within urban areas confirming that ethnic inequalities are not merely a reflection of rural poverty.²⁹

Indeed for some minority populations even the Chinese language is alien. Yet they find themselves in an economic and social environment where their native languages are being driven to disuse while the Chinese language and culture is rapidly becoming the only medium of survival. Coupled with the abandonment of most previously-existing protections of local labour even in the 'autonomous regions', minority populations find themselves in a labour market where they must compete in a sinicised environment with a rapid influx of Chinese migrants from other regions for whom Chinese is their native language and who have often had access to better education. In fact, minority populations in the west region are among the most poorly educated in the whole country. For example, only 15% of the Tibetan population in the region have some form of secondary education and the accompanying degree of fluency in Chinese.³⁰ Moreover, the education provided in many minority areas has been a distorted form of education where the priority appears to be

²⁶ *ibid.*

²⁷ Fischer (2008)

²⁸ Golley (2004)

²⁹ Fischer (2008)

³⁰ Fischer (2008)

ensuring subordination rather than intellectual and economic advancement. The type of mentality among policy makers and enforcers that is responsible for such distortions is typified by Chen Kuiyuan, who in 1994 while he was the TAR Regional Party Secretary is reported to have said at a conference on education that the success of education "...does not lie in the number of diplomas issued... It lies, in the final analysis, in whether our graduating students are opposed to or turn their hearts to the Dalai clique and in whether they are loyal to or do not care about our great motherland..."³¹

OBSTACLES TO SUCCESS

A major obstacle to the success of policy in reducing and reversing the rise in regional inequalities may prove to be fact that the attempted coverage of the campaign is too broad and not targeted enough. The extreme geographical aspects of the west which features mountains and deserts also presents challenges. The heavy dependence on direct government fiscal appropriations coupled with the government's own financial constraints as well as rampant corruption and misallocation of state funds forms another major hurdle. For example, in the TAR subsidies and subsidised investments have been incredibly inefficient, characterised by a 'negative multiplier effect' on growth; with only 0.5 yuan of GDP increase for every one yuan of increased subsidies and investment in 2001, and the situation had barely improved by 2005.³²

The constant neglect of real objective education in the western region has also resulted in poor human resources. Despite the Open Up the West Campaign associated drive for ecological and environmental management, much of the western region's ecology remains in a dire situation, and the promotion of mass in-migration from other parts of China may once again end in ecological and perhaps human disaster, repeating the catastrophe in Qinghai during the massive in-migration drive during the 1950s.³³

There is perhaps also a lack of local knowledge amongst policy makers in Beijing who tend to take too much of a top-down totalitarian approach to problems rather than taking an approach to problem solving where the welfare of the actual people on the ground is at its core. Particularly, in minority areas which are often ruled by non-minority officials even at the local level, there appears to be a complete lack of understanding of and empathy with the aspirations and concerns of the minority population and their distinct cultural values and way of life. If government policies do not address their concerns and lead to an improvement in their welfare but instead to their greater marginalisation resistance to government control and policies will continue.

Indeed, this widespread and acute disaffection with current government policies including elements of the Campaign to Open Up the West is embodied in the events on the Tibetan plateau and Xinjiang earlier in 2008, and this sentiment will only be aggravated if the only government response to expressions of the ethnic populations' dissatisfaction is brutal crackdown and intensification of attacks on their distinct identity through population in-migration and tighter government control of all aspects of life. Moreover, their sense of belonging to the Chinese nation is not aided when the overwhelming response to their expressions of discontentment by the masses of their compatriots from the majority ethnicity, whether on the streets of towns and cities or forums on the internet, is to crush and destroy their entire people.

Such disaffection and the resulting social division and resistance do not bode well for the development of the west region nor for the unity and stability of the whole of the PRC upon which the current rapid economic growth is founded. True lasting stability cannot happen under the threat of force from Beijing. But it can occur in a society where central government policies reflect the rights and interests of all the nationalities and peoples who together make up the nation, not just the interests of a subdivision of the population. Therefore, the implementation of policies which are based on economic rationalism that enhances the market, empowers the population through objective education and at the same time respects the dignity and addresses the concerns of the different sectors of the People's Republic of China's society including those of the minorities will be more effective and more universally embraced. Such policies will have a greater chance of not only reducing regional economic disparities but also in reducing ethnic

³¹ Chen Kuiyuan, The Regional Party Secretary, speaking at the 5th TAR Conference on Education, 26 October 1994.

³² Fischer (2007)

³³ Goodman (2004b)

inequalities within the west region and in maintaining the successes over the long run without continued resistance. Then the peoples of the west region will be better able to contribute to the development of their region and the nation at large, sharing in a common sense of belonging and in the fruits of common prosperity.

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Middle class exodus and democratic decay in the Philippines

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Few countries in the world can rival the Philippines as an example of a non-substantive democracy. Recent general elections have been marred by electoral irregularities while the election of increasing numbers of populist or elite figures raises the question of how Southeast Asia's first democratic republic can be so persistently undemocratic? While the variables behind this troubling observation are numerous and varied, this paper takes the position that one of the major factors leading to the poor-quality of democracy in the Philippines is the mass emigration of middle class Filipinos. This paper will consider the moderating role played by the middle classes in contemporary Southeast Asia and then identify how and to what extent the Filipino middle class has shrunk over the last decade. A key result has been the "parochialization" of the Philippine electorate, with voters remaining in the Philippines typically voting for populist candidates or along traditional patron-client lines. The political loss of Filipinos abroad has been exacerbated by the nature of the overseas absentee voting system, which is yet to provide a realistic channel for the majority of overseas Filipinos to cast their votes. It is difficult to imagine the Philippines achieving more than a minimalist democracy until significant reforms are enacted to retain middle class citizens and improve the absentee voting mechanism for Filipinos living abroad.

"Many things are best in the middle; and there, in a state, I care to be"
Phocylides

"The most perfect political community is one in which the middle class is in control, and outnumbers both of the other classes."
Aristotle

"One of the defining characteristics of the Philippine middle class is that they all want to get out"
Senior Western Economist, Manila

VOTING WITH THEIR FEET

"You don't join a political organization, you line up at an embassy"¹ is the increasingly popular mantra for educated, middle class Filipinos who have become disillusioned by the nation's failure to achieve meaningful political reform and its consistently underperforming economy. The Philippines, recently described as the "most persistently undemocratic democracy in Asia"², is one of several countries in the world caught in a

"powerful authoritarian undertow"³ where democracy has been overthrown or stifled and the state works not to generate public goods or govern in the interest of its people, but rather to "produce private goods for officials, their families and their cronies".⁴ The democratic breakthrough achieved at Epifanio De La Santos Avenue (EDSA)⁵ in 1986 now appears to be little more than a hiccup in the ongoing game of "musical chairs among the elite".⁶ With the middle class who led the way at EDSA

¹ Sheila Coronel of the Philippine Center for Investigative Journalism, as quoted by Perlez, Jane, (2002). "Educated Filipinos, Disillusioned at Home, Look Abroad for a Better Life." *The New York Times*. April 8, 2002.

² Fabros, Aya., Rocamora, Joel. & Velasco Djourina (Eds.), (2006). *Social Movements in the Philippines*. Institute for Popular Democracy. Philippines.p.28.

³ Diamond, Larry, (2008). "The Democratic Rollback: The Resurgence of the Predatory State". *Foreign Affairs*, March/April 2008.

⁴ *Ibid.*

⁵ Epifanio De La Santos Avenue is the major artery road in Metro Manila and site of the 1986 "People Power" movement that toppled former president Ferdinand Marcos.

⁶ BusinessWorld, (1998). "12 years after EDSA, Democracy Still Wanting", *BusinessWorld*. February 27, 1998.

now leaving the country en masse, only a thin veneer of democratic choice remains for the vast and poor majority in South East Asia's first democratic republic.⁷

How is it that after the optimism and momentum for political reform generated in 1986, the Philippines has reversed its democratic trajectory a mere twenty years later? The complete array of contributing factors are diverse and interacting; a complete analysis would no doubt incorporate an examination of economic development, social values, religiosity and the political legacy of previous colonial and post-colonial authoritarian governments. However, this paper will restrict itself in specifically exploring the Filipino middle class and how this stratum has influenced the nature of governance in the Philippines since 1986. I will argue that middle-class flight and the limited opportunity for overseas Filipinos to participate in the political process has led to greater parochialism and the perpetuation of a non-substantive democracy in the Philippines over the last two decades.

This paper will first consider the relationship between the middle class and the state from a political theory perspective and then assess whether there is evidence to support adopting such a perspective in a modern and regionally-specific context. Second, the nature of the Philippine middle class will be discussed and key demographic changes of the last twenty years will be investigated. Next these demographic changes in Filipino society will be analysed; the middle class contribution to political transformation will be particularly emphasized. This has historically seen a period of democratic breakthrough in 1986, to the current situation where a poor quality, elite dominated democracy exists. Finally, prospects for the establishment of a substantive democracy in the Philippines will be briefly considered along with potential policies that may improve the quality of democracy in the Philippines through bolstering the middle class.

Before continuing, two key concepts must be appropriately defined. First, what exactly is the middle class? According to Aristotle, "in every state there are three parts: the very prosperous, the very

needy, and the middle class."⁸ Historically the middle class has been made up of the self-employed: skilled tradesmen and artisans. In the modern era, this group has grown to include professionals, managers, and administrators in both the government bureaucracy and private firms.⁹ The middle classes are typically educated and politically aware, though not necessarily politically active. Meanwhile they usually possess valuable technical competencies and organizational skills,¹⁰ which are highly prized in the political arena.

The second key concept is democracy. In defining this term, it is imperative to draw the distinction between democracy's procedural and substantive meaning. The term "democracy" usually describes any political system where leaders are elected by free and fair elections.¹¹ However, given the troubling number of governments worldwide that have manipulated the electoral process in order to disenfranchise voters and disconnect the electoral outcome from the will of the people¹², it is clear this definition is inadequate—or minimalist at best. Hence, this paper will adopt a substantive definition of democracy: that is, a form of democracy practiced in an environment of liberalism and constitutionalism, whereby participation and representation is meaningful and individuals have the opportunity to exercise their vote with confidence in the accuracy and legitimacy of the electoral process.

THE MODERATE MIDDLE CLASS

The relationship between the middle class and governance is perhaps best articulated in Aristotle's *Politics*. Here it is suggested that due to the moderate characteristics of the middle class, they are more likely to behave according to reason and less

⁷ Franco, Jennifer C., (2000). *Campaigning for Democracy: Grassroots Citizenship Movements, Less-than-Democratic Elections, and Regime Transition in the Philippines*. Institute of Popular Democracy, Philippines. p. 39.

⁸ Apostle, Hippocrates G. & Gerson, Lloyd P., (1986). *Aristotle's Politics*. p. 121.

⁹ Carandang, Ricky, (2004). "Shrinking Middle Class", *Newsbreak*. April 12, 2004.

¹⁰ *Ibid*.

¹¹ Abueva, Jose V., (1997). "Philippine Democratization and the Consolidation of Democracy Since 1986 EDSA Revolution: An Overview of the Main Issues, Trends and Prospects" in Felipe Miranda, ed., *Democratization: Philippine Perspectives*.

¹² While "the people" is a contested term, here it is used as shorthand to broadly describe the members of a given political entity.

disposed to the ruthless pursuit of power.¹³ The middle class plays a balancing role in the political system; they are able to join with the lower class should there be need to open up the political process or achieve some degree of redistribution of wealth, while they can join with the upper class to oppose the threat of a tyrant emerging from the lower classes who threatens the status quo.¹⁴ In short, the “addition of the middle class to one of the other two classes tips the scale, preventing the remaining extreme class from becoming dominant.”¹⁵ One can conclude that the best form of political organization is where power is vested in the middle class and that the presence of a large middle class in society leads to political stability and good governance—relative to oligarchic or tyrannical forms of government.¹⁶ It follows thus, that a growing middle class will lead to a greater potential for democratic governance; this is to say that, the rise of a strong middle class is one of the “critical causal factors engendering democracy”.¹⁷

In South-East Asia, there is plenty of evidence to suggest that as the middle class grows and becomes educated, there is indeed significant pressure for democratization to occur. Since the 1980’s, pro-democracy movements built largely around the middle class have been identified as a significant contributing factor to democratization across the region.¹⁸ In Thailand, democratic breakthrough was achieved in 1992 when the mobile-phone wielding middle class joined political protests in the country; while in Indonesia, the middle class eventually joined university students in calling for the resignation of former President Suharto in 1998. Likewise in the Philippines, democratic

breakthrough was achieved through the middle class-led “people power” movement in 1986.¹⁹

The stream of middle class led democratic movements in contemporary Southeast Asia reinforces the balancing role the middle class plays checking any excessive accumulation of power by either the rich or poor. It logically follows that if the middle class is weakened, this potential for political reform is lost and an oligarchy of the rich or “extreme democracy” of the poor becomes a more likely challenge to a substantive democratic system.²⁰

‘OFW’ EXODUS

There is evidence to suggest that the Filipino middle class is indeed shrinking. In both sheer numbers and relative influence, the middle class is losing ground in contemporary Philippine society. Attrition due to high rates of emigration is the most direct cause, though many are also slipping from middle to low income brackets in a society where the fruits of economic development continue to be unevenly distributed. While high profile families that have experienced growth in their real incomes in recent years, can afford to stay;²¹ for middle class families a choice must be made whether to “leave for greener pastures or slip one rung down the economic ladder”.²² Today, approximately 8 million Filipino citizens, representing around ten per cent of the population are living abroad. The number of Overseas Filipino Workers (OFWs) departing the country grew annually from 36,000 in 1976 to almost 700,000 in 1991.²³ As indicated in Figure 1²⁴, this trend has shown no sign of abating.

Of note is the number of Filipinos who have departed the Philippines on a permanent basis. In 2003, approximately 2.7 million of the 7.4 million Filipinos overseas were migrants who had attained permanent residency or citizenship abroad.²⁵

¹³ Apostle, Hippocrates G. & Gerson, Lloyd P. (1986). *Op cit.* p. 122.

¹⁴ Glassman, Ronald M., (1995). *The Middle Class and Democracy in a Socio-Historical Perspective.* pp. 13-14.

¹⁵ Apostle, Hippocrates G. & Gerson, Lloyd P., (1986). *Op cit.* p. 123.

¹⁶ This is not to discount the potential for a more self-serving middle class. Indeed the actions of the middle class based anti-democratic “People’s Alliance for Democracy” of Thailand in 2007 and 2008 exemplify this possibility, see Winichakul, Thongchai, (2008). “Anti-democracy in Thailand” *New Mandala*. On balance however, a strong middle class has been seen to promote democracy, see Glassman, (1997). *The New Middle Class and Democracy in Global Perspective.* p. 142.

¹⁷ Glassman, Ronald M., (1997). *Ibid.* p. 142.

¹⁸ Lee, Junhan, (2002). “Primary Causes of Asian Democratization: Dispelling Conventional Myths”, *Asian Survey*. Vol. 42. No. 6. pp. 821 – 837.

¹⁹ BusinessWorld, (1998). *Op cit.*

²⁰ See Glassman, Ronald M., (1997). *Op cit.* p. 101.

²¹ Perlez, Jane, (2002). *Op cit.* See also Carandang, Ricky, (2004). *Op cit.*

²² Carandang, Ricky, (2004). *Op cit.*

²³ *Ibid.* By comparison, the population of the Philippines increased from 43,194,417 in 1976 to 73,091,778 in 1998. See The World Bank, (2008). *World Development Indicators.*

²⁴ Carandang, Ricky, (2004). *Op cit.*

²⁵ Javellana-Santos, Julie, (2003). “Immigrants may Vote, but Where are the Funds?” *OFW Journalism Consortium.*

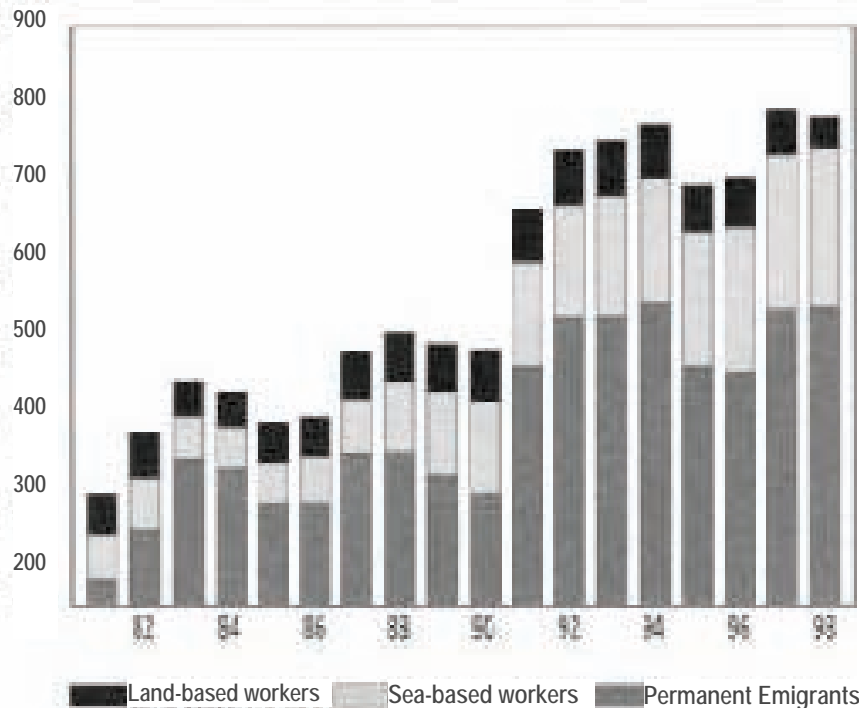


Fig. 1: Annual Flow of Filipinos to Foreign Destinations (in thousands, 1981-1998).

Increasingly, those leaving the country are the educated middle classes. In the past the typical OFW was a Hong Kong nanny or a blue collar worker employed in construction or merchant shipping.²⁶ In recent years however, the largest group of departing OFWs are the “professional and technical workers” of the middle class.²⁷ Essentially, emigration is selective of the best educated and skilled individuals, which are typically drawn from the middle class. In 1975, only 20% of the Philippines labour force had completed high school, while 80% of OFW’s were high school graduates. Meanwhile in 1980, some 12.5% of the Philippine labour force had at least some college education, while 50% of the OFW population had some college education.²⁸ In more recent times, between 1990 and 1999 it has been noted that the number of professional workers who went abroad actually exceeded the net additions of professionals to the labour force.²⁹

²⁶ Perlez, Jane, (2002). *Op cit.*

²⁷ Wehrfritz, George & Vitug, Marites, (2004). “Workers for the World; The Country’s Prime Export is People. But is Migration a Real Development Strategy”, *Newsweek (International Edition)*. October 4, 2004.

²⁸ Battistella, Graziano. & Paganoni, Anthony (Eds.), (1992). *Philippine Labor Migration – Impact and Policy*. Scalabrini Migration Center. See the chapter “Migrant Workers from the Philippines” by Carnio, Benjamin V.

²⁹ *Ibid.* See the chapter “Impact of Migration” by Vasquez, Noel.

The dual impact of the middle class exodus and declining middle class incomes on the size and influence of the middle class has been empirically captured. In a recent empirical study by the National Statistical Coordination Board,³⁰ it was shown that the middle class, fell from 23% of total families in 1997 to 19.9% of total families in 2003, as indicated in the Figure 2³¹ below. While the middle class has shrunk, the low income class has grown. This is significant, as it suggests that the electorate is increasingly composed of low income class voters.

Also significant is that while the proportion of middle class citizens is falling in total, it is the skilled tradesmen and young professionals in particular who are departing. Those left behind are predominantly of the “new middle class” variety.³² These employees are the salaried middle-managers and administrators in the bureaucracy or private firms; and as such do not enjoy the political freedom of the more independent

³⁰ Based on the results of the Family Income and Expenditures Survey conducted by the National Statistics Office (NSO) in the years 1997, 2000 and 2003. See Virola, Romulo A., Addawe, Mildred B. & Querubin, Ivy T., (2007). “Trends and Characteristics of the Middle - Income Class in the Philippines: Is it Expanding or Shrinking?” *10th National Convention on Statistics (NCS)*. October 1-2, 2007.

³¹ Here we are using the distribution of families as a proxy for the distribution of citizens. This may be an imperfect method as there may not be a one to one conversion between class breakdown by family and by individual. However it is unlikely that in the six years to 2003 changes in the average family size of a particular class group could significantly skew the relationship between income distributions by family and per capita, meaning the data in figure II is a generally reliable barometer of the aggregate decline in the middle income class demographic. Source: *Family Income and Expenditures Survey*, National Statistics Office. See Virola, Addawe & Querubin, (2007).

³² For a complete discussion on the characteristics of the old and new middle class demographics, see Glassman, Ronald M. (1997). *Op cit.* Pp. 108-121.

Year	Income Class					
	Low		Middle		High	
	Level	Percent	Level	Percent	Level	Percent
1997	10,881,914	76.6	3,260,474	23.0	50,074	0.4
2000	11,598,258	77.0	3,422,524	22.7	51,160	0.3
2003	13,172,033	79.9	3,282,511	19.9	25,849	0.2

Fig. 2: Distribution of Families by Income Classes: 1997, 2000 and 2003.

“old” middle class. As career advancement and even job stability are directly linked to loyalty to the firm or government agency, many of these new middle class workers have simply been co-opted into “one white collar pyramid or another”.³³ In a country where both the machinery of government and the private sector are under the control of the elite, the opportunity of the Philippine middle class to play a balancing role in the political system has been severely undermined.

The reasons behind the middle class flight from the Philippines can be attributed to the poor performing economy, political instability, dissatisfaction with political reform as well as the effect of government labour and migration policy in facilitating the movement of labour overseas. In the interests of brevity, these factors cannot be explored in depth. However, we can conclude that due to changes in its composition and characteristics, the middle class has been shrinking both in size and political influence since it led the democratic breakthrough in 1986. The ongoing hemorrhage of these educated, politically aware Filipinos is “deprive[ing] their homeland of the chance to build a stable middle class and to crack a political system still encrusted with the oligarchs of the past.”³⁴

‘WOWOWEE VOTERS’ AND THE LOST MIDDLE CLASS

With almost eight million Filipinos living abroad on a temporary or permanent basis, there is a significant impact on the structure and nature of the electorate. It must be noted, that as the overwhelming majority of overseas Filipinos are workers, they represent a sector of the population that is almost entirely of voting age, compared to the domestic population which comprises a significant proportion of people below the legal voting age. What this means is that while the Philippines’ diaspora includes some ten per cent of the total

population, the proportion of total eligible voters they represent is significantly higher.

Essentially the migration of middle class Filipinos is a political loss. This is not to say that the middle class is

not politically self-interested; but rather, that they tend to be informed voters who are more independent and issues oriented. As these educated individuals leave the country however, the electorate becomes increasingly parochial.³⁵ Indeed, it has been observed that overseas voters represent a “more sophisticated electorate” than those who remain in the Philippines.³⁶ It is no surprise that so many former television personalities and action stars have been elected to office in recent years.³⁷ Instead of informing voters of a candidate’s policies and ideology, electoral campaigns have become little more than a popularity contest aimed at entertaining “Wowowee” voters in a shameless effort to win their support.³⁸

Moreover, low income voters are typically locked into existing patron-client relationships with local power brokers or elite families and tend to vote for the candidate that performs personalized constituent services as opposed to representing their long term or class political interests.³⁹ Indeed, it has been found in the Philippines that the welfare of the poor is significantly reduced in provinces governed by a

³⁵ Battistella, Graziano. & Paganoni, Anthony. (Eds.), (1992). *Op cit.* See the chapter “Impact of Migration” by Vasquez, Noel. p. 28

³⁶ Hogg, Chris, (2004). “Philippines: Fighting for the Migrant Vote”, *BBC News (Online)*, 22 March 2004.

³⁷ Some examples – among others – include Vice-President Noli De Castro, Senator Loren Legarda, Senator Ramon Revilla Jr., former presidential candidate, Ferdinand Poe Jr. and former President, Joseph Estrada.

³⁸ Personal Observation, May 2007, Manila (Senate Election Campaign period). “Wowowee” is a popular midday television program that employs inane humour, cheap gimmicks, catchy music and provocative dancing to capture the short lived attention of its typically uneducated viewers. Some political rallies were not unlike the program in format.

³⁹ Velasco, Renato S., (1997). *Op cit.* Renato discusses the phenomena of the *Comite de Silencio* (Committee of Silence): congressmen who are always re-elected by their constituencies owing to patron-client relationships, despite their long and conspicuous silences when congress is in session.

³³ *Ibid.* p. 167

³⁴ *Ibid.*

local dynasty.⁴⁰ But while that is the case, many officials from longstanding political families with a strong local power base continue to be elected.⁴¹ Essentially, by offering short term incentives, or one-time personal favours, political elites can maintain their power across time and generations despite providing very little in the way of positive change for their poor constituents. These patron-client networks, built on the symbiotic relationship between *maginoo* (lord) and *alipin* (serf) play a crucial role in ensuring the electoral success of the oligarchic families who continue to dominate the legislature.⁴²

On the other hand, middle class Filipinos living abroad are perceived as being beyond the reach of local patron-client networks. When overseas Filipinos were finally given the opportunity to cast absentee votes in the 2003 elections, political observers expected a reinvigoration of the Philippine democracy as candidates and parties would have to compete to attract the votes of these 7-8 million Filipinos abroad. Described as “financially independent, issues oriented and not swayed by popularity... our lost middle class”,⁴³ these Filipinos represented something of a challenge to the oligarchic political families who have long dominated the political landscape. In essence, OFW’s living abroad are the one demographic group who are free to vote objectively in elections and unlikely to be co-opted—or coerced—by local bosses or power brokers for their support.

While that is the case, the Overseas Absentee Voting Act (Republic Act No. 9189)⁴⁴ has had little success in providing overseas Filipinos with a realistic avenue to participate in the electoral process. The Commission on Elections (COMELEC) mandated that voter registration and vote casting had to be done in person,⁴⁵ at the nearest embassy or

consulate. For OFWs in the USA and Middle East, the transport costs involved to do this were simply prohibitive. Meanwhile, overseas Filipinos who had attained permanent residency overseas were required to complete an affidavit indicating they intended to take up residence in the Philippines within the next three years. This condition also denied millions of citizens the right to vote. Given the restrictive nature of the act, it was unsurprising that in the 2004 election, just 356,000 OFW’s registered to vote (with 65 per cent turning out on election day), while in 2007 just ten per cent of 540,000 registered overseas Filipinos voted⁴⁶—this equates to just 54,000 votes counted out of almost 8 million OFWs.

From this analysis, we can draw the following two conclusions. First, the electorate is increasingly comprised of a greater proportion of parochial voters, who tend to cast their vote for patrons or populist figures that do not adequately represent their long term class political interests.⁴⁷ Second, overseas Filipinos—predominantly of the middle class—have not been granted reasonable opportunity to participate in the electoral process. This has led to a form of democracy where all the trappings of the electoral process are upheld, but participation by informed voters has been severely eroded and representation of the needs and political aspirations of the majority low income class electorate has been usurped by sordid self-enrichment as the primary objective of many elected officials. Despite the groundswell of optimism for political reform expressed at EDSA in 1986, just two decades on, the Philippines has traded an autocrat for an oligarchy.

⁴⁰ Balisacan, Arsenio, (2003). “Poverty and Inequality” *The Philippine Economy: Development, Policies and Challenges*. p. 334-335.

⁴¹ The Aquino, Roxas, Osmena and De Leon families are each examples of intergenerational political families.

⁴² Coronel, Sheila S., (2004). “How Representative is Congress?” *Philippine Centre for Investigative Journalism*.

⁴³ Araya, Jr., Alfred A., (2003). “Political Parties Face Challenge of Getting the Absentee Vote” *OFW Journalism Consortium*.

⁴⁴ Congress of the Philippines, (2003). Republic Act No. 9189: The Overseas Absentee Voting Act of 2003. Government of the Republic of the Philippines.

⁴⁵ *Ibid.* With the exception of Japan, Canada and the UK where postal ballots were trailed.

⁴⁶ Rojas, Henry S., (2007). “Overseas Absentee Voting: What Went Wrong?” *ABC-CBN News*.

⁴⁷ Since 1986 successive governments have come to power on a platform of pro-poor rhetoric that is rarely matched by policy efforts. High profile anti-poverty measures have been more concerned with scoring “*pogi* points” (brownie points) with the electorate rather than generating real welfare improvements. For example, the Comprehensive Agrarian Reform Programme (CARP) of the Aquino administration was aimed at combating rural poverty; the legislation however was systematically watered down and inadequately resourced by the landowner dominated legislature. Meanwhile, the “*Lingap Para sa Mahihirap*” (Looking after the poor) program of the Estrada administration was quite literally a pork barreling exercise where a range of benefits and subsidies were made available to the poorest 100 families of each province or city. See Balisacan, (2003). *Op cit.* pp. 312-316.

THE PREDATORY PREDICAMENT

How best then to achieve meaningful political reform and a substantive democratic system in the Philippines? Armed leftist movements built around the rural poor have proven unable to attract the mainstream support required to fundamentally alter the status quo⁴⁸; while at the ballot box lower class voters continue to return elite candidates to office through voting along entrenched patron-client lines. It seems that any serious challenge to the ruling elite will require the ability, independence and leadership of the middle class in order to succeed. Furthermore, middle class participation must be sustained if a substantive democracy is to become the norm—and not an aberration—in the Philippine political landscape. We can conclude that one of the major barriers to democratization in the Philippines is the lack of a stable and politically active middle class that comprises a greater proportion of the population. Thus, perhaps the most effective strategy to increase the possibility of a high-quality democracy in the Philippines is to bolster the size of the middle class and help facilitate their participation in the political arena. This might be achieved through a number of approaches:

- First, *expand* the existing middle class—particularly those persons employed in occupations of the “old middle class” variety. This can be achieved through encouraging small business in the economy, for example by providing tax breaks or subsidies to small proprietors.
- Second, *retain* the existing middle class. With poor economic opportunity being a key push factor for emigration, it is essential to promote well paying and meaningful career opportunities for skilled Filipinos to ensure they remain in the country and are present to participate in the political system.
- Third, *grow* the middle class, through the promotion of low income earning families to higher income levels. This approach would require significant reform to health and education sectors, such as universal elementary and high school provided at little

or no charge as well as medical and nutritional assistance for the poor.

- Lastly, *reform* the Overseas Absentee Voting Act. The present manifestation of the act disqualifies a great proportion of overseas Filipinos, while making the process of registration and voting unreasonably demanding for voters. A more inclusive system is required as well as universal access to postal voting if OFW votes are to be successfully captured in future elections.

Of course, the aforementioned policies are broad and overarching; their respective intricacies and the means by which to achieve them are the subject for other papers. However, one common feature shared by all these policies is that they rely upon the presence of a well-behaved government, which aims to maximize the welfare of its citizens. While the durability of even the most self-serving governments depends on engaging to some extent the aspirations of the citizenry, the exodus of middle class Filipinos as a political force has left the ruling oligarchs with little incentive to enact reforms. The Philippines is left facing a peculiar predicament: as long as it is dominated by an elite oligarchy, it is almost impossible to imagine the government undertaking measures to empower and grow an independent middle class which would inevitably form a bulwark of opposition against it. While as long as the middle class remains a weakened or insignificant actor in the political scene, the potentiality for the honest, free and representative practice of democracy remains extremely limited.

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⁴⁸ Leftist military groups such as the Hukbalahap and the New People's Army were significant threats to the government during the postwar period, but did not achieve the capacity required to seize power through hostile means. See Steinberg, David J., (1994). *The Philippines: A Singular and a Plural Place*. Pp. 113-114, 128-129, 160 – 161.

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The gendered elements of homosexual marriage and society's reactions to the issue

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The following analysis will be carried out to investigate the gendered elements of homosexual marriages and how society has reacted and revolved around the issue. It will deal with definitions of marriage and whether homosexuals fit into this definition. In addition it will explore the gendered stereotypes within same-sex relationships in regards to household roles, relationship attitudes and the raising of children.

The ever controversial issue of homosexual marriage has remained contentious since the term was introduced, primarily because it is seen as unnatural and does not correspond with what society defines as normal. While attitudes may be progressing, a conventional definition of marriage must be established in order to determine whether homosexual relationships can fit into this category. It is also important to briefly examine societies evolving attitudes towards homosexual relationships to show the progress of the gay liberation movement and its affects on society. Aside from the judgment of the heterosexual world, many myths about homosexual marriages have been imagined. These myths circulate around same-sex married couples mimicking heterosexual relationships, where one adopts a masculine role and the other the role of the *housewife*. Secondly, the myth that all homosexual men are promiscuous and all lesbians are completely committed to their partners (as little research has been accumulated about lesbians, they will only be discussed in brief). And finally, the myth that lesbians are naturally nurturers, allowing greater access to the adoption of children while men are discriminated against for being masculine. These myths will be discussed in further detail, establishing the gendered elements surrounding the issue of homosexual marriage.

In discussing homosexual marriage it is imperative to establish a definition of marriage and of homosexuality. Behavioural scientists describe homosexuality as a person's "emotional commitment, desire or fantasy" regarding an individual of the same sex (Talbot, 1985: 10). This definition includes public single and coupled homosexuals as well as those homosexuals who choose not to participate in the act of homosexuality yet still desire the same sex.

Finding a common definition of marriage however is complex, in that religion and the state interfere with notions of marriage for society. This article will endeavour to avoid any religious views, as there are too many variations of too many religions; to include religion would move away from the issue at hand. Marriage will therefore be defined by John Witte Jr., as:

"the Western legal tradition... (of) monogamous, heterosexual couples who had reached the age of consent, who had the physical capacity to join together in one flesh, and whose joining served the goods and goals of procreation, companionship and stability at once" (Witte, 2003: 43).

While this concept of marriage is obviously romanticised, it does however describe the partners of marriage specifically as a man and a woman who come together to procreate. This definition excludes same-sex marriages entirely. Noticeably they are excluded because they do not contain two members of the opposite sex and secondly because they cannot naturally produce children with only each other. From this exclusion, negative connotations of same-sex couples have emerged, and these relationships therefore have been deemed as deviant, anti-social and unnatural behaviour. The main reason for this is that society is more interested in favouring prospective procreative couplings compared to relationships founded on "mutually agreeable genital stimulation," (Wilkins, 2003: 232). Wilkins' opinion can be heard loudly throughout society which inherently judges homosexual relationships as unproductive, sexually selfish and aberrant. Interestingly however, childless marriages involving heterosexual couples are becoming more and more common (ABS 4102.0: 2002). Thus, perhaps it is necessary for the definition of marriage

to adapt, excluding procreation from its definition, so as to encompass both heterosexual and homosexual childless marriages. This will be discussed in more detail in relation to homosexual couples' access to adoption. Without the modification of these heterosexually made definitions, homosexual activists have and will struggle to redefine themselves as equal members of society in order to produce a positive identity for same-sex couples

The emergence of a homosexual institution was imperative in order to encourage tolerance of homosexuals by an overwhelmingly heterosexually dominant society. Prior to the 1960s homosexuals were often victimised and ridiculed for their lifestyle choices (Stewart, 2001: 7). Most gay men and women avoided voicing their sexual preferences and often entered into heterosexual marriages, as advised by their psychologists, in order to suppress their homosexual thoughts. Thus society's opinions of homosexual marriages at this point in time were decisively negative and homosexuals were plagued by discrimination. After the demonstrations of the gay liberation movement in Greenwich, USA, in the late 1960s, homosexual rights and acceptance began to improve. Frank Kameny's aggressive pro-gay slogan of "Gay is Good" forced a situation whereby homosexual discrimination became seen as out dated, ignorant and homophobic (Phy-Olsen, 2006: 69). Other examples of gay rights campaigns surprisingly came in the form of festivals. The gay pride festival is now a celebrated calendar date for homosexuals and heterosexuals alike. Allowing the heterosexual world an insight into what was seen as an *unnatural* way of life produced a more accepting atmosphere for homosexuals in western society.

The gay liberation movement provided access to the establishment of a gay sub-culture. This would be the first sub-culture based on sexual preference. By the 1990s this sub-culture was so well identified that capitalism played its part and began producing homosexual exclusive products. Within this strategy of capitalism, stereotypes were introduced once more. Advertisements portrayed the gay man as living the highlife, one of luxury, style, holidays and most importantly, one free of the burden of children and marriage (Ibid: 71). Capitalism and its acceptance of homosexuals also came at a cost, bringing with it the lifestyle typecast of homosexuals.

The establishment of homosexual stereotypes encouraged the development of society's attitude towards homosexuals and whether they should

marry. Using the stereotypes, which society perceived to be the normal behavioural patterns of homosexuals, an excessively negative attitude emerged regarding homosexual marriage. The main excuse heterosexuals gave when claiming that homosexuals should not marry is that they do not adequately fit in to the definition of marriage. In addition, homosexuals themselves argue that marriage is a heterosexual institution and the idea of submitting to it, is in contradiction of what the gay liberation movement sort to accomplish (Ibid: 113). Marriage to homosexuals was viewed as a patriarchal and oppressive structure put in place to monitor and regulate a heterosexual society. Thus, the idea of homosexuals wishing to conform to the heterosexual institution that is marriage is inexplicable. Public opinion surrounding this debate is vast and extensive, while the majority of opinions stemming from heterosexuals tend to be against same-sex marriage, some do consider that every human has the right to marry whom ever they choose. It is unfortunate that homosexuals have acquired such reputations as they constantly burden their lifestyle choices and actions. Gender-role socialisation is a leading contributor to the establishment and the continuation of these stigmatic homosexual stereotypes.

STEREOTYPES WITHIN HOMOSEXUAL MARRIAGES

Gender is ever present in every community member. Even visiting the bathroom requires one to adhere to their specific gender. For members of same-sex relationships, gender plays an additional role. Since heterosexuals view homosexuals as atypical, they have often tried to understand their lifestyle differences by comparing them to their own. In this fashion gendered stereotypes have appeared as a result of trying to understand the unknown. Heterosexuals predominantly achieve this by deeming homosexual relationships as mimicking the marriages of heterosexuals. The straight world insinuates that one spouse takes on the masculine role of domination, independence and economic wealth. Meanwhile the other partner assumes the feminine role of submission, dependence and is economically reliant. In this way they are assuming the roles of husband and wife. Joseph Harry counters this claim, writing: "While pairings of masculine and effeminate men do occur in the gay world, they are far from the majority of the case," (1979: 623). He continues, discussing that it is commonly thought that the masculine role player also plays his role in

bed being the penetrator, while the submissive partner acts as the penetrated (Ibid, 1979: 623). Bell and Weinberg confirm that these common misconceptions are flawed, insisting that same-sex couples instead focus on “task-sharing and task-flexibility” rather than submitting to the heterosexual imaginations that established such rigid stereotypical roles (Bell & Weinberg, 1978).

Therefore it is evident that popular stereotypes are consistently inaccurate. Much of the research carried out concerning homosexual relations, dating back to the 1970s, revolves around the confirmation that gendered typecasts are false. In fact some researchers even go so far as to infer that homosexual relationships are more egalitarian than those of heterosexual relationships. This is due to the absence of cultural prescriptions which determine that one partner ought to be the dominator and the other the submissive. As a result of these cultural guidelines most, if not all, men are socialised to prioritise sex over affection and women are conditioned to emphasise the opposite (Harry, 1979: 626). It is for these reasons that books like “Men are from Mars, Women are from Venus” written by John Gray (1992) are even conceived. Socialisation plays an important role in imposing gender roles and determining acceptable ways to act. Since homosexuals do not follow any specific social norms their marital roles must be significantly “self-invented,” (Harry, 1979: 627). Their experimental way of life, which differed considerably to those in heterosexual relationships, are now established homosexual norms which most same-sex couples adhere to. The absence of strict gender-role formulas may be understood as either negative or positive. Positively it could be seen as a “state of freedom” or conversely may be viewed as a “state of anomie,” (Ibid: 628). The state of freedom allows couples to develop their relationship on their own terms. While on the other hand the state of anomie suggests that incompatible expectations as to suitable role behaviours within the relationship exist, making for conflicts and hardships. According to the majority of studies however it is apparent that homosexuals have taken the lack of social rules as an opportunity to create a relationship based on the hopes and fears of the two independent beings. Therefore while the heterosexual world judges and accuses the relationships of homosexuals to mimic their own, studies show that they are commonly misunderstood. Harry & Lovely studies confirm that a mere “one percent” within the study sample described themselves as a “houseperson,” (1979: 186). These studies have shown that while gendered elements

exist in society, they are subjective opinions portrayed by the majority who happen to be heterosexual.

PROMISCUITY AND INFIDELITY

Another common gender conception that stereotypes have fashioned is that single and coupled gay men are excessively promiscuous while lesbians tend to depend on one stable relationship. Unlike the typecast of marital roles between homosexual couples, this stereotype appears to possess more truth. Many lesbians and gay men do choose to be single rather than to commit to marriage like relationships. Single homosexuals are often viewed as self-reliant, be sexually experimental and thrive on excitement, in addition to having a more active involvement in the gay community (Thompson, 1983). This independence frequently provides the individual with heightened opportunities for accumulating sexual partners. Another reason homosexuals often choose to remain single is that they have not completely accepted the homosexual way of life and prefer to hide it from the heterosexual world, taking sexual encounters over relationships (Harry, 1979: 628). Saghir and Robins argue that gay liaisons are not habitually sexually exclusive (1979: 57). They confirm that “infidelity was characteristic of the majority of homosexual males,” (Ibid: 57). Schafer’s findings describe comparable data where a mere 16 percent of males were faithful to their partners of more than two years while only 46 percent remained faithful over a period less than two years (1977: 361-63). These infidelity rates are thought to be a result of social conditioning that men experience whilst developing. Male socialisation is focused primarily on sex and independence, thus embedding into males the need to satisfy sexual desires rather than emotional requirements. Females comparably, have been socialised as natural nurturers and care-givers, making them the perfect candidates for housewifery. Therefore females in same-sex relationships practice the most fidelity, while heterosexual relationships are a compromise of such values with the woman limiting the male’s predisposition toward infidelity (Gagnon & Simon, 1973). The acknowledgment of addictive promiscuity in numerous homosexual men is an additional cause of concern for society. The majority of interrogations of homosexual men claimed an average of 1,000 different sexual partners throughout their lives. The majority of these sexual encounters were anonymous and usually took place at locations of homosexual association. The

global acknowledgement of these admissions makes it unsurprising that the conservative heterosexual society continues to deem gay sex as affiliated with physical (STD's) and psychological health issues (Phy-Olsen, 2006: 117-119). These stereotypes of promiscuity and infidelity based firmly on men, distinguish the genders where women prefer stable longstanding relationships over the infidelity and casual sexual relationships of their male counterparts. Thus, gender-role association is a significant component which deciphers the gendered elements of homosexual marriage.

STEREOTYPES OF HOMOSEXUALS AS PARENTS

Gendered stereotypes play a major part in the issue of homosexual parenthood. Not only has the public typecast gays and lesbians as unfit parents, family courts have additionally made the assumption that homosexuals are incapable of raising children (Editors of the *Harvard Law Review*, 1990. Their reasons extend from "inherent mental illness" to lesbians being "less maternal" than heterosexual females (Ibid). These conclusive stereotypes established in the 1970s to 1980s have gradually been replaced as a result of research carried out in the 1990s. New research found that there was no difference between lesbian and heterosexual mothers on maternity, happiness and general mental health (Falk, 1994). The courts also suggested that gender role behaviour may become an issue when raising children, because homosexual mothers were too masculine to raise their children appropriately. However Patterson's studies concluded that the paternal sex role, the warmth towards the child and the responses to child behaviour did not vary from that of heterosexual mothers (Patterson, 2000: 1064). Even with the competent research of Patterson and Falk discrimination against homosexual parenthood persists.

Additionally, homosexuals are viewed as lacking the desire to procreate. The general public see most, if not all, gay people as free of the responsibilities of raising a child. Sullivan argues that homosexual's parental instincts can be "redirected towards the broader social good", becoming teachers, nurses, doctors and social workers instead of parents (1995: 198-199). This notion of simply forgoing parenthood is not only seen as the norm by heterosexuals. In actuality homosexual men specifically deemed being gay as equivalent to being childless (Mallon, 2004). For many men their identity as a homosexual man was seen to be incompatible with their prospective

identity as a father. Interestingly homosexual men incorporate the irrational stereotypes of the heterosexual world into their own self-identity. Gay men desiring fatherhood adapt to the perceptions of how the rest of the world view them, resulting in many potential fathers voicing concerns about their future child's possible experiences at school (Berkowitz & Marsiglio, 2007: 375). However, as Mallon investigates, "empirical evidence confirms that one's sexual orientation does not determine one's ability to love and care for a child," (2004). Sadly, however, social service professionals, society and even gay men themselves pay a great deal of attention to these unconfirmed myths.

Moreover heterosexuality and parenthood are intrinsically intertwined because of the social institution of marriage that expects procreation. It is impossible to birth a child without a man and a woman therefore the very notion of man and man giving birth is unfathomable. This concept has made gay men's access to adoption excessively mediated by bureaucratic structures that dictate a couple's capabilities of becoming parents. In this way gender is the underlying complication that many homosexual couples struggle against in the battle for parenthood. That being said it is important to recognise the social changes in heterosexual marriages in present day society, accepts more widely those couples who choose not to procreate (ABS 4102.0: 2002). This social acceptance could redefine marriage not only for heterosexual couples but also more advantageously for homosexual relationships. By redefining the notion, that procreation inevitability follows marriage, the limitations of access to marriage, suffered by homosexual couples, will be substantially alleviated.

Abnormality in a heterosexual world will continue to be judged where common misconceptions persist. Positively, homosexuals' way of life is increasingly more accepted due to the loud and proud gay activists stemming from the 1960s. These groups have created a sub-culture that provides support and acceptance to same-sex couples and in some cases, marriages, making it easier for them to act on their own accord; thus they are beginning to deconstruct previous notions of same-sex marriages. Homosexual marriage, however, remains a contested issue, with very few states legalising what heterosexuals take for granted. While the gendered stereotypes of gay marriages are mostly out of date it is interesting that prejudices still occur in same-sex parenting and public opinions remain judgemental in relation to their relationship styles, even though

numerous studies prove these typecasts false (Falk, 1994 and Patterson, 2000). What is more, as a result of social expectations of homosexual singles, many potential homosexual fathers have failed to reject the stereotypes placed on them. Instead they voice their fears of their ability to raise children. Thus, it is evident that the gendered stereotypes appropriated to homosexual parents are not only embedded in the wider community but they are also deeply engrained within the identity of homosexual fathers. Gender socialisation therefore does play a central role in homosexual marriages, from relationship roles to relationship choices and unfortunately to the rearing of children. However, through wider social acceptance of childless heterosexual couples and changing attitudes towards homosexual relationships by the heterosexual world the meaning of marriage could be redefined to incorporate homosexual couples.

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How safe is Your Facebook Profile? Privacy issues of online social networks

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Online social networking sites have become one of the greatest social technological phenomenon's of the 21st century. However, most users are unaware of the many privacy issues that come with having a profile page on a social networking site. By placing personal information on the world wide web users make themselves vulnerable to online predators, selling of their information to third parties and in some instances, websites owning everything an individual places on their profile page or friend's page, including photos. The problem is intensified because of the fact that communicating online via social networking sites has become not only popular but fashionable and for many young people, necessary to maintain their social status among friends. Because of this, young people are especially at risk of exposing themselves when sites are joined without any thought as to what may happen to personal information, photos and postings that are entered or placed on their or their friend's profile pages. This paper looks at privacy issues of online social networking sites from around the world including Australia, USA, Japan, Korea, Brazil and India. It intends to raise awareness of privacy issues that people may face when creating their online identity with the hope that more care may be taken both by corporations and individual users.

INTRODUCTION

Social networking sites are an unmatched technical development of the 21st century. Millions of young people aged 14 to 24 years old from all over the world participate and interact with their favourite social networking site on a daily basis. Some of the most popular sites that will be discussed include Korea's Cyworld, Orkut a popular site in both Brazil and India and Facebook and MySpace which are popular in the United States and Australia. There are hundreds of different social networking sites that offer a range of services from blogging, to photos and video sharing and sites where travel plans can be shared.¹ However this study is limited to those that focus on an individual creating a personal profile, as it is this kind which involves posting particularly personal information on public domains. Once a profile is created participants can invite each other to become friends, usually approval by both people is required for this to occur. Once friends, a small link connects their profiles, usually by a photo and/or a name and users can then interact

with each other's profiles by writing comments, sending messages, videos and photos.²

While this paper mainly focuses on the negative aspects to online social networks, it is important to be aware that there are many benefits that individuals gain by participating and interacting on such sites.³ Boyd argues that it is important not to exaggerate the risk presented to users and suggests that just as a parent would give their teen some space in the offline world, parents should do the same online.⁴ There is research suggesting that for the socially isolated or those with low self-esteem, online social network sites can actually be of significant benefit, as it is easier to form links and make friends online. The research showed that the more intensively those with low life satisfaction or low self esteem use Facebook, the more social capital they gain.⁵

¹ See examples of sharing photos at <<http://www.picasaweb.com>>, sharing videos at <<http://www.youtube.com>> and sharing travel plans at <<http://www.dopplr.com>>

² Danah Boyd, 'Why the Youth (Heart) Social Networks Sites: The Role of Networked Publics in Teenage Social Life' (2007) Youth, Identity, and Digital Media Volume, *MacArthur Foundation Series on Digital Learning*, 6.

³ Danah Boyd, *Identity Production in a Networked Culture: Why Youth Heart MySpace* (Speech to be delivered at the American Association for the Advancement of Science, USA, February 19, 2006).

⁴ Boyd, above n 2, 22.

⁵ Nicole B. Ellison, Cliff Lampe and Charles Steinfield, 'The Benefits of Facebook "Friends:" Social Capital and College Students' Use of Online Social Network Sites'

1. TRENDS

*"If you're not on MySpace, you don't exist"*⁶

1.1 Why socialise online?

1.1.1 Creating online personal profiles has mainly occurred due to the human need and attraction to connect with people.⁷ For many young people, social networking sites are just another place to 'hang out.'⁸ Young people will continue to work out identity issues, hang out and create spaces that are their own, regardless of what technologies are available.⁹ Socialising is especially important to teenagers as inclusion and peer support are vital to getting through awkward teenage years.

1.2 Why are young people volunteering so much personal information?

1.2.1 When young people create personal profiles online, they often include identifiable information like full names, date of birth, home town, school, relationship status, sexual preference, mobile numbers and email addresses. PEW research on American teens showed that 82% of teens with online profiles post their first name, 79% a photo of themselves, 61% their city/town name, 49% include the name of their school and 29% their last name.¹⁰

1.2.2 Why young people are so willing to share personal information with often complete strangers they met online is an interesting phenomenon. A common misconception is that young people use social network sites to form new friendships or relationships, when in fact most use it to maintain connections that already exist.¹¹ For example PEW research revealed that 90% of teens on MySpace use the service to stay in touch with people they already know.¹² In Korea too, 85% of participants in a

survey on Cyworld said they joined to maintain existing friendships.¹³ Given this, young people are more willing to place personal information on their profiles as they believe or assume that most people who will view their page will be 'friends.'¹⁴ However, it is much easier to become a 'friend' online than offline and many users do not restrict their privacy settings to only friends. The risk is illustrated by the PEW study which indicated that 31% of American teens with profiles have 'friends' who they have never met.¹⁵ These privacy concerns are further compounded by the new instant 'chat' feature where more personal conversations can take place with 'friends.'

1.2.3 Personal information on social network sites is also being volunteered because of changing cultural trends, increased familiarity and confidence in technology and lack of exposure or memory of misuse of personal data.¹⁶ It was also obvious from the survey that 18-34 year olds are much more likely to be comfortable providing detailed personal information to join social network sites than those above 50 years old.¹⁷ This is because young people have grown up with the internet where it has become normal to provide personal information to use certain online services.

2. PRIVACY ISSUES

2.1 While many privacy concerns are common to all people using social networking websites, some illustrate more privacy issues than others. Issues to be discussed include consent, control of personal data, data collection, data deletion and accountability. Personal data is defined to mean any information or content which can be reasonably identifiable to an individual.¹⁸ All of these will be discussed within the context of the eight OECD

(2007) 12 *Journal of Computer-Mediated Communication*, 1158.

⁶ Girl, 18, to her Mother as cited in Boyd, above n 2, 1.

⁷ Boyd, above n 3.

⁸ Ibid.

⁹ Ibid.

¹⁰ Amanda Lanhart and Mary Madden, *Teens, Privacy & Online Social Networks: How teens manage their online identities and personal information in the age of MySpace*, PEW Internet & American Life Project (18 April 2007) iii.

¹¹ Ellison, Lampe and Steinfield, above n 5, 1155.

¹² Amanda Lanhart and Mary Madden, *Teens, Privacy & Online Social Networks: How teens manage their online identities and personal information in the age of*

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¹³ Jaz Hee-jeong Choi, 'Living in Cyworld:

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¹⁴ Ibid, above n 12, ii.

¹⁵ Ibid, 32.

¹⁶ Alessandro Acquisti and Ralph Gross, *Imagined Communities: Awareness, Information Sharing and Privacy on the Facebook* (2006) 1.0.

¹⁷ Unisys, 'Minimising Risks of Online Social Networking' (Press Release, 11 December 2007).

¹⁸ Definition adapted from the *Privacy Act 1988* (Cth) Section 6.

1980 Privacy Principles which were designed to be flexible and adaptive to technological change.¹⁹

2.2 Consent

2.2.1 A reoccurring issue is ‘consent’ which encompasses the Openness Principle which states that the way in which data will be used should be open and accessible and the Purpose Specification Principle which states that data should only be used in ways in which are expressed at the time of agreement.²⁰ The issue of consent can be broken down into several parts. Firstly, whether or not fully informed consent is given to all aspects of the social network service at time of registration, secondly, whether what is *done* with the registration information is consented to and lastly, whether the information that users *voluntarily* provide on their profile pages is within the boundaries of what was originally ‘consented’ to. Other issues include consent in relation to minors and third parties.

*Before Registration: visibility of privacy notices*²¹

2.2.2 The visibility of privacy policies is directly related to the Openness Principle. Cyworld, Orkut, Facebook and MySpace all possess a link to the site’s Terms of Use and Privacy Policy from their respective home pages. Many policies are not written in plain English or may be difficult to find. Orkut’s policies are the same as Google’s Privacy Policy, yet to locate it several links must be followed as well as information being located in several different documents.²²

2.2.3 Before registering, on most social networking sites, users are required to tick a box indicating they have read and accepted the site’s Privacy Policy and Terms of Use. While this theoretically makes users aware of what their personal information and content they may post may be used for, in reality the boxes are ticked without any reading. This is evident through research done on college users of Facebook where 30% of those surveyed did not know that they could manage who can search for their profile and 18% did not know that they can control who can access their profile page, which is an option clearly stated in the Privacy Policy.²³

Registration

2.2.4 An aspect which relates to both the Openness Principle and the Security Safeguard Principles (personal data should be protected) is that Facebook asks users to type in their current email account password so the site can access the account’s contact list in order to find email addresses that are not already registered as members to Facebook.”²⁴ Facebook states below this request that it won’t store the login information and will not contact any of these contacts without the user’s permission.²⁵ The issue is however that the site is obtaining access to email accounts and passwords. While it is possible to skip this step, the option is not obvious and many teenage users would assumingly do this without much thought as it is towards the end of the registration process.

Consent in relation to information voluntarily offered on profile pages

2.2.5 Information on profile pages is a particularly difficult area, as users are volunteering information which they have a right to do. However many young people are simply not aware of what may happen to the information they place on these profiles. For example, Orkut’s policy makes it clear that while the user *owns* the content that is placed on Orkut, Google clearly states that it has full and irrevocable *control* of any information posted, including

¹⁹ The OECD has 30 member states, including the countries discussed in this article; Australia, US and Korea. The organisation is also currently offering “enhanced engagement with view to membership” with Brazil and India. To view the Eight Privacy Principles see; Organisation for Economic Co-Operation and Development, *OCED Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* (2002).

²⁰ Ibid.

²¹ See OECD paper to view what a recommended privacy notice should look like:

<[http://appli1.oecd.org/olis/2006doc.nsf/linkto/dsti-iccp-reg\(2006\)5-final](http://appli1.oecd.org/olis/2006doc.nsf/linkto/dsti-iccp-reg(2006)5-final)> at 3 December 2008.

²² See Orkut’s US website;

<<https://www.google.com/accounts/ServiceLogin?service=orkut&continue=http%3A%2F%2Fwww.orkut.com%2FRedirectLogin.aspx%3Fmsg%3D0%26page%3Dhttp%253A%252F%252Fwww.orkut.com%252FHome.aspx%253Fmode%253Dsignup&hl=en-US&rm=false&passive=true>> at 11 January 2008.

²³ Alessandro Acquisti and Ralph Gross, *Imagined Communities: Awareness, Information Sharing and Privacy on the Facebook* (2006) 4.3.

²⁴ To register and view this process go to

<<http://www.facebook.com.>>

²⁵ Ibid.

'private' messages.²⁶ Google also states that it can make the content available to other organisations or individuals that Google has a 'relationship' with.²⁷ This clearly violates the Collection Limitation Principle as data collection must be limited. The Purpose Specification Principle and Use Limitation Principle is implicated as all postings and messages (including content) can be linked to an individual's identity and that information is not being used in a manner which is relevant to providing the service.

Minors and consent

2.2.6 Children and those under 18 years old are particularly vulnerable to becoming victims of sexual assault and paedophilia that may begin from meeting strangers online. It is therefore vital that they are adequately protected by social networking sites and parents alike. Cyworld and Facebook's minimum age to become a member is 13 years old, while for MySpace it is 14 years old.²⁸ Facebook do not permit those 18 years or older to view the profiles of any person under 18.²⁹ However, the Openness Principle is violated in regards to minors' being permitted to join sites as their ability to understand privacy policies and terms of use agreements is severely reduced. If most young people or adults have trouble deciphering privacy policy information, then minors' will find it extremely difficult to comprehend the implications regarding their personal information both what they surrender at registration and what they post on their profile page. It is therefore imperative that the most fundamental clauses be written in simple English aimed at children as well as requiring users to select their privacy settings *before* registration.

Consent and third parties

2.2.7 Facebook and MySpace both allow third parties widgets to access its core functions.³⁰ Facebook permits any company or person to develop an application that will end up looking as though it is part of Facebook itself and users can opt-in to use the additional feature.³¹ In order for the application to be added it requires access to personal information. It is not at all clear to the user exactly what information they may be gaining access, it was only through personal email correspondence with Facebook that it was clarified to mean only the information visible on a participant's profile page.³²

2.2.8 Also implicated is the fact that many users may not be aware that third parties or related partners of the social network sites may be able to obtain information about a user. For example Cyworld and Facebook both have clauses to the effect that they will supply third parties with personal information only when 'it is reasonably necessary to offer the service.'³³ This ambiguous phrase has the potential to be interpreted however the company wishes and breach the Use Limitation Principle which states that data cannot be used for purposes other than for the purpose the website states.

2.3 Control of Personal Information

Although in many ways a user offers 'consent' when they sign up to an online site, most are unaware of the implications of voluntarily providing personal information on profiles as well as not being aware of how this information may be processed. An individual can lose control of their data when a digital dossier of personal information is generated. This occurs when profiles on social networks sites can be downloaded and stored over time by site operators for back up purposes so as to

²⁶ Google, *Terms of Service* (16 April 2007) <<http://www.google.com/accounts/TOS?hl=en-US>> at 3 December 2008.

²⁷ Ibid, 11.2.

²⁸ Cyworld (US Site), *Privacy Policy* (12 June 2008) <<http://us.cyworld.com/main/aboutus/privacy.php>> at 3 December 2008. Facebook, *Facebook Principles* (26 November 2008) <<http://www.facebook.com/policy.php?ref=pf>> at 3 December 2008. MySpace, *Privacy* (28 February 2008) <<http://www.myspace.com/index.cfm?fuseaction=misc.privacy>> at 3 December 2008.

²⁹ Ibid.

³⁰ Michael Arrington, *Facebook Launches Facebook Platform; They are the Anti- MySpace* (May 2007) Techcrunch

<<http://www.techcrunch.com/2007/05/24/facebook-launches-facebook-platform-they-are-the-anti-myspace/>> at January 8, 2008. MySpace, above n 29.

³¹ Facebook, *Platform Application Terms of Use* (24 May 2007) <http://www.developers.facebook.com/user_terms.php> at 17 January 2008.

³² Personal email correspondence with Facebook Customer Service, 9 January 2008.

³³ Facebook, *Privacy Policy* (6 December 2007) <<http://www.facebook.com/policy.php>> at 3 December 2008.

incrementally create a digital dossier of personal information.³⁴ This can also occur out of the control of the user as users' 'friends' on their sites can write a comment about them on another friends profile or 'tag' the individual in photos. It is in this way that profile information has the potential to be used in ways that the user did not intend and stored for indefinite periods.³⁵ Since the cost of disk storage and downloading is constantly being reduced, it is possible to take 'snapshots' of a whole network for storage or back up purposes.³⁶ The main threat associated with digital dossier aggregation for young users is when future employees or colleges are able to perform searches that may bring up data or even compromising photos that an individual thought either no longer existed or not possible for that source to obtain.³⁷ For example a gay student attending a Christian college in the US was expelled after administration officials viewed photos of the student dressed in drag on Facebook.³⁸ Losing control in this way may be in conflict with the Purpose Specification and Use Limitation Principles as an individual's personal data is not being used in a way they believed or told it would.

2.4 Data Collection

Limiting data collection

2.4.1 The Collection Limitation Principle states that the collection of personal data should be limited.³⁹ At registration online social network sites require certain pieces of information such as birthdays, and addresses which are debatably not vital to creating and maintaining the service. For example, Facebook, Orkut, Cyworld and MySpace all require a full name, date of birth and email address with Orkut additionally requiring an address and gender.⁴⁰

2.4.2 Korea's Cyworld registration requires the potential site member to supply their national identity number which breaches the limitation requirement. The national ID number is a highly sensitive and unique number given upon registration of birth which serves important functions such as opening bank accounts.⁴¹ Korean applicants must also provide Cyworld with their real full name which is then validated online in cooperation with Seoul Credit Rating which makes it more difficult for users to create pseudo names.⁴² While this may be a breach of the Collection Limitation Principle, it process assists in protecting minors from joining the website and keeps the site relatively free of illicit material and cyber predators due to the fact that offenders are highly identifiable.⁴³

2.5 Data Deletion

2.5.1 An individual's right to have their personal data completely deleted is an important right to users of online social networks as it can otherwise impinge on their privacy later in life. The Individual Participation Principle guides such usage, allowing individuals to request data.⁴⁴ Most social network sites researched require the user to de-activate their account through functions on their website; however Cyworld requires the user to email site administration while Orkut requires a written letter to Google requesting a deletion which is extremely onerous.⁴⁵ To network operators, complete deletion is costly and technically demanding which means personal information can be stored indefinitely even though a user may believe that all aspects of their account has been deleted.⁴⁶ Even when an account is 'deleted' all the social networking sites researched state they may still retain data on backup copies for an unspecified period.⁴⁷

³⁴ European Network and Information Security Agency, *ENISA Position Paper No. 1: Security Issues and Recommendations for Online Social Networks*, ed. Giles Hogben, October 2007, 8.

³⁵ Ibid.

³⁶ Ibid.

³⁷ Ibid.

³⁸ Knowledge@Wharton, *MySpace, Facebook and Other Social Networking Sites: Hot Today and Gone Tomorrow?* (3 May 2006) <<http://knowledge.wharton.upenn.edu/article.cfm?articleid=1463>> at 3 December, 2008.

³⁹ OECD, above n 19.

⁴⁰ Information gathered by beginning the registration process from the respective homepages; facebook.com, cyworld.com, myspace.com, orkut.com.

⁴¹ Mr. Byung Wook Kwan, OECD employee, Interview on the issue of the national identification number, 10 January 2008.

⁴² Choi, above n 13, 176.

⁴³ Kwan, above n 43.

⁴⁴ OECD, above n 19.

⁴⁵ Cyworld, *Cyworld Privacy Policy* (12 June 2008) <<http://www.us.cyworld.com/main/aboutus/privacy.php>> at 3 December 2008. Google, *Google Privacy Policy* (14 October 2005)

<<http://www.google.co.uk/privacypolicy.html>> at 3 December 2008.

⁴⁶ European Network and Information Security Agency, above n 37, 8.

⁴⁷ Cyworld, above n 46. Orkut, *Privacy Notice* (21 May 2008) <<http://www.orkut.com/html/en->

2.6 Accountability

2.6.1 The Accountability Principle requires that those who give effect to the Guidelines be held accountable for their compliance. All social networks sites in some way provide users mechanisms to get in contact with administrators regarding their privacy concerns. It has been suggested that even if a user felt the website had broken promises it made in the privacy policy, it is doubtful that the user could sue the website for breach of contract on the basis of the policy loopholes and vague language contained in the agreements.⁴⁸

3. CONCLUSION

3.1 It is difficult to balance the right of privacy and control of personal information when individuals voluntarily place personal information on their profile. Once information is placed on public domains users can easily lose control over who sees it and who may use it. While privacy settings are there to protect users, in practice this is not always the case, whether it is because of slack web design or through lack of knowledge or care by the user.

3.2 The underlying issue is that young people are simply not concerned with giving personal data to social networking sites or placing detailed information on their profile pages. Because a change in teen culture is unlikely, the corporations behind social networking sites must act with more responsibility. Action must be taken on a multi-lateral scale such as cross border agreements on privacy standards to reduce the prevalence of pornographers, identity theft and other types of privacy concerns as there is obvious difference between privacy regulations between countries such as Australia and the US compared to Brazil. Organisations such as the OECD, APEC and other regional organisations have the potential to be instrumental in developing tighter cyber privacy laws. This must be encouraged and insisted upon in order to ensure social networking sites better protect its users, especially its young participants.

**This article is an adaption from a more detailed paper, please contact the author if you wish to obtain a copy.*

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US/privacy.orkut.html?rev=4> at 3 December 2008,
Facebook above n 3, MySpace above n 29.

⁴⁸ Electronic Privacy Information Centre, *Social Networking Privacy* (30 November 2007)
<<http://epic.org/privacy/socialnet/>> at 3 December 2008.

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‘Me old mate Victa’: Technological change and society in post-World War Two Australia

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Way back in the early days
Mowin’ kept us fit and lithe
Coz the only way to do it
Was to swing a flaming scythe

Until some bright spark somewhere
Said, “Now this’ll be a goer!”
And came up with that curse of kids
The horrible push mower

But then one day Merv Richardson
An engineer from Adelaide
Showed the world a better way
To spin a mowing blade

He took a two stroke engine
Made a peach tin petrol tank
Slapped it onto four old wheels
And gave the rope a yank

And so, in 1952
The Victa mower was born
And ever since that time has turned
Australian grass to lawn

Victa’s become an institution
The sound of our weekend
Though I curse those early starters
If me sore heads on the mend

Nothin’s worse than Sat’dy mornin’
After Friday on the tiles
When the Victas wake up with the crows
And you can hear them roar for miles

Or when your mates have come for lunch
And you’ve just lit the barby
And the Victas on both sides of you
Start a local mowing derby!

– Brian Doyle excerpt from ‘Me Old Mate Victa’¹

¹Brian Doyle, ‘Me Old Mate Victa’

<<http://www.abc.net.au/rural/telegraph/poetry/stories/s438532.htm>>, first accessed on 30th September, 2008

Do technologies arrive “just in time” to cater to some particular market? Brain Doyle indicates so in his poem *Me Old Mate Victa* where the curse of the push mower was suddenly evaporated with Merv Richardson’s invention of the two-stroke engine (commonly known as the Victa Mower). Peter Timms, in his history of the Australian suburban garden, argues similarly, stating that ‘the Victa was just what home gardeners had been waiting for’.¹ While arguments such as these prove useful in developing a narrative or story of technology in Australia, they do not address the issue of technological change and its relationship with society.¹ In presenting this history of the lawnmower I want to particularly highlight technology as something that does not simply evolve to perform some function ‘in a better way’; nor is society passive in ‘waiting’ for technology to arrive. The history of the lawnmower in the context of Australian society, predominantly in the period immediately following the Second World War, demonstrates how adaptation and entrenchment of values takes place in a period of change

Determinism—that is defining cause as something existing outside the idea in focus—in historical analysis seems an easy method to turn to, if anything, because it simplifies the story that is portrayed. Smith articulates it best when he says:

“The frustration we experience with technological determinism and technocratic thinking is as much with ourselves as it is with the larger societies in which we live. As moths to flames, we find ourselves continually attracted to its alluring but dangerous glow.”¹

Therefore, before embarking on ‘a history of the lawnmower’, it is necessary to deliver a frame of reference that does not fall in the trap of technological determinism. This, I present in two segments. Firstly, technology is an extension of self: a material expression of human desire to perform a task. Such a conception stems from Mazlish and his exploration of how society is in the process of reconciling the discontinuity between humans and machines.² To demonstrate: a rock is perceived as an object without direct relationship to an individual. However, if I were to pick up the rock and throw it at someone, one might relabel the rock as a weapon—as a technology. The action placed on the object, changing the relationship between the rock and myself, in this case for the purpose for my desire, is what defines it as technology.

However, there is also a collective acknowledgement of technology that has to be addressed. This is the second portion of my definition and stems from discussions made by Heilbroner, who argues that ‘technological change must be compatible with existing social conditions’.³ The continuum between humans and their technologies is conditional on the environments, or more formally on the institutional arrangements, of their society. This definition will be demonstrated through an exploration into the history of lawnmower. Particularly, I want to focus my attention to the re-conceptualisation of the lawnmower in the period after the Second World War in Australia. Why does this re-conceptualisation take place? I will argue that there are institutional arrangements in Australia’s cultural history that converge to a point where an invention is given legitimacy through desire to serve a purpose.

NO MORE WAITING: A USERS HISTORY OF THE LAWNMOWER?

Technological change centres on the recognition that there are available resources to (re)develop tools to perform particular actions. A common example is Edison’s knowledge of the various materials that could be made available to sustain illumination of an electric current.⁴ Similarly the development of the lawnmower stems from the realisation that mechanisation can be applied to the action of cutting

¹Merritt Roe Smith, ‘Technological Determinism in American Culture’, *Does technology drive history?: The Dilemma of Technological Determinism*, Merritt Roe Smith and Leo Marx (eds.), MIT Press, Cambridge, 1994, p. 35

²Bruce Mazlish, *The Fourth Discontinuity: The Co-evolution of Humans and Machines*, Yale University Press, New Haven, 1993 pp. 5-6

³Robert L. Heilbroner, ‘Do Machines Make History?’, *Does technology drive history?: The Dilemma of Technological Determinism*, Merritt Roe Smith and Leo Marx (eds.), MIT Press, Cambridge, 1994, p. 63

⁴Robert D. Fridel, and Paul Israel, and Bernard S. Finn, ‘Afterword’, *Edison’s electric light : biography of an invention*, Rutgers University Press, New Brunswick, 1986, p. 225

grass; the knowledge is there, it is simply the matter of the adaptation. No real development of the French agricultural implement, the scythe, had been made since its inception in the mid-seventeenth century. However, during the eighteenth century, large British estates began to develop what were known as 'the natural gardens'.⁵ This was then followed by the cultivation of common land into parkland during the nineteenth century and is concurrent with the development of sporting grounds.⁶ Thus, a formation of the tradition of maintaining short grass for aesthetic and sporting purposes is popularised and it is from this context that the most significant change in the action of cutting grass is made.

Edwin Beard Budding, a freelance Engineer working in the Gloucestershire area, found his inspiration for the first lawnmower from a cylindrical rotary blade that was used to cut cloth at a local mill, sometime in 1830. The patent for the first lawn mower was granted on the 25th of October 1830 and its motivation and application is stated in the patent:

"A new combination and application of machinery for the purpose of cropping or shearing the vegetable surfaces of lawns, grass-plats, and pleasure grounds, constituting of a machine which may be used with the advantage instead of a scythe for that purpose ...grass growing in the shade too weak to stand against the scythe to cut, may be cut by my machine as closely as required, and the eye will never be offended by those circular scars, inequalities and bare places so commonly made by the best mowers with the scythe, and which continues visible for several days. Country gentlemen may find in using my machine themselves and amusing, useful and healthy."⁷

There are notable aspects of Budding's design that have not changed; the handles to push the mower, or the side-wheels used to direct the rotating blade forward for example. However, these early conceptions were a great deal more cumbersome in comparison to what one may think of as the contemporary equivalent push-mower. Early versions were often made from cast-iron, and required a pull (often by a pony, donkey or horse) at

the same time as a push (preferably performed by the gardener). These early designs sought to cater to the conditions that were placed upon it during the nineteenth century.

The push-mower, for single person use, is popularised from the patents of Follows and Bate in 1869 and comes to be known as the side-wheel lawnmower.⁸ The reason why this particular model of the mower is developed though is not because of simple evolution of technology, but as a result of the growth of detached and semi-detached housing during the later half of the nineteenth century in Britain, the United States, and of course in Australia. Suburbia acts as firstly as a British phenomenon, in reaction to rapid industrialisation of its economy, which in turn, develops a new affluent middle-class that cultivated its own values. These emerging traditions were espoused in the presentation of their neighbourhoods (located outside the city centre) in which the garden became central.⁹ The United States and Australia, similar in their economic development, follow suite and are indeed able to nourish the idea—both having wide open spaces for building and relatively egalitarian societies.¹⁰ In Australia, companies such as Crowe Engineering Works, Clyde Industries, as well as British manufacturing subsidiaries (Qualcast and Shanks) produced manual cutters that would help entrench the idea of 'maintaining the lawn' throughout the 1930s and 40s.¹¹ Powered mowers, were available by the 1940s in Australia—the development of the petrol engine mowers had first being sold to the Cadbury Brothers for their Bournville sports ground in 1902¹²—however, they were again cumbersome machines that were much too unwieldily for the average household to maintain.¹³ However, they did suit relatively well for a mower business, and indeed this is where this history finds Victa Mowers in 1950; son Garry and father Mervyn, trying to load

⁸*Ibid.*, p. 13

⁹Timms, pp.23-4, p. 32

¹⁰*Ibid.*, p. 19

¹¹Cockington, James, 'Pushed for time', *The Age*, December 5, 2007,

<<http://www.theage.com.au/news/planning/pushed-for-time/2007/12/03/1196530579050.html>> , first accessed on 4th of October, 2008

¹²Halford, p. 19

¹³Brian Carroll, *Australian Made: Success Stories in Australian Manufacturing Since 1937*, Institution of Production Engineers Australian Council, Parkville, 1987, p. 92

⁵Timms p. 117

⁶David G. Halford, *Old lawn mowers*, Shire, Princes Risborough, 1982, p. 3

⁷*Ibid.*, p. 4

such a powered lawnmower into the sidecar of Garry's motorbike.¹⁴

Of course the history of technology can never be as simple as a single inventor, cast with an idea. Mervyn Victor Richardson was not actually the inventor of the two-stroke rotary engine driven mower as is commonly mythologised in Australian history. In fact, the first patent of a rotary blade, horizontally spun by a vertical motor is said to have been issued in Great Britain on 29th of February 1932 to a David Hamilton Cockburn.¹⁵ However, even this is disputable: an earlier patent exists in the US was issued to Joshphus Miller of Louisville, Kentucky on The 10th of November 1931.¹⁶ Richardson cannot even be attributed with the first conceptualisation of this motorised horizontal blade in Australia; this honour falls to Lawrence Hall, from Adelaide, who in 1948 developed a rotary blade lawn-mower to cut his parents lawn. Hall's lawnmower, named 'Mowhall' used his experience as a boat engine builder to develop a petrol-driven prototype, however, it was limited in its usability; needing two people to push and pull the contraption across the lawn.¹⁷ It was in 1948 that Richardson saw the 'Mowhall' in demonstration and subsequently turned his attention to developing a similar concept that would be as light and inexpensive as the vacuum cleaners in most homes

at the time.¹⁸ As the Australian Dictionary of Biography presents it, once Richardson decided to use a Villers engine in August 1952 it only took Richardson a couple of hours to draw up a new design that turned the motor on its side (varying it from the 1930s designs) and set two blades, rotating horizontally on the frame of a billy-cart.¹⁹ His wife, Vera, was given the first honour of its use, testing it on a patch of overgrown grass in the backyard of their Concord home in Sydney.²⁰ Within two years, Richardson had given up his work as an Engineer salesman to run Victa Mowers and within four years, the company established its factory on Parramatta Road, within 10 years, Victa Mowers had established a production line that could produce a mower a minute.²¹

Therefore, we can see that numerous inventions are associated with the lawnmower, and like in so many histories of technologies, such as the zipper, or the light bulb, there is not one, but many inventors, each bringing particular insight. However, what succeeds in each period and environment is determined by what continues to suit the needs of the society. Richardson is able to discover an approach to conceptualising the lawnmower that would meet the desires of gardening during the 1950s in Australia—to make it inexpensive and easy to cut ones grass. These conditions are different in the case of the British history of the lawnmower, which could equally focus on the development of the first cylindrical blade mowers for large estates as it could on the development of the rotary blade mower. However, it is a collective acknowledgement of a particular invention that gives licence to a specific 'technology' that represents *that* tool which is used to perform *that* particular action. To better understand how this process occurs with the lawnmower in post war Australia, I will next turn my attention to further exploring the historical conditions of Australian suburbansism that leads to this collective acknowledgement of Victa as 'Australia's top selling mower'.²²

¹⁴Vivian Encel, *Australian genius, 50 Great Ideas*, Atrand Pty Ltd, Crows Nest, 1988, p. 70

¹⁵<<http://www.wikipatents.com/gb/0385473.html>>, first accessed on 4th of October, 2008 holds a copy of the patent GB 385473, the patent is indicated by IP Australia to be the earlier design see

<www.ipaustralia.gov.au/patents/ex_victa.shtml>, first accessed on 7th September, 2008

¹⁶US 1831681. To see a copy of this patent see Google Patents:

<http://www.google.com/patents?id=Pn9OAAAAEBAJ&pg=PA1&dq=US+patent+1,831,681&source=gbs_select&d_pages&cad=0_1#PPA3,M1>, first accessed on 4th October, 2008. Intellectual Property and Internet Barrister Chambers *Design Chambers*, in Wimbledon, UK have noted in their research that 'Unlike the Rotoscythe [the British patent], the Louisville mower did not feature any grass collection system nor were the cutting blades completely surrounded by the deck (or otherwise) of the machine' for more information see: <<http://www.designchambers.com/electra/index.htm#RotoscytheFirst?>>>, first accessed on 4th October, 2008.

¹⁷Australian Academy of Technological Sciences and Engineering & The Power House Museum, 'Sell – Advertise and Inform People', *The Innovation Cycle* <http://www.powerhousemuseum.com/australia_innovate/sell.html>, first accessed on 4th of October, 2008

¹⁸Richard V. Wood, 'Richardson, Mervyn Victor (1893 - 1972)', *Australian Dictionary of Biography*, Volume 16, Melbourne University Press, 2002, pp.84-85 and Brian Carroll, 'This Was Australia: Mow and Ye Shall...', *The Sun (Sydney)*, 17th July 1984, p. 40

¹⁹Wood, pp. 84-85

²⁰Encel, p.70 and Carroll, 'This Was Australia: Mow and Ye Shall...', p. 40

²¹Carroll, p. 92

²²This caption was part of Victa's 1959 Advertising campaign, see Australian Academy of Technological Sciences and Engineering & The Power House Museum,

A BETTER WAY?: CHANGE AND TECHNOLOGICAL HISTORY

Those who have written of the lawnmower in Australia, for example Brain Carroll, Vivian Encel, as well as the bush poet Brain Doyle, have assumed that application of mechanisation to the cutting of grass has been a natural advancement.²³ However, there are other commentators who are willing to be more nuanced in their approach to examining this impact. Peter Timms, for example, delivers important insight when he argues that 'the cylinder mower...has almost entirely given way to the quicker, more convenient rotary'.²⁴ Was the lawnmower improved upon or did it continue to change to satisfy our desires? Thus far, this essay has argued the former—efficiency is a desire that is created to fit a societal position or ideology created. To comment on whether this is progress forwards or not is to comment on another theoretical argument. Therefore, in analysing historically significant technological change in society, we have to be wary of the potential to blur the lines between change and progress. As such, the focus of this essay will now turn to the exploration of the relationship between the technical changes to the lawnmower and changes in Australian society after the Second World War.

Overcoming constraints is one of the more dominant factors driving technological change. However, more important is the definition of that constraint in the first place. Budding's definition of his constraint was driven by cultural conditioning of the idea of a 'natural garden', which by the 1830s was demanding quality and consistency in the maintenance of lawns. Halford's history of the lawnmower, *Old Lawn Mowers*, has many examples of lawnmower inventions where the constraint has not been properly identified. James Sunder's and Alexander Shanks' steam-powered lawnmowers, for example, appear as obsolete in 1900 in the face of the new petrol driven lawnmowers.²⁵ Heilbroner argues that what is perceived as advancement in technology 'not only must be congruent with the surrounding technology but must also be compatible with the existing economic and other institutions of

society'.²⁶ Therefore definition of the constraint by Mervyn Richardson in 1952 comes from his understanding of institutional arrangements.

Graeme Davison describes four broad periods that converge to form the basis of suburbanism in Australia. First is that of early colonial development, starting with Arthur Phillip, of the building of semi-detached and detached housing in Sydney.²⁷ This method of housing was then subsequently expanded with the arrival of free immigrants during the 1830s and 40s and then entrenched by a sustained period of prosperity during the 1860s.²⁸ Conditioning of this culture of housing was promoted uniformly across the colonies, as a result of weak local councils and strong paternalistic colonial governments, particularly in New South Wales.²⁹ However, as Alastair Greig has most comprehensively noted, it was the housing shortage of the post World War Two period that instigated not only large amounts of government assistance for housing, but also allowed for the infusion of modernist ideas into house design and planning.³⁰ Phillip Scranton, as an historian reminds us that 'individuals act both in and upon institutions (a family, a firm, a government), and they embody, realize, and reproduce those institutions through their daily activity'.³¹ As such the late 1940s and 1950s act as a period in Australian history where existing values and traditions, such as the push mower on the weekend, are adapted and reshaped to reflect modernist

²⁶Heilbroner, p. 63

²⁷Graeme Davison, *The past and future of the Australian suburb*, R.C. Coles (series ed.) Urban Research Program, Research School of Social Sciences, Australian National University, Canberra, 1993, p.5, see also Alan Gilbert, 'The Roots of Anti-Suburbanism in Australia' *Australian cultural history*, S.L. Goldberg and F.B. Smith (eds.) Cambridge University Press, Melbourne, 1989, p. 33

²⁸Davison, p. 5

²⁹*Ibid.*, p.5 see also Alan Atkinson, 'Time, Place and Paternalism: Early Conservative Thinking in New South Wales', *Australian Historical Studies*, 23/90, April 1988, pp. 1-18, for discussion of colonial paternalism in New South Wales, discussion by Geoffrey Bolton, *Spoils and Spoilers: Australians Make Their Environment*, George Allen & Unwin, Sydney, p.68 on the export development of the colonies which resulted in weak small, rural towns in comparison to the developing cities.

³⁰Alastair Whyte Greig, and Australian National University, *Home Magazines and Modernist Dreams: Designing the 1950s House*, Urban Research Program, Research School of Social Sciences, Australian National University, Canberra, 1995, p. 1

³¹Scranton, p. 152

'Sell – Advertise and Inform People', *The Innovation Cycle*

<http://www.powerhousemuseum.com/australia_innovate/sell.html>

²³Carroll, p. 92 and Encel, p. 70

²⁴Timms, p. 112

²⁵Halford, pp. 16-17

assumptions, such as the re-conceptualisation of the lawnmower into a petrol driven, commercial product.

The development of suburbanism in Australia, throughout the late 1940s is evident in Mervyn Richardson's re-conceptualisation of the lawnmower: as was noted previously in this essay, he asked why the lawnmower was not as light and manoeuvrable as other domestic products such as the vacuum cleaner. However, this influence is not simply the environment, in which the Victa Mower is born, but also the environment, in which Victa Mowers Company used to entrench their products into the commercial space of 1950s and 1960s Australia. Victa Mowers advertising strategies were typical of their style in that they used psychology-based advertisements that sought to idealize the suburban dream.³² The slogan from Victa's 1959 advertising campaign 'Turn your grass into lawn' is classic in its appeal to symbolism that the lawn plays portraying the public front garden of the typical suburban home.³³ However, Victa Mowers went well beyond the traditional mould in its advertising. Richardson began demonstrating his Victa mowers during the summer of 1952 as they came off the production line in his garage. This technique continued throughout the 1950s, 1960s and 1970s with staff devoted exclusively to travelling to schools, hardware stores, and department stores to demonstrate how to use a Victa lawnmower.³⁴ The result was that Victa Mowers has consistently portrayed itself as the technological innovator in lawn-mowing and Australian society has as a result acknowledged it as representing lawn-mowing 'technology'.

CONCLUDING THOUGHTS

The visual created by the 'mower symphony' of the 2000 Olympic opening ceremony, with hundreds of keen performers pushing model Victa mowers and weaving themselves into the Olympic rings formation, must have seemed truly bizarre to the millions watching around the world. Nevertheless, to many of viewers who had had any association with the concept of Australian suburbia it spoke in volumes. The Victa Lawnmower represents how the history of one invention in a specific societal context can be collectively legitimated as the history of an entire technology. The lawnmower in Australia represents a desire, created by the conditions of housing shortage in combination with the existing traditions of suburbanism established in colonial Australia, to find a convenient tool to perform the task of mowing the lawn. The Victa Lawnmower, despite not having been the original invention, was, and still is, acknowledged as the technology that represents lawn mowing in Australia. This history of the lawnmower has also demonstrated that historians of technology should be careful in articulating the theoretical framework from which they aim to work from. There is great potential for well-developed technological histories to give important insights into the societies of the past, which in turn can offer up insight into the operation of societies today.

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³²For discussion of psychology-based advertisement and portrayal of nationalist ideals, see Smith, p. 13

³³On Victa Mowers advertising see Australian Academy of Technological Sciences and Engineering & The Power House Museum, 'Sell – Advertise and Inform People', *The Innovation Cycle*

<http://www.powerhousemuseum.com/australia_innovate/s/sell.html>, the symbolism of the lawn as a public space can be read in Peter Timms, p.64-66 and John Fiske and Bob Hodge and Graeme Turner, *Myths of Oz : reading Australian popular culture*, Allen & Unwin, Sydney, 1987, p. 30

³⁴Australian Academy of Technological Sciences and Engineering & The Power House Museum, 'Sell – Advertise and Inform People', *The Innovation Cycle* <http://www.powerhousemuseum.com/australia_innovate/s/sell.html>

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Can we consider life as property?

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Axel Tiesen, writing in a journal article in 1914, lamented the fact that although ‘we have reached the point where products of your mind, whether literary, musical, artistic or inventive have been invested with the legal quality of property’, life, being the source from which ‘all other values spring’, has no property value. This essay wants to take a step back from Tiesen’s article and ask the more fundamental question of whether life *can* be considered as property. Tiesen’s lamentation that life, despite being the source from which ‘all other values spring’, has, by itself, no property value is true insofar as he is thinking about life as being *private* property. In a by-gone religious age, life was a *divine* property and in a post-religious age, life is best conceived of as a *communal* property. In either case, it is of no private value.

1. INTRODUCTION

Axel Tiesen, writing in a journal article in 1914, lamented the fact that although ‘we have reached the point where products of your mind, whether literary, musical, artistic or inventive have been invested with the legal quality of property’, life, being the source from which ‘all other values spring’, has no property value.¹ This essay wants to take a step back from Tiesen’s article and ask the more fundamental question of whether life *can* be considered as property. This essay will begin by delineating the parameters of its investigation, especially with regard to the scope of the word ‘life’. Then, this essay will use a Lockean conception of property as its philosophical starting point before moving on to consider whether the modern ‘death of God’² has made the Lockean conception of the proprietorship of life irrelevant. If it has, the question to ask then is whether the Lockean conception can be salvaged and modified to suit modern realities. This essay will argue not only that the Lockean conception can be modernized, but that it must be modernized in the absence of any other viable alternatives.

2. WHAT IS LIFE?

Western philosophy has, at least since Descartes, conceived of the human person as consisting of physical and non-physical substances.³ According to

Descartes, it is essential to everything physical that it has spatial extension, and being spatially extended implies having parts.⁴ As the body has spatial extension and is divisible into parts, it is accordingly classified as the physical component of the human person. On the other hand, as we cannot conceive of the mind as having those characteristics, it is accordingly classified as non-physical. This is not dissimilar to the *anima–animus* distinction drawn by ancient Greek philosophers: *anima* refers to the physical atoms that make up the body while *animus* refers to the rational, incorporeal substance that infuses the body and enables humans to have the capacity for self-reflection, a quality which Greeks believed to be lacking in animals.⁵ Human life comes into existence when there is an infusion of the *animus*, the non-physical substance, into the *anima*, the physical substance.

In this essay, the word ‘life’ will be used solely in reference to the *mental* element, or the *animus*, of the human person for two reasons. First, compared with the proprietorship of the human mind, the proprietorship of the human body has already been the subject of much judicial⁶ and academic

¹ Axel Teisen, ‘Should Human Life be Considered as Property?’ (1914) 79 *Central Law Journal* 57, 58-9.

² This phrase is, of course, an oft-repeated quote from Friedrich Nietzsche, *The Gay Science* (Walter Kaufmann trans, 1974 ed) 181.

³ See David Rosenthal, ‘Dualism’ in Edward Craig (ed), *Routledge Encyclopedia of Philosophy* (1998), vol 3, 133.

⁴ See Daniel Garber, ‘Descartes, Rene’ in Edward Craig (ed), *Routledge Encyclopedia of Philosophy* (1998), vol 3, 1, 11-12.

⁵ See Margaret Osler, ‘Gassendi, Pierre’ in Edward Craig (ed), *Routledge Encyclopedia of Philosophy* (1998), vol 3, 848, 854. See also Michael Erler, ‘Lucretius’ in Edward Craig (ed), *Routledge Encyclopedia of Philosophy* (1998), vol 5, 854, 854-5.

⁶ See, eg, *Moore v Regents of the University of California* (1990) 793 P 2d 479. See also Debra Mortimer, ‘Proprietary Rights in Body Parts: The Relevance of *Moore’s Case* in Australia’ (1993) 19 *Monash University Law Review* 217.

discourse.⁷ Second, the wide acceptance in many jurisdictions⁸ that brain death is the criterion for death of the organism as a whole, even though the rest of the organism can be kept alive, contains a tacit acknowledgement that it is mental activity, and the things that mental activity supports, that are relevant to the value of life; when the capacity for consciousness has departed permanently, human life ceases to exist.⁹ Thus, given the importance of mental consciousness to the value of life generally and the lack of discussion with regard to its proprietary value, this essay will focus primarily on considering whether *mental* life can be considered as property.

3. LOCKEAN CONCEPTION OF PROPERTY

Let us start with a basic question: who owns your life? For a preliminary answer to this question, let us return to the state of nature. The state of nature is, Locke tells us, 'a State of Liberty, yet it is not a State of License':

The State of Nature has a Law of Nature to govern it...For Men being all the Workmanship of one Omnipotent, and infinitely wise Maker; All the Servants of one Sovereign Master, sent into the World by his order and about his business, they are *his Property*, whose Workmanship they are, made to last during his, not one another's Pleasure...¹⁰

⁷ See, eg, John Zodrow, 'The Commodification of Human Body Parts: Regulating the Tissue Bank Industry' (2003) 32 *Southwestern University Law Review* 407; Russell Scott, *The Body as Property* (1981); and Rosalind Atherton, 'Claims on the Deceased: The Corpse as Property' (2000) 7 *Journal of Law and Medicine* 361.

⁸ For the state of the law on this issue in Australian jurisdictions, see *Transplantation and Anatomy Act 1978* (ACT) s 45; *Human Tissues Act 1983* (NSW) s 33; *Human Tissues Transplant Act 1979* (NT) s 23; *Transplantation and Anatomy Act 1979* (Qld) s 45; *Death (Definition) Act 1983* (SA) s 2; *Human Tissues Act 1985* (Tas) s 27A; *Human Tissues Act 1982* (Vic) s 41; and *Human Tissue and Transplant Act 1982* (WA) s 24(2). For the state of the law on this issue in the United Kingdom, see *Airedale NHS Trust v Bland* [1993] 1 All ER 821.

⁹ John Harris, 'Life and Death' in Edward Craig (ed), *Routledge Encyclopedia of Philosophy* (1998), vol 5, 625, 627.

¹⁰ John Locke, *Two Treatises of Government* (2nd ed, 1967) 288-9 (emphasis added).

For a Man, not having the Power of his own Life, *cannot*, by Compact, or his own consent, *enslave himself* to anyone, nor put himself under the Absolute, Arbitrary Power of another to take away his life, when he pleases.¹¹

To Locke, a distinction is thus drawn between alienable and inalienable rights. *Private* property entails the right to alienate, by selling, giving or even destroying, what is owned.¹² In the words of Laslett, private property is 'something which a [hu]man can conceive of as distinguishable from himself [or herself]'.¹³ Consequently, we cannot alienate any part of our personalities that are constitutive of, and essential to, who we are, but we can alienate that with which we have chosen to mix our personalities. Under Locke's labour theory of property, by mixing one's labour with some resources nature provides for the common use of the human species, one is entitled to appropriate not only the product of the earth and one's toil, but also the land one works upon.¹⁴ Things which are appropriated in this manner are considered to be private property because they remain accidental, or non-essential, to the human person and are therefore alienable.

This is to be contrasted with the parts of our personalities that are considered to be essential, in the sense of being integral to and constitutive of who we are, and thus are inalienable. The more essential it is, the more inalienable it is. For example, selling one's labour does not carry the social condemnation that is attached to selling one's sexuality because sexuality is considered an essential part of human personality and is thus not to be treated as a private property or a vendible commodity.¹⁵ If sexuality is considered essential, one's mind, being the seat of one's consciousness and vitality, will surely be as essential as sexuality, if not more.

If proprietorship of the mind cannot be vested in the individual, owing to its inalienability, what better, and *safer*, place is there to vest it if not in God? We

¹¹ Ibid 302 (emphasis in original).

¹² Ibid 227.

¹³ Editorial Introduction by Peter Laslett in Ibid 102.

¹⁴ Edward Andrew, 'Inalienable Right, Alienable Property and Freedom of Choice: Locke, Nozick and Marx on the Alienability of Labour' (1985) 18 *Canadian Journal of Political Science* 529, 542.

¹⁵ Ibid 547.

therefore end up with a situation where I have possession of life but God has proprietorship over it. Without intending to trivialize this point, we can nonetheless say that we hold our lives on *lease* from God. It is perfectly logically consistent to hold that one can possess an inalienable right to something which is not one's property. In fact, it would be logically inconsistent to hold that one possesses an inalienable right over one's property, for alienability is well-entrenched in our jurisprudence as an indispensable ingredient of proprietorship.

Hence, the reason why we cannot alienate our lives at will is none other than the elementary property law principle of *nemo dat qui non habet*. One cannot voluntarily renounce one's conscience and consciousness because they are not one's property. To be sure, there are a range of situations where people have argued for a right to renounce these mental faculties: suicide, euthanasia and drug-taking.

4. DEATH OF GOD AND RISE OF HUMANS

As Nietzsche's prophecy of the impending death of God¹⁶ appears to be reaching its fulfillment, at least among the Western intelligentsia, the tenability of Locke's model of the ownership of life will inevitably be called into question. The transcendental site which was thought to be a safe and secure place to vest the proprietorship of life has now been fractured by modernity. Life is well and truly *bona vacantia*.

In the absence of a transcendental proprietor, the most obvious site in which the proprietorship of life can *revert* to is humans themselves. This emancipation of natural rights from natural law is exactly what Nozick is trying to achieve in *Anarchy, State and Utopia*:

A person may choose to do himself...the things that would impinge across his boundaries when done without his consent by another...Voluntary consent opens the border for crossings. Locke, of course, would hold that there are things others may not do to you by your permission; namely, those things you have no right to do yourself...My nonpaternalistic position holds that someone may choose (or permit another) to do to

himself anything, unless he has acquired an obligation to some third party not to do or allow it.¹⁷

As the sub-narrative of natural rights disentangles itself from the meta-narrative of natural law, there is a concomitant *privatization* of rights, including the right to life. For example, Hart writes that 'rights are typically conceived of as *possessed* or *owned by* or *belonging* to individuals', 'as a kind of moral property of individuals'.¹⁸ Life is thus conceived of as a private property and is therefore alienable.

By vesting proprietorship of life in the individual, Nozick presents a radically libertarian position whereby anyone can do anything to his/her life. Taken to its logical conclusion, this position will illegitimize any laws restricting the voluntary surrender of one's consciousness; it follows then that there will be no basis for any laws controlling euthanasia, illicit drug-taking or the sale of one's mind for scientific experimentations. Nozick's position will, as a matter of course, open the floodgates to a whole range of issues which society might, at the moment, have no stomach for.

There is, at least, one other huge philosophical problem raised by the vesting of the proprietorship of life in human persons themselves: the ownership of infants. While Locke posits that we own what we produce, he deftly circumvents the problem of the ownership of infants by arguing that God retains proprietorship over all lives,¹⁹ and parents are mere custodians of the lives of their infants until they reach maturity.²⁰ If God were to be eliminated and the proprietorship of life be vested in the individual himself/herself, this would raise intractable problems: At which point do you acquire ownership of your mind? If your parents produce you through intercourse, or if a scientist produces you through a test-tube, will you not then be owned by your parents or the scientist?

5. WHAT ABOUT SOCIETY?

If the proprietorship of life cannot be vested in humankind, we then have to look for a new locus in

¹⁷ Robert Nozick, *Anarchy, State and Utopia* (1974) 58.

¹⁸ H L A Hart, 'Are There Any Natural Rights?' (1955) 64 *The Philosophical Review* 175, 182 (emphasis in original).

¹⁹ Locke, above n 10, 197.

²⁰ *Ibid* 199.

¹⁶ Nietzsche, above n 2, 181.

which life can be vested. To find that new locus, it would be wise to revisit Locke's theory and see what modifications can be made to it to make it more acceptable to present realities. Instead of throwing the baby out with the bathwater, I would suggest that we could easily substitute *society* in place of God in the Lockean scheme, whereby an individual will possess an inalienable right to his life but society will retain proprietorship over it. I will give two reasons to support its conceptual viability.

First, we are social products anyway. Dworkin has argued that the value of life must be understood in terms of natural and human investment in life. Natural investment implies that nature itself makes an investment in terms of natural resources when life is created and that investment increases in a linear way as the life continues. In the case of human investment, there is both the investment of the human whose life it is and that of the other people who invest time, effort and resources in creating and sustaining that life.²¹ On this view one has no right to squander this natural and human investment.

Second, this is not unlike modern democracy where everyone owns a part of everyone else. Democracy, viewed through the lens of proprietorship, is a system where there is ownership of the people, by the people, for the people. And where everybody owns everybody, one can be excused for thinking that nobody owns anybody.²² As a result, society as a whole can, as the ultimate proprietor of life, lay claim to certain features of one's personality and designate them as one's inalienable possessions and in so doing, hopefully achieve the original Lockean goal of '*preserv[ing] and enlarg[ing]*'²³ the conditions for freedom.

6. CONCLUSION

Tiesen's lamentation that life, despite being the source from which 'all other values spring', has, by itself, no property value²⁴ is true insofar as he is thinking about life as being *private* property. In a by-gone religious age, life was a *divine* property and in a post-religious age, life is best conceived of as a *communal* property. In either case, it is of no private value.

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²¹ Harris, above n 9, 626. See also Ronald Dworkin, *Life's Dominion* (1993) 213-4.

²² This ingeniously insightful observation has to be credited to Jean-Jacques Rousseau, *The Social Contract* (Maurice Cranston trans, 1968 ed) 59-62.

²³ Locke, above n 10, 324 (emphasis in original).

²⁴ Teisen, above n 1, 59.

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