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Insight into Animal Cloning and the Food Chain: a Qualitative Examination of Key Opinion Leaders and a Cross Section of the Irish Public.

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Insight into Animal Cloning and the Food Chain: A Qualitative Examination of Key Opinion Leaders and a Cross Section of the Irish Public

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Abstract: The ability to clone elite breeding animals, aimed at addressing the needs of modern food production, had been earmarked as a possibility for the agricultural sector since the birth of Dolly the sheep in 1996. A ruling by the Food and Drug Administration in the United States in 2008 that permits under-license, the commercial cloning of agricultural animals has seen this possibility realised. No such ruling exists here in Europe, but the FDA policy not to label cloned-derived products, and a history of wariness to food biotechnology in Europe may expedite this debate. With the plethora of issues that cloning of animals presents (animal welfare, religious issues, trade issues etc.), the policy debate in Europe looks set to incorporate ethical, legal and social issues from a complex set of state and civil stakeholders. Against the backdrop of ambitious targets for the Irish beef and dairy sectors and with biotechnology identified as a driver of growth, this study is an attempt to generate insight in an Irish context. The aim of this research is to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes, as well as those of the Irish public. Specifically, this research aims to gauge the current levels of awareness among specific groups and examine their likely acceptance.

In accomplishing the research aim, the development of the methodology took a qualitative approach. A series of in-depth interviews was carried out with Irish key opinion leaders (n=19) spanning regulatory organisations, scientific institutions, consumer interest groups, industry representatives, retail and other non-government organisations. The methodological challenge of engaging with the public on a complex technology was overcome with a novel methodology called Food-Bio QUIS (Food-Biotechnology Qualitative InsightS). Food-Bio QUIS uses established

methodology from the area of citizen engagement to develop dialogue and established methodology from qualitative research (specifically focus groups) in the selection of individuals and in analysis of the data. In total 6 Food-Bio QUIS groups were carried out with a cross section of the Irish public (n=35).

The results indicate that formal discussion on the use and implications of animal cloning in food production had not occurred within key opinion leader organisations. While receptivity to agri-food cloning varied among interviewees, the near-term prospects for this technology were largely viewed with scepticism. Among the Irish public, key findings on the receptivity to cloning included animal welfare aspects, varying interpretations on modern agriculture and the influence of science-fiction on the receptivity to new technologies.

Declaration

I certify that this thesis which I now submit for examination for the award of MPhil, is entirely my own work and has not been taken from the work of others, save and to the extent that such work has been cited and acknowledged within the text of my work.

This thesis was prepared according to the regulations for postgraduate study by research of the Dublin Institute of Technology and has not been submitted in whole or in part for another award in any Institute.

The work reported on in this thesis conforms to the principles and requirements of the Institute's guidelines for ethics in research.

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Signature_____ Date _____

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Away from ‘cloning animals’ I would like to take this opportunity to thank my family, dad Leonard, mum Finola and sisters Laura and Deirdre for their encouragement and unconditional support. And to Rachel, you have been, and continue to be, amazing.

Abbreviations:

AI: Artificial Insemination

ART: Assisted Reproductive Techniques

BSE: Bovine spongiform encephalopathy

CIWF: Compassion In World Farming

CT: Cultural Theory

DAFF: Department of Agriculture Fisheries and Food (Ireland)

DNA: Deoxyribonucleic acid

EB: Eurobarometer

EBI: Economic Breeding Indexes

EC: European Commission

EFSA: European Food Safety Authority

EGE: European Group for Ethics in Science and New Technologies

EMA: European Medicines Agency

EP: European Parliament

ET: Embryo Transfer

FDA: Food and Drug Administration (USA)

Food-Bio QUIS: Food Biotechnology Qualitative Insights

FSA: Food Safety Authority (UK)

FSH: follicle stimulating hormone

GM: Genetically Modified

GMO: Genetically Modified Organism

HMC: handmade somatic cell cloning

IAVS: Irish Anti-Vivisection Society

IDI: in-depth interview

IDT: intuitive detection theorist

Ibid: The term used to provide a reference for a source that was cited in the preceding text.

IVF: *in vitro* Fertilisation

IVM: *in vitro* Maturation

IVP: *in vitro* Production

KOL: Key opinion leader

LOS: Large Offspring Syndrome

MOET: Multiple ovulation and embryo transfer (MOET)

NGO: Non-Government Organisation

NRS: National Readership Survey

OPU: Ovum Pick-Up

PP: Precautionary Principle

SBV: Suckler Beef Value

SCNT: Somatic Cell Nuclear Transfer

SNPs: Single Nucleotide Polymorphisms

VMAC: FDA Veterinary Medicine Advisory Committee

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1: An introduction to 'Insight into Animal Cloning and the Food Chain: A Qualitative Examination of Key Opinion Leaders and a Cross Section of the Irish Public'.

The aim of this research is to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes, as well as those of the Irish public. Specifically, this research aims to gauge the current levels of awareness among specific groups and examine their likely acceptance. Farm animal cloning gained significant attention with the much publicised news of the birth of Dolly the sheep in 1997. The significance of Dolly was that she was an exact copy of a living, fully mature farm animal. Using this technology extended the realms of possibility with respect to medical applications for transgene farm animals and moreover that specific desirable characteristics would be present in cloned offspring. This research captures an aspect of how cloning technology has developed such that it is now being used in an agri-food context. Valuable farm animals can now be replicated or copied and used for breeding with the purpose of producing food; this study is focused on awareness and likely acceptance of this development in an Irish context. The impetus for conducting the study arose from the commercialisation of agri-food cloning in the USA and the potential of this technology to add value to the beef and dairy sectors, both of which form a central part of Ireland's total food exports.

The layers of the study include a technical examination of the 'state of the art' for assisted reproductive technologies, an update on the policy and legislative positions and an in-depth critique of pertinent academic literature. The literature review sets

out the framework for examining the research aims and leads into the chapter detailing the research design. The results chapters bring together the findings of engagement with key opinion leaders and a cross section of the Irish public with respect to research design and the literature that has informed the research design. The implications of the study are outlined in the final chapter and context is given though the most recent market and policy developments. These chapters are introduced in greater detail in the following paragraphs.

The second chapter examines the specific technologies that proceed and have paved the way for farm-animal cloning. These technologies include artificial insemination, sex determination of sperm and embryos, oestrus control, embryo transfer and *in vitro* embryo production techniques. The development of cloning technology is documented from 19th century experimentation to modern day applications. The success of farm animal cloning is quantified, as are the potential financial returns for successful applications within the agri-food sector. The state of the art of cloning is followed by a chapter critiquing the development of governance structures to regulate the application of cloning for food purposes. This third chapter examines the response of the FDA and its handling of the commercialisation of agri-food cloning. The European regulatory environment is also examined with respect to its constituent components and influencers and the on-going challenge that agri-food cloning has posed.

Chapter four examines an appropriate perceptual framework for studying public attitudes to risk. The chapter considers the differences between lay and expert assessment of risk and also presents arguments that various expert stakeholders and influencers perceive risks differently, often at odds with members of the public. The

literature for individual perception of risk is considered with a critique of the psychometric paradigm and the role of various heuristics, bias and potential deviations in risk assessments. The role of socio-cultural influences of risk is also addressed, with consideration given to social factors that can amplify risks to the public.

Within the methodology chapter (five) an overview is given to the various stages of the research design and the strategies of inquiry that were considered. This chapter outlines how the research format was developed, and how two stages of qualitative research are interlinked within a 'nested qualitative in qualitative design'. Prior to outlining the primary data collection, consideration is given to the literature review and how this shaped the research design. The process for the initial primary data collection – in-depth semi-structured key opinion leader interviews (n=19) – is outlined in stages, as are the factors for candidate selection and data analysis. The process for the second stage of data collection (opinions from the Irish public, n=35) was less straight forward. The methodological challenge of how engaging with the public on a complex technology was overcome with an experimental methodology is described. The experimental Food-Bio QUIS (Food-Biotechnology Qualitative InsightS) and the incorporation of key messages from the in-depth interviews is described in detail. The Food-Bio QUIS method uses established methodology from the area of citizen engagement to develop dialogue and established methodology from qualitative research (specifically focus groups) in the analysis of the data. The selection of a cross-section of the Irish public is explained as are the parameters of the hybrid methodology and the method of data analysis.

The analysis of the primary data begins in chapter six, where some of the main themes and questions are addressed by key opinion leaders. The analysis of the series of interviews determines levels of awareness and factors relating to its application in an Irish context. Among the themes emerging from this cohort related to animal welfare; ethical considerations; the role of the public and how the Irish public may react to cloning. Where applicable, these findings are related to the literature and given context. The second results chapter – chapter seven – introduces the information snippets from the in-depth interviews that are used to draw information from the Irish public. The practicality of using the information is explained, as are the three tranches of information gathering. The participants are introduced and results from a brief survey on other attitudes ties the literature to their views shared subsequently. The key themes are considered in the context of individual decision making and the role of socio-cultural influences on their views. Of the themes to emerge from the data the role of trust, the concept of 'naturalness' and potential animal welfare implications of cloning featured prominently.

The final chapter within the study gives context to findings with respect to developments within the Irish agri-food industry. The chapter also gives a critical reflection of the research design, and the plausible interpretation of the results. The key findings are outlined in this chapter including the themes that emerged around the commercial applications; animal welfare; consumer engagement and implications for the likely success of cloning technology. Future areas of research and recommendations are discussed before the final comments.

2. Farm Animal Cloning: The State of the Art

This chapter sets out to understand animal cloning and its applications to modern day agriculture. It explores the development of cloning and the technologies that have paved the way for its use in the food system. In the context of the research aims, this chapter explains the key terms of reference and presents the evidence for the commercial viability of cloning.

Somatic Cell Nuclear Transfer (SCNT) cloning is a method of replicating an animal using the nuclear material from a mature, adult cell (Wilmut *et al.*, 2001). Some definitions have suggested that a clone is like an identical twin, but born at a different point in time (FDA, 2008). Within an agri-food context, SNCT has the potential to deliver a range of benefits. Unlike reproductive technologies that have preceded it, cloning provides an opportunity to create genetically identical animals based on the mature, observable characteristics (the phenotype); this guarantees that the trait of market value will be present in the offspring. Butler and McGarry-Wolf (2010) have suggested that the main benefit of cloning to the dairy industry is the possibility of increasing the number, distribution, and availability of cows and bulls with superior genetics. Desirable traits encompass increased milk yield and superior disease resistance (to common ailments such as mastitis); moreover, cloning in conjunction with purposeful bio-engineering, can deliver desirable genetic traits into livestock (such as enhanced milk quality). Within the beef sector, similar benefits have been predicted for improving the overall genetic profile of the herd, with further advantages pertaining to quality and consistency of animal carcasses (Dove, 2005).

From an economic development perspective, any technology that could add value or competitive advantage to the Irish beef or dairy industry must be reviewed and considered for implementation. According to the latest statistics from An Bord Bia (2012), Irish agricultural output currently contributes in the region of €8.9bn to the Irish economy; in 2011, the dairy and meat sectors accounted for more than 60% of total food and drink exports. The dairy industry alone had a turnover of €2.8bn in 2011 (estimated: An Bord Bia, 2012), with the UK, EU, Africa and North America being significant trading partners. Irish beef production is estimated at 559,000 tonnes per year (worth €1.510bn in 2010), while live cattle exports contributes a further €245m (2010 data) to the economy. Ninety percent of beef produced in Ireland is exported to over 50 countries. In the main, cattle are grass-fed, and there is little use of concentrated feed stuffs (Schmitt *et al.*, 2005). Ireland benefits from a temperate climate, thereby permitting beef cattle to graze for much of the year (supplemental feeding generally comes in the form of silage). Allied to these features, one of Ireland's key strengths is a technologically advanced and integrated breeding sector (Coleman *et al.*, 2009).

In Ireland, traditional systems of livestock breeding have undoubtedly benefited from indexing[1] and genetic marker systems. The system of Economic Breeding Indexes (EBI) is particularly advanced, with a national cattle breeding database tabulating information from the Irish government (Department of Agriculture, Fisheries and Food) herd-books[2], milk yield records, AI (artificial insemination) companies and progeny testing at farm level (Evans, 2008). Animals with a high EBI

[1]For example the Suckler Beef Value (SBV) index was first introduced in 2007, and estimates the expected profit per progeny from a breeding animal (male or female). It is made up of various sub-indices including weanling health, carcass weight, daughter milk yield and daughter fertility (Cromie, 2011)

[2] A herd-book is any book, register, file or data medium which is maintained by a recognised organisation and in which animals are registered with reference to all their known ascendants.

for use in AI can command higher prices, with a greater likelihood of achieving the desired traits in offspring. Traditionally, breeding in Ireland has been focused on performance evaluations of animals and their offspring. More recent advances on selection, however, have been through genomics[3].

Used in conjunction with increasingly sophisticated computer analysis technology for genomic data, SNP[4] analysis is reported as proving successful for the Irish cattle-breeding sector (Berry *et al.,* 2009). This approach to animal breeding has been responsive to shifts in the methods of production and the economic environment for Irish farmers. For example, genomic selection has allowed some Irish dairy farmers to select multi-purpose animals on the basis of superior milk production and meat quality, as well as enhanced fertility, calving capacity, beef quality and general animal health (Wickham, 2008). The projected deregulation of key aspects of primary production and removal of the system of milk quotas in 2015 (O'Dwyer, 2011) is likely to accelerate the interest in genomic selection pertaining to milk yield, mastitis resistance and improved fertility.

Within Ireland, scientific advances in breeding and selection have largely been driven by public investment in animal science at institutions such as University College Dublin and Teagasc; advances through private funding have been achieved via organisations such as the Irish Cattle Breeding Federation and the National Cattle

[3]Genomics is a study of genes and their function. The discipline seeks to understand genome structure and how genes are mapped. Applied to the breeding industry, it has the ability to improve the success of selection. Its application relies on the use of DNA markers (single nucleotide polymorphisms or SNPs) to provide greater assurance on aspects such as breeding for disease resistance or ensuring maximum value through definitive pure-bred verification (Cunningham and Meegan, 2001).

[4] Single nucleotide polymorphisms, frequently called SNPs (pronounced "snips"), are the most common type of genetic variation among people. Each SNP represents a difference in a single DNA building block, called a nucleotide. Such changes may occur within a regulatory region (which may affect gene expression) or a structural gene (which may affect the amino acid composition of the expressed protein). Beneficial changes in animal phenotype may be linked to the occurrence of SNPs in an animal genome, and such information exploited in breeding programmes.

Breeding Centre. Implementation of assisted reproductive techniques at farm level is carried out by a government-approved list of companies that supply semen, ova and embryos (DAFF, 2003). Artificial insemination (AI) is also routinely administered by a veterinarian or farmer. The potential role of cloning technology in food production is best viewed against the background of existing technologies. The following section reviews several assisted reproductive technologies at the disposal of Irish farm animal breeders, and attempts to trace the lineage of techniques that have paved-the-way for animal cloning.

2.1 Technological Advances in Farm Animal Breeding

Early work on Assisted Reproductive Techniques (ART) focused on AI, but subsequently the animal breeding field has become increasingly sophisticated. Faber *et al.,* (2003) have identified sperm sexing, oestrus control, multiple ovulation and embryo transfer (MOET), *in vitro* production (IVP) of embryos, and cloning (sometimes in tandem with genetic modification) as reproductive technologies that may be applied to farm animals.

2.1.1 Artificial Insemination and Cryo-preservation

This is a reproductive technique where sperm is extracted from the male and manually placed into the reproductive tract of a female for the purpose of impregnation. The process originally aimed to reduce the incidence of sexually transmitted diseases between farm animals, but was subsequently adopted by breeders as a way of better managing livestock programmes[5]. The main advantages of AI are ease-of-use, a relatively high success rate (94%; Diskin and O'Farrell, 1998) and a low cost. It allows animal breeders the choice of using the best possible

[5] Livestock programmes will involve the promotion and preservation of particularly valuable breeds of animals.

bulls of established quality to improve the genetic make-up of their cattle herd; critically, frozen semen can be transported globally. Through proper semen collection, dilution and storage, an elite breeding bull has the potential to sire up to 100,000 calves using AI in any one year (Morris *et al.*, 2001). Approximately one fifth of the female breeding stock in the world is now produced by artificial insemination (Thibier and Wagner, 2002).

AI is also recognised as a leading contributor to a reduction in the genetic diversity of national herds: there is now a well-recognised over-reliance on a few specific breeds (for example, Holstein breeds in the dairy sector; Hammami *et al.*, 2007). In the United Kingdom in 2000 for example, it was found that 8% of the dairy population had been sired by sons or grandsons of a single bull ('Starbuck'; ABEC, 2002). Such a reduction in the gene-pool will limit a continual mixing of genes, and may increase herd susceptibility to disease. The recognition of this potential within AI has led to implementation of breeding practices to maximise genetic diversity. However, the generation of increased genetic homogeneity through ill thought-out AI practices has a direct relevance to the question of cloning animals for food purposes.

2.1.2 Sex Determination of Sperm and Embryos

An ability to choose the sex of an animal is seen as particularly advantageous in the global dairy industry, as only female animals are considered productive (De Vries *et al.*, 2008); with the exception of a small number of breeding animals, most males are slaughtered with little financial return for the farmer (Xu *et al.*, 2009). The basis for gender lies in the sex chromosomes, and it is the sperm that determines the sex of the offspring. Female animals possess two X chromosomes, while male animals

combine one X and one Y. The male sperm which seeks out the egg during reproduction will possess either a single X or Y chromosome, and this will be combined with an X chromosome from the female to produce either a male or female offspring. Therefore, an ability to increase the proportion of X-bearing sperm in semen will ensure that 'XX' embryos predominate after fertilization.

Semen-sexing is a biotechnological advance used in conjunction with many reproductive techniques. Commonly known as the "Beltsville sperm sexing technology," the method takes advantage of a 3.8% difference in DNA content between X- and Y-bearing bovine sperm (Wilson *et al.*, 2005). This difference can be exploited using a fluorescent stain and a technique called flow-cytometry[6] to 'sort' sperm into male and female. Some estimates have suggested that the added cost in using sexed semen is off-set through the doubling of viable females in a herd (Fetrow *et al.*, 2007). Sex can also be determined at the embryo stage of development. Bondioli (1992) has reviewed sexing techniques based on cyto-genetic analyses, the assay of X-linked enzymes, estimation of differential development rates, detection of male-specific antigens, and the use of Y-specific DNA probes. Such techniques represent a considerable increase in complexity and cost, and their uptake has been variable (Humbolt *et al.*, 2010).

2.1.3. Oestrus Control

The mammalian female reproductive system harbours a variety of hormones that control fertility throughout the reproductive phase of life. The natural oestrus cycle (rhythm) determines when the animal is sexually receptive to the male, and how

[6] Flow Cytometry is a technique for counting and examining microscopic particles, such as cells and chromosomes, by suspending them in a stream of fluid and passing them though an electronic detection apparatus. The presence of a fluorescent label on target cells allows a laser to deflect their path so that they may be harvested in a collection chamber.

often it may reproduce. In dairy cows for example, which are polyoestrus, the average reproductive cycle is 21 days, but this can vary from 18 - 25 (Jónsson *et al.*, 2008). Ooestrus may be artificially controlled by using an administrable internal-progesterone-releasing device which stabilises reproductive cycles in cattle, thereby allowing the breeder to have greater accuracy in predicting ovulation for the administration of AI.

2.1.4 Multiple (Super) Embryo Transfer (MOET)

Using MOET techniques, multiple follicles (immature egg cells) are transformed to fertilisable ova (eggs) by inducing their growth in the animal with the use of a hormone (follicle stimulating hormone or FSH) (Roche *et al.*, 1998). The ova are then fertilised using AI *in vivo* (in the animal) and the resulting embryos are flushed (removed) after seven days. The embryos can then be transferred to multiple surrogate animals, or cryogenically frozen for later use. MOET can therefore boost the reproductive capacity of superior females: the normal one-calf-per-animal-per-year can be increased to more than ten (Butler and McGarry-Wolf, 2010).

2.1.5 *In vitro* Embryo Production (IVP) Techniques

As an alternative to collecting fertilised embryos, artificial embryo production methods have also been developed. These procedures are carried out in a laboratory setting and rely on the extraction and manipulation of ovarian follicles or oocyte cells at various stages of development. With reliable procedures (see figure 2.1) IVP can provide a more flexible alternative to MOET. Furthermore, these techniques have facilitated the development of more advanced cloning technologies; for example, Gordon (2004:271) asserts that SCNT was not possible until a culture from embryo cells was developed.

Fig. 2.1: Bovine embryo technologies and associated processes

Technology	Basis
In vitro Maturation (IVM)	Immature eggs are removed from ovaries and matured *in vitro* in the laboratory
In vitro Fertilisation (IVF)	Oocytes (eggs cells) are fertilised by sperm *in vitro.*
Embryo Culture	Fertilized oocytes may be cultured in a wide range of media and the cleaving (dividing) embryos then transferred to the surrogate animal within 48 to 72 hours.
Mass Production of Embryos	Generally uses slaughter-house-procured oocytes and IVF to produce viable embryos. This is carried out when the female parent identity is not required and when the oocytes are pooled for ease of production. Such embryos are typically frozen for direct transfer and are priced competitively.
Genetic Recovery	Similar to the process for slaughter-house-procured oocytes (above), but is used in situations where the animal is of known genetic merit, and known parentage is important.
Ovum Pick-Up (OPU)	OPU allows for the extraction of ovarian follicles from live animals using a needle and vacuum, guided via an ultrasonic technique.

Source: Modified from Galli *et al.,* 2003

2.1.6. Embryo Transfer

Embryo transfer (ET) refers to the process by which one or several embryos (naturally produced or otherwise) are placed into the uterus of a female with the intent to establish a pregnancy, thereby overcoming the low reproductive rates and long generation intervals of valuable dams (Morris *et al.*, 2001). In conjunction with AI, the process of ET has reportedly improved breeding efficiencies for elite beef and dairy animals (Faber *et al.*, 2003).

Fig. 2.2: Milestone events in embryo transfer and related techniques

Year	Species	Event
1890	Rabbit	Birth of kitten as a result of ET
1949	Sheep/Goat	Birth of a lamb and kid from ET
1951	Pig	Birth of piglets from ET
1951	Cattle	Birth of calf from ET
1971	Cattle	First commercial 'cattle ET' company formed
1973	Cattle	Birth of calf after frozen stage (Frosty II)
1974	Horse	Birth of a foal after ET
1982	Cattle	Birth of calf after IVF
1983	Buffalo	Birth of calf after ET
1986	Sheep	Lamb born via nuclear transfer
1988	Cattle	Cattle twins by IVP ET
1997	Sheep	Birth of lamb cloned from adult cell

Source: Gordon (2004)

The use of ET in the cattle breeding industry began in the early 1970s, when European dual-purpose breeds of cattle became popular in North America, Australia and New Zealand. Breeders and speculators sought means to overcome the high costs and lengthy quarantine periods linked to the importation of European breeding stock, and to capitalise on premium prices that progeny from these rare dams and sires could command (FAO, 1991).

2.2 The Development of Farm Animal Cloning

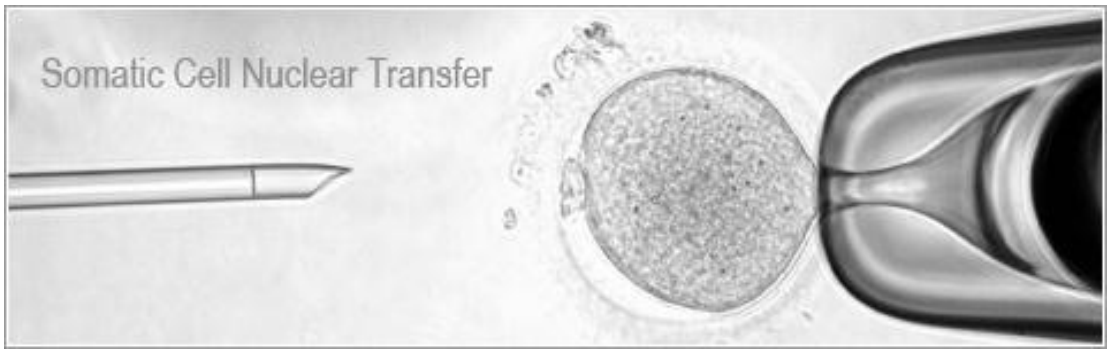
The history of animal cloning has its roots in the 19th century. Jacques Loeb in 1894 found that fertilized sea urchin eggs ruptured when exposed to hypotonic solutions, occasionally resulting in the formation of two embryos (this is referred to as parthenogenesis). Experiments with amphibian zygotes[7] found that restriction via pincering of cells and subsequent release after the 8 or 16 cell (division) stages resulted in the transfer of a nucleus to the non-nucleated part of the cytoplasm[8], resulting in a clone (McKinnell and DiBerarino, 1999). These early cell cloning experiments proved that the complete genome is replicated during cell division. The next significant breakthrough in cloning was in 1952, when Briggs and King successfully transferred blastula cell nuclei (embryos up to the 128-cell stage) into enucleated frog eggs (Briggs and King, 1952). By removing the nucleus of the amphibian ovum, the 'hollow' cell could then be fused with another embryonic cell. This technique meant that nuclei could be transferred from various differentiated parts of the amphibian embryo. This technique worked in 40% of all tests. It was also observed that as cells underwent further differentiation there was a corresponding decrease in the success of nuclear transfer. This aspect was seen as a significant hurdle to cloning, and various methods of reprogramming were employed to try to achieve the de-differentiation of somatic cells. Success in the cloning of an adult somatic cell via nuclear transfer was not recorded in mammals for another forty years.

A major obstacle to the cloning of higher animals was the smaller size of the mammalian egg. Before nuclear transfer could take place, micro-manipulation

[7] A zygote is the initial cell after the male and female gametes fuse.
[8] Cytoplasm refers to the fluid inside the cell (membrane), but excluding the nuclear material.

techniques (see figure 1.3), allowing the accurate removal of DNA from mammalian eggs (and its fusion with single somatic cells) needed to be developed in the late 1960s and early 1970s (Gurdon and Byrne, 2003).

Figure 2.3: Microscopic image of a micro-manipulator



Source: Anon., 2011

2.2.1 Embryo Splitting

A limited form of cloning was developed in the 1970's whereby fertilised oocytes could be bisected to generate two viable embryos (Gordon, 2004). The selected embryo was split in half using a micro-manipulator and micro-scalpel, and then each 'half embryo' transferred to recipient animals (Nicholas and Smith, 1983). The technique was able to produce genetically identical 'twin' animals.

2.2.2 Blastomere Nuclear Transfer and Embryonic Cloning

The first mammal produced by embryonic nuclear transfer was achieved in mice (McGrath and Solter, 1983). The technique employed involved enucleation of the zygote followed by virus-mediated cell fusion. In 1986, the first instance of embryonic cell nuclear transfer in agricultural animals was recorded. Willadsen (1986) successfully used electro-fusion to combine the cells of early stage

blastomeres (specifically, the 16-cell developmental stage) with enucleated eggs, and recorded two healthy bovine clones. In 1993, embryonic nuclear transfer procedures were successful in creating multiple generations of cloned animals. This process, known as ‘Embryonic Cloning’, opened up the possibility of producing an unlimited number of genetically identical animals (Stice and Keefer 1993).

2.2.3 Somatic Cell Cloning

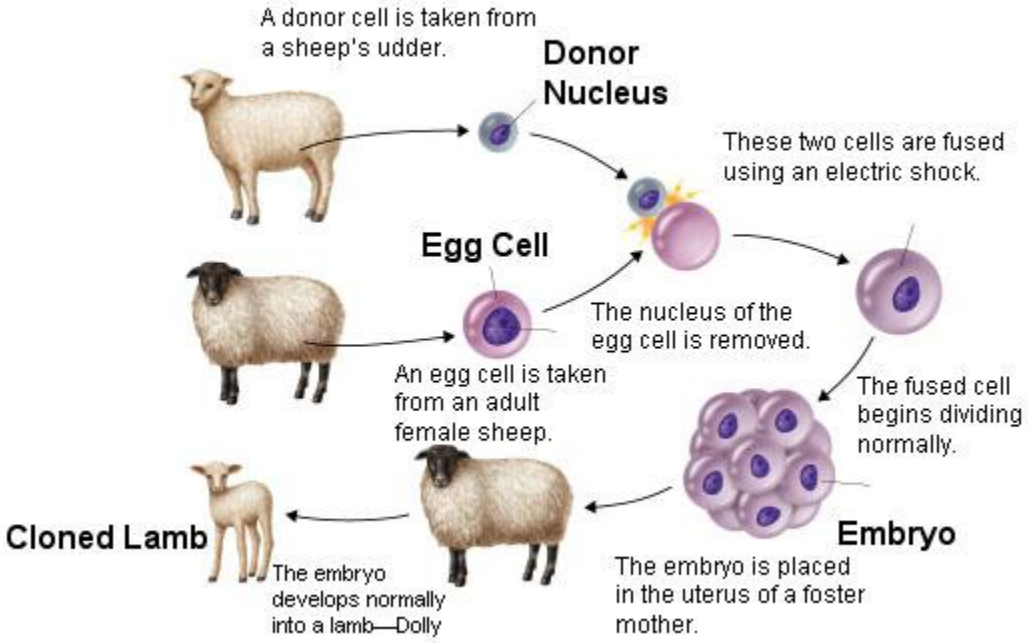
Developments came to worldwide attention when scientists reported the cloning of the first mature mammal – a sheep named Dolly – using Somatic Cell Nuclear Transfer (SCNT) (Wilmut *et al.*, 1998). This process used pre-existing nuclear transfer techniques (see figure 1.2), but derived the cells from the mammary gland of the adult donor. This was the first time a clone had been produced from DNA extracted from a somatic (adult/ differentiated) cell.

The crucial obstacle that SNCT overcame was the reprogramming of the genetic elements of a somatic cell to transform it into a totipotent (undifferentiated) embryonic cell **(**Houdebine *et al.*, 2008). This was mediated via inactivation of the cultivated cells by means of serum starvation (Cunningham, 1999). This breakthrough in technology meant that genetically faithful copies could be made of animals based on their adult phenotype (observable characteristics, such as milk production).

The cloning process involves removing the nucleus from a donor ovum using micro-manipulation techniques (see figure 1.3). The cultivated – totipotent – somatic cell is then inserted into the protective coat around the ovum before an electrical pulse fuses and activates the ovum and the cell. After a period of growth, the embryo is transferred to a surrogate donor. The embryo's nuclear DNA is identical to the DNA of the donor cell, but the mitochondrial DNA (a small amount of DNA in the cytoplasm of the egg) remains from the egg donor (Oback *et al.*, 2003). Clones may have some different physical characteristics (phenotypes); this is thought to be due to the variations that can occur in the reprogramming stage, and the exposure to

different environmental conditions *in utero* and after birth (Oback *et al.,* 2003). The process by which Dolly the sheep was cloned is outlined in figure 2.4.

Figure 2.4: The Cloning of Dolly the Sheep



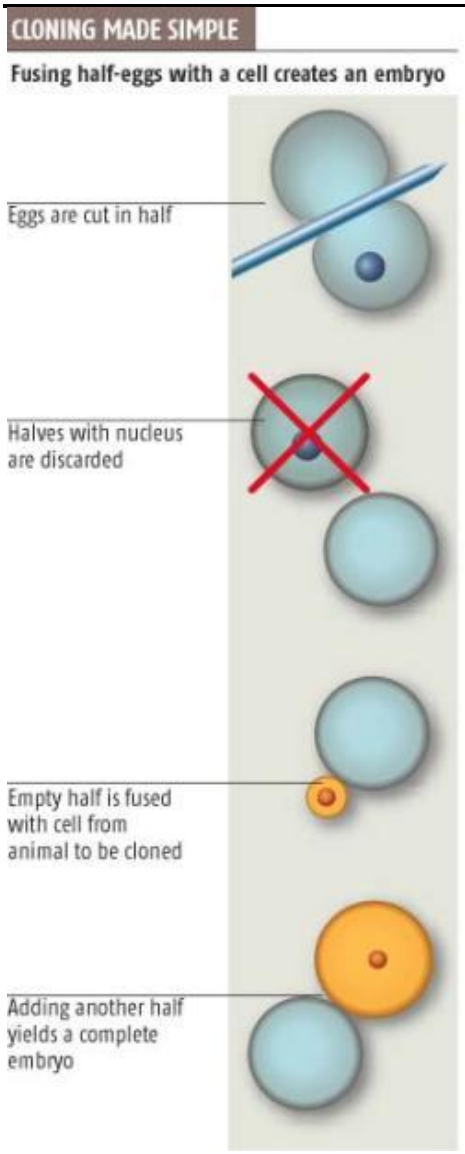
Source: Gibbs *et al.*, 2001

A key development since the first successful SCNT of a farm animal has been the possibility of cloning animals from a deep-frozen state, thereby opening up the possibility of saving or 'genetic banking' animals that have proved to be particularly valuable to breeders or farmers (Wakayama *et al.,* 2008; Folch *et al.,* 2009). Cloning has also been successfully achieved with DNA from a freshly slaughtered animal; this development allows for the selection of animals on the basis of carcass quality (Adams *et al.,* 2004). While some procedures have been developed to improve the efficiency of cloning (see HMC), issues persist with levels of success.

2.2.4 Handmade Cloning (HMC)

The most notable development in animal cloning since the initial SCNT in 1996 has been the development of the 'handmade somatic cell cloning' (HMC) technique. HMC is a simplified alternative to the micromanipulation used in 'traditional cloning' (see figure 2.5).

Figure 2.5: Handmade Cloning



Source: Westphal (2002)

The technique involves halving an ovum (immature egg) that has had its protective membrane (*zona pellucida*) removed (by enzyme treatment). The halves (cytoplasts) are stained with a fluorescent dye (Hoechst 3342) to identify the side containing the DNA. The cytoplast without the DNA is then fused with a single somatic cell (of the animal to be cloned) and then further fused with another half-cytoplast to complete a viable embryo (Tecirlioglu *et al.*, 2003); again, the fusion is mediated via chemical means using a lectin. This technique has been considered to be more robust, and in future may improve cloning success. The possibility for automation of this cloning procedure has also been noted (Vajta *et al.*, 2003).

2.2.5 Success Rate of SCNT Cloning

A major stumbling block for the widespread adoption of farm animal cloning is its low success rate in comparison to other ARTs. Chavatte-Palmer and colleagues (2011) reported that pre- and early post-implantation losses associated with cloning can affect up to 70% of the pregnancies. This figure is high when compared to similar processes such as embryo transfer after IVF, which has a 40% success rate (Galli *et al.,* 2003). Problems with the cloning process can manifest at various stages of embryo and foetal development (figure 2.6). The developmental problems with cloning have been well documented, and are now referred to as 'cloning syndrome' (Ortegon *et al.,* 2007).

Figure 2.6: Five Stages of Cloning Failure

Pre-implantation	65% of one-cell SCNT clones fail to develop to blastocyst (embryos up to the 128-cells) stage in '*in vitro'* conditions.
First Trimester	50% losses are common for nuclear transfer in sheep, cattle and goats. This is attributed largely to placental abnormalities
Second Trimester	Spontaneous abortions have been recorded with few abnormalities to the foetus, but a range of abnormalities to the placenta.
Third Trimester	Hydrallantois (accumulation of fluid) is a feature of foetal death.
Late term/ early	Deaths at this stage have been attributed to hypoxia, neonatal period respiratory failure and circulatory problems.

Source: Edwards *et al.,* 2003; Hill *et al.,* 2000; Vajta and Gjerris, 2006

Incidences of foetal overgrowth and Large Offspring Syndrome (LOS) have also been associated with clones at birth (Constant *et al.,* 2006). Foetal overgrowth has been frequently cited as a welfare issue with cloning, not just for the clones themselves, but for the surrogate animals (often necessitating Caesarean section). The most remarkable feature of LOS is the increase in birth-weight; Young and colleagues (1998) reported that double the normal birth-weight in lambs is not uncommon. The incidence of LOS is particularly high in nuclear transfer pregnancies, and in most cases is associated with placental deficiencies such as enlarged umbilical cord, enlarged heart, and abdominal ascites (fluid pockets). This syndrome has been reported as affecting an average of 50% of late-gestation nuclear transfer pregnancies (Constant *et al.,* 2006). LOS is not unique to cloning, but its frequency in other reproductive technologies, such as embryo transfer, is much lower.

Two reasons for the high rates of embryo failure, abortion and developmental abnormality have been hypothesised by Houdebine (2003:45). The first relates to possible 'dormant' genetic problems, featuring a detrimental mutation that exerts an effect during embryo development. The second reason relates to inappropriate genomic reprogramming. This would be considered an epigenetic rather than a genetic problem. Indeed, the bulk of the literature is concerned with reprogramming inefficiencies rather than 'mutation' as the main stumbling block to improving cloning success (Gary *et al.,* 1996; Edwards *et al.,* 2003; Farin *et al.,* 2004; Keefer, 2008).

Talbot and colleagues (2010) have highlighted that as of yet, there is no 'real-time' procedure for assessing whether a cloned embryo is properly 'reprogrammed' to display

normal developmental gene expression at the stage prior to transfer into the surrogate mother. The implications from their findings are that if such a method could be developed, then the rate of success with cloning could improve with respect to pregnancy success.

2.2.6 Commercial Applications of Farm Animal Cloning

Dove (2005) has noted that SCNT was developed to solve a very practical problem in pharmaceutical biotechnology: the difficulty of faithfully perpetuating transgenic farm animals for use in the production of medicines. Many biopharmaceuticals used in human health (such as insulin) are replacement proteins, used to address a production deficiency in the patient. Currently, such medicines are largely produced in bioreactors using genetically modified microorganisms or isolated mammalian cells. However, an alternative production system involves the insertion of human genes (encoding the protein medicine) into the DNA of animals; if such DNA is 'switched on' in the milk-producing udder cells, then the protein medicine will be secreted into the animal's milk (and may be purified). Such recombinant DNA approaches may also be used to 'humanize' animal tissues, thereby making animal organs suitable for human transplantation (termed xenotransplantation). Significantly, in 2006 the European Medicines Agency (EMA)[9] approved the first recombinant protein drug produced by transgenic animals. Recombinant anti-thrombin III, produced in the mammary gland of transgenic goats, was launched as ATryn® for prophylactic treatment of patients with congenital anti-thrombin deficiency (Niemann *et al.*, 2009).

[9] The European Medicines Agency is a decentralised agency of the European Union, located in London. The agency is responsible for the scientific evaluation of medicines developed by pharmaceutical companies for use in the European Union.

Using a process called pro-nuclear[10] injection; a foreign gene may be inserted into the DNA of an animal to make it transgenic. However, before the emergence of cloning technology, the expansion of such valuable animals into 'production' herds ran the risk that the foreign gene may not be passed on to the progeny through sex. Xeno-transplantation and expression of proteins with pharmaceutical applications in the milk of animals were therefore two of the pioneering drivers of modern cloning technology (Atala, 2004; Campbell *et al.*, 2005).

Apart from applications for transgenic-related technology, Trounson (2001) has suggested that the future for cloning within the human medical field will include the prevention of inheritance of mitochondrial mutations, prevention of age-related aneuploidy[11] in women, production of artificial gametes for sterile individuals or couples, and for therapeutic cloning to enable cell and gene therapies. However, while research has shown that support for various biotechnologies is application-dependent (McNeil and Williams, 2002), the cloning of humans is likely to undergo intense ethical and societal debate.

Beyond the field of human medicine, cloning has been employed by several other sectors; these include sports, wildlife protection and companion animals. The high value of some sports animals has seen cloning used to replicate valuable rodeo bulls, Spanish fighting bulls and geldings (Gordon, 2004). Whether it will become more widespread in the sporting world is a matter for individual sporting bodies and their regulations, but the initial

[10] Using pronuclear injection, 200-300 copies of a gene of interest are injected through a fine glass needle into recently fertilized eggs (Ittner and Gotz, 2007)

[11] This refers to a chromosomal abnormality (a missing or an extra chromosome) which may result in spontaneous abortion of the foetus or developmental problems in the newborn.

applications have centred on the replication of elite animals on the basis of performance-related traits (Suk *et al*., 2007).

Several species of rare and extinct animals have been cloned (Lanza *et al.*, 2000; Folch *et al.*, 2009), and this opens the possibility of 'resurrecting' such species. The cost-benefit for cloning in this respect is made more favourable by usefulness in public-private environmental protection measures, the maintenance of eco-tourism (through the protection of rare animals) and the sale of endangered species. So-called 'trophy animals' can be sold for large sums of money (Westhusin *et al.,* 2001), and this may offset the cloning procedural cost.

The cloning of companion animals has developed into a thriving and competitive business. Currently, South Korea leads in this field, with the RNL BIO business cloning pet dogs at a cost of up to $150,000 per animal (Veale, 2009). This exceptionally high cost not only reflects the difficulty in cloning dogs, but also the value which individuals place on perpetuating the phenotype that made their companion animal unique. Pet cloning is carried out worldwide, with the closest cloning laboratory to Ireland located in the United Kingdom (Woestendiek, 2010).

The adoption of cloning within other business models, such as agriculture, will be largely due to demonstrably greater efficiencies and a reduction in cost of the procedure (Westhusin *et al.,* 2001). In this respect, Bell and colleagues (2003) have identified opportunities in cloning dairy cows with high milk yield and superior physical attributes

(such as strong legs); these would then be mated with superior bull-sires to produce a new generation of high-performance dairy cows. However, any such gains would need to be off-set through a cost-effective cloning process. Golan and colleagues (2009) estimate the current cost of cloning a cow-calf at $15,000; Butler and McGarry-Wolf (2010) place this figure closer to $10,000. While several factors will impact on this cost, Faber and colleagues (2003) suggest that for bovine species, the cost is directly related to percentage success of the cloning process (see figure 2.7).

Figure 2.7: Reduction in cost of cloning calf-cow with improved success rates

Percentage Success	Cloning Cost
4%	$17,628
8%	$9390
12%	$6644
16%	$5271
20%	$4448
30%	$3349
40%	$2800

Source: Faber *et al.*, 2003

Before looking at models to assess the cost of cloning for agri-food purposes, it is important to mention several misconceptions that are associated with clones in a breeding context (see figure 2.8). The latter perpetuate the idea that once the 'perfect' animal is found, copies can be made continuously without the need for breed improvement. Van Vleck (1999) suggests that this is not the case, as the 'perfect' animal does not exist in a traditional breeding context and continuous improvement is always needed. For this reason,

traditional breeding methods and genetic evaluation will be needed for the effective implementation and economic evaluation of cloning technology. While this may be the optimum situation, AI in the dairy sector has proven that demand for specific desirable traits results in higher levels of inbreeding.

Figure 2.8: Misconceptions with regard to animal clones and breeding

Cloned offspring are identical in all respects
Clones are superior (i.e. how they will perform is known exactly)
Superior records of the clone originator guarantee that all members of the clone are superior to other animals.

Source: Van Vleck, 1999

Economic estimations as to the value of cloning to the agri-food sector are sparse. Butler and McGarry-Wolf (2010) suggest that this is due to the fact that cloning is not yet commonplace: little is known about the market for agri-food cloning companies, and thus minimal data exists to compare cloning to other breeding techniques. However, projections by Dematawewa and Berger (1998) and Butler and McGarry-Wolf (2010) offer some indication of its potential value to the dairy sector. Dematawewa and Berger (1998) based their estimations on the genetic gain in milk-yield as a net economic value by using economic weightings that consider income and production costs. Cloning was compared to twelve breeding systems which were combinations of progeny testing, AI, sexed-semen and ET. They adduced that if dams were replaced with clones, and produced 10 embryos per year (using sexed-semen and elite sires), then the system could triple the annual genetic

gain compared to AI and progeny testing. They also suggest that the process of cloning will be of much greater success in a system of modern progeny testing, as opposed to more basic 'AI systems'. This would indicate that Ireland's advanced system of EBI and SNP testing would be well positioned to benefit from the technology.

However, in Dematawewa and Berger's model, the cost of cloning would have to be in the region of $84 for the technology to be considered a viable alternative to breeding schemes; this cost is very low when considered in the context of routine veterinary procedures. Van-Vleck (1999) also suggested that the cost of cloning would have to be the same cost as that of a one-time embryo transfer to produce a cow that would produce several calves. Both estimations are significantly less than the current cost.

As an alternative to purchasing SCNT dams, Butler and McGarry-Wolf (2010) suggest that the greatest gains would be through the cloning of elite AI sires. Their model is based on two milk production enterprises over a 10-year period, both with the same costs, but one using cloning. They suggest that if the base rate for genetic improvement is 1.5% per year through conventional breeding programmes, the replacement of animals with clones could increase this to a rate of 1.65% per year. This would represent a 10% improvement in milk yield, and thus exponentially increase income, depending on economies of scale. Their study suggested that under the right conditions, cloning is a profitable technology for the agri-food system.

2.3 Conclusions

This chapter has outlined a perspective as to where cloning technology is positioned in modern animal breeding systems. SCNT falls on a continuum of technological development within animal breeding, as the process uses and refines techniques already in existence for other breeding procedures. Key factors for the success of cloning are likely to focus on its value proposition. Through the adoption of procedures such as 'hand-made cloning' and purported greater levels of healthy calves, there are indications that cloning *may* represent a profitable agri-food technology. However, on the evidence of the literature, the benefits of increased profit through a higher level of consistency are not yet the reality. To this end, further research is needed to address the procedural success although the resultant higher costs may leave investors wary. Investment could be further hindered by ethical considerations regarding the loss of animal life. Thus while SCNT falls on a continuum of technological development within animal breeding, its adoption as a 'like-for-like' ART is not a foregone conclusion.

The next chapter explores the development of governance structures to regulate the application of cloning for food purposes. Policy development in America and Europe are compared, to highlight similarities and differences between both. Key opinion leaders and the role of the public will also be outlined.

3. Development of governance structures to regulate the application of cloning for food purposes

The application of cloning technology to the livestock industry is regarded by proponents as having the potential to deliver significant improvements in animal health, productivity and product consistency (Wheeler, 2003). From a European market perspective, agri-food animal cloning raises many exceptional issues which are not encountered with conventional food produce. For developers of such innovation, market rejection of such agri-food technology is problematic and compounded by a variety of misunderstandings with respect to cloning promulgated by popular media. For some, there are profound ethical concerns related to the cloning of animals.

This chapter chronicles the development of governance structures regulating the application of cloning for food purposes through comparative analysis of policy development in America and Europe. Key opinion leaders and their roles are identified, as are their respective approaches to public engagement.

To place the European position in context, it is useful to examine the steps taken by the United States of America (USA) in the regulation of cloning. Agri-food cloning has already been commercialised in the USA, and the regulatory process arguably offers greater clarity than that of the EU.

3.1 FDA Animal Cloning Risk Management

In 2003 the American Food and Drug Administration[12] (FDA) issued an initial report on the safety and risk associated with food from cloned animals. They concluded that food (milk and meat) from cloned animals (cattle, pigs and goats) was safe for consumers to eat. The validity of the risk assessment issued by the FDA was scrutinised by the Veterinary Medicine Advisory Committee (VMAC), an advisory committee to the FDA. VMAC met on the 4th of November 2003 in Rockville, Maryland to discuss the risk assessment (FDA, 2012). Ten members of the committee listened to the results and recommendations of experts from the Center for Veterinary Medicine. There were two key questions that the FDA put to the VMAC, namely:

1. Based on what we have presented, has the risk assessment adequately identified the hazards and characterized the risks relating to animal health?
2. Based on what we have presented, has the risk assessment adequately identified the hazards and characterized the risks relating to food consumption?

The committee queried the experts on the data and their recommendations as well as opening the discussion to the public for comment. On the first question the chair of the committee summarised that there was no consensus to the portion of the risk assessment that addresses risks relating to animal health. The committee outlined that the data was lacking to fully evaluate whether the risks could be characterized. A common theme of the comments was the scarcity of data regarding both clones, and the clone offspring. The

[12] The FDA is an agency within the United States Department of Health and Human Services for protecting human health through assuring the safety, efficacy, and security of food supply.

committee also did not reach a consensus on whether cloning risks differed qualitatively from those risks experienced with other assisted reproductive technologies. As to the second question, the majority of the committee supported the findings of the FDA. In some cases – as with the first question – questions arose around the lack of data available. Overall, it was agreed that the FDA had "gone as far as they can go given the current available data" (FDA, *ibid*).

After considering the concerns submitted, and conducting a peer-reviewed assessment of their analysis by independent scientific experts in cloning and animal health, the FDA approved the use of cloning for the production of food in 2006 (albeit with a temporary moratorium in place). During this moratorium the FDA invited comments from the public and interest groups on three working documents on animal cloning in the food chain. The FDA received approximately 30,500 comments (FDA, 2012b). Approximately 17,500 of these were in the form of letters, and approximately 13,000 were position documents from organizations. Some letters and papers had multiple signatures; in total the FDA cited this number as 130,000 respondents. The FDA also differentiated 'substantive comments' from key opinion groups. These groups are outlined in fig 3.1 and top-line comments outlined in fig 3.2.

Fig 3.1 Groups cited as providing 'substantive comments' by the FDA

Academics: consisting of individual scientists self-identifying as members of a university or other academic institution (n = 8);

Technology Providers: including clone producers and individuals or organizations engaged in other assisted reproductive technologies (n = 18);

On Farm Technology Adopters: consisting of farmers, ranchers, or pork producers, either individually or as representatives of farm bureaus or associations (n = 7);

Technical Associations: including groups representing technology providers or academics engaged in research on animal breeding (n = 3);

Commodity Trade Associations: including groups representing producers of dairy, beef, or pork commodities (n = 9);

Retailers: including trade associations and individual corporate entities engaged in marketing food products (n = 20);

International Trade Groups: consisting of US-based commodity export groups, and an international group interested in dialog on trade in food (n = 3);

Animal Advocacy Groups: including groups interested in the care and welfare of animals (n = 10);

Consumer Advocacy Groups: including organizations whose members are interested in representing interests of consumers (n = 11);

Other Countries: in which representatives of regulatory agencies of other countries express their opinions, (n = 3);

Other Professional or Scientific Groups: representing organizations with interests in animal health or care, or groups of regulatory professionals (n = 4).

FDA, 2012a

Fig 3.2 Representative 'substantive comments' submitted to the FDA

Animal Health Risk:
A small subset pointed out that although risks from cloning exist, the observed health issues are not unique to cloning but also occur at lower frequencies when other assisted reproductive technologies (ARTs).

There were assertions that there is no such thing as a healthy clone and the possibility that greater numbers of sick animals due to cloning would increase the use of antibiotics and present new challenges for herd management.

Comments outlined the need to accumulate more long-term data on the health of clones, and engage in more proactive efforts to address the adverse effects of cloning on animal health and welfare.

Public Health Risk:
Concerns for possible potential toxicity, allergenicity or alterations in the nutritional quality of milk or meat from clones.

Calls for more thorough and long-term testing of foods from clones to identify and characterize potential food consumption hazards created by the cloning process and to identify the public health consequences of consuming these foods.

The capacity of existing food safety inspection systems was questioned in their ability to detect clones suffering from health problems and prevent them from entering the food supply.

Concerns were expressed that cloning would decrease genetic diversity of livestock breeds; making herds more susceptible to infectious or other types of diseases.

Economic Consequences:
Groups predicted that release of food products from cloned cattle into the food supply would have detrimental economic effects, particularly on the US dairy industry.

Concern for the Public:
It was expressed that for the purposes of consumer choice, food derived from cloned animals should be labelled.

Comments outlined that the FDA needed to participate in additional, transparent public discourse on cloning, including an international dialogue to facilitate global introduction of technology, harmonize regulatory processes among countries, and avoid potential trade disputes.

Ethical Concerns:
Many of the general and substantive comments discussed ethical issues associated with animal cloning, and some strongly encouraged the FDA to address these issues.

Commentary on the ethical concerns was based on the adverse health outcomes observed in some clones and their surrogate dams. Some groups were concerned about the implications of agricultural cloning for human cloning.

FDA, 2012a

In response to the comments directed at their working document (Fig 3.2), the FDA clarified several points with respect to their risk assessment. The first pertained to their approach; the FDA outlined that there were no existing risk assessment paradigms with which to evaluate the safety of food from clones or their progeny. In order to develop the approach presented in the Draft Risk Assessment, the agency drew on the expertise of its specialists in food safety, animal health, toxicology, physiology, molecular biology, and risk assessment to develop a comprehensive and rigorous approach to evaluate all of the available data on clones, their progeny, and the food from those animals. This was presented and agreed by the VMCA. One of the key features of the approach developed and used by the agency is that it relies on a "weight of evidence" evaluation – that is, instead of developing a threshold number or type of studies, the analysis considered all of the information available at a particular time, and made a determination on the overall body of information considered as a whole (FDA, 2012a).

With respect to comments on the degree of animal health risk associated with cloning that occur in cattle and sheep as a result of LOS, it was clarified that not all clone pregnancies are affected by LOS. In fact, most calf and lamb clones are born healthy, grow and reproduce normally, and are no more susceptible to health problems than their non-clone counterparts. In swine and goats, cloning-associated abnormalities are far less common than in cattle and sheep; LOS is not observed in these species, and the vast majority of pig and goat clones are born healthy without subsequent health problems. In terms of detecting anomalies in clones, it was clarified that clones will be subject to the same pre- and post-

mortem inspections as conventionally bred food animals. As the same anomalies are found in clones as are found in animals bred by other assisted reproductive technologies, the FDA recommended no special post-market control points for clones are necessary.

In response to assertions regarding food risk, the FDA found no evidence to indicate that foods from clones pose an increased allergenic risk. No novel proteins have been identified in meat or milk from clones, and studies using animal models have not indicated that the allergenic potential of meat or milk from clones is increased relative to meat or milk from conventional animals.

With regard to comments on consumer receptivity, the FDA suggested it was too early to draw firm conclusions from polls as to whether clones or their products will be accepted by US consumers, largely due to the public's general lack of knowledge of animal breeding and agricultural practices. They explained further that public acceptance appears to be largely influenced by unrealistic representations of clones in science fiction novels or movies. Furthermore, although the FDA appreciates that some members of the public have strong opinions on this topic, the agency has not been charged with addressing moral, religious, or ethical issues associated with animal cloning for agricultural purposes. The FDA outlined that they have attended several public conferences that addressed these types of ethical concerns as well as those regarding animal health related to animal cloning for agricultural purposes to ensure that the discussions are based on factually correct scientific statements. Many of the concerns regarding the moral, religious, or ethical issues of animal cloning for agricultural purposes are equally applicable to other methods of animal

breeding and management, and have been the subject of many scholarly discussions and publications. Because cloning falls on a continuum of other assisted reproductive technologies, they believe that discussions on these ethical concerns about animal cloning for agricultural purposes should be held in the larger context of these assisted reproductive technologies (FDA, ibid).

In December 2008, the FDA effectively approved the commercialisation of food from cloned animals, with the publication of three pertinent documents: a 'comprehensive risk assessment' (FDA, 2008a), a 'risk management plan' (FDA, 2008b) and a 'guidance for industry' document (FDA, 2008c)[13]. The 'comprehensive risk assessment' maintained the 2006 position, reiterating that clone derived products were considered 'substantially equivalent' to food from conventionally bred animals (FDA, 2008a). The 'risk management plan' had the greatest commercial implications for early adopters of the technology and the general public. This recognised that animal cloning raises many moral, religious, and ethical concerns, in addition to those already associated with animal health and food safety.

These issues notwithstanding, the 2008 document opened the door for early adopters of the technology to integrate cloning into existing agri-food systems. Crucially, the plan did not call for labelling of clone-derived food, and viewed it as being no different from that derived from conventionally bred animals. Moreover, if a producer wanted to communicate that a product was 'clone-free' from a marketing perspective, then permission for this would be assessed by the FDA on a case-by-case basis, and at their discretion. With

[13] The 'Guidance for Industry' document (for clone producers, livestock breeders and farmers/ranchers purchasing clones) does not include any specific recommendations: only those products from cattle, swine and goats are safe to enter the food system.

specific reference to animal welfare concerns, the management plan emphasised that it was not within the remit of the FDA to solve the any associated problems related to cloning. However, a commitment to provide on-going scientific advice in relation to animal welfare to technology developers and companies working in this area was provided (FDA, 2008b). The plan also reported that all developmental and welfare problems occurring with cloning have been observed with other assisted reproductive technologies, and thus are not thought to be hazardous to human health[14].

3.2 The European Regulatory Environment

Before examining the European approach to governing farm animal cloning, context is given with respect to the European regulatory environment. The European situation of food risk governance is different in a number of respects to that elsewhere. The first factor relates to the so-called 'Precautionary Principle' (PP). The latter was initially developed in response to environmental problems that arose in relation to pesticide usage, and to provide a framework to address public concerns regarding new technologies (Tait, 2001). The PP endeavours to provide a first stage response in the face of a possible risk to human, animal or plant health. Controversially, in situations where the scientific data does not permit a complete risk evaluation, the PP may be evoked to stop distribution or order withdrawal from the market of products likely to present a danger. However, the precautionary principle may only be invoked when the three preliminary conditions are met:

[14] By means of clarification, the risk assessment specifically excludes genetically engineered animals. No new genes have been introduced into these clones, and all of the genes present in clones come from their traditionally bred domestic livestock counterparts. Because of their long history of safe use as food, domestic livestock are not thought to produce toxic substances. Therefore, hazards to and from clones themselves would result from epigenetic dysregulation (the inappropriate expression of genes, including over- or under-expression, or expression at the wrong time). Hazards arise similarly in animals generated via other ARTs (FDA, 2008b).

identification of potentially adverse effects; evaluation of the scientific data available; and, evaluation of the extent of scientific uncertainty. This approach can be contrasted to the weight of evidence approach adopted by the USA whereby the basis for evaluation is the scientific information available. The precautionary principle has drawn criticism previously with respect to GM foods and the perceived politicised nature of the process, and links to a protectionist position of European agriculture (Tait, 2001; Curtis *et al.*, 2004).

The second difference between the EU and US regulatory systems centres on efforts to regain citizen trust due to a perceived failure to deal with food crises in the 1990's. Food safety failures with regard to BSE[15] highlighted flaws in the mechanisms of risk analysis and communication for governing authorities (Jacob and Hellström, 2000). Commentators have suggested that pre-1990's food regulation was largely *ad hoc* and developed in the jurisprudence of the European Court of Justice (Vos, 2000); the systems relied on a technocratic framework which stressed the scientific method and featured relatively little involvement of the public in actual decision-making (see Radaelli, 1999). Following these high profile food crises and public concern over the introduction of food biotechnologies – such as genetically modified crops – the European approach needed to adapt to restore trust (Millstone, 2009).

In efforts to regain this trust and to establish transparency The European Food Safety Authority (EFSA) was established in by law in 2002 (EC 178/2002). Its aims were to improve EU food safety, re-build consumer confidence and re-build confidence of trading

[15] Bovine spongiform encephalopathy (BSE), commonly known as 'mad-cow disease', is a fatal neuro-degenerative disease in cattle that causes a spongy degeneration in the brain and spinal cord.

partners in for the EU food system. Its remit was to provide scientific advice and support for EU legislation food and animal feed in the EU. All communication from EFSA sought to be independent, and it distinctly separated risk analysis from risk management (this would still fall within the remit of the European Commission). EFSA is neither part of the European Commission nor answerable to it, and is managed independently. EFSA aims to work in close co-operation with national authorities and to actively consider stakeholder needs (especially consumers). Communication from EFSA continues to include any assumptions made with regard to the risk analysis; any uncertainties in the information used including gaps and; any limitations of the current state of understanding.

The implication following the establishment of EFSA was that the European Commission now had an independent risk advisor with respect to the management of food risk. While independent risk assessment was one component of restoring trust, the other was to actively increase stakeholder participation (Wentholt *et al.,* 2009). A major component of this idea is the positioning of government in coordination and facilitation, rather than simply command (Tait, 2009). Underpinning this approach is the recognition and inclusion of a wider spectrum of key stakeholders or key opinion leaders (KOLs) in the debate; KOLs include consumer associations, environmental organisations, industry, farming organisations, retailers, other non-government (NGOs) and the general public. Under this direction, food safety issues broaden to consider ethical, socio-cultural and citizen perspectives, all in an attempt to instil/restore trust. The orthodoxy for the involvement of such key opinion leaders is an independent risk assessment by EFSA, and then the

facilitation of contributions through sub-committees, meetings and working papers by the European Commission.

With this approach to food risk management, more emphasis is given to the context against which risk information is communicated. Risk managers must consider the presence of other actors in the public sphere that will influence citizen perspectives on the safety of the food chain or novel food technologies. For example, actors representing environmental protection will release their own information on the probability of harm occurring and will often focus on 'worst case scenarios'; such communication will often resonate with the public in a way that statistical information will not. Other actors notwithstanding, some technologies may also trigger responses among the public that are linked to religious or deeply held principles. For example, the genetic modification of an animal for the purposes of food production could be considered a violation of a religious principle, or contrary to beliefs of what is 'natural'.

Therefore, in considering cloning, the European environment for such novel technologies may appear restrictive. Indeed, it has been suggested that in the case of food biotechnology, so called 'citizen arguments' (Barling *et al.,* 1999) have established a very real barrier for the development of innovative products. Such citizen resistance is rooted in a world view that is mistrustful of institutional links, perceives a narrowing of product choice due to globalization, and questions the need for certain products. Concerns relating to the sustainability of some biotechnological innovations and (possible) irreversible disruption of the natural balance also feature in such arguments.

3.3 EFSA, EGE and EC Animal Cloning Risk Management

In January of 2008, the European Food Safety Authority (EFSA) issued a draft scientific opinion on the implications of animal cloning for food safety, animal welfare and the environment. It concurred with the FDA regarding the low prospect of food risk associated with cloning (EFSA, 2008). Subsequently, the European Commission[16] tabled a proposal to include food from clones under the scope of a revised version of the Novel Food Act (EC 258/97) on the basis that is 'produced by non-traditional breeding techniques which might have an impact on food' (EurActive, 2008b).

The precursor to this decision was a request by the European Commission that EFSA publish an opinion on agri-food cloning (March, 2007). At the same time, the EC requested The European Group on Ethics in Science and New Technologies (EGE)[17] to provide an opinion on the moral aspects of the technology. The EGE report (also published in January 2008), opposed the cloning of animals for food supply. Their justification was based on the current level of animal suffering and the health problems of clones and surrogate dams; they did not refer to the offspring of cloned animals. Their report also highlighted concerns that pertained to human health and safety risks, animal health and safety, animal integrity, biodiversity, risk of epidemics, social and economic effects on rural areas and agricultural trade (EGE, 2008; also see fig. 3.1).

[16] The European Commission sets the EU's overall political direction – but has no powers to pass laws.
[17] The European Group for Ethics (EGE) is a neutral, independent, pluralist and multi-disciplinary body, composed of fifteen experts appointed by the Commission for their expertise and personal qualities. The remit of the EGE is to examine ethical questions arising from science and new technologies, and on this basis to issue opinions to the European Commission in connection with EU legislation or policies.

Figure 3.3: Ethical concerns in animal cloning for food supply

Concerns for the cloned animals (and for their offspring)
Using the animals for human purposes
Animal integrity (animal rights)
Animal health
Animal welfare

Concerns for the environment
Biodiversity/ Biosafety
Environmental sustainability
Pollution, degradation

Concerns for society
Public perception
Social desirability/ Social acceptance
Consumers' rights
Justice issues (local, regional and global)
Intellectual property rights
Industrialisation of agriculture/ Sustainability of agriculture

Concerns for humans
Human health and well-being (including food safety and food security)
Potential for misuse in humans ('slippery slope' concerns)

Source: European Group on Ethics and New Technologies, Opinion No.23 (EGE, 2008)

In considering the position outlined by the EGE, there is some precedence for considering the animal welfare perspectives in a European context. Animal welfare has historically played a large part of agricultural policy in the EU. The roots of such policy are thought to be in work carried out in animal protection in the 1960s (Veissier, *et al.*, 2008). The basis for this was a belief that respect for animals is part of the common heritage for European countries, and that it has links to human dignity. Indeed, the Amsterdam Treaty in 1987 established in law that animals are sentient beings (they have the ability to experience

feelings such as pain or pleasure; much of the basis of this contention is based on the recommendations of the Farm Welfare Council 1992), and they are protected for this reason (Anonymous, 1997; Farm Animal Welfare Council, 1992). Echoing the EGE position, several non-governmental organisations (NGOs) and the British Standards Agency have asserted that cloning may contravene an existing animal welfare directive[18] (Eurogroup for Ethics, 2008; CIWF, 2010; BBC, 2010). Therefore, certain aspects of animal welfare may have heightened importance the European risk management process compared with that of the USA. Furthermore, the method of drawing out these concerns differs between the USA and the EU. The USA drew commentary by inviting interest groups and the public to make suggestions or voice concerns on their FDA risk assessment; this can be contrasted with the formalised ethical evaluation carried out by the EGE and the citizen poll in the EU.

The EFSA draft scientific opinion was scrutinised by a range of KOLs in February of 2008. This cohort included scientific communicators, consumer groups, animal welfare organisations, scientists, farming organisations/co-operatives, retailers, small-business organisations and representatives from the European Commission and the EGE (EFSA, 2008b). The key point emerging from this examination related to the limited number of scientific studies on which EFSA based their opinion. It was also articulated that EFSA needed to communicate more 'simply and widely' on the issue, while traceability and the regulation food products from cloned progeny were also important (EFSA, 2008c). EFSA agreed to take the recommendations under advisement and outlined that the European

[18] Under Council Directive 98/58, concerning the protection of animals kept for farming purposes, Paragraph 20 of the Annex suggests that cloning may be indirectly prohibited: "Natural or artificial breeding or breeding procedures which cause or are likely to cause suffering or injury to any of the animals concerned must not be practiced." (EC,1998).

Commission would ultimately make decisions regarding the risk management of cloning using their report, and the report of the EGE.

In September of 2008, the European Parliament (EP) unanimously voted for a ban on cloning for food on the grounds of animal welfare concerns (622 MEPs in favour, with 32 against and 25 abstentions). In statements after the vote, MEPs outlined that their concerns revolved around a lack of scientific evidence to prove safety beyond reasonable doubt, and a perception that the technology contravened an existing animal welfare directive (EuroActiv, 2008b). Additional concerns related to a reduction in genetic diversity, with fears that whole herds could be decimated by disease. Neil Parish (EP Agricultural Committee Chairman) opined that the vote was needed to protect animal welfare and maintain consumer confidence (ibid). The EP vote preceded the specially commissioned 'Flash Eurobarometer' poll on animal cloning, which was published the following month in October 2008.

The Eurobarometer (EB) series of surveys has been monitoring the evolution of public opinion in the Member States on a variety of issues of concern to the EU public since 1973. Its main aim is to help in the preparation of texts and in European decision-making[19]. A key aim is to act as a signpost for issues that may emerge as possible regulatory concerns. The EC specifically measured public opinion and ethical barriers regarding novel biotechnologies in 1992, 1993, 1997, 2000, 2003 and 2005. On no occasion before the specially commissioned '2008 Flash EB' (specifically examining views on farm animal

[19] Their surveys and studies address major topics concerning European citizenship: enlargement, social climate, health, culture, information technology, environment, the Euro and defence

cloning) did the European Commission examine the prospect of consuming food from cloned animals with the European public[20]. This could indicate a failure on the part of the EC to identify the emergence of animal cloning as viable method of food production – an important market trend falling within their 'food-biotechnology' risk management remit.

When the European situation is compared to that of the USA, this omission becomes more perplexing. The FDA carried out their initial risk assessment for cloning in 2003; subsequent consultation with interest groups and independent scientific assessment were carried out before the technology gained approval (albeit with a moratorium) in 2006. It was not until March of 2007 that the EC commissioned their safety assessment; it was another year before they surveyed the views of the public. During this time period, cloning in an agri-food context moved from being a novel technology to one which was being used to produce food elsewhere. The actions of the EC meant that, despite the inclusion of pertinent stakeholders, and the transparency of its risk analysis process, the lack of foresight in not examining cloning at an earlier juncture may be seen retrospectively as further diminishing the trust of the EU public in the process of food risk evaluation. The subsequent discovery in the UK that meat from the offspring of a cloned cow was consumed by the public in 2009 (BBC, 2010) is further evidence of this.

The lag observed in the EC process, relative to the US, may be further understood by their initial problem-framing mechanism. The EC engaged the Danish Centre for Bioethics to carry out the initial investigative research on cloning. This research encompassed the goal of producing an update on cloning technology, regulatory positions of different

[20] Animal Cloning has been included in the 2010 Eurobarometer on Biotechnology (EB, 2010).

jurisdictions and an identification of the potential ethical issues (Gamburg *et al.*, 2006). The research was carried out between November 2004 and October 2006, suggesting that the European risk management programme for cloning was initially more closely aligned then that of the FDA. However, the extended consultative mechanism, and the general European approach, did not factor in the speed-to-market for products elsewhere. The result was that clone-derived food was in the food-chain in the US before perspectives were adequately assessed in Europe.

When the EC published the views of the public in October 2008, it was observed that Europeans reacted negatively to the prospect of food from cloned animals (EB, 2008). One of the top-line findings from the study suggested that the vast majority of citizens appeared to have a good degree of knowledge regarding what constituted 'animal cloning'. This finding is in the context that citizen engagement around the area of the biotechnology is notoriously difficult, given the complexity of the processes (See Lassen, 2006; Priest *et al.*, 2003). The results showed that 'eight out of ten people' correctly chose the multiple choice answer that 'cloning is making an identical copy of an existing animal'. In a similar fashion, the vast majority of the European public agreed with statements 'that the long term effects of animal cloning on nature are unknown' and that 'we do not have enough experience about the long-term health and safety effects of using cloned animals for food'. These findings from the citizen-poll were noteworthy, as these issues could not be clearly answered by EFSA, due to a shortage of scientific evidence. Unsurprisingly, Europeans rejected the idea of animal cloning for human consumption. However, questions regarding how the potential risk of cloning should be managed are arguably difficult for the general

public to comprehend. Indeed criticisms of the Eurobarometer in the past include their engagement being focused on means of communication, rather than the outcomes (Schmitt, 2003); moreover, those using the EB results need to be cognisant that the pubic are not experts in policy processes, and will only judge the process by the outcomes. For example, the vast majority of the European public suggest that animal welfare should be the key driver within the food system (Eurobarometer, 2007). However, when examined with respect to 'willingness to pay' the key driver is not animal welfare, but price (Nocella *et al.*, 2010).

Since the flash Eurobarometer of October 2008, EFSA has re-affirmed their position regarding the safety of clones from a food and environmental perspective (EFSA, 2009; 2010). Contrasting with this, John Dalli (European commissioner for health and consumer policy) has stated that animal cloning for food purposes should be removed from the revised Novel Food Act and receive its own 'Cloning Directive' (EurActiv, 2010). A vote by the European Parliament in July 2010 once again voted to ban cloning, and in this instance, recommended its removal it from the revision of the Novel Food Act (cloning was subsequently dropped from this Act). The current animal cloning situation in Europe (as of January 2012) is that neither a proposal that cloning receive its own 'cloning directive' (EurActiv, 2010), nor a proposal that outlines a five year suspension of cloning[21] has been approved. Such a regulatory impasse, with politicization of the risk assessment process, is

[21] The Commission has presented a proposal for the following measures: temporary suspension of cloning for five years: suspension of the use of the cloning technique in the EU for farming purposes; a temporary ban on the importation of clones and on the marketing of foods from clones. The proposal also recommends the establishment of a system to track the importation of semen and embryos, which would include information such as whether they stem from cloned animals. It was proposed that pertinent zootechnical and animal health legislation would need to be amended which would allow farmers and industry to set up data banks

strongly reminiscent of the situation encountered by the introduction of GM foods in the late nineteen nineties.

The national response to the use of farm animal cloning has been the release of a pamphlet by the Food Safety Authority of Ireland (FSAI) in November 2009 (FSAI, 2009). The document states that animal cloning is not used for commercial food production in the EU and further highlights that the situation in other parts of the world is not as clear. This document further describes the recommendations put forward to the European Commission by the EFSA and the EGE. It is clarified that animal cloning for the purposes of agri-food production is not currently covered specifically by EU legislation and does not make any assertions in a national context.

3.4 Discussion

An assessment of the EU process for regulating the introduction of animal cloning into the food chain will vary depending on the perspective of the specific KOLs. Pronounced differences in opinion among the European institutions on this subject, and the legacy issues relating to mistrust on GM foods and a variety of other real food safety issues, make it difficult to predict the future EU regulatory climate for cloned produce.

The USA has approved the technology and one of the key differences in the approach to agri-food cloning is that through the FDA the USA has taken a "weight of evidence" evaluation. The EU has come to a somewhat similar perspective on the safety of animal cloning though EFSA, but evidence (and the weighting of that evidence) from other agencies has meant an uncertain outcome for cloning in Europe.

From the examination of the regulatory path taken by both the USA and the EU, the scientific risk assessment and the defence of the results by the experts involved were quite similar. It could also be argued that key opinion leaders – *i.e.* industry groups, technology developers, consumer groups, animal welfare organisation – both influenced the process on both sides. Where there was a marked difference in the process was the evaluation of the evidence on the part of the USA. With respect to the ethical arguments against SCNT for agri-food purposes the FDA determined that because cloning falls on a continuum of other assisted reproductive technologies, these ethical concerns should be held in the larger context of these assisted reproductive technologies. The same ethical arguments in the

European context – and the maintaining of public confidence – are cited as being the main reasons the European Parliament voted against cloning.

By their own standards (as set out in the establishment of EFSA), where the EC governance structure has fallen short on agri-food cloning, is with respect to their remit of engaging the public. The examination of public perspectives on agri-food cloning in 2008 occurred too late to be of real value to the process (food from clones entered the European food chain in 2009) and highlighted deficits with respect to gathering information on the topic. When the issue of public engagement is considered in the USA context, dialogue from public conferences was considered during the final evaluation. Ultimately, the FDA concluded that while some members of the public have strong opinions on this topic, they are not charged with addressing moral, religious, or ethical issues associated with animal cloning for agricultural purposes (they saw their role as providing balanced and factually correct scientific information throughout the series of public conferences).

Thus, in considering the stumbling blocks for cloning regulation in Europe – including the range of ethical and moral aspects – and specifically the role the public may yet play, the following chapter examines the topic of perceived risk as it relates to agri-food cloning.

4. Consideration of an Appropriate Perceptual Framework for Studying Public Attitudes to Risk

4.0 Introduction

The following chapter examines risk perception as it relates to food, and highlights the factors that may influence public opinion on clone-derived food products. The broad definitions[22] of Fischoff and colleagues (1978) for actual risk and perceived risk were used to establish a baseline to consider the specific issues which arose in the current project. While the topic of risk/benefit perception is touched on throughout the following chapter, the evidence of the examination of both European and USA policy progress would suggest that animal cloning is at a stage of risk framing among the public; awareness was high but the indications were that the technology is poorly understood. In the instance of new food technologies, it has been suggested that not only do the public have difficulty in assessing the associated risks, but that the benefits of such technologies are not obvious (Siegrist, 2008). Indeed, many studies of novel food technologies tend to focus on second generation products where increased public discourse and awareness has allowed greater risk/benefit analysis (Hagman and Scholderer, 2009; Morris, 2011) To this end, the following chapter examines the decision making processes associated with *risk perception* as it pertains to agri-food cloning, as opposed to *risk/benefit perception*.

[22] An actual risk is a statistical estimation or objective judgement regarding the severity and probability of a risk occurring; perceived risk is a subjective judgment that people make about the characteristics and severity of a risk (Fischoff and colleagues, 1978)

Prior to the nineties, consumption of food was generally considered as a low risk activity, and what did warrant consideration centred on food hygiene or starvation (Knox, 2000). Modern Europeans now also consider possible health effects, adulteration and the possible presence of chemical-residues as potential food risks of concern to them (Hohl and Gaskell, 2008). At a basic level, perceived risk is a determinant of food choice, and thus related to willingness to consume a food. For example, when a food source is affected by an outbreak of pathogenic bacteria, sales of the affected food decrease due to the perceived risk (Yeung and Morris, 2001). At a more complex level, risk can be influenced by individual attitudes or wider social or cultural values (Kasperson *et al.,* 1988). Within a food context, perceived risk can encompass concerns relating to methods of production, as well as the finished product, and also extend to perceived adverse consequences for other groups (family or environment; Bredhal, 1999; Green *et al.,* 2003). Apart from food, another example of a complex risk perception includes nuclear energy. This is a technology that has been influenced by broader social attitudes resulting in a high level of dread or *subjective* risk, but this has little bearing on the historic or *objective* risk level (Horlick-Jones *et al.,* 2010).

Renn (1998) has highlighted this dual-facetted nature of food risk perception (objective and subjective) and proposed that the technical estimation of a risk, as used by scientists, may not resonate with other stakeholders (other stakeholders include individuals likely to be affected by the hazard in question). In some cases – such as bacterial or chemical contamination of food – risk-assessors and their communication is valued greatly, but in other cases where the technology is novel or perceived radical, the communication of risk or safety has been more difficult. Renn (ibid) suggests that while standards of consistency

and internal conventions may be established by a risk-assessor, the perceived validity outside of the risk-assessor's own worldview may be questioned. These types of post-modernist views have been cited by some as a driver for including non-expert social constructions of risk into evaluation of new technologies (Radaelli, 1999; Tait, 2009). However the orthodoxy suggests – in Europe at least – that risk evaluation begins with scientific assessment and then other stakeholders and non-experts contribute their perspectives to this assessment. Scientific assessment will still determine the objective risk and establish limits, but other key opinion leaders will assess if this is acceptable. Lowe and colleagues (2008) suggest that integrating these perspectives improves the understanding of interaction between technological change and the economic, social and environmental contexts in which it occurs. Integrated systems are thought to be favoured among individuals as they highlight the existence of identifiable control systems (which can respond quickly to contain a risk) and they highlight the availability of information that offers individuals the ability to exercise informed choice (Houghton *et al.,* 2006).

Within the general literature, cloning is often compared to genetic modification of crops, as both technologies operate at DNA level (though unlike GM – which involves the 'switching on', 'switching off' or the addition of genes – cloning does not actually alter DNA, rather copies it whole) (Creamer *et al.,* 1988; Daniell, 2004; Vajta and Gerris, 2006). Similar to GM-derived food, early indications are that the public believe cloning is 'interfering with nature' or 'messing around with genes', and that there may be delayed unforeseen consequences arising from this (Eurobarometer, 2008).

In examining how risk is perceived – and taking the post nineteen-nineties European approach to risk analysis and communication – several factors require consideration. These factors include the divergent lay public/expert perception of risk and the role of information provision in this context; how individuals process risk information (*i.e.* the psychological decision-making process, and the factors influencing this) and the socio-cultural perspective on how risk is perceived, particularly the role of public trust placed in decision-makers, and role of the media in the social amplification of risk. Accordingly, two main theories have emerged as being of key significance in this field (Sjöberg, 2004): the Psychometric Paradigm (rooted in psychology and social science) and Cultural Theory (emerging from sociology and anthropology). The following section examines these theories in detail, and their contribution to risk perception.

4.1 Lay and Expert Assessment of Risk

Some of the early studies examining how experts view the concept of risk were carried out by Slovic and colleagues (1979). This work built on the conventional wisdom that experts see risk differently to the lay public (while experts conceptualize estimates of probability, the lay public think more in terms of consequences). This dichotomy was subsequently the basis of many studies that compare the different perspectives of public and expert approaches to risk estimation (Rowe and Wright, 2001; Hansen *et al.,* 2003; Salvadori *et al.*, 2004; Siegrist *et al.*, 2006; Hagemann and Scholderer, 2009). Drivers for this type of research often seek to establish whether a perceived risk (rational or otherwise) will result in the rejection of a technology or scientific advance (and ultimately commercial failure). Sjöberg (2004b) suggested that experts and the public perceive risk differently for several reasons (see Figure 4.1).

Figure 4.1: Differences in Expert and Public Perceptions of Risk

1. Experts will have access to all the information (the public may be misinformed regarding the risk).
2. Experts will pay more attention to probabilistic measurements of adverse consequences.
3. Experts may be guided by the values or 'corporate message' of their organisation.
4. An expert specialising in a specific area of science may have a sense of greater control or familiarity with the risk than might a member of the general public.
5. The role of the expert may have an impact if their job is concerned with the promotion of a certain technology.
6. General political ideology can also be a powerful risk factor in how experts perceive risk (a typical example being the halting of nuclear power generation in Germany following the natural disaster that affected the Fukushima power plant in Japan).

Source: Sjöberg, 2004b

While some of Sjöberg's assertions have validity, his differentiation between expert and lay opinion is not entirely accurate. For example, the public has access to much of the information that experts have – through websites and various sources – but arguably the public will not possess the means to convert this into knowledge (and then over the years, into wisdom). It is also true to say that experts will pay more attention to probabilistic measures, but this is because they are trained in rationalism and objective thinking; such formal training may help identify and quantify a specific hazard quicker. Sjöberg also suggests that experts can be guided by a corporate message and lack integrity; it is difficult to justify this particular assertion, as this would mean that individuals cease to be valid practitioners of objective risk analysis. He suggests that this can be driven by vested economic/ career interest, or the promotion of a certain technology. Where such an assertion may be reconciled is such that, the objectification of a risk associated with an organisation *by the same organisation* is likely to draw criticism from other stakeholders, and the public. Criticism in this respect is likely to focus on the organisation – and its experts – only acting in their own interests.

Discussing Sjöberg's assertions, McCarthy and Brennan (2009) have also pointed out that the basis for his reported differences between experts and the general public arises from a small number of studies (Slovic *et al.,* 1979; 1980; 1985). McCarthy and Brennan also questioned both how 'experts' are defined, as well as their assumed veracity.

Compared to an expert, lay public perceptions of risk are considered to incorporate instinctive and intuitive reactions to risk to a greater degree (Slovic and Peters, 2006). Indeed, Verbeke and colleagues (2007) suggested that the difference between lay public/expert perceptions of risk with respect to scientific evidence is their ability to understand it. Consequently, appropriate education/information-transfer must be considered to overcome this obstacle.

It is often assumed that addressing the 'information asymmetry'[23] between scientists and the public, via proactive information provision about specific emerging technologies, will reduce the perception of risk and pave-the-way for technology acceptance (Hoban, 1999; Hobbs and Plunkett, 2007). Indeed, this is the underlying basis for the so-called 'Cognitive Deficit Model' (Hilgartner, 1990). The underlying premise when using the deficit model is that the best strategy to bring public opinion into line with that of the 'expert' is a one-way educational effort, designed to eliminate the layperson's ignorance (Hansen *et al.*, 2003; see table 4.2). However, critics of the model suggest that it fails to recognise that peoples' values can be both flexible and diverse, with often complex ways of engaging with information (Sturgis and Allum, 2004). A typical example of these flexible values is a higher level of acceptability for medical uses of biotechnology as opposed to agricultural applications (Eurobarometer, 2010).

[23] 'Information Asymmetry' deals with the study of decisions in transactions where one party has more or better information than the other.

Fig: 4.2: The Assumptions of the Cognitive Deficit Model (as outlined by Hansen and colleagues)

1. Subject to acceptable levels of risk, the optimisation of productivity is a commonly shared value in modern societies.

2. Acceptable levels of risk associated with optimal productivity are universally, or at least widely, agreed.

3. Scientific knowledge is the most effective, and hence desirable, basis on which to improve both the production of goods and risk control, and therefore, scientific evidence should be the primary guide in risk management.

4. If the public does not comply with the advice and recommendations of scientific experts, this is because they have a poor understanding of the scientific reasoning informing that advice (i.e. a 'knowledge deficit').

Source: Hansen *et al.*, (2003)

Thus, while authors suggest that the provision of information about biotechnology can increase perceptions of potential benefits, it does not necessarily reduce perceptions of risk (Frewer *et al.*, 1994; Loureiro and Bugbee, 2005). Several authors have been critical of biotechnology education – in the sense of traditional information transfer – as a way of explicating risk to the public (Lassen, 2006; Priest *et al.*, 2003). Reasons for criticism include inadequate knowledge which may lead to the public to drawing moral conclusions about practices within science that are ill informed. It has also been suggested that more knowledge will equal greater positivity but both Lassen and Priest and colleagues suggest this is not the case. Where greater clarity can be gleaned is that education would appear to have a greater correlation with perceptions of biotechnology if individuals have higher levels of formal education generally (Hoban, 1998). This would suggest that it is not the information deficit *per se*, rather the ability for individuals to understand the process.

Some research has concluded that when technical information for a food risk is rejected (or does not reduce the perceived risk), the public are judged by communicators to be 'uninformed, irrational and sometimes dangerous to public health programmes' (Sapp, 2003). Marris (2001) proposes that this is not necessarily due to the lack of public understanding of the science, but rather communication strategies that are underpinned by a number of 'erroneous beliefs' regarding the lay public. Marris suggests that this is due to a mismatch between institutions' comprehension of public perceptions, and the actual attitudes expressed by the public (*i.e.,* the intuitive nature of risk perception is not necessarily accounted for). While Marris' point has validity, the truth is probably somewhere in-between. What can be said for certain is that the communication of risk is fraught with challenges. Information does not necessarily equal acceptance, and both trust and sources of information are important factors. It follows that in addition to the actual information, the way in which this information is conveyed, will in turn impact its acceptability.

To overcome these challenges, information imparted on innovative food-technologies needs to consider the organisational factors and contextual background that shape perceived risks. To this end, it has been suggested that stakeholder opinion in the field of biotechnology should include diverse organisations and viewpoints (Wentholt *et al.,* 2009). Using animal cloning as an example, stakeholder opinion would therefore comprise of experts in animal husbandry, animal reproduction, animal rights specialists, cloning technology, consumer groups, farmers, processors, retailers, the appropriate legislative/policy institutions, and any

other significant stakeholder likely to voice substantial opinion. The inclusion of this wide range of stakeholders may go some way to articulating the technical and more philosophical aspects of perceived risk with regard to farm animal cloning.

Understanding the constructs underpinning lay opinion with regard to a new technology (such as farm animal cloning) is not only important from a societal and policy perspective, but also important in terms of the focus of private and public investment[24]. Following on from this, exploration of the discrepancy between expert and lay public communication approaches is essential if future beneficial biotechnology innovation is to find acceptance in society. How an individual will trust and process information from these experts will be significant, and in this respect, the psychological and socio-cultural decision-making processes by which individuals perceive risk come to the fore.

[24] The concerns for industry and investment are around two main aspects:
a. This type of technology is protected via patenting. Patent protection has a 20 year term. If the R&D costs cannot be recouped and profit made within this term (e.g. due to languishing in regulatory limbo) then the business may fail;
b. The stock market and investors understand this: so no early stage funding of companies involved in anticipated 'risky' areas.

4.2 Individual Perception of Risk

4.2.1 Psychometric Paradigm:

The psychometric paradigm (Fischhoff *et al.*, 1978) is recognised as a landmark in terms of understanding public attitudes to risk. It provides a framework for the analysis of thought processes in the formulation of risk perception (Slovic, 1987). The emergence of the paradigm was an attempt to explain the disparity between how 'experts' and the lay public perceived risks associated with new technologies and natural hazards that emerged in the 1960's. The paradigm was developed as a way to examine why the lay public often saw hazards as high risk, even when they had a low probability of occurrence. The early work on how risk is perceived is believed to be rooted in utility theory (Fishburn, 1966), where it is considered in terms of a series of 'gambles' that an individual takes.

Building on Fishburn's work, Starr (1969) suggested that risk acceptance is not only based on estimates of risks and benefits, but also related to more subjective dimensions, such as the level of control an individual perceives that he/she has over the specific risk. Starr's work highlighted that the autonomy of the individual is overlooked when governments impose an involuntary risk, and this led to an increased interest in general risk management, and more emphasis on how people perceive, tolerate and accept risks (Slovic, 1987). As the study of risk developed, subsequent work highlighted the role of societal and cultural aspects, which are now recognised as playing a significant role in risk perception (these elements are dealt with in proceeding sections). The original psychometric paradigm recognised nine dimensions of risk (see figure 4.3).

Figure 4.3: Nine Dimensions of Risk within the Psychometric Paradigm

Whether the risk is voluntary or not?
How immediate the risk is (or whether there is a delayed effect?)
To what extent the risk was known precisely?
Is the risk catastrophic or chronic? (Would it kill many people at once or one person at a time?)
Is the risk common or was the risk dreaded?
To what extent is the risk known?
How severe the consequences might be?
To what extent did people feel they could control the risk?
How novel was the risk?

Source: Fischoff *et al.,* 1978

The original study asked people to rate 'risk' for a number of specific hazards, ranging from food colouring, to surgery, to nuclear power (Fischoff *et al.,* 1978). It was found that much of the perceived risk was attributable to how the public 'dreaded', risks and also the extent to which risks were 'novel'.

Later studies using the psychometric paradigm have been carried out with greater numbers and have incorporated other dimensions of risk. Slovic and colleagues (1985) initially identified eighteen constructs for risk measurement, but subsequently refined these to three factors after their analysis. The key factors could be distilled to 'dread', 'unknown' and 'exposure'. Dread risk is considered to be a 'perceived lack of control, having catastrophic potential or fatal consequences, and the inequitable distribution of risks and benefits'. Unknown risk is considered to be a 'hazard that is regarded as being unobservable, new and

delayed in its manifestation of harm' (Slovic, 2000). Exposure can be considered as the magnitude of the risk for society in general (*i.e.*, the danger for those exposed, and the number of people actually exposed to the risk; Sjöberg, 2004).

Allied to these constructs, other factors vie for recognition as playing an important role in the perception of risks relating to specific technologies. For example, Sjöberg (2000) has argued that the level of perceived 'naturalness' of a technology should be included as significant in individuals' perception of risk. This perceived risk also includes aspects such as human arrogance and interference with the process of nature. It is thought that in dealing with hazards such as genetic engineering or ecological risk, that this phenomenon is an especially important factor (Thompson, 1997; Pascalev, 2006; Jamieson, 1996; Hull *et al.*, 2002; Siegrist, 2008). Another development in risk perception has been the concept of stigma attached to new technologies (Gregory *et al.*, 1995). Slovic (2000 p. 341) describes this stigma as 'technologies, places and products that are perceived to be unduly dangerous'. Slovic suggests that the concept of stigma can go beyond what was considered to be merely a hazard, and manifest as something that needs to be avoided (not only because it represents a danger, but because it was something that was considered good and is now marked as tainted). He suggests that as a result, 'technological stigmatisation' is a powerful component of public opposition to many new technologies, products and facilities. 'Chemicals' are an example of a stigmatisation. Links to cancer or poor health have resulted in the lay public believing that all 'chemicals' cause more harm than good (Gregory *et al.*, 1996). This is undoubtedly an erroneous belief, as 'chemicals' – for arguments sake, synthetic chemicals – play a major part in every walk of life (such as

sanitation, manufacturing and healthcare) and have unquestionably improved human life. To a certain extent 'technological stigmatisation' is part of the meta-narrative of what is challenged by post-modernism (Maxwell, 1996). GM-derived foods are linked with automation and homogenisation and are removed from the post-modernist emphasis on 'local knowledge' and 'complexity of economic and social inter-dependencies' (Sayer, 1993; Midmore, 1996).

The psychometric paradigm has been used as a framework to assess the perceived risk associated with GM crops (see Fife-Schaw and Rowe, 1996; and Sparks and Shepherd, 1994). Within this structure, the relative roles of affect, emotion, and stigma as modulating factors can be observed (these aspects are explained in greater detail in the subsequent section). Finucane and Holup (2005) found that public perceptions of GM foods were characterised by elements of 'unknown' and 'dread'. The major perceived risk associated with GM food is due to the fact that the technology is unfamiliar to the public, and as such, it becomes difficult to estimate the risk. The nature of the modification of the changes are at a DNA level, and so changes in appearance are not necessarily visible, and potential harmful effects may not be manifested within the short term. Hallman (2000) suggests that most of the fears concerned with GM food are centred on fears regarding potential allergens that may arise as a result of the genetic modification process, and any accidental toxins that may be produced. Here Hallman alludes to the concept of whether a risk is voluntary, and to what extent this particular risk is within the control of the individual; this is distinct from (and perhaps additional to) a fear of allergens or toxins. Finucane (2002) also asserted that the rejection of a new food technology often involves the influence of other factors, such as

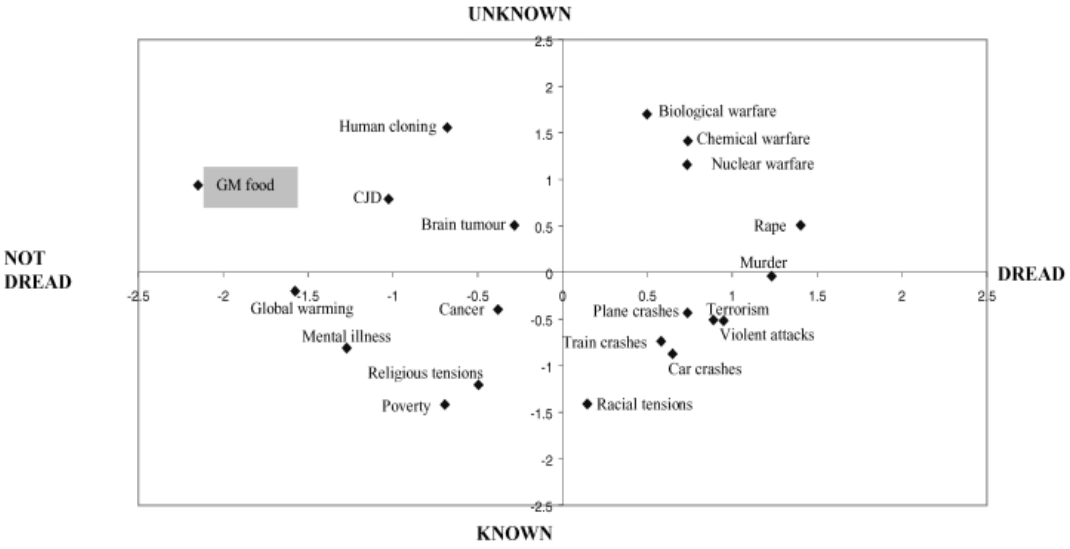
associations with globalization (and large conglomerates) and the possible damage to the livelihood of farmers: thus, the discussion on GM foods becomes inextricably linked in the mind of the consumer with 'big oil', 'big pharma' and often the purchase of other products of these companies.

It has been suggested that the public reaction to animal cloning bears similarities with that witnessed in the case of GM crop technology (relatively high consumer awareness, but low acceptance; Rollin *et al.*, 2011), but animal biotechnology – to which animal cloning belongs – has several notable differences. Einsiedel (2005) outlined that public perceptions of risk associated with animal biotechnology focused on aspects such as the moral status of animals, the (un)naturalness of the technology, the adverse impact on human dignity in creating 'modified animals', and unforeseen consequences and threats to the environment (many constructs present in the psychometric paradigm). Gaskell (2000) reported that Europeans perceived cloned animals and clone-derived food negatively, and were perceived as being particularly risky and unacceptable. Knight (2006) proposes that this is due to the level of 'human interference with genes', but arguably it could be due to novelty, unforeseen nature, dread or severity of the risk. Indeed, research suggests that the vast majority of the Irish public believe the long-term effects of farm animal cloning on nature are unknown, and furthermore exceed what is acceptable as a 'technical issue' for regulatory authorities (Eurobarometer, 2008). Although the use of cloning within an agri-food context is relatively novel, reproductive sciences are often associated with controversy. Clarke (2007) theorised that one of the reasons that emerges is that novel assisted reproductive technologies tend to interfere with 'natural processes' (within this

context, 'natural' is a relative term, as agriculture by definition interferes with natural processes).

Gregory and Satterfield (2002) have suggested that the terms used in the risk literature are central to the development of discourse between risk experts and the public affected by risk management policies. The terms are important, as they relate to specific risks and can be used to categorise perceptions. By categorising and understanding where particular risks exist with respect to others (through the use of perceptual maps, as in figure 4.4), appropriate analysis and communication can be achieved.

Figure: 4.4. Plot of factor scores (based on mean ratings for 126 U.K. citizens) showing location of GM food in relation to other concepts on the "dread" and "unknown" factors.



Source: Townsend *et al.*, (2004)

From the literature and the examples cited, the Psychometric Paradigm does appear to be a useful theoretical framework to characterise and articulate the types of risks that form

individual perceptions. Greater clarity in this respect may allow risk managers to address the concerns of the public in a manner that may be more immediately useful. However, some of the criticism of the psychometric model is such that it does not address individuals, and the extent to which individuals perceive risk (Marris *et al.,* 1998). Slovic and colleagues (1982) analyzed how 'groups of experts' and the lay public might generally perceive risk., and the majority of studies have used large sets of data for analysis (Siegrist *et al.,* 2005). While this has meant the psychometric paradigm can be used in isolation to examine cross-cultural comparisons of risk (Gierlach *et al.,* 2010; Bronfman and Cifuentes, 2003; Hohl and Gaskell, 2008), individual differences can be overlooked. Non-aggregated data has only been used on a handful of occasions, but its use is thought to further explain perceived risk (Marris *et al.,* 1998; Langford *et al.,* 1999). These studies have discovered that group findings are not necessarily supported at an individual level in the same groups; the implication is that the tranches of observation that are summarised can hide some of the variations that are central to explaining risk. Sjoberg and colleagues (2004) explain that deviations occur among individuals describing the same risk; these risks can be further explained by examining the variations in individual decision-making and the individual factors influencing those decisions.

Thus, in the consideration of the literature, the bulk of the evidence pertaining to measurements of risk using the psychometric paradigm must be considered in terms of the totality of the sample, as individual perception of risk is not necessarily accounted for. To further explain the psychometric paradigm – and deviation that has been highlighted in

individual perceptions of risks – the element of individual bias is explored in the following section.

4.2.2. Heuristics, bias and potential deviations in risk assessments

To further explain risk-perception it has been suggested that much is due to behavioural rules adopted by individuals. Tversky and Kahneman (1973) suggested that people assess the probability of an uncertain outcome through a limited number of heuristic principles, established through prior experience. Through individuals applying heuristics, the complex task of assessing probabilities and predicting values leads to simpler judgement procedures. Among the components that make up these biases are: affect; anchoring/adjustment; availability; framing; confirmation; and optimistic bias.

4.2.2.1. Affect Heuristic: Strong emotions, such as fear and anger, can play a role in risk perception. For example, fear can amplify risk estimates and anger can attenuate those risks. Individuals tend to react rapidly and somewhat subconsciously to hazards; in risk perception literature this is referred to as 'the affect heuristic' (Finucane *et al.,* 2000). The affect heuristic describes the perception of good or bad that a risk engenders in the psyche of an individual. Slovic and colleagues (2007) suggested that objects and events are tagged in people's minds to varying degrees with affect. In the process of making a decision, people refer to an 'affect pool' containing all the positive and negative tags that they have stored consciously or unconsciously. Slovic (2000) has highlighted that in judging probabilities or making predictions of risks, people often resort to simplifying the concept of heuristics, which can lead to biases. The affect heuristic is thought to play a role in

motivating behaviour; pleasant feelings motivate actions that people anticipate will reproduce those feelings, whereas unpleasant feelings will have the opposite effect. Slovic (1992) found that the inverse relationship between perceived benefit of an activity (for example, eating a GM food) was linked to the strength of positive or negative affect associated with that activity, as measured by a bi-polar scale, such as good and bad. These findings imply that people judge a risk on how they feel about it, as well as how they reason and deliberate over it. If feelings towards a putative benefit are positive, they tend to judge the risks as being low. The opposite is true if feelings towards the anticipated effect are negative, in which case the risks are regarded as being higher (Slovic and Peters, 2006). The implications from Slovic and Peters findings are that if overall positive or negative affect associated with an activity guides the perception of risk, then provision of information will impact on the person's risk perception.

Dohle and colleagues (2010) have highlighted the importance of affect in risk perception. They suggest that risks are evaluated through affective reactions toward risks, and not only by a knowledge-based analytical system. To use the example of animal cloning; if available information indicates that the health benefits of eating food derived from cloned animals are high (and health benefits are positively regarded by the individual) then the risk inferred is lower, giving an overall positive affect. Alternately, if there few positive messages regarding the benefits of cloning animals (perhaps only suggestions that it is no more useful that conventional breeding), then the risk inferred by the individual is higher, giving an overall negative affect (trust in the source of the information notwithstanding).

4.2.2.2. Anchoring/ Adjustment Heuristic: Anchoring is based on estimates and decisions of known 'anchors' or familiar positions. Individual judgments result from the employment of a heuristic, which acts as an anchor around which views are adjusted when confronted with new information (Tversky and Kahneman, 1973). For example, support for nuclear power is likely to vary depending on individuals' political views (Costa-font *et al.*, 2008b); in this context individuals adjust their attitudes and perceptions to the underlying values held by their political position or party affiliation. The party affiliation then becomes an anchor from which to evaluate overall risks. Anchoring is underpinned by relative thinking as opposed to absolute thinking. It is thought that in cases in which anchoring biases occur, the value (perception) is biased toward the initial value (Otway and Thomas, 1982).

4.2.2.3. Availability: Using the availability heuristic, people predict the frequency and probability of an event by the extent to which occurrences of that event are easily 'available' in memory. The tendency for people to overestimate the likelihood of rare events, such as being struck by lightning, and underestimate the likelihood of more common events, such as road traffic accidents or diet-related illness, can be explained by the availability heuristic. Risks that are widely reported in the media (such as lead paint and contaminated dog-food), easily came to the mind of the public, and thus are attributed greater risk significance (Feng *et al.*, 2010)

4.2.2.4. Framing: Framing is thought to affect decision-making when different descriptions of the same problem highlight different aspects of the outcomes (Kahenman, 2002). In the seminal work on framing, sample groups were given the same risk, but the

outcomes were explained differently (Tversky and Kahneman, 1981). In the first instance, the sample were asked hypothetically if – from a group of 600 people – they would either choose to save 200 people, or choose a 33% possibility of saving everybody or choose a 66% possibility of saving no body. The majority choose the first option. In the second instance the group were asked whether they would choose to let 400 die, or choose a 33% possibility that nobody will die and a 66% probability that all 600 will die. The majority chose the second option. Kahenman (2002) suggests that the clear majority of respondents will favour the risk-seeking option. The underlying premise of this example is that there is no substantive difference between the options, only that they stimulate different associations and evaluations[25]. Druckman (2001) found that in risk communication, an understanding of framing requires identifying a link between how citizens psychologically process frames, with how experts strategically choose frames.

4.2.2.5. Confirmation: Confirmation bias is concerned with a search for new information in a way that confirms individuals' preconceptions, and steers clear of information and interpretations which contradict prior beliefs (Klayman *et al.*, 1995). Confirmation bias is similar to anchoring, in that decision makers examine evidence expected to confirm, rather than disprove, a hypothesis (Chapman and Johnson, 2002).

4.2.2.6: Optimistic Bias: Optimistic bias is the level to which certain risks are overestimated due to the element of perceived control. This bias relates to over-estimation of the likelihood of positive events, and under-estimation of the likelihood of negative

[25] There is an element of understanding statistics with this example (which in itself may be a bias), but what Kahenman highlights that the same risk may be amplified or attenuated depending on how it is expressed.

events. For example, the actual risk (statistical probability) of diet-related illness is quite large, but is often disregarded. The individual will see a higher level of control over what they eat, thus lowering the perceived risk (Verbeke *et al.,* 2007). The converse is believed to be applicable with regard to food biotechnology-related risks: the actual hazards are perceived by technical experts to be quite small, but the perceived level of control is also low, and thus the individual over-estimates the risk (Frewer *et al.,* 2003).

From the literature, the psychometric paradigm does appear to play a significant role in assessing how risk is perceived among populations. However, when utilising the psychometric paradigm it must be considered in conjunction with heuristics. Slovic (2000) has highlighted that in judging probabilities or making predictions of risks, people often resort to simplifying heuristics, which can in itself lead to bias. Therefore, in the perception of risk, the psychological decision-making approach is important, but a social or anthropological process has also been suggested as being pertinent in explaining how individuals regard risks. This socio-cultural approach to individual risk is outlined in the following section.

4.3 Socio-Cultural Perception of Individual Risk

In examining an individual's perspective on risk, an attempt has been made by researchers to understand any accompanying ideological factors. Marris (2001) suggests that with regard to GMOs, deep-felt concerns often persist and accumulate. In this way they help to shape people's understanding of the world, which is then used to determine views about other issues. Such concerns can therefore have important long-term effects on public reactions to technological innovations. Marris indicated that the public's view was clearly shaped by previous experiences with other issues. Indeed, the literature suggests that individuals select and interpret social information on a range of issues in order to support their pre-existing worldviews (see Lord *et al.*, 1979; Plous, 1991; Koehler, 1993; Frewer *et al.*, 1998; Poortinga and Pidgeon, 2004; White *et al.*, 2003). The approach to understanding these variations (and a prominent construct in risk literature) is the concept of Cultural Theory (CT), based on the work of Douglas and Wildaysky (1982). This does not refer to cross-cultural or socio-demographic variables, but more to the outlook of the individual in terms of ways of life: the latter may be assigned to a social structure and provide a unique outlook on risk. The four ways of life (figure 4.5) illustrate the extent to which people are restricted within their prescribed way of life.

Figure: 4.5. Cultural Theory: 'Way of Life' groups

- **Hierarchical:** This is a group defined by binding prescriptions and strong boundaries. They observe their place in the world as defined by classifications such as age or gender. It is suggested that these individuals see these classifications as a way of enabling society to run smoothly. They see control as resting with hierarchical institutions.

- **Individualist:** Individualists do not see themselves as belonging to a group and do not see themselves as having prescribed roles. They do not feel a sense of responsibility toward other members of society and they see the allocation of power as a matter of their own responsibility, not position or status.

- **Egalitarian:** Egalitarians have strong group boundaries and are noted as having distinct control over their social habits. They are defined as having a strong sense of social connectedness and expect every individual to negotiate their relationship with others. They do not believe that individuals are granted authority by virtue of their position.

- **Fatalist:** Fatalists have low group association and a strong sense of social distinctiveness. They see control as resting with hierarchical institutions and see themselves as having little or no power to influence the course of events in their favour.

Source: Douglas and Wildaysky, 1982

The stronger the ties to the groups, the less individual choices are subject to actual control by the individual. The 'way of life' groups are defined by the extent to which individuals are connected by feelings of belonging or solidarity. It is suggested that the closer the individual is to their prescribed way of life, the less that individual is open to negotiation or persuasion. Thus, in the progression of this argument, religious beliefs or strong nature-favouring convictions in a hierarchical 'world-view' may impact on the perceived risk with

applying biotechnology to food production. The 'way of life' groups used by Douglas and Wildaysky in CT are grounded in the work of Herbert Spencer[26] which sees society as a structure, and everything (including people) as functions of this structure. Criticism has been directed at the concept of 'functionalism' within CT, as articulated by that Douglas and Wildaysky: the emphasis on collective entities (the four lifestyle groups) is at the cost of a consideration of the decisions which individuals make to pursue their own needs in social relations. It has also been suggested that CT is poorly correlated with abstract observations of what individuals perceive as 'risky', and may only be of significance in specific types of risks (Brenot *et al.,* 1998).

However, the specific types of risks to which the application of CT is considered to be most useful relate to those associated with the environment, technology in society and trust in institutions (Seifert and Torgersen, 1995; Marris *et al.,* 1998; Peters and Slovic, 1996; Frewer *et al.,* 2005). Arguably, food biotechnology fulfils these criteria. Furthermore, Wandel and Bugge (1997) suggest that CT will impact on individual animal welfare perspectives, and is particularly prominent in the case of veganism. However, CT in relation to animal welfare and food must be considered as a part of a complex series of ethical reasoning and trade-offs (Harper and Makatouni, 2002; Marris, 2001). For example, Schröder and McEachern (2004) have suggested that individuals can hold two views on animal welfare. On the one hand, they may think as citizens influencing societal standards, and on the other, as consumers at the point of purchase. Therefore, relating this finding to perceived risk in farm animal cloning, variance may be observed depending on where

[26] A political theorist who paralleled his own economic theories to Darwin's theory of 'natural selection' and coined the phrase 'survival of the fittest'.

individuals position themselves in the debate. In Ireland for example, farm animal cloning might be seen as being a 'far off' technology, and it may not be regarded as an influencing factor on aspects such as the animal's quality of life or basic standards as to how animals should be treated. From a consumer perspective, there are some indications that animal welfare standards can be used as an indicator of food safety (Harper and Makatouni, 2002).

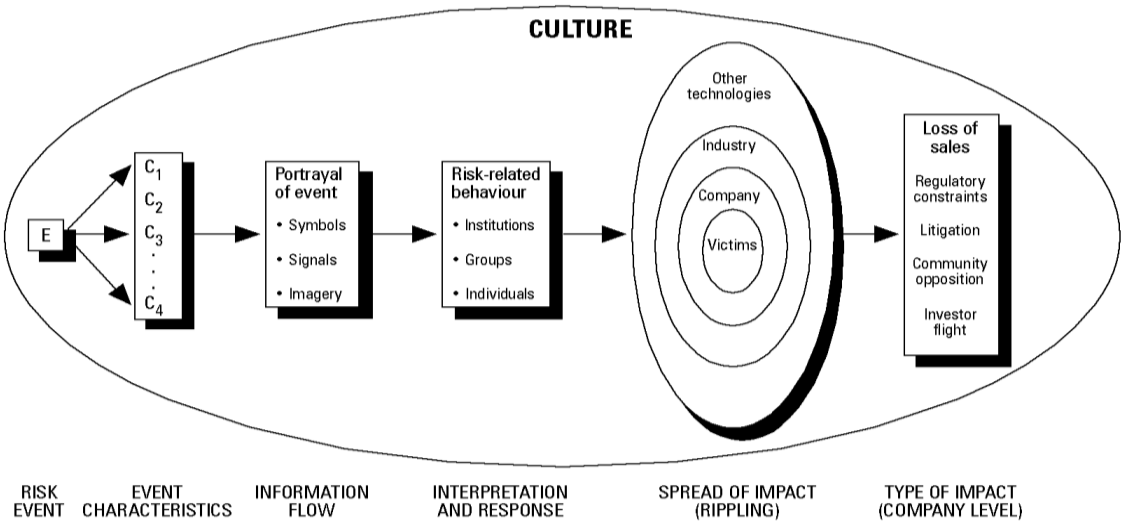
4.4 Social Amplification of Risk

Kasperson and colleagues (1988) sought to link technical risk assessments with the psychological, sociological and cultural perspectives of risk perception and risk-related behaviour. Their work focused on the transfer of information about the risk, and the response mechanisms of society. To this end, they sought to clarify why relatively minor risks, or risk events, can elicit strong public concerns, and result in substantial impacts upon society and the economy. With respect to information-transfer, they found that signals about risk are processed by individuals and 'social amplification stations' (including the scientist who communicates the risk assessment, the news media, cultural groups, interpersonal networks, and others). While Kasperson and colleagues based their assumptions on relativist-type decision making on the part of 'experts' (as is a trend in risk communication literature; see Sjoberg, 2000; Slovic *et al.*, 1979; 1980; 1985), the inclusion of 'cultural groups' and 'inter-personal networks' suggested a greater role for diverse ethical influences in the wider discourse.

It is hypothesized that 'amplified risk' (the portrayal of a risk through a tabloid newspaper for example) may lead to behavioural responses (avoidance of the related product), which

in turn, can result in secondary impacts (a reduction of sales leading to commercial failure) (Kasperson *et al.,* 1988). These secondary impacts are then interpreted by social groups and individuals, so that another stage of amplification may occur to produce third-order impacts (reduction of sales for all companies in the affected sector and widespread commercial failure). The upshot is that the amplifications may 'ripple' to other groups: geographically, or indeed, to future generations. Kasperson and colleagues (*ibid*) suggested that each order of impact will not only disseminate social and political impacts, but may also trigger (through risk amplification) or hinder (through risk attenuation) positive changes for risk reduction. They held that the concept of 'social amplification of risk' is therefore a dynamic one, taking into account the learning and social interactions resulting from experience with risk. Fig 3.6 provides a graphical representation of the 'Social Amplification of Risk'.

Fig 4.6: The Social Amplification of Risk



Source: Kasperson *et al.,* 1988

Such explorations of sociology and cultural theory to explain attitudes to risk have been criticized. For example, Althaus (2005) asserted that with the introduction of the concept of culture into the debate, then inevitably risk would become politicized: 'a cultural perspective wrenches risk from its scientific and mathematical foundations by positing risk to be a choice word for danger'. Risk (as Althaus suggests) is a probabilistic measure that can have variable results depending on how it is communicated (Tversky and Kahneman, 1981). Thus, in mitigating the perceived risks and developing risk communication strategies, exploring cultural ideologies with links to perceived risk may be beneficial. Pidgeon and colleagues (2003) observed that clarifying the role of culture in risk communication has become a main concern in efforts to bridge risk perception research and social context. Manifestations of this include the involvement of different stakeholders in the consideration of risk, or granting a forum for non-government agencies to present their arguments.

While the sections 4.2 and 4.3 examined individual differences in psychological perceptions, the 'social amplification of risk' seeks to contextualize such differences relative to their environment. Within this context, socio-demographic traits, such as income, age and education are relevant. For example, with regard to the risk posed by cloning[27], socio-demographic data suggests that men (62%) perceive cloning as less risky than women (71%). However, managers (73%), retirees (72%) and those aged >40 years are most wary about the use of cloning for food (for all examples see Eurobarometer, 2010). These constructs are not always indicative of why variations occur. For example, a

[27] Asked to agree or disagree if 'animal cloning in food production makes you feel uneasy'

common finding in surveys of perceived risks finds women are inclined to be more risk averse than men (Flynn *et al.,* 1994; Rivers *et al.,* 2010). Taken in isolation, this finding provides little insight, as it does not explain why women are more risk-averse (Brenot *et al.,* 1998). However, when considered in the context that women are often the primary household-food shopper, it is understandable that they may exhibit more risk aversion, as they are making decisions with the future health of others in mind. What is implicit, therefore, is that analysis of personal attributes – such as gender – needs to be accompanied by further investigation of social, cultural and political constructs.

In considering the social context of risk, it has been reported that a variety of groups will often present competing evidence based on their values and priorities (undoubtedly framing-bias will also play a role; Lima *et al,* 2005). At a basic level, this has a risk-reward element, but depending on the specific risk, and indeed the tenacity of the groups involved, it can become more complex. For example, waste incinerators have been roundly rejected in Ireland due to 'green' lobbying and the subsequent formation of community level anti-incineration groups (Ray-Davis, 2009). When compared to Denmark – where a similar green ethos prevails – incineration accounts for over 50% of municipal waste disposal. This apparent paradox has been explained in terms of the employment which this technology provides in Denmark[28], and the efficient energy production yielded, which greatly influence the risk-acceptability discourse (Hansen *et al.,* 2003).

[28] Local government in Denmark is given more autonomy toward innovation and enterprise for such development through the Danish Environmental Protection Agency

4.4.1 Social Amplification Stations

When the public are unable to determine the risk associated with new foods produced using biotechnology, they may rely on the analysis of various actors to reduce the complexity of decisions. Evidence suggests that differences in political culture are important explanations of observed differences in public response to risks associated with biotechnology (Priest *et al.,* 2003). Such research highlighted that responses to questioning on food biotechnology were the result of considered judgments about which social actors are most relied upon. For example, Trail *et al,* (2004) found that because the US government promoted a positive message about GM technology, people who trusted these sources of information had lower risk and higher benefit perceptions. Those placing trust in the 'natural order' and 'green' groups had a bleak/fatalist view. In this context, fatalist or hierarchical worldviews may also alter how risk messages are related, highlighting the potential role of cultural theory. The implication for risk management, and those commercialising novel food technologies, is that the area of source credibility and trust becomes another contributor as to how the public perceive risk (see Gaskell, *et al.,* 2000; Hallman, 2000; Kurzer and Cooper, 2007; MacMillan, 2003; Sheingate, 2006; Montpetit and Rouillard, 2008).

Within the context of farm animal cloning, a number of stakeholders vie for positions of trust with respect to risk amplification stations. Forty percent of the Irish public indicated 'trust' in the national and European food safety agencies (Eurobarometer, 2008). Indeed, this trust – or lack of trust – in authority has been identified as being an important element of risk perception in novel food technologies (Saba *et al.,* 1998), and health scares

(Verbeke, 2001; Berg, 2004). Additionally, in the 2008 Eurobarometer study, only 30% of the Irish public indicated they would trust animal welfare organisations with respect to information on cloning. The role of such organizations in the public discourse may be significant in terms of the considerations with respect to how animals can be treated in the cloning process; these organisations, with a strong lobbying capability, specialise in creating a groundswell of public support rapidly through highly visual demonstrations to attract media coverage. Those likely to be influential in the perceived risk associated with farm animal cloning, are animal welfare organisations, national and international anti-food biotechnology lobby groups and organic farming advocacy organisations. The potential role for animal welfare issues in Irish public discourse is already evident with both the Irish Anti-Vivisection Association and Compassion in World Farming campaigning against the technology (IAVS, 2011; CIWF, 2011).

Eurobarometer data (2008) indicated that 22% of Irish people thought that public views on the moral and ethical issues involved in novel biotechnologies needed to be incorporated into their governance. This figure is high relative to other European countries (overall fourth), but still represents a minority. However, this minority may grow, dependent on how the risk is communicated or amplified. In addition to animal welfare organizations, several other stakeholders could be categorised as 'social amplification stations'. Within this cohort, anti-GM organisations and organic farming representative bodies may voice opposition to the cloning of farm animals for use within the agri-food sector.

Religious organisations may be also considered ‘risk amplification stations’ with regard to cloning. Mersmann (1996) observed that much religious opposition to recombinant DNA research and technology can be strongly entrenched. In public perception studies it was observed that GM crops were considered as ‘just wrong’ or that they go against people’s ‘inner beliefs’ (Saba *et al.*, 1998; Kershen, 1999). While Thompson (1997) opined that for Christians there is a firmly held belief that biotechnology interferes with ‘God’s handiwork’ or creation, the evidence is not conclusive. For instance, Hallman (2000) reported that most Christian and Jewish groups find at least some types of genetic modification to be acceptable, while other groups – he cites Muslims, Sikhs and Hindus – may see biotechnology as ‘violating food purity prescriptions’ (this may further differ with geographic locations or local interpretation of the Koran). Overall, the strength of religious influence as a ‘social amplification station’ will have several variables: the strength of individual religious conviction versus other competing ethical frameworks, the extent to which religion takes a position on a technology [the Catholic Church have denounced human cloning, but envisage a role for animal cloning (de Dios Vial Correa, 1997)], and the autonomy in individual decision-making versus religious dogma. Cloning is at an early stage, but other biotechnology research – for example stem-cell technology – has been intensely debated from a socio-cultural perspective, with strong opposition from the Catholic Church (Reichhardt *et al.*, 2004).

In looking at media influence with respect to ’social amplification stations’ for animal cloning, Renn and colleagues (1992) suggested that their influence may be significant. Systematic examination of news content has shown that GM foods attract a

disproportionate level of negative commentary; as much as eight times as many articles that lead with potential risks (as opposed to positive benefits) (Bruhn, 2003). Some commentators have interpreted this to mean that the media only present negative aspects while ignoring others (Marks and Kalaitzandonakes, 2001); however it could also be considered that in an effort to present 'balanced' perspectives, media sources may be including and amplifying a large number of campaigning groups or interest groups (for example, a news story may be how scientists have commercialised the technology for food production, but the reporting of the story may want to include the farmers' perspective or the animal-welfare perspective in light of the breakthrough). Furthermore, the manner in which stories are framed or interpreted may contribute to this. Marks and Kalaitzandonkes (2001) also base their assertions on UK media linking food biotechnology with previous and on-going food crises, including BSE, dioxin contamination and *Salmonella* outbreaks; again, there is a possibility that anchoring bias may be influencing the style of reporting (potential financial loss to the food industry could be posited in the context of a previous food-pathogen outbreak). The established way of reporting potential food risks in Ireland tends to follow a typical pattern. Pertinent stories are carried by the state broadcaster with commentary from the Food Safety Authority and possibly a farming or industry organisation. Private broadcasters, broadsheet newspapers and tabloids will also carry stories, with comment from retailers, farmers, consumers, and possibly animal-welfare organisations or organic farming representatives – depending on the risk – as the story develops.

The role of symbolism and language may contribute to the media as a 'social amplification station'. Studies have shown that the debate on animal cloning is characterised by an absence of scientific discourse, and instead deploys the use of imagery and metaphors from science-fiction (Nerlich *et al*, 1999). It has been observed that the discourse on cloning which was initiated with the advent of Dolly the sheep quickly jumped to the cloning of humans (Peterson, 2002; Haran, 2008), though the reproductive scientists behind Dolly were quick to dispel the idea as 'unethical and inhumane' (Kass and Wilson, 1998). While the significance of Dolly for healthcare and agriculture may have been dramatic for industry professionals, there is also the possibility that it meant less to the general public. Post-modernist perspectives may posit that 'big agriculture' or 'big pharma' have been carrying out this type of clandestine research for years, and the obvious next step would be to clone man. Metaphors surrounding cloning often stem from the idea that the science of cloning, and the science-fiction of cloning are one-and-the-same (Nerlich *et al.,* 1999). Science-fiction often depicts clones as unfeeling or inhuman replicas or drones, evoking feelings of horror and repulsion as to what this might have meant for the future of mankind. In the case of GM food, the phrases 'Frankenstein food' and 'gene genie' became prevalent in media discourse (France, 2001).

In considering the impact on the various social amplification stations, Sjoberg and Herber (2008) suggest that three trust-related factors exist in the public/risk manager relationship. The first is antagonism, which measures value similarity. For example, how individuals rate the risk manager with regard to whether they acted in accordance with the wishes of the individual (is the primary motivation of the stakeholder to ensure consumer safety or to

make money?). The second factor measures how well risk managers handle questions regarding the management of the risk. The third variable – epistemic trust – measures confidence as to whether individuals trust the risk managers' profession, or trust the science behind the technology under discussion.

A more recent approach to trust has been proposed by White and Johnson (2010). Their 'intuitive detection theorist' (IDT) model of trust proposes that trust be placed in the risk-manager from judgments about their performance on three criteria: their ability to discriminate safe from dangerous situations (discrimination ability); their tendency under uncertainty to assume danger is present (response bias); and their propensity to be open and honest with the public about events (communication bias). Sjoberg and Herber's model did not explain the inter-relatedness of these factors, but instead suggested they are 'competitive explanatory variables relative to dependent variables', rather than combined elements in an integrated model of trust in risk management. White and Johnson (2010) did examine the inter-relatedness of the variables, but found that interaction effects among the dimensions were weak and contradictory.

4.4.2. Competing Demographic and Socio Economic Variables

With respect to literature outlined hereto, the focus has been on individual decision making and followed by some of the broader social influences on risk perception. The final section in this chapter focuses on the role of demographic and socio-economic variables that have emerged as being related to risk perception; this section explores gender, age and occupation/social class, and uses the major surveys where possible.

4.4.2.1 Gender

Previous studies have identified gender as an important element in shaping attitudes to risk, with females documented as being more risk-averse (Slovic, 1987). Furthermore, men have been recognised as being more positive in terms of their attitude to science and new technology (Bak, 2001). When it comes to food generally, the literature suggests that females are more concerned with associated risks than are males. Dosman and colleagues (2001) found that gender was a strong variable in influencing perceptions of food hazards, with women more inclined to consider food additives, food bacteria, and pesticides in food as a greater health risk than men. In the case of food biotechnology, Finke and Kim (2003) reported females as being more concerned about health risks from GMOs than males. Indeed, Costa-Fonta and Mossialos (2007) found that women systematically perceived higher risks and lesser benefits associated with GM-derived food. In the context of food derived from a GM animal, or a plant modified using animal DNA, female consumers have also been found to be less willing to consume it (Hossain and Onyango, 2004); conversely, male consumers were more likely to accept GM foods when the technology involved an animal, suggesting that males are possibly less risk averse than females to animal-based GM products. This research suggests that males may look at immediate benefits of novel foods, while females take into account more long-term effects which are not yet known.

4.4.2.2. Age

With risk perceptions being formed over time, there is an accumulated development of the anticipation of risk, and so the age of an individual may also have an effect on the risk

evaluation process. Costa-Fonta and Mossialos (2007) found that the perception of risks associated with biotechnology was greatly influenced by the fact that these technologies are novel (or at least, novel to the common man). Their results suggested that age modulates how new information is perceived; age tends to shape prior experience, as would access to new information at school or university. This has been borne out in a specific UK study of consumer attitudes towards GM food labelling, where age was found to be the only significant socio-demographic variable (Rimal *et al.*, 2007); older respondents were more likely to be concerned about the food labelling practices that would not distinguish between GM and non-GM, compared with the younger respondents. Indeed, Hossain and Onyango (2004) reported that compared to those in the 35–54 age group, younger consumers (< 35 years) were more willing to consume beef from GM cattle, while older consumers (≥ 55 years) were less willing to do so.

4.4.2.3. Occupation/ Occupational Status (Social Grade)

The Eurobarometer (2008) survey showed that there was a distinction in opinion between employees and those engaged in manual labour – indicating a distinction on the basis of social grade. This study found that these groups differed in their pattern of responses, which may in turn have a link to education level (note: the Eurobarometer survey dealt with a large number of individuals; n=25,000). It has also been observed that the moral acceptability of genetically modifying animals increased with a higher level of education (Knight, 2007).

4.5 Conclusions

The literature associated with perceived risk is strewn with facile comments regarding 'human nature'. Commentary regarding these risks straddles the areas of sociology and psychology and does not have a satisfactory middle-ground. While elements of cultural theory can be incorporated to explain the degree of individual differences in assessing risks as they pertain to the psychometric paradigm, it is unclear which school fully reflects the narrative in which the Irish public will consider farm animal cloning for use within the food system. This backdrop may be further clarified with insight from the key opinion leaders. What can be gleaned from the literature is that constructs involved in risk will vary, depending on the risk in question. From the risk constructs described in this chapter, animal cloning may share some perceived risk elements with other food biotechnologies, such as GM crops. Among these elements are the 'unknown' or 'unforeseen consequences', the 'unnaturalness of the technology' and a perceived 'lack of control'.

Allied to these risks is the use of animals to produce food. Such use represents a complex risk proposition for the public, as animals are considered to have certain rights by a majority of the population (though it must also be considered that these rights may be a trade-off between other factors, such as food price). Cloning may also share some socio-cultural aspects of risk with other food biotechnologies; for example, the cloning process may conflict with various individual worldviews as to what is appropriate and what is not, or indeed individual religious belief. The concept of risk amplification must also be considered with respect to cloning; early stage public opinion has found that the perceived

risks share similarities with GM foods and the interpretation of pertinent 'negative' news stories. Cloning was also observed to draw negative commentary with regard to science-fiction. In this context the role of risk amplifiers, such as campaign groups must also be considered. These socio-cultural references and perceived similarities may well form the basis for the frames of reference with which communicators engage with the public on animal cloning. Furthermore, the literature has shown that demographic and socio-economic factors also impact on risk perception – arguably this will be a factor in canvassing divergent views in a cross-section of the Irish public.

In summary, how risk is perceived will have a significant impact on the related policy and decisions as to the commercial viability of farm animal cloning. Therefore, establishing the constructs likely to feature, and further investigating these constructs among the public, is of great significance to the area of farm animal cloning for food production purposes. Using the themes outlined in this chapter, this research aims to investigate the views of key expert stakeholders in the risk process, and to integrate these results into a preliminary exploration of public views on the technology. The following chapter outlines the methodological framework this research has taken in investigating the research aims.

5: Materials and Methods

The aim of the following chapter is to outline the various drivers and considerations with respect to the choice of methodology used in the course of this study. The chapter outlines the objectives, design and instruments used in the research, and the method of data analysis.

To ensure rigour with respect to the research design, a set of 'guidelines' was assimilated and integrated into the study design (see figure 5.1). Maxwell (2005) suggests that a research design should be based around five key criteria. He explains these are interactive as collecting and analyzing data, developing theory, elaborating research questions, and addressing validity threats are usually all going on more or less simultaneously, each influencing all of the others. All elements have played a considerable role in informing and guiding the following chapter.

Figure: 5.1. Interactive Model of Research Design

1. Goals: What issues do you want to clarify, and what practices and policies do you want it to influence? Why carry out the study and why might we care about the results?

2. Conceptual Framework: What do you think is going on with the issues? What settings do you plan to study? What theories, beliefs and prior research will guide or inform your research and what literature, preliminary studies and personal experiences will you draw on for understanding the people or issues you are studying?

3. Research Questions: What do you specifically want to understand by doing the study? What do you not know about the phenomena you are studying that you want to learn about? What questions will your research attempt to answer, and how are these questions related to one another?

4. Methods: What will you actually do in conducting this study? What approaches and techniques will you use to collect and analyze your data? There are four parts of this component of the study design: (1) the relationship you establish with the participants in your study; (2) your selection of settings, participants, times and places of data collection (sampling); (3) your data collection methods; and (4) your data analysis strategies and techniques.

5. Validity: How might results and conclusions be wrong? What are the plausible interpretations and validity of these and how will you deal with these? How can the data that you have, or that you could potentially collect, support or challenge your ideas about what's going on? Why should the results be believable?

Source: Maxwell, 2005

5.1 Development of a Research Design

In simple terms, a research design entails a choice of the best observational technique for a given research question(s) (Anderson and Taylor, 2007). The aim of this research is to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes, as well as those of the Irish public. Specifically, this research aims to gauge the current levels of awareness among specific groups and examine their likely acceptance. The research has challenges which include, eliciting information from a diverse range of key opinion leaders and engaging with the public on a topic of technical and scientific complexity. As the following pages outline, the decision between quantitative and qualitative methods were central to the overall research design as was the early identification of an epistemological strategy.

Before looking at the research design, it is prudent to identify the different theories with respect to knowledge generation. This is important, as it will have a bearing on how the knowledge generation process is informed, and how its validity and reliability may be maximised. Figure 5.2 outlines the various types of epistemological knowledge. While this list is not exhaustive, it includes several prominent positions. Creswell (2009) has divided epistemic knowledge into positions that can be held by the researcher (post-positivism, constructivism, advocacy/participatory and pragmatism).

Figure: 5.2. Examples and Descriptions of Epistemological Positions

Positivism
Positivism suggests that the only real knowledge is that which is based on sense, experience and positive verification. A positivist epistemology implies that the goal of research is to produce objective knowledge that is impartial and unbiased, based on a view from 'the outside', without personal involvement or vested interests on the part of the researcher.

Empiricism
Empiricism is closely related to Positivism and suggests that the knowledge of the world must be derived from 'the facts of experience'. The more that is known about a phenomenon, then the more detail we perceive when it is observed. Sense perception provides the basis for knowledge acquisition, which proceeds through the systematic collection and classification of observations. Empiricism suggests that theoretical work alone cannot bring us closer to the truth, and knowledge claims must be grounded in data.

Hypothetic-Deductivism
A number of serious practical as well as logical limitations of positivism and empiricism led to the development of alternative theories of knowledge. Karl Popper is credited with the formulation of 'Hypothetic-Deductivism' after a critique of traditional inductive approaches to research. Popper proposed that instead of induction and verification, scientific research should rely upon deduction and falsification. Thus Hypothetic-Deductivism works by looking for disconfirmation, or *falsification*. In this way, we can find out which claims are *not* true and, by a process of elimination of claims, we move closer to the truth.

Social Constructionism
Social Constructionism draws attention to the fact that human experience, including perception, is mediated by historic, cultural and linguistic drivers. That is, what we perceive and experience is never a direct reflection of environmental conditions, but must be understood as a specific reading of these conditions. This does not mean that we can never really know anything; rather, it suggests that there are 'knowledges' rather than 'knowledge'. Language is an important aspect of socially constructed knowledge. The same phenomenon or event can be described in different ways, giving rise to different ways of perceiving and understanding it, yet neither way of describing it is necessarily wrong.

Source: Adapted from Willig, 2008

In line with the goals within the interactive research design research model (Fig.1) the orthodoxy for gathering a diverse range of opinion leaders lending their expertise will mean that the data generated will be contradictory. In the context of this research these views are all equally valid; thus in seeking and analysing this data, a Social Constructionist approach

was deemed most applicable (see Fig 5.2). The Social Constructionist approach recognises and allows for the range of issues associated with cloning to be contextualised. This approach also appreciates that the knowledge generated by these opinion leaders is likely debated or traded-off in the decision making by the Irish public. The link between epistemology and methodology has been described by Bryman (1984), who suggests that a qualitative approach, which seeks to understand the actor's view with respect to the social environment, lends itself to constructionist approaches. The relative merits of qualitative and quantitative approaches are examined in a subsequent section (5.1.2).

Several designs are available to researchers with respect to designing a research study (see Figure 5.3). In terms of the time dimension, a cross-sectional study was most applicable to the research question, because it aimed to gauge the current levels of awareness among specific groups and examine their likely acceptance[29]. A cross-sectional study gathers information on a population or a phenomenon at a 'snapshot' in time (Babbie, 2010). Both retrospective and longitudinal attributes were ruled out, due to the novelty of the subject matter and the typical time required in carrying out such studies, respectively. In considering the research objective, exploratory and descriptive approaches are common in cross-sectional studies (Babbie, *ibid*), but it has also been suggested that predictive cross-sectional studies may not be accurate (Bryman and Bell, 2007:56). Bryman and Bell (*ibid*) state that that there can be no time ordering for causal influence, as all the variables are collected at once (though strictly speaking there is no true 'predictive' methodology;

[29] Though it turned out to be insignificant in the results, the incident in the UK where a farmer was found to be using the progeny of a cloned animal to produce milk, is a potential influence on public perceptions; 'before' and 'after' groups are likely to differ greatly in awareness and opinion. Similarly, in terms of 'expert' opinion, a tightly run series of interviews reduces the likelihood of a briefing paper or policy development biasing their views relative each other.

perhaps longitudinal studies may give the greatest insight in this respect). Furthermore, Babbie (2010:106) suggests that exploratory cross-sectional studies can be useful, but it must be remembered that the causal process used to explain the phenomenon occurs over a period of time.

5.1.2. Strategies of Inquiry

Creswell (2009) suggested that a researcher has three options with respect to the research design. These are quantitative, qualitative and mixed method designs. The following section differentiates qualitative and quantitative design, while a mixed method approach will use elements of both.

Figure: 5.3. Types of Research Design: Objectives with respect to time

	Time Dimension		
Research Objective	*Retrospective*	*Cross-sectional*	*Longitudinal*
Explorative	Retrospective Explorative Study (type1)	Cross-sectional Explorative Study (type 2)	Longitudinal Explorative Study (Type 3)
Descriptive	Retrospective Descriptive Study (type4)	Cross-sectional Descriptive Study (type 5)	Longitudinal Descriptive Study (Type 6)
Predictive	Retrospective Predictive Study (type7)	Cross-sectional Predictive Study (type 8)	Longitudinal Predictive Study (Type 9)
Explanatory	Retrospective Explanatory Study (type10)	Cross-sectional Explanatory Study (type 11)	Longitudinal Explanatory Study (Type 12)

Source: Adapted from Johnson and Christiansen, 2010, and Babbie, 2010

Qualitative research definitions often reference quantitative methods by way of explanation. For example, Gordon and Langmaid (1988) explained that qualitative research is concerned with *understanding* things rather than measuring them. Similarly, Harris and colleagues (2009) defined qualitative research as a method of generating data that has not been accumulated with standard statistical procedures or other means of quantification. Others have pointed to the naturalistic aspects of qualitative research, which draw on multiple methods with respect to the 'human nature' of the individuals studied, focuses on content, is emergent and evolving, and at its core is interpretative in nature (Rossman and Rallis, 2003). One of the major differences between the two types of research is that quantitative methodology draws from a large sample size and is then subjected to statistical analysis, whereas qualitative research is generally carried out with a smaller sample size, and the analysis is on themes pertaining to the phenomenon. Qualitative research generally cannot be reflective of a larger population, whereas true random sampling if used with quantitative research aims to do just that. Quantitative research is concerned with gathering information on phenomena that are quite well known, whereas in qualitative research, generally little is known about the phenomena (Harris *et al.,* 2009).

Qualitative research methods are considered to be a solution for investigating a range of views and differing opinions, especially when the need to generalise the results is not necessary[30]. It can be used to describe lived experiences, where quantitative methods can hide the social process that can be associated with a phenomenon. For this reason,

[30] In the context of this research, reconciling the limited sample size with achieving a range of differing opinions is achieved with the inclusion of stakeholders from all sides of the policy debate.

qualitative research can give greater and deeper understanding of social phenomena, compared with quantitative methods. To this end, Levy (2005) has suggested that the challenge with qualitative research is dealing with the inner lives of participants, their introspections, 'hazards' associated with self-expression, their truth and lies, their ignorance, their uncertainty, their contradictions and their defence mechanisms. Qualitative research looks to embrace this complexity, and factor this into the reasons and rationale that individuals provide when examining data.

A defining factor within qualitative research is that the researcher is heavily involved in the study; quantitative research methods, by contrast, attempt to gather data by objective methods in order to provide information about comparisons, predictions and relationships, and attempts to remove the investigator from the investigation (Smith, 1983). This type of research is often undertaken not with a hypothesis in mind, but with a flexible plan to explore a phenomenon. Inductive reasoning is only adopted when the data are recorded and used to draw conclusions.

Within the research questions there are several variables with respect to a diverse range of key opinion leaders and a technically difficult subject matter for the lay public that orientated the design method. The topic is emergent and evolving, and overall not well known. The approach needs to embrace complexity and tease out the social processes associated with decision making. Furthermore, the research seeks to canvass the breadth of views on farm animal cloning from key opinion leaders and the public with the aim of understanding what factors may influence likely acceptance; not necessarily to quantify

them. These aims are all typical – and only achievable – through a qualitative research approach. Thus, with respect to the goals and conceptual framework of the interactive research design (fig 5.1), a qualitative approach was selected for the current study. The range of qualitative strategies for the conceptual framework is outlined in Figure 5.4.

Figure 5.4: Strategies of Inquiry

Quantitative	**Qualitative**	**Mixed Method**
Experimental designs Non-Experimental (surveys)	Narrative research Phenomenology Grounded theory studies Transformative Case Studies Ethnographies	Sequential Concurrent

Source: Creswell, 2009

Among the qualitative strategies of inquiry, ethnography was ruled out, as it collects data longitudinally. Narrative research and case studies were similarly dismissed as they examine the significance of phenomena retrospectively (cloning for the purpose of food production is a relatively new phenomenon). Grounded theory as a strategy of inquiry uses multiple stages of data collection and constantly compares the data for differences and similarities (Strauss and Corbin, 1998). Grounded theory attempts to derive a hypothesis from first examining the data and then coding it; the codes are categorised and then form the basis of a theory, which in turn forms a 'reverse hypothesis'. This method is useful, insofar as it is thorough, but such an approach could be unwieldy with respect to questions on policy, and particularly where in-depth knowledge is needed on the part of the researcher for credibility.

The phenomenological approach is one where the researcher identifies 'the essence of human experiences about a phenomenon', as described by research participants (Creswell, 2009). Creswell suggests that the process of understanding individuals' lived experiences marks phenomenology as both a philosophy and a research method. The process necessitates the researcher putting aside their own preconceptions to understand the views of the participants. Moustakas (1994) – considered the founder of phenomenological research – considers experience and behaviour as integrated and inseparable. Typical research questions evolve around what a phenomena means and how it is experienced. In his approach Moustakas describes 'heuristic processes' when considering data generated during research; this suggests that this particular approach lends it to a phenomena that can be poorly defined or understood and when people are in the early stages of evaluation. Furthermore, selecting the phenomenological approach as part of the research design also dovetails with a social constructionist approaches within the literature[31].

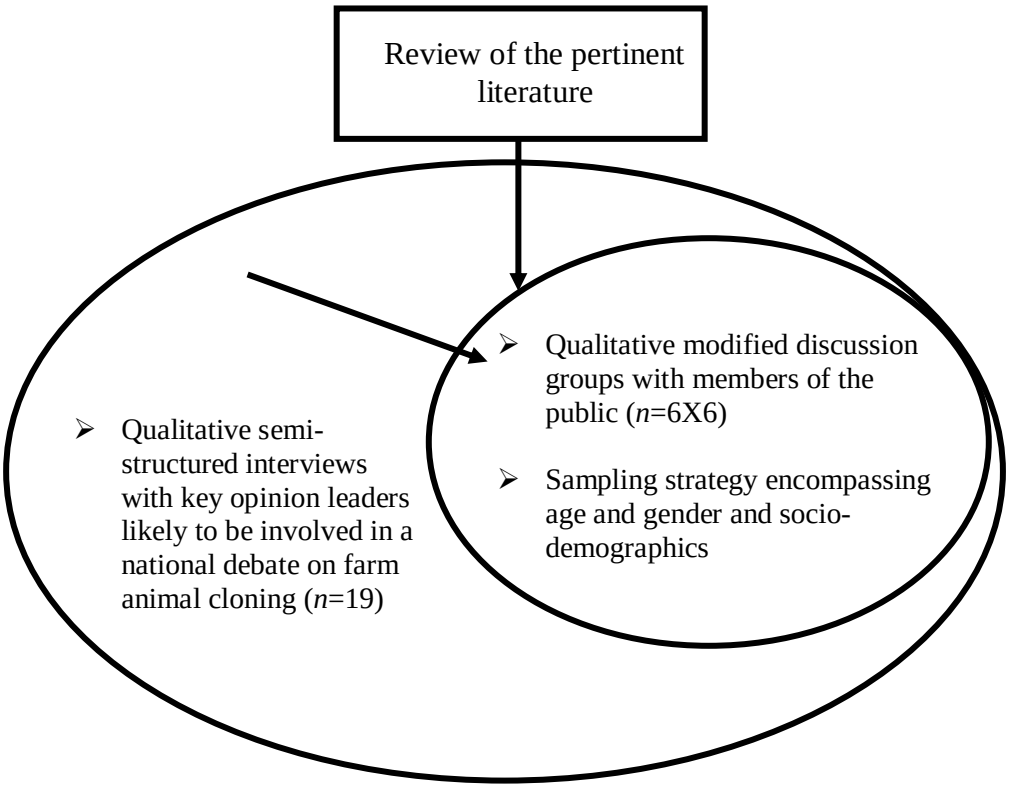
Thus, the research design used in this study can be summarised as a social constructionist, cross-sectional, exploratory, qualitative, phenomenology approach. In outlining the 'research flow', research questions are again central. To gauge the likely acceptance of a range of key opinion leaders is a discrete piece of work; however, in generating the perspective from the Irish public when knowledge is low, input from key opinion leaders is

[31] **Linking epistemology and qualitative research**
Bryman (1984) suggests that the philosophical underpinnings of qualitative research are typically attributed to phenomenology, Verstehehen (a German term referring to understanding the meaning of action from the actor's point of view) and symbolic interactionism. The phenomenology position takes the actor's position as the point of departure for the research. Bryman (*ibid*) compares this to a positivist approach that tends to exhibit a tendency for the researcher to view events from outside, and from the perspective of 'a cluster of empirical concerns' which are imposed upon social reality with little reference to the meaning of the observations to the subject of investigation.

needed. To this end, both research questions are inter-related, as public opinion is modulated with respect to the views of the opinion leaders and the views of the public will impact the likely decisions made by these opinion leaders. Therefore, the research design can be described as a 'nested qualitative-in-qualitative design' (see figure 5.5).

Figure: 5.5. Nested qualitative in qualitative research design:

The graphic depicts how both methods of data collection are inter-related, as 'expert opinion' impacts on public opinion, and public opinion forms part of the overall narrative.



Source: Adapted from Gibson and Brown, 2009

5.2 Research Stages

The stages undertaken through this research process included an examination of the pertinent scientific literature and relevant policy and government documents. This gave an indication of the areas of contention and the areas to which key opinion leaders would contribute in an Irish context. The next focus within the secondary data was on the area of how the public tend to view and understand new food biotechnologies. In this context, the area of risk perception became the perceptual framework for examining public views on agri-food cloning. Differences in how risk could be perceived among different members of the public were used latterly in selecting members of the Irish public for qualitative research. The second stage of research was a series of in-depth interviews with Irish key opinion leaders (n=19). These interviews clarified key national perspectives with regard to agri-food cloning and contributed to the final stage of the research. One of the key issues outlined with the risk literature was a problem overcoming technical complexity and engaging with the public with regard to new food biotechnologies; using a hybrid qualitative methodology called Food-Bio QUIS (Food-Biotechnology QUalitative InsightS) this was addressed. Food-Bio QUIS is a hybrid of DEMOCs – rooted in citizen engagement methodology – and focus groups that uses snippets of pertinent information to allow the public to understand and discuss the technology. The second stage of research used key information generated from the interviews with the Irish key opinion leaders to engage with the Irish public (n=35).

5.3 Secondary Research: Literature Review

The aims of the literature review were to establish the technological breakthroughs that have led to farm animal cloning (mainly through scientific journals), to outline the current legislative positions from a food safety, animal welfare and commercial perspective (government documents, governance websites and policy papers), and to review any prior studies aimed at understanding public perceptions toward the use of cloning and novel biotechnologies generally (mainly though consulting sociology and psychology-based academic literature). The literature presented in chapters two and three sought to clarify the progress of the field from a technological, policy and adoption perspective. To give context and background, literature was reviewed in terms of previous reproductive techniques and associated technologies. The literature also provided a timeline for the development of cloning, and explored probable and possible applications of the technology. In chapter four, the choice of literature to shape the framework and examine the views of the public was based around themes related to food choice, risk communication, attitudinal/sociological perspectives, individual choice motivations and consumer acceptance of novel foods/biotechnology, with direction taken from the Eurobarometer series of surveys.

5.3.1 Development of the Research Format

The development of the research format was guided by the interactive model of research design (fig 5.1). The goals – as defined in the research questions – shaped clearly what the research was aiming to achieve and the method section of the interactive model of research design questions ‘what will you actually do in conducting this study?’ and ‘what approaches and techniques will you use to collect and analyse your data?’. To canvass the

view Irish key opinion leaders and of the Irish public to gauge awareness and likely acceptance needed a certain level of interaction was needed. To this end, the method of engagement became important in collecting and analysing the data. The complex themes emerging from the literature – positions on animal welfare, trade-offs with respect to investment, religious influence – indicated that greater clarity was needed in the debate in an Irish context. Moreover, the views of Irish key opinion leaders became increasingly important in identifying what the salient issues might be for the Irish public. Thus, in the development of the research format, the first *tranche* of data collection aimed to understand the technology and its issues, while the second used this information to best extract the opinion from the Irish public.

Deciding on the methodology for the research questions posed complex challenges, and particularly so as it was in the area of food biotechnology. This is subject which suffers from complexity and low levels of understanding among the public. It was evident in light of the literature that the research had to be exploratory and qualitative in nature. Generating primary data from the views of experts in the area lent itself to several established research methods, but ascertaining similar insight from the public posed challenges. This dilemma is not unique to this research; indeed Frewer and colleagues (1994) suggested that the best way to achieve understanding in the complex relationship between society and innovation in the area of biotechnology is to consider the results of different approaches as an integrated whole. They suggested opening up to newer ideas and harmonising the results to facilitate understanding of the science and society relationship more generally, as well as focusing on particular applications (as was the case with their research on genetically

modified foods). Thus, the research format adopted attempted to open up to elements of risk communication, citizen engagement and broader constructs that may give insight into how the public might view novel technologies (these elements and constructs have been explored as part of the literature review). The following section outlines why the specific qualitative methodology was considered appropriate and the specific methodologies available to the study.

5.3.1. Primary Data Collection 1: In-Depth Semi-Structured Key Opinion leader Interviews

There are a variety of options open to phenomenological qualitative research. In considering the aim of this section of research – to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes, as well as those of the Irish public – the methodology chosen must bring together many types of knowledge, and must be sufficiently open to allow participants to establish their position. For the purposes of this research, all views and perspectives from key opinion leaders (fig 5.7) would be viewed as equally valid, borne out by their expertise, positions and likelihood of being involved in a national debate on farm animal cloning.

In selecting an appropriate methodology for collecting verbal data, the options of ‘interviews’, ‘narratives’ and ‘group procedures’ were all considered (Flick, 2009:212). The possible choices of methods of data collection are outlined in figure 5.6.

Figure: 5.6. Methods for collecting verbal data

Interviews	**Narratives as Data**	**Group Procedures**
Focused Interview	Narrative Interview	Group Discussion
Semi-Structured Interview	Episodic Interview	Focus Groups
Problem-Centred Interview	Joint Narrative	Expert Interview
Ethnographic Interview		

Source: Flick, 2009

Of the available options, the group procedures were ruled out, as the group dynamics may not have been conducive to exploratory research with several policy actors. While the group situation is useful in generating shared knowledge, and perhaps simulating a possible debate in the key issues, other factors, such as individual levels of knowledge and awareness, may have been difficult to ascertain. Furthermore, there are practical issues in bringing together several of these policy actors at one time. The use of 'narrative-as-data' was also considered, but the non-influencing nature of narratives meant that certain subjects would be limited in terms of how they could be explored. Thus, an interview approach was most suited to the research. Ethnographic interviews were ruled out due to their association with longitudinal studies. Problem-centred interviews were not considered, as the approach was exploratory. Focused interviews were eliminated, as the questioning needed to be non-directional and unstructured (Flick, 2009:212). Both semi-structured and expert interviews use an interview guide and are exploratory in nature; however, semi-structured interviews were considered more applicable, as expert interviews are only interested in the 'expert' and not the person (this may rule out exploration of expert-stakeholder ethical frameworks).

5.3.1.1 Instrument

The method best suited to the research was a semi-structured in-depth interview format. In-Depth Interviews or IDIs are typically used to explore the feelings, opinions or points-of-view of individuals. They have been used previously to explore consumer perceptions of innovative food products and new technologies (Bogue *et al.,* 2009). Unique to IDIs is their ability to derive in-depth understanding of personal opinions, beliefs and values; this was particularly of interest to the issues emerging in the literature around animal welfare, investment decisions and religious perspective with respect to agri-food cloning.

IDIs can be used to gain an understanding of the forces that are influencing the decisions of participants. There is no pressure from external sources to conform to group sentiment or group dynamics (the influence of the researcher notwithstanding), with the probing element of IDIs potentially being useful to uncover hidden feelings. Mariampolskii (2001:49) suggested that IDIs should be used when the topic is sensitive or demands insight without the influence of peers. With respect to the research questions, the aim was to canvass the views of key opinion leaders and thus the one-to-one element was an important component of the research.

Drawbacks of IDIs are that they are time-consuming, and the numbers sampled are low when compared to focus groups and other such participatory methods. When compared to a focus group, there may not be the same emphasis on exchange of ideas, but there is scope for the interviewer to be more directed and focused in canvassing the key topics.

5.3.1.2. Sampling Framework

The criteria for the selection of individuals for the in-depth interviews were determined by the following:

- The relevance of the person's day-to-day role to the emerging issue of food animal cloning; this was guided by an analysis of the key opinion leaders included in American and European policy debates. Interviewee organizations included government research institutions, universities, agri-food industry, animal-welfare and consumer representative groups, in addition to government agencies

- The seniority of interviewees: Individuals had to occupy senior positions in management or academia, with significant potential to be influential in the emerging national debate on cloning

The selection of interviewees took several steps. The first was the identification of the key organisations likely to be involved or affected by a national debate on farm animal cloning. These relevant organisations were identified in the chapters examining the state of the art of the technology and governance structures to regulate the application of cloning for food purposes. These organisations included animal breeding businesses, meat producers, food retailers, research scientists in pertinent fields, animal welfare organisations, consumer organisations, government funding bodies, venture capitalists, religious representatives and ethical advisors. The second step was the identification of at least three individuals in those organisations that would fulfil the selection criteria – this gave a 'long list' of 39

candidates. The aim of having three candidates allowed for *at least one* to agree to be interviewed, but if more than one agreed they were also interviewed. The method of engagement was an email asking if they would participate in an interview focusing on novel food technologies in the food industry (agri-food cloning was not mentioned until the interview). All contacts were from a proprietary database but in some cases, interviewees were asked for a referral if access to a particular individual was difficult. Using the proprietary database and 'snowball technique' 19 people agreed to be interviewed (see fig. 5.7). With respect to the interactive model of research design (fig 5.1), and the focus on the plausible interpretations and validity of the data generated, there are several assumptions made with respect to the interviewees and the data. These included the information that the interviewees give is honest, that it is a likely reflection of their organisational perspective and that these perspectives are likely to end up in the public sphere (in the likelihood that there is a public debate on farm animal cloning).

Figure 5.7: Expert Stakeholder Interviewees

Organization type	Primary remit	Qualification (Highest)
Government Agency		
Advisory, investment	Company business support	MSc
Advisory, regulatory	Ethics	PhD
Food industry support	Economic analysis	MA
Regulatory	Food safety	PhD
Research Institution		
State research	Animal productivity	PhD
University	Animal reproduction	DSc
University	Animal genetics	PhD
University	Human/animal immunology	PhD
University	Scientific communication	PhD
Private Company		
Beef production	Domestic/International sales	HDip
Animal breeding	Artificial insemination	MSc
Food retail sales	Group purchasing manager	MSc
Venture capital,	Emerging technologies	PhD
Non-Governmental Organisation (NGO)		
Agriculture,	public representation-lobbying	MSc
Farming, organic,	public representation-lobbying	MA
Farming, organic,	public representation-lobbying	MSc
Animal welfare,	public representation-lobbying	BSc
Animal welfare,	public representation-lobbying	BA
Religious body,	Christian	MSc

The interviews were carried out by the researcher using a semi-structured interview guide (see Appendix A for the full five page questionnaire). The guide used a series of open-ended questions to establish what technologies were top-of-mind for individuals and developed later to drill-down on key issues (see fig. 5.8 and 5.9).

Figure 5.8: Early stage interview guide questions

a) *I want to start off by asking you a little bit about you day to day work and where in industry you have most interaction?*

b) *Has this changed in any way over the past few years?*

c) *In terms of your role in xyz and the food industry in Ireland, what do you think will be the most important issue on your agenda over the next year?*

The themes selected for interview were driven by the themes that emerged from the chapters on the state of the art of farm animal cloning and the development of government structures to regulate farm animal cloning. It was important to establish if this was a technology being discussed (see fig 5.9) and whether it was being positioned relative to other assisted reproductive technologies (from the literature this was a major difference in US and EU governing structures). Other factors of importance included to the trade-offs in willingness to invest in this technology and whether it could be commercially successful. There were also a range of issues that emerged regarding the food-safety, ethical barriers and public reaction that needed perspective from Irish key opinion leaders. Ultimately the

interview guide was based around five major themes which were the food industry; technological innovation; societal perspectives; exploitation of non-human animals; and moral aspects.

Figure 5.9: Interview guide questions specifically on farm animal cloning

A. How would you rate your understanding of animal cloning? Would you consider it to be an extension of existing animal reproductive techniques? Where you see the main uses for this technology?

B. In your opinion, what do you see as the long term risks/ benefits associated with animal cloning? For which groups do you see the risks outweighing the benefits and vice versa?

C. In your opinion, as a research strategy, should Ireland be investing to see if animal cloning could improve the safety or profitability of the beef and dairy industries?

D. In terms of anticipated public response to cloned farm animals, how do you think the public will react? Do you see any precedence for this? When?

The subject of animal cloning was contextualised during interviews against a general narrative of an evolving food biotechnology sector, and the relevance of this to the Irish agri-food system. The interview guide was very slightly adjusted to accommodate specific interviewee expertise profile (for example, all interviewees were asked about the role of religion in relation to cloning, and its relevance to the debate, but with the Catholic Church representative it was examined in more detail). Groeben (1990) has suggested that this is a limitation of the semi-structured interview, as it means that the guide is not consistent throughout, but does allow for more insight in the particular area of expertise of the individual.

5.3.1.3. Data Collection and Analysis

The majority of interviews took place at the interviewee's work place (between October 2009 and January 2010) and lasted between 1 – 2 hours. Interviews were audio-recorded (supplemented by written notes) and were later transcribed by the researcher *verbatim*. Analysis of the interviews was carried out using NVivo7 software (QSR International), with specific focus on emerging themes and how they relate to the research questions. Data coding was carried out thematically as a multi-level procedure (using the software, themes were further categorised to 'sub-themes' and 'sub-sub-themes'). According to Boyatzis (1998), thematic analysis has a number of advantages, including pattern recognition within the data, planning and systems thinking with respect to organising patterns in a usable way, and also a required level of knowledge with respect to the subject matter. Boyatzis (*ibid*) also suggests that thematic analysis should be underpinned with an acknowledgement of the cognitive complexity, with multiple causes and variables within the data. In terms of the

physical act of coding data, Munhall (1994:305) advised that it was up to the researcher to determine which themes convey meaning with regard to the study phenomenon. Munhall (*ibid*) also suggested that by using this approach, themes can be disregarded if seen as incidental, but thorough working of the data, and the use of inter-observer consistency, may negate this potential problem. The validation of the salient themes was carried out using this inter-observer reliability method and input from the research team.

The analysis of the data in from the series of in-depth interviews is outlined in Chapter 6. The rationale behind the methodology and integration of these results into a method to canvass the views of the Irish public is outlined in the following section.

5.3.2. Primary Data Collection 2: Food-Bio QUIS

The review of the literature highlighted among other factors that a knowledge deficit was likely to be a significant factor in engaging with the public on cloning[32]. This position was later strengthened through the analysis of data from key opinion leaders during the series of IDIs. Canvassing the views of the Irish public with respect to the use of animal cloning for food production purposes represented a serious methodological challenge. The option of carrying out the research despite the predicted knowledge deficit was explored; this was discounted by the strong body of evidence in literature suggesting that results would be limited.

The provision of information was subsequently explored as the method by which the views of the public could be canvassed. Again, this route had challenges. While this research is concerned with 'information provision and data collection', much of the literature is concerned with 'information provision in educating/seeking to increase acceptance'. The role of the information source also emerged also emerged as being important, as it can amplify or attenuate the perceived risk depending on levels of trust and other such factors (Kasperson *et al.,* 1988). The implications for this research method are that while 'information provision' is important to generate insight, it could also inadvertently induce a 'perception change'. *Prima face* this may seem obvious, but if the respondent was already familiar with the phenomenon, the provision of information could either change

[32] The Eurobarometer survey series indicated that since 1991, Irish responses to questions on biotechnology were characterised by positive attitudes to the applications, but low intention to use. Ireland has also consistently scored poorly with regard to knowledge of biotechnologies and found that the public regarded their usage as 'risky'. The 2008 survey (specifically on farm animal cloning) revealed that while three quarters of Irish respondents said that they had heard of cloning, and knew what it meant, the vast majority could not differentiate it from other animal biotechnologies. This level of incorrect response was the highest in 27 EU countries. These broader trends indicated that the research approach should assume low knowledge of cloning (Eurobarometer, 1992, 1993, 1997, 2000, 2003, 2005, 2008, 2010).

perspectives or strengthen the individual's previous position. One of the priorities then, in selecting the research instrument is that it would encompass perspectives on all key issues. Thus, the opinions of Irish key opinion leaders formed the basis of the 'information provision' element of the research element.

5.3.2.1. Instrument

The aim of this phase of the research was to canvass a cross-section of the Irish public to gauge the current levels of awareness among specific groups and examine their likely acceptance. In terms of the qualitative approach, canvassing the views of specific groups lent itself to several established methodologies – though the element of information provision meant some were not suitable. Of the available group procedures, joint narratives were ruled out, as they do not allow for stimulus or intervention (Brunner and Feldman, 1996); such prompts are often needed where the researcher wants to capture reaction or insight from individuals, but is hampered by the phenomenon being new or unknown.

The options suited to the research aims were either a focus group or a group discussion. Further consideration was given to a potential modification of the group scenario to allow for information provision. Focus groups with modifications were finally selected because of the manageable group size (4-8), purposive sampling, the broad range of available literature specifically relating to the data likely to be generated, and the ease with which stimulus or intervention can be made to the generic focus-group format.

In the past, focus groups have been adopted to overcome lack of knowledge on the part of participants through providing stimulus materials or projective techniques, such as association, completion, construction, and choice ordering (Will *et al.*, 1996). McNeil (2005) further asserted that these projective techniques can include personification, analogies or hypothetical situations, role playing, word association or prompt cards. When examining public perceptions on cloning in the United Kingdom, the Food Safety Authority (FSA) modified the focus-group format to include the provision of self-led research executed in the preceding week (FSA, 2008). While these techniques were very close to a suitable methodology (particularly focus-groups incorporating prompt cards), the complexity and range of issues to be included in the group discourse ruled out 'conventional' projective techniques.

In broadening the search for methodologies to gain qualitative insight from a cross-section of the public, the area of citizen engagement was examined. With respect to the research questions set out in the interactive model of research design (fig. 5.1), this study aims to canvass the views of the Irish public and not Irish citizens *per se*. Rowe and colleagues (2004) define citizen engagement as the practice of consulting and involving members of the public in the agenda-setting, decision-making, and policy-forming activities of the organization or institutions responsible for such functions. The benefit of this type of methodology is that it can be used when looking to stimulate debate and overcome information barriers with respect to complex new technologies (Besley *et al.*, 2008). The role of citizen engagement for this purpose is often endorsed by democratic movements that seek to involve citizens in technologies that often require public funding, or technologies

that will have a significant impact on society. However, the differentiation in this study is such that the views of public include political driven (citizen) elements – whether the Irish government would be acting in the people's interest by investing in cloning for example – but also how they perceive the technology and their willingness as consumers to eat resultant products.

Typically, the outputs from such citizen engagement are used for government reports, and are often part of a broader consultation process for policy formation. Critics of citizen engagement have suggested that very little scope is given to examining 'true' perceptions, as the methodology designs are overly concerned with information provision (Schibeci *et al.*, 2006). However, within the present study, the research objectives were clear, and an established, systematic method of data analysis was employed thereby ensuring a focus on interpreting public perceptions. A selection of the more common citizen engagement methodologies is outlined in the following section.

5.3.2.1.1. Qualitative Public Discourses/ Citizen Engagement

Fishkin and Luskin (2005) showed that through appropriate methods of engagement it is possible for the lay public to deliberate on issues, that they benefit from doing so, and that the process neither biases nor polarizes their opinions. Price and Neijens (1998) have critiqued this approach, such that public opinion can apply to different phases (level of exposure to the issue or level of tacit knowledge) or stakeholders (such as only 'scientists') in the democratic decision-making process. Furthermore, it has been suggested that deliberative polls attempt to explore several distinct issues at once, making it difficult to

identify specific objectives for evaluating success (for example, social justice for farmers and protection of animals are two distinct issues associated with farm animal cloning). Price and Neijens (1998) suggest that various aspects of the methodology (provision of information, group dynamics) can impact on citizen decision- making. Moreover, they suggest that lack of knowledge about how methodology influences individual and collective opinion outcomes will lead to difficulty in interpreting results.

5.3.2.1.2. Deliberative Polls

Fishkin (1996) suggested that ordinary polls reflect what the public is thinking, even when it is disengaged or inattentive. He further suggested that a deliberative poll attempts to reflect what the public would think, if it were truly engaged by the issues. Typically, deliberative polls are carried out with between 200 and 600 members of the public. The methodology is therefore posited as one of the more statically representative methods of citizen participation. The method is particularly useful when trying to engage citizens on a topic where there is little knowledge on the topic or the possible trade-offs. The sample is taken at random, but may be adjusted if minority groups are excluded.

The first step in the methodology is to poll a participating sample. This acts as the baseline for opinion. At this point the sample is sent information-balanced briefing materials. The sample is then invited to participate in small moderated discussion groups where they develop questions to challenge the 'expert opinion' in the area. At the end of the process, the sample is re-polled. Deliberative Polls are often run in association with TV stations (Channel 4 in the United Kingdom carried out a Deliberative Poll on how society should

tackle crime in 1994). Deliberate Polls are useful, as they delivers a statistically significant sample, increases understanding of a possibly complex issue and demonstrates the difference between informed and uninformed opinion. The downside to this method is that it does not deliver qualitative insight, it is expensive (especially the larger TV debates) and there is not as much room for debate as a methodology such as a Citizens' Jury.

Citizens' Juries are primarily focused on gathering informed citizen opinion for use by public-policy decision makers. They are used particularly where public opinion is sharply divided, and decision- makers are struggling as to what to do. They were originally designed for small communities to deal with local issues, but are now being used to look at national issues (Jefferson Centre, 2004). It has been suggested that with close attention to the process, citizens' juries are a legitimate and innovative approach to participation in public-policy processes in contemporary democracies (Smith and Wales, 1999). In this regard, the juries are useful in advising decisions, rather than making the decisions for policy makers. In the trademarked USA Citizens' Juries™, random and demographically representative panels of citizens meet for four or five days to discuss an issue. During the course of this period 18-24 population representatives hear from various expert stakeholders and are allowed time to deliberate. At the end of the Citizen Jury, the panel deliver their verdict and recommendations to the public. The Citizen Jury can deliver informed opinion and possible solutions, and furthermore may generate wider debate on the issues. However, the jury can take several weeks to assemble, they can be costly, and there may be an issue if the policy makers reject the jury findings.

5.3.2.1.3. DEMOCs

The New Economics Foundation (NEF) developed a method of public engagement called DEMOCs (DEliberate Meetings Of CitizenS). DEMOCs it is a method of citizen engagement to involve citizens in the evaluation of new technologies. DEMOCs was developed to supplement and give alternatives to Citizens' Juries and Deliberative Polls. Techniques such as Citizens' Juries have elements defined by particular criteria; they will have a jury (often "at random" selection of citizens), witnesses or specialists in a topic and an overseer or an advisory panel. DEMOCs is played as a game. The game involves three elements: participants – who play the game –, the provision of information – carefully chosen information on the phenomenon or technology delivered on 'playing cards' – and a facilitator – who manages the game and will often, but not necessarily, have an expertise on the topic. DEMOCs is defined as a method of participation in the form of a card game around which participants discuss issues for approximately two hours, and come to agreement or divergent views on those issues, or on general principles (Bruce, 2003 *a*). Walker (2002) has reflected on DEMOCs, suggesting that opinions can shift considerably in the game (when compared to straw-polls held on the topic before commencement) and that participants can find large areas of consensus. The game encourages individuals to form opinion on complex issues, and it is suggested that it empowers them to believe they have a right to have a say. The game also avoids a 'teaching' or 'lecturing' environment which may engender a negative bias in participants, and the format may provide a level of enjoyment for participants. In his evaluation of the game format, Walker (2002) cites Huizinga (author of *Homo Ludens*) and suggests that games make people feel safe, that

they stimulate creativity through the provision of "absolute freedom within very definite limits".

DEMOCs games have been used in two-fold public discourses where the first part of the process is concerned with establishing facts and issues pertaining to the technology (the second being the game itself). Walker (2002) suggested that the facts that form the basis of the game are 'certified and balanced' before engaging in the participatory game with the public. The game has been adapted in the past for public consultation on issues such as GM foods, nano-technology and synthetic-biology (Bruce, 2003; 2008; Bhattachary *et al.*, 2010). DEMOCs has also been used as a learning tool for schools in areas such as animal experiments, climate change, genetic modification of food and stem-cell research (NEF, 2005 *a,b,c,d.*). In general, the game had been used as part of a strategy to deliver insight, opinion and voting on public consultations. These outputs have been in government report form, and have gone on to contribute to policy in the respective areas.

5.3.2.2. Selection of Instrument

Citizen Engagement methodologies have all been used to allow the public to debate complex issues, or issues involving several key opinion leaders, often where there is limited knowledge. In looking for common themes in these consultation methods, the clarification of the pertinent cultural and societal trends appears to be an important consideration. Typically, this crucial precursor is achieved through the establishment of a panel of experts from a diverse range of backgrounds. These key opinion leaders are often from a mixture of disciplines, such as bioethics, technology, science, medicine, engineering, law, philosophy,

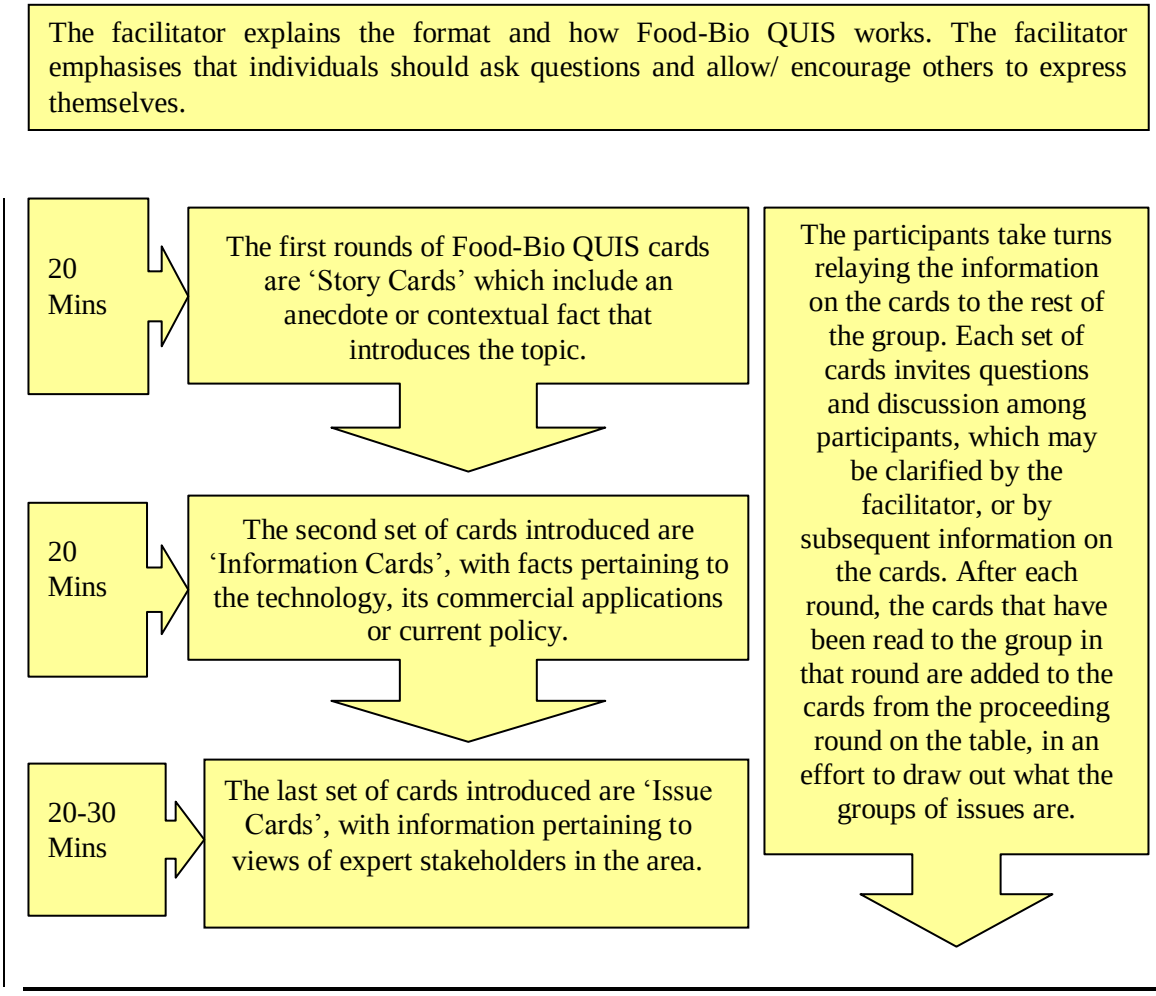
theology, or other areas of social sciences. In incorporating the views of these key opinion leaders, the aim is to identify the likely 'key issues', and to incorporate these into the public consultation. To this end – and with respect to the methods in the interactive model of research design (fig 5.1) – the aim was for the key opinion leader perspectives to define the areas of discussion for the Irish public. From the literature, there is no definitive methodology on how such consultations should be carried out, but the overarching theme throughout the consultation mechanisms is to engage the public where it has been otherwise difficult.

Thus, while several of the available mechanisms may potentially have generated some insight for this research project, ultimately the research question and method of analysis dictated that a hybrid approach (incorporating citizen engagement and focus-group methodology) would hold the best possibility for success. The methodology adopted the DEMOCs game format and used it as a projective technique within a focus group setting. This format permitted the provision of pertinent information in a structured format so that the complex technology could be explained, while also allowing the provision of information from a broad range of key opinion leaders (see figure 5.8). It was also considered that the 'playing card' element of DEMOCs would aid in the grouping of information in order to 'map-out' the technology issues. The reasons for incorporating elements from focus group methodology lay in the option of setting systematic selection criteria for participants (such as purposive sampling), the ability to elicit divergent views (as opposed to achieving consensus) and the ease of reporting of results. The author is not aware that this specific type research has been undertaken before.

5.3.2.2.1. Food-Bio QUIS

The modified focus group method was designated 'Food-Bio QUIS', FOOD BIOtechnology QUalitative InSights. The aim of Food-Bio QUIS is to provide insight from the public on complex food technologies based on contributions from key opinion leaders, and in the interests of informed decision-making. The methodology incorporates elements of an established qualitative research method – focus groups – and elements of public participation methodology – DEMOCs –. The information used in this case was generated from the series of in-depth interviews with Irish key opinion leaders (figure 5.10)

Figure 5.10: Food-Bio QUIS, procedural outline



The general procedure for the game aspect follows elements of a focus group methodology. The facilitator introduces himself/ herself and the research topic, and gives the rules or conventions before beginning. Food-Bio QUIS also follows conventional focus group procedures in the discussion of emergent topics, and the summing up of what was discussed within the group. It also draws parallels in terms of leading the discussion areas, but differs in their delivery. Typically in a focus group, the facilitator will steer the group towards 4-5 core areas of interest; by contrast, Food-Bio QUIS introduces 10-15 areas through the provision of cards (see fig. 5.10) bearing pertinent information (see fig. 5.11).

Figure 5.11: Outline of Food-Bio QUIS cards to introduce discussion topics

Type of Card	**Purpose**	**Example**
Story Card	Anecdote or contextual	Dolly the sheep may have been the world's most famous clone, but she was not the first. Cloning creates a genetically identical copy of an animal or plant. Many animals - including frogs, mice, and cows - had been cloned before Dolly. Plants are often cloned – taking a cutting produces a clone of the original plant. Human identical twins are also clones.
Information Card	Facts pertaining to the technology/commercial applications or current policy	In the United States food labels do not have to state that food is from animal clones or their offspring. The FDA has found no science-based reason to require labels to distinguish between products from clones and products from conventionally produced animals.
Issue Card	Wider arguments from the full range of policy stakeholders	While it is up to each individual to determine their viewpoint on different technologies, the major world religions do not have an issue with livestock cloning. The Catholic Church, in its "Reflections on Cloning," says "there is a place for research, including cloning, in the vegetable and animal kingdoms." On the whole, leading Muslim and Jewish thinkers also agree that cloning is acceptable to meet standards of kosher and halal.

Participants are asked to keep a written note of any comments that arise while somebody is speaking, and these comments are invited at the end of each round. It is this information and discourse that forms the basis of the qualitative insights.

5.3.2.2.1.1 Food-Bio QUIS Sample Groupings

In line with common practice for focus-group selection criteria, groups were composed of people who were similar to each other in a way that is important to the research; the nature of the similarities is determined by the purpose of the study (Krueger and Casey, 2000). The selection criteria for this research were driven by the literature and guided by the methods in the interactive model of research design (fig 5.1). The aim of the research is to canvass the views of the Irish public and for this purpose it was integral to differentiate the individuals into groups that would widen the spectrum of views generated. From the literature – beyond the level of the individual perception of risk – the key measureable demographic and socio-demographic variables that are correlated with risk are gender, age and social class. These three variables became the basis for grouping members of the public, though several exclusion criteria were also employed. The establishment of parameters for the three main variables was based on the NRS system that has become standard for market research (MRS, 2006).

In total, six groups were selected for the study with two male, two female and two mixed gender and furthermore three each of ABC1 and C2DE groupings. The selection of age-groups was spread from 18-24 to 25-34 to 35-44 to 45-59 to 60+. Individuals were recruited through the contacting of two different sports organisations, a book club and an

office manager. Individuals declared their interest to participate in a study 'looking at new technology in the food industry' by passing on their phone numbers the designated contact. Individuals were called and went through a screening on the three main criteria and the exclusion criteria until the six groups were full. In total, over 60 people were screened.

Further to the 3 main selection criteria, there were also several exclusion questions in the recruitment questionnaire based on best practice for market research (MRS, 2006), and several factors that were specific to the research and based on literature (FSA, 2009). In terms of best practice: willingness to participate in a modified focus-group; no recent participation in focus groups or in-depth interviews; Irish residence; individuals who had not campaigned against GM crops or in favour of animal rights; persons that were not at all interested in the news or current affairs. The research also excluded individuals from market research, public relations, journalism, advertising, government, biotechnology, animal welfare, farming and food manufacturing industries. Based on the literature in chapter three; a minimum level of meat consumption (no vegetarians, no vegans); and education not being related to the research area in question.

The exclusion criteria also included a minimum of a Leaving Certificate education; the rationale for this was to ensure that individuals would have the ability to read/comprehend materials during the process. By putting the educational pre-requisite in place the study excludes individuals that might be otherwise willing and to participate in a conventional focus group. Thus while this may appear inequitable or unethical, when the practicality of

methodology was considered, a high level of comprehension was deemed important as to prevent situations where participants may be embarrassed/ feel inadequate in front of peers.

Figure 5.12: Group Selection

	Group 1	**Group 2**	**Group 3**
Criteria 1 Gender	Male	Male	Mixed
Criteria 2 Age	25-34	35-44	18-24
Criteria 3 Social class	A,B,C1	A,B,C1	C2,D,E
Worldview /Pet Ownership /Meat Consumption	Mixed	Mixed	Mixed

	Group 4	**Group 5**	**Group 6**
Criteria 1 Gender	Female	Mixed	Female
Criteria 2 Age	45-59	60+	30-44
Criteria 3 Social class	A,B,C1	C2,D,E	C2,D,E
Worldview /Pet Ownership /Meat Consumption	Mixed	Mixed	Mixed

5.3.2.2.1.2. Other non-quota related criteria:

Pet ownership/ Meat Consumption/ World View

In addition to selecting participants according to the selection criteria above, other participant characteristics were also recorded, as they emerged from the literature as possibly being influential on perceptions related to cloning. These views were gathered on a brief questionnaire administered before the discussions began (typically as soon as people arrived). The incorporation of individual pet ownership was to examine whether having a companion animal had an impact on attitudes to cloning There were some indications that pet-ownership would influence opinions on animal welfare standards, and what was

deemed ‘appropriate use’ for animals. Meat consumption was recorded to ensure that participants were consumers of meat products, but it also served to highlight medium and higher consumption patterns within the groups (Morgan *et al.*, 2008). The measurement of world view (as outlined in Chapter 4) gave another dimension to individualistic risk, and was incorporated as a non-probabilistic addition to participant views. The literature suggested that world view may be more significant when the risk relates to a food or an environmental hazard, rather than terrorism or illness. Religious influence was also a factor related to the social amplification of risk and was not quota sampled but would be discussed throughout. The reason for this was that the literature suggested that it was not necessarily religious association, rather the strength of religious conviction. As the strength of religious conviction is difficult to measure – and may introduce a bias to proceedings by pre-discussion testing – it was decided to let the topic emerge during the group discussions and in response to religious prompts.

5.3.2.2.2. Data Collection and Analysis of Food-Bio QUIS

Three of the Food-Bio QUIS discourses were held in a sports organisation (of which participants were members), two at participants’ homes and one in the Dublin Institute of Technology. They took place between February and March 2011 and lasted between 60-75 minutes. Interviews were audio-recorded (supplemented by written notes) and were later transcribed by the researcher *verbatim*. As with the IDIs, data analysis on Food-Bio QUIS was carried out using NVivo7 software (QSR International). Data coding was carried out thematically as a multi-level procedure (using the software, themes were further categorised to ‘sub-themes’ and ‘sub-sub-themes’). The validation of the pertinent themes was carried

out using inter-observer reliability and input from the research team. The results of this data analysis are outlined in chapter 7.

5.4 Conclusion

This chapter on materials and methods has attempted to outline the various drivers and considerations with respect to the choice of methodology used over the course of this study. The interactive model of research design (fig 5.1) was a useful tool in guiding and testing the design and validity throughout. The aim of this research is to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes, as well as those of the Irish public; the steps taken in the research design have highlighted where the current body of knowledge has contributed, where this study aims to contribute. The nested qualitative in qualitative research design sets out how the established in-depth interview methodology ties in with the experimental Food-Bio QUIS as the views of key opinion leaders and the Irish public are canvassed. Using this methodology, the following two chapters set out the results of this study and examine how the design contributed to those results.

6 In-depth Interview Results

6.1 Introduction

The following chapter outlines the findings from data generated during a series of in-depth interviews (IDIs) with 19 key opinion leaders (KOLs) likely to be involved in a national debate on farm animal cloning. The interviews are set against a backdrop of an Ireland which competes globally in beef and dairy sales, which identifies biotechnology as a pillar of economic growth and is at the cutting edge of livestock breeding programmes. A semi-structured interview guide was used to elicit responses from the interviewees. While the questions were pre-determined, the aim of the researcher was to let the conversation flow as much as possible, excluding some questions and returning to the script when suitable to do so. The questions were supplemented with open-ended prompts. The emphasis with the verbal cues was to allow the interviewee to speak and explain their position as much as possible. The IDI guide was based around five major areas which were: food industry development; technological innovation; societal perspectives; exploitation of non-human animals; moral aspects. The discussion guide took the major issues from the policy discourse in Europe and the USA and mapped these out with some closed, but mainly open lines of questioning and prompts. Some lines of questioning are included in within the following results and Appendix A has an example of a full guide.

Interviews were digitally recorded (supplemented by written notes) and were later transcribed. The transcripts were coded and the key messages were grouped into themes. The themes were then cross referenced across all scripts to compare and contrast the opinions of the key opinion leaders. In handling this large amount of data (text) the coding and thematic grouping was accomplished using a computer called NVivo7 (QSR

International). The practicality of using NVivo7 meant that all scripts were uploaded and chunks of text could be highlighted and assigned a theme (a folder). Once a broad theme was established, this could be further refined to a sub theme (a sub-folder). With this grouping of the data, discussion of the key themes was given structure and the data was easier to manage. For example, within a broader theme of ethical perspectives the coded script could be further refined to deontological or utilitarian beliefs; in this example, views on how animals should be treated in research were given greater insight.

One of the limitations of the semi-structured approach was some of the subject areas discussed were pre-determined before the scripts were thematically analysed. However, this allowed key opinion leaders to discuss the subject areas highlighted as relevant in US and EU policy debates to date. Insofar as possible, questions were open ended and differing perspectives were encouraged through prompting. In terms of the validity of the themes in the following chapter, they were debated, reworked and agreed as salient by the research team.

6.2 Determination of Levels of Awareness of Food Industry Issues

Interviewees were initially asked to identify priority issues (opportunities and challenges) for the European food sector. This was broached through a series of 'soft' lead-in questions (see fig. 6.1).

Figure 6.1: Introduction questions

d) *I want to start off by asking you a little bit about you day to day work and where in industry you have most interaction?*

e) *Has this changed in any way over the past few years?*

f) *In terms of your role in xyz and the food industry in Ireland, what do you think will be the most important issue on your agenda over the next year?*

Only a single person cited the emergence of animal cloning for food purposes as an unprompted, top-of-mind issue, liable to emerge over the short-medium term.

> *I suppose novel food is the busiest [area], but nanotech and the animal cloning are busier now because the Novel Food [Act] is being revised, and there's new legislation coming and it's going to include animal cloning. When I say include, it's going to include it… include it to ban it, which doesn't make sense. … Nanotechnology was as mentioned as well. They're on the horizon at present in other countries, not in Europe yet, but it's coming down the tracks. So it's important to keep ahead of those.*
>
> **Government agency, regulatory-food safety representative**

Further discussion revealed that with only a few exceptions, formal discourse on the topic of animal cloning at the organizational level had not occurred to any significant degree: only a single participant organization had incorporated such debate into a policy document (at the time of interview). There was little evidence that this reflected a conscious relegation of the issue to a lower level of importance on the basis of detailed consideration. Rather, it was the level of awareness regarding the progress of such innovation for food purposes that appeared to be low; interviewees were generally reactive to questions concerning cloning rather than proactive in demonstrating knowledge of the key aspects. Consequently, the problem-framing stage, integral to the process of risk governance (Renn, 2003), had not occurred in Ireland up to that point. It is important to highlight that the interviews pre-dated the 'clone-gate' incident in the United Kingdom (Meikle and Phillips, 2010) by six months. While receptivity to the idea of cloning for food purposes varied among interviewees, the near term prospects for this technology were largely viewed with scepticism.

> *I would say it's just about got no chance, probably because the producer just won't bother to go there — too expensive. In the short term, and 10 years is the short term in this technology, [it is] too expensive to be at all viable.*
>
> **Private Company, Beef Production**

In questions relating to modern technology in food production, interviewees demonstrated good awareness, with over half advocating a role for genetic modification as a component

of plant breeding. A similar number expressed doubt about the putative health benefits of functional foods. However, with the exception of interviewees directly engaged in the animal or meat sectors, an awareness of more near-term technologies in animal husbandry was not apparent. Additionally, knowledge relating to high profile failures of animal biotechnology, such as the 'Beltsville pigs'[33] (Tansey & D'Silva, 1999), or newer GM innovation, such as 'Enviro-Pig'[34] (Minard, 2010) was not apparent. This reflects the wider European situation, where public recognition of terms such as 'genetic modification' (GM) and 'cloning' is higher than terminology such as 'genomic selection' (Gibbs *et al.*, 2009).

Following on from this, objective knowledge about the role of currently used ART in animal breeding varied widely (see questions in fig 6.2). Artificial insemination (AI) was the primary reference point for most interviewees who were not directly involved in this sector.

Figure 6.2: Knowledge of Farm Animal Cloning

How would you rate your understanding of animal cloning?

i. Would you consider it to be an extension of existing animal reproductive techniques?

ii. Where you see the main uses for this technology?

[33] The United States Department of Agriculture Beltsville facility carried out the genetic modification of pigs using a bovine or human growth hormone gene to increase yield (Pursel & Rexroad, 1993). The pigs demonstrated increased weight gain and feed efficiency, and exhibited changes in carcass composition that included a marked reduction in subcutaneous fat. However, the pigs also had obvious physical deformities, including premature arthritis, dermatitis and problems affecting their major organs.

[34] EnviroPig is a pig which has been genetically modified to excrete less phosphorus, with putative benefits for feed conversion and the environment.

Respondents possessing a technology background, and who demonstrated knowledge of ART, differed in opinion on the commercial viability of techniques such as embryo transfer/splitting: the value of the animal was of paramount importance in the consideration of this option.

> *So AI could be used more in the dairy [industry]. AI is not used widely in the beef side. Embryo transfer is only used for high-value animals that tend to be pedigree animals. I don't think you can say much more about that.*
>
> **University Scientist, Animal Reproduction**

There was evidence of a close association of cloning with transgenic technologies in the minds of some respondents, perhaps reflecting an awareness of the origins of the technology within the human health sphere.

Greater consensus was apparent in those possessing a technology background on the issue of farm animal cloning. More than half agreed that cloning could be viewed as "an extension of the natural breeding process." A single reservation was registered relating to a perceived fundamental flaw of the technique: The incorporation of mature DNA into an egg was cited as a major pre-disposing factor for possible increased mutation rate and premature aging (this was not cited in the literature as being a concern for US or EU authorities). There was also evidence of a close association of cloning with transgenic technologies in the minds of some respondents, perhaps reflecting an awareness of the origins of animal cloning technology within the human health (pharmaceutical) sphere. An

animal productivity representative working in research for a government agency said during the interview:

> *No, it's a very big step; it's a very different approach altogether. The other technologies are really just assisting or trying to control or trying to enhance the normal process – maybe correct a hormonal deficit or maybe increase the number of eggs present – so to give you a better chance of one being fertilized or implanting multiple embryos, again in the hope that one at least would grow in the womb or whatever the term used. So they're all really just trying to tweak [original emphasis] the existing process. I suppose semen-sexing would be a bit outside tweaking the existing process, but cloning is definitely coming at it from a totally different angle."*
>
> **Government Scientist, animal productivity**

6.3 Cloning as an Investment strategy

Figure 6.3: Investing in Cloning

In your opinion, as a research strategy, should Ireland be investing to see if animal cloning could improve the safety or profitability of the beef and dairy industries?

Among those interviewees who could envisage a role for cloning in the food sector, a number of key factors were identified as being of critical importance in deciding its commercial future (in response to figure 6.3). Among these, the prior market performance of the technology in the USA, the likely required scale of operation, the feasibility of integration into existing farm practices (conventional and organic) and the resolution of any outstanding questions relating to food safety were specifically mentioned. A stakeholder from the food retail sector opined that any stance adopted would be influenced by the consumer and their needs. They also suggested that an early decision on the part of the policy makers was important, so that Ireland would not be on the 'back foot' with regard to the technology. Other possible limiting factors included the perceived European regulatory uncertainty (as has been outlined in chapter 3). However, farming and industry representatives highlighted the urgent need for the incorporation of economic projections into the value of cloning for the Irish industry: if it delivered a cost-benefit, they felt it should be examined further.

Stakeholders fitted into two camps: one believing that Ireland should adopt a watching brief, and the other that some research in this area should be carried out. A venture

capitalist, government scientist and a meat industry funder believed that Ireland was not a leader in technology development in this area, and thus the position Ireland should adopt is to wait until it develops elsewhere. It was also suggested that the agencies keeping a watching brief on policy developments elsewhere should adopt a strategy for justifying and communicating this type of research. As a research strategy, cloning animals for the purposes of food production is not generally seen by Irish key opinion leaders as an area that would warrant funding for commercialisation at this present time. KOLs opined that Ireland should adopt an early-stage research strategy with regards to cloning; medical and biomedical applications were seen as a better use of funding by one academic scientist and an animal reproduction scientist. It was suggested by an academic scientist, a farming representative and a meat industry representative that Ireland needs funding in this area to maintain competitiveness. These individuals suggested that Ireland needed to be at the cutting edge of new technology to keep up with competitors, such as New Zealand, and to be able to contribute to how cloning develops globally.

> *We should definitely be looking at a research strategy, we absolutely must, because we are going to be benefiting, either directly or indirectly, from other people's research, or we'll be using or exploiting. So in order to best use and exploit what's been found in other places, we need to be at the cutting edge level ourselves, just to be able to make those decisions, so we must be engaged in it, and we should be aiming to be world leaders so that we too can be decision makers, field leaders in it and influencing what's happening in other countries.*
>
> **University Scientist, Immunology**

This ‘cutting edge’ research position is in contrast with a government scientist who considered cloning low on the list of technologies which deserved seed capital.

> *It wouldn’t be my first (area to invest in), it wouldn’t be top of my list of things that we need to spend money on in the country or in this organisation, but my view of it is that we in (organisation) and the country as a whole needs to keep a watching brief on this at the moment. As with lots of things, we tend to be not the developer and not the first people to do all the basic research, but we tend to come in when things are getting near application and develop technologies further and adapt them further for use in Ireland.*
>
> **Government Scientist, Animal Productivity**

6.4 Animal Welfare

The theme of animal welfare featured prominently during data analysis. Discussion centred on what was considered as the appropriate use of animal life. While all KOLs tended to mention the same uses for animals, some justified the high mortality rates in the context of the potential benefits on offer, while others objected. For example, with regard to the production of medicines for human health through transgenic animals, an individual animal welfare KOL described it as a ‘nightmare’ scenario, while another endorsed the approach:

As mammals go the cow is a fairly big one, produces a lot of milk and if you can secrete proteins into milk (as a bioreactor) and have them (proteins) then isolated in a very easy manner, that makes sense to me.

Venture Capitalist, Emerging Technologies

This was not to say that this individual condoned animal cruelty; rather their decision-making was informed through prioritizing the needs of humans, and insofar as possible, preventing any undue animal cruelty. An academic scientist who indicated no fundamental objection to cloning stated that cloning for the purposes of food production is cruel, given the current levels of animal suffering.

Well, the potential for welfare (problems), cloned animals don't tend to be particularly healthy animals. So there's a potential welfare problem. So I'm not a big fan of it to be honest for (food) animals.

Academic Scientist, animal genetics

Animal welfare specialists outlined that they opposed cloning on the basis that the level of donor animals to produce one cow (they cited 80 donor animals) and the resultant surgery was too high a cost. They also outlined that the motivation for cloning animals was focused on increasing the level of milk production, a use which they believed to be unnecessary. Cloning was considered to be animal exploitation, and those involved were considered to

have ‘no regard’ for the suffering of the animal. Another welfare specialist believed that cloning was removing genetic diversity from animals, thereby making them more susceptible to disease. Organic farmers opposed cloning on the basis that they believed that cloning created animals that were ‘riddled with disease’, and more suited to expensive systems of production (they suggested that animals can be produced cheaper in the ‘natural’ environment). The comments mirrored the substantive comments submitted to the FDA and the report submitted to the European commission by the EGE.

Among the objections raised by stakeholders, many of them related to the perceived waste of animal life – these objections were made by animal welfare specialists and an academic scientist. Questions related to whether the perceived cruelty involved in animal cloning or genetic engineering could ever be justified. Many of the objections were based around the commoditisation of animals, with their lives being reduced to merely producers of food. A representative from the Catholic Church spoke of the compassion that was needed when considering how animals are used in food production. He spoke of the need to care for animals, and kill them with the least amount of distress. An animal welfare specialist outlined that when animals are used for food, they deserve a better quality life and a ‘humane’ death. This particular stakeholder took issue with farming practices that confine animals to pens or cages. Another animal welfare specialist questioned whether the practice of keeping animals in confined spaces led to contamination of food from those animals. This was an interesting finding as the literature also suggests that poor welfare is associated with food safety in the minds of the public (Yeung and Morris, 2001).

Among interviewees there was a general understanding that there should be a code of practice that respect an animal's basic needs and affords them considerations. Of the cohort interviewed, many indicated the need for standard practices, but there was no consensus in this respect. While universal standards exist (5 freedoms of animals, see Webster, 2001) there was no point of reference for these stakeholders to argue for or against certain technologies.

6.5. Ethical considerations with regard to cloning.

Figure 6.4: Ethical Perspectives

A. *When you think of animals being used to produce food, can you think of any existing areas that may represent ethical difficulties?*

B. *When you think of such ethical considerations, what do you think are the primary influences for you -as a xyz- in forming an opinion?*

   i. *Do you think the 'ends-justify-the-means' when it comes to ethics and developing a new technology, or should the 'means' be given equal consideration?*

   ii. *Do you think it is possible to a construct a set of principles that might allow you to judge the ethical acceptability of technology, or must technology be assessed on a case-by-case basis?*

Ethical perspectives were examined through direct questioning (see figure 6.4) but also from *verbatims* throughout the interviews. In a specific question on the use of animals in research, a government scientist stated the following:

In terms of working on (animal) cloning or that (sic), I wouldn't bring ethics out, that wouldn't be a problem for me. I suppose whatever ethical guidelines that are there from a medical perspective, don't really impinge on us; we wouldn't be working on human embryos.

Government Scientist, animal productivity

While later questioning revealed that this stakeholder believed that animals need to be afforded certain considerations in scientific research, the statement is at odds with the sentience/welfare position of others interviewed. The views of the government scientist had some resonance with government regulatory advisor interviewed. This individual advocated a role for animal testing and technological development, but underlined responsibility that lies with scientists.

If there is a targeted technology and they're trying to do something, there is some justification for that. But just screwing around (pointless animal testing), I wouldn't be for that. It's hard to manage mind you, all those scientists are fairly isolated and they work on their own.

Government agency, regulatory-food safety representative

While some interviewees suggested that 'the market' will decide whether cloning and resultant animal suffering was acceptable, this is not a widely shared view. A university scientist specialising in reproduction suggested that animal welfare would not be a limiting factor; rather it was not ethically acceptable to invest money in a technology where the research will see little return on investment. Other scientists differed in their attitude; the verbatim below suggests that animal biotechnology and associated animal welfare issues are nominal in the context of welfare practices used in the food industry. It was also suggested that looking to cloning and other such technologies is acceptable as it will aid food production in years to come.

Interviewee: *Putting in a gene into a chicken seems to me – personally – just not 'at the ball-park' in terms of the animal welfare comparison (sic) to battery [pause] what is that called?*

Interviewer: *Battery chickens?*

Interviewee: *Yes! So we've [Irish people] this really schizophrenic attitude and we're up on our high horses about something that hasn't even been developed and here we are surrounded by major ethical dilemmas that we completely ignore. So we want really really (sic) cheap food and then we get upset about a gene being put into a chicken, we really are being as a Nation – as a race – astonishingly naïve.*

University Scientist, Immunology

Arguments were presented that cloning must be considered in the context of producing food in the future where the population is set to rise and the resources for producing food will become scarcer. Within this cohort there was a general understanding that technology will be a major feature of future food production. The farming representative and a commercial animal breeder suggested that there is an onus on technology developers to examine the possibilities for such technologies.

> *I think that that is definitely not ethically unacceptable [to use cloning or biotechnology] and I think that you could argue, that if we had the knowledge, that it's ethically unacceptable not to do this. If you could make animals, let's just say happier in their environment, maybe we should have a responsibility to do that. You have to remember that genetic modification of animals is just a quick way of doing what we've been doing for the last 10,000 years. We've been doing animal breeding (sic) though selection – which turns out to be genetic selection, we figured that out in the last 50 years – and now we can actually do genetic selection (sic) at the molecular level whereas we've been doing genetic selection since we've domesticated animals.*
>
> **University Scientist, animal reproduction**

In considering the ethical objections raised by interviewees it is interesting to note that two individuals that would be considered ethical stakeholders in a European regulatory context, rejected animal cloning on the basis of flawed science. The flawed science referred to a

lack of knowledge on the part of technology developers and the loss of animal life in the process.

> *We're up to [identifying] a hundred thousand genes. We only know the workings of 1 to 2 percent of the genes of farm animals so they're muddling them all around and they [scientists] haven't a bogs notion (sic) what they're doing. The repercussions of this are huge amounts of mess ups – there's (sic) huge amounts of animals that are 'oh that's a mistake' – never mind all the animals used finding-out how to do things.*
>
> **Public Representation Lobbyist, Animal Welfare**

Further to animal cruelty arguments outlined above, the concept of animal sentience[35] emerged as a prominent theme for animal welfare specialists and regulatory advisors specialising in ethics. From the literature the prevalence of sentience was a greater feature of European policy in relation to the use of animals. In addition to the various views articulated with regard to animal welfare, there were also suggestions that 'the market' should decide whether it was appropriate; these views came from a farming representative and beef producer.

[35] Sentience refers to the ability to experience feelings (pleasure and pain for example) and as such is central to the animal rights movement. The Amsterdam treaty recognises that animals are sentient beings and should be protected by law in Europe for this reason (Anonymous, 1997).

To be honest with you, this was shown over the last year with the likes of Hugh Fearnley-Whittingstall with the chicken in Tesco[36]*. People – ok they raised chickens – but they still couldn't afford to buy those good [outdoor reared 'healthier'] chickens, they could still only afford to buy a chicken which was £3. There is an ethical issue there for those people because. They know all of the suffering that the animal went through, but really, if it's not them that's being hurt, they're going to choose something for price if it suits them. So, ethics are there, but really in the race for survival, ethics go out the window.*

Beef Producer, International Sales

[36] In January 2008 Hugh Fearnley-Whittingstall presented three one-hour shows detailing how commercial breeds of broiler chickens are reared for their meat in just 39 days. This compares to slow growing breeds which live for at least 75 days in more humane and natural surroundings. Fearnley-Whittingstall is currently trying to encourage people to become more aware of food production issues through his "Chicken Out" campaign.

6.6. The role of religion with respect to cloning

The role of region was discussed in the context of what role the church should play in national development decisions regarding animal biotechnology. There was no consensus among interviewees. An animal welfare specialist and an organic farming representative both advocated a role for the church in ethical consideration.

> *I think that it is playing God (genetic modification) and it's a boundary we shouldn't be crossing. They call it 'Frankenstein' technology I think and to me it's 'not on' from a religious or theological point of view; but people who don't have a religious faith might not have any problem with it at all, so you won't get the same divide as you would on a lot of things.*
>
> **Public Representation Lobbyist, Animal Welfare**

This opinion was at odds with the religious representative who believed cloning is not necessarily contrary to Catholic dogma, and that the Church did not have issue with regard to animal biotechnology being used in the agri-food sector *per se*. The view of Christian representative outlined that within the Irish state that – despite the influence of the church in the past – the responsibility of policy pertaining to cloning is a matter for regulatory authorities. There was an acknowledgement that if the will of the public was for input from the church, they would oblige, but it was apparent that this is not the orthodoxy.

I don't think it's necessarily playing God to seek to improve the things that have been given to us because I suppose, again, (sic) at the heart of the scriptural understanding of creation, there is this idea that these things were given to us for our use. I think then (sic) it's the responsibility of Scientists or Legislators to listen – and clearly they're not just going to just be listening to the church. What I'm saying is, clearly Legislators have to make the Legislation – it's not appropriate for Bishops to make Legislation – and I think that's where some of the whole Church/State stuff (interference) in the past (comes from). The residues of that around people's consciousness (sic) are that ultimately there are two extremes; one extreme would be the church in some sense proposing legislation, the other extreme, is the church feeling they can't say anything in case it might be perceived to be influencing things.

Religious Representative, Christian

While there was agreement on a need to establish ethical barriers, only one interviewee stated that the church should influence this process. A meat industry representative suggested that it is beyond the bounds of relevance or responsibility for the Church. The fact that Ireland was a secular state was mentioned by several stakeholders as reason not to incorporate religious views, but there was also an acknowledgement that religion still shaped ethical values for a large portion of the population. The implication was that while it would not be part of any legislation, religion may still form shape for how the public will perceive a technology such as cloning.

6.7. The Irish Public as Stakeholders

Interviewees uniformly predicted a negative response among the public to the use of cloned animals for food purposes. Some felt that education could be a positive modulating factor in gaining public confidence. It was thought that education would lead to a situation where, understanding how a technology worked, would equal acceptance. Representatives from the meat processing and retail sectors also hypothesized a possible role for cloning in delivering consumer-driven consistency in meat quality. The potential of harnessing the technology to reduce antibiotic use was also cited by a university scientist.

A KOL from the beef sector was concerned that cloning may be endorsed by the government without a clear communication strategy for the public. In such circumstances, it was believed that cloning would be 'doomed from the start', and consumer confidence would be damaged if information was not made available for citizens which outlined the strategy and research aims of the technology. An interviewee from the food retail sector suggested that any mention of cloning would evoke references by consumers to cloning being 'against nature', or violating religion. The venture capitalist interviewed echoed both sets of views. It was suggested an introduction of a technology – such as cloning – without some sort of public-engagement would have negative repercussions.

There would be a legitimate and appropriate sort of almost Joe Duffy[37] back lash if cloning was carried out without public consent.

Venture Capitalist, emerging technology

A similar aspect of engagement was also mentioned by a meat sector funder, who highlighted that without an information strategy, other groups or bodies can fill the information void with negative commentary.

I have a feeling it could be difficult. Maybe if you can put the message across to consumers that 'these are the benefits that arise' from it, while at the same time reassuring (them) that there's no adverse reactions ...all of these sorts of issues. Plus, it delivers benefits in terms of better meat quality, higher protein content or whatever (sic), it might be then (sic) you stand a chance. If a perception 'gets out there' that this is 'test tube stuff', that it's really just 'Scientists having a bit of craic to see what happens', then you have a problem.

Beef Producer, International Sales

Several interviewees also elaborated on aspects that may represent catalysts for public resistance. One KOL believed that the public would associate cloning with science-fiction. The regulatory advisor suggested cloning would be associated with 'Frankenstein's monster' type imagery. Another similarly suggested that cloning will suffer with

[37] Joe Duffy presents a popular Irish radio interview and phone-in chat show called Liveline which is broadcast on RTÉ Radio 1 each weekday afternoon between 13.45 and 15.00. The programme – known for its slogan 'Talk to Joe' – seeks the public's opinion on various questions, normally one or more controversial current events.

acceptance, through a type of technological stigmatisation. A government scientist believed that the concept of cloning will suffer in ways that other assisted reproductive technologies have not. While they suggested that there may be some softening of negative opinion with time, it was thought that the images cloning engenders would cause widespread public resistance.

> *Well embryo transfer has been around for a long time, and I suppose it's a technique used in humans as well for assisted reproduction – or certainly in in-vitro culture of embryos and that – so I don't think embryo transfer would have a huge resistance. Cloning obviously would have a huge public sentiment (sic) against the idea of producing clones. The word clones; people have these ideas of androids, and, I would say it (resistance) would be quite vocal by a reasonably large section of society. I would think there would be a lot of resistance here in this part of the world anyway.*
>
> **Regulatory Advisor, Food Safety**

The experts interviewed suggested that the public would associate cloning with human cloning. An expert from the animal breeding sector believed that cloning would immediately be associated in the minds of the public with 'wealthy people harvesting organs'. While the individual suggested that this type of pre-conception does little to benefit the acceptability of products of animal-biotechnology, they hypothesised a scenario whereby animal cloning could be used in conjunction with genetic-modification to produce animal bio-reactors, capable of producing medicine 'naturally' in their milk.

This concept of application-specific-acceptability of cloning was mentioned by an academic scientist specialising within immunology. They suggested that there was little resistance to biotechnology which produced human medicine in the public sphere, and the NGO lobby groups tended not to oppose such technology. This individual suggested that such NGO groups were vocal on food innovation, and thus were a factor in modulating public opinion. More broadly, they suggested that people are more conservative when it came to food, and what could be deemed as acceptable. It was suggested that reactions to food are intrinsic in public behaviour and this key opinion leader suggested that education would do little to change this.

> *The anti-GMO lobbies – very early on – said they have no problem with medicines because they are there are already, and there have been for many years. Genetically-modified human proteins produced in yeast and bacteria, they're used for human health; so cloning, at that basic level, of bacteria and yeast is old and acceptable in human medicine. So, I think people would accept pharmacological innovation, food is different; they're much more conservative about food that's very clear. And I think there's something intrinsic about that, and no amount of education would change that (sic). That's just people's perception.*
>
> **University Scientist, Immunology**

The NGO KOLs articulated their own objections, but were less sure of how the public would react. Representatives from the organic farming industry suggested that if there was

a labelling pre-requisite with cloning, then this would shape public perceptions. They suggested that for the public, seeing the term 'cloning' would generate an overall negative effect. Apart from general negative feelings, an animal welfare specialist outlined that if the public were aware of the 'surgical procedures' and low success rates, then it would be roundly rejected. However, the same interviewee expressed the view that there is segment of the population that would overlook the animal welfare issues and choose food from cloned animals if it delivered cost savings.

In terms of communication altering public opinion, a regulatory advisor to the government suggested that NGOs can play a significant role in shaping peoples perspectives.

> *If there was a real good reason for it (cloning) – and as yet I don't really see it – and if that message got out first, I'd say you'd have more than 50% (of the population) that would say 'grand, go ahead with it'. I'm sure the head-cases*[38] *would be out there first, the religious folks and the anti GM folks who are already saying that they don't want it. It's very easy – and you see it now in Lisbon (treaty) – it's very easy to throw stuff in there to muddy the waters. (For example) 'I'm not really saying that, but it could happen'; that's been the way with the GM stuff (debate).*
>
> **Regulatory Advisor, Food Safety**

[38] A head-case generally refers to a person who is not of sound mind.

The disparity in opinion between KOLs and how they see the public responding is an area that warrants further investigation. The KOLs anticipated the responses of the public, but these were not discussed as reasons to prevent cloning being developed at a policy level or to develop communication strategies. On the evidence of the 'expert' opinions outlined here, reconciling anticipated public responses with their own views was not a feature of their responses. For example, among the regulatory advisors who recognised the role of religion in shaping the public perspective, the activity of consumer activists in regulatory affairs, little was suggested of using these perspectives to ease concerns. Of the recommendations to emerge, one was that those people promoting or legislating for the technology would need to get information into the public domain first; the other was more proactive education with regard to new technologies. The element of putting information in the public domain probably exists already (in many cases through government and company websites) and proactive communication with regard to early-stage technology could be considered an expensive and risky strategy.

The anticipated response from the public further highlighted the need to explain how the public process information to make their decisions on novel technologies. Using cloning, there is an opportunity to assess what type of cultural associations or context it has in the minds of the public. Knowing where and how this type of information is assimilated, and if it has a correlation with willingness to engage in a new technology may prove an interesting tool for policy makers in the area. Further to this, there is also an opportunity to explore which institutions or organisations elevate or alleviate the perceived risks.

6.8 Conclusions

In weighing-up the results of the in-depth interviews, the methodology employed must be considered. All 19 interviews were transcribed verbatim and analysed thematically. Carrying out thematic analysis on the data did pose some problems for the research, mainly centred on the 'areas of questioning' that were pre-determined. Without *a priori* knowledge, the data may suggest the there are several prominent themes emerging, but further examination would explain these themes were modulated by lines of questioning. Furthermore, there was an element of fact-finding and closed questioning that did not lend itself to interpretation, but did help clarify KOL positions. Therefore, thematic analysis could only be carried out by comparing and contrasting 'sets of answers' to specific questions. Examples of this are Ireland's role in technology development – which individuals tended to answer with respect to their institution or company – and the ethical treatment of animals – for which for many of the respondents was a personal perspective.

Thus in considering the results, several key conclusions can be drawn. The views of Irish KOLs on animal cloning for the agri-food sector are of particular interest, because unlike the situation for GM crops, Ireland is a significant producer and exporter of meat and livestock. Whereas the adoption of GM crops was roundly rejected by a sector that primarily services the domestic market, the vast majority of milk and meat produced in Ireland, is exported; in this context, the adoption of agri-food cloning elsewhere and putative benefits suggesting increases in meat and milk yields, the responses of the key opinion leaders selected for the study were surprising. The findings indicate that an

informed debate on the topic among expert stakeholders in Ireland has not taken place, and those interviewed were not yet at a problem-framing stage. Indeed, a low awareness of the advanced commercial status of cloning elsewhere was apparent.

Given the expertise of the cohort interviewed (as their qualifications and positions would attest to) that cloning has not registered as a commercially viable technology or a potentially commercial viable technology means that any benefits are – as yet – unsubstantiated. In any case, Ireland does not appear to be ready to compete on a technological footing in this area, and is likely to adopt a reactive or 'watching brief' position, rather than taking a proactive stance; such an approach would not rule out possible access to cloning technology in the future (for example, through licensing).

As cloning was considered among interviewees, several areas issues were discussed as potential stumbling blocks for the technology. A key part of any future success will relate to public response and so, if cloning were to have economic or social benefits, a method of actively engaging with the public will be central. While it was offered by several KOLs that the public are unable to discuss such technology, or indeed that interest groups often supply conflicting messages, it was evident that this was an area to be addressed. Suggestions that information should be made available or that technology developers should look to educate the public were offered, but ready-made solutions were not evident.

The issue of animal welfare was – on balance – probably the greatest stumbling block to acceptance of cloning. Some university scientists that understood the technology believed

the current level of animal suffering should prevent its use in an agri-food sense, while others fundamentally rejected the misuse of animals on the basis of an affront to the animal's intrinsic worth. Others suggested that the viability of the technology be explored, and revealed a trade-off in the balance of the human food chain would be of greater benefit. With one exception, the role of religion did not appear to represent a stumbling block, however, with respect to the anticipated response from the public, several believed it will be an issue. This was contextualised in the form of a risk-amplification on the part of interest groups suggesting that new technologies are, interfering with nature or 'playing God'. While it was understood that as a secular state, religion would not influence investment strategy or regulation, it was of interest to note that government ethics advisor outlined that the deontological perspective is often the one taken by the public.

The challenge for cloning technology in Ireland and elsewhere, will be reconciling the economic and development prospects with the societal concerns that it is likely to face. To this end, effective early-stage engagement with the public comes into focus; overcoming the technological and biological complexity of cloning, while factoring the bias and strongly held beliefs of citizens will be central to generating such insight. The results of an experimental methodology to engage with the public - incorporating key messages from these in-depth interviews – are outlined in the following chapter.

7. Investigation of Opinions of the Irish Public on Cloning for Food Purposes

Public trust and risk perception are recognised as being paramount in considering the development of any new food product (Huotilainen & Tuorila, 2005). A number of high profile food crises in the nineteen nineties placed the system of food safety regulation under the spotlight; the legacy of such issues was a marked decrease in public confidence in how food safety is managed. Commentators trying to understand this development have suggested that before this time, European food risk management was primarily based on technical assessments, relying on scientific parameters, with little room for engagement with the public (Radaelli, 1999). In order to build trust and improve openness in communication, current philosophies on risk management have sought to become more transparent (Houghton *et al.,* 2008).

The initial phase of this project sought to establish the perspectives of Irish key opinion leaders with respect to the use of animal cloning for food production purposes. Building on this, it was of interest to translate these observations into themes for further dissection by a cross-section of the Irish public. The methodology selected for this purpose – termed 'Food-Bio QUIS' – features the provision of background information generated through a series of in-depth interviews with key opinion leaders to the participants as a stimulator of discussion. Succinct snippets of externally validated[39] information are provided on information cards. The information cards are sequentially read aloud by participants in three staggered tranches during the session (see chapter 5, fig 5.8). Each participant reads

[39] The validity of the footnotes was validated by Perry Walker – the creator of the DEMOCs game – as well as contributions from the research team.

one card aloud in round one, and two each in rounds two and three. In one of the groups an individual withdrew at the last minute and the five cards were read aloud by the facilitator.

Participant profiles are shown in Fig. 7.1. As set out in the materials and methods chapter, individuals were pre-screened on age, gender and socio-economic status and then on worldview, pet-ownership and meat-consumption level in a brief questionnaire just prior to Food-Bio QUIS beginning.

Fig 7.1: Food-Bio QUIS Sample Profiles (SC Social Class; P pet-ownership MC meat consumption)

Name	Sex	Age	SC	P	MC	World view
Kenny	M	30	ABC1	n	Medium	Individualistic+Heirarchal+Fatalist
Carl	M	31	ABC1	n	Medium	Individualistic+Hierarchial
Peter	M	30	ABC1	n	High	Individualistic+Hierarchial
Tomas	M	29	ABC1	n	High	Individualistic+Hierarchial+Fatalist
Peadar	M	34	ABC1	y	High	Egalitarian+Individualistic
Fergus	M	26	ABC1	y	High	Below the mean for all worldview affiliations
Barry	M	35	ABC1	n	High	Individualistic+Fatalist
Ciaran	M	41	ABC1	n	High	Hierarchal
Kevin	M	37	ABC1	y	Medium	Individualistic+Fatalist
Brian	M	36	ABC1	n	Medium	Individualistic
Colin	M	38	ABC1	y	High	Egalitarian+Fatalist+Individualistic+Hierarchial
Clodagh	F	20	C2DE	n	Medium	Egalitarian+Fatalist+Individualistic
Killian	M	20	C2DE	y	High	Egalitarian+Individualistic+Hierarchial
Conor	M	19	C2DE	y	Medium	Egalitarian+Fatalist+Individualistic+Hierarchial
Aisling	F	18	C2DE	y	Medium	Below the mean for all worldview affiliations
Terry	M	19	C2DE	n	High	Egalitarian+Individualistic
Amy	F	19	C2DE	y	High	Fatalist+Hierarchal
Leah	F	50	ABC1	y	Low	Egalitarian
Ena	F	53	ABC1	y	High	Egalitarian+Individualistic
Eileen	F	50	ABC1	y	High	Egalitarian+Fatalism
Katie	F	51	ABC1	y	High	Egalitarian
Roisin	F	49	ABC1	y	Medium	Egalitarian
Karen	F	45	ABC1	y	Medium	Fatalism
Colm	M	65	C2DE	y	High	Individualistic+Egalitarian+Fatalism
Stephanie	F	64	C2DE	y	High	Egalitarian+Fatalist+Individualistic+Hierarchial
Theresa	F	60	C2DE	y	Medium	Egalitarian+Fatalist
Grainne	F	62	C2DE	n	Medium	Hierarchal+Individualistic+Fatalist
Maura	F	61	C2DE	n	Medium	Individualistic+Egalitarian+Hierarchial
Declan	M	65	C2DE	y	Medium	Heirarchal+Fatalist
Lily	F	32	C2DE	n	Medium	Egalitarian+Fatalism
Kate	F	39	C2DE	n	High	Hierarchal+Fatalist
Emma	F	43	C2DE	y	Medium	Egalitarian
Siobhan	F	32	C2DE	n	High	Egalitarian
Ciara	F	30	C2DE	n	High	Egalitarian
Aine	F	30	C2DE	n	High	Egalitarian

7.1. Introduction to Food-Bio QUIS

At the start of each Food-Bio QUIS session, and in advance of the introduction of card (prompt) information, participants were invited to give their initial reaction to the aspect of animal cloning. This was elicited by the facilitator through open ended questioning[40] of participants to test their prior knowledge or recollections of cloning. Similar to the results obtained with the KOLs, participants showed no awareness of the impending commercialization of cloning for food purposes. Mass-media reporting of the clone-gate[41] incident in the UK appeared to have gone unnoticed, and there was no evidence of any residual memory regarding a link between cloning and the food chain.

Perhaps, unsurprisingly, a common reference point for many participants was Dolly the Sheep. Such awareness appeared to have an age-related dimension: only one of the 18-25 year old group members professed to have heard of Dolly[42]. Recollection of their initial opinions of the sheep was dominated by comments about the sensationalist nature of the media coverage at the time; this was variously described as a being a 'circus' or a 'joke'. However, discussion of Dolly appeared to evoke a sense of worry and fear among many participants (especially in ABC1 35-44 group), with some expressing that they viewed the news at the time as being an indication of impending human cloning.

[40] What had you heard about animal cloning before today? What were your thoughts at the time? How did you feel the public reacted to it? Why do you think they reacted like that?
[41] It was revealed that a UK farmer was using progeny of cloned animals to produce food for the UK marketplace in the summer of 2010.
[42] The news regarding the birth (and subsequent successful post-natal health) of Dolly the sheep was announced in February 1997.

A dominant theme (evident across ABC1 25 – 44 groupings) was the perceived objection of religious groups to this technology, with scientists being accused of 'playing God'. Associations were made by individual participants between cloning and genetic manipulation: this ranged in scope from designer babies to genetic modification (of crops and animals). There was also evidence that human reproductive medicine may form a reference point for some in this debate:

> *I thought it was bizarre, because I was wondering why they needed to clone a sheep. Like [sic], why couldn't they have lambs normally?*
>
> **Karen, 45 (ABC1)**

Such preliminary discussions formed the backdrop to the initiation of defined Food-Bio QUIS rounds. The facilitator distributed six pieces of information – one each – to participants (referred to as 'Story Cards', as they aimed to set the context for discussions) and the information was read aloud in turn. The story cards for Round A are shown in figure 7.2.

Fig 7.2: Food-Bio QUIS 'Story Cards'

A1. John Hunt: Bio-scientist: John Hunt is a bio-scientist based in the mid-west of the United States who has specialised in the area of animal reproductive technology. After several years researching reproduction in cattle, he and a colleague set up a business offering animals breeders the opportunity to clone their top breeding bulls.
The business has been running for two years and their clients are very happy with the clones they have produced.
However, John and his colleague say that only one animal from every eight attempts will survive pregnancy and become a healthy adult. John hopes that for the welfare of the animals this will improve over time.

A2. Dolly the Sheep: Dolly the sheep became worldwide news when she was announced one year after her birth in 1997.She was the world's first clone born using DNA transferred from a mature adult cell (an udder cell). She was the only sheep to survive to adulthood from 277 attempts. At only 6 years old, Dolly was relatively young when she died. But there's no proof that cloning was to blame. The examination also confirmed what vets had suspected since early 2002 – that she had arthritis in her hind legs. Until the first signs of arthritis were detected, Dolly had shown no signs of ill health and had given birth to four healthy lambs.

A3. Animal breeder dilemma: Des has been working with an animal breeding company for the last 10 years. The most valuable bull to the company is 'Torro', worth €100,000, more than twice any other bull on their books. Torro is getting old however and the business has been approached by a biotechnology company that said they would be able to clone Torro for €10,000. Ultimately the decision to go ahead rests with Des; from the scientific information he has gathered, cloning 'Torro' seems like a good decision, isn't very different to what they do already and won't have an effect on the meat or milk his offspring produce. On telling is wife about the decision to clone their top bill, she argues against the decision; she says that cloning is like 'playing God.'

A4. A Letter to The Irish Times: In a letter to The Irish Times, a concerned citizen, Pat Collins, opposed any funding to be given to animal cloning research in Ireland. He said that animal cloning violates the integrity of the animal: the technology completely ignores what the animal is, apart from what we use it for; it is turned into a resource that can be copied and used, if desired. The following week Dr Deirdre Byrne, a bio-scientist working in the area, suggested that the research into animal cloning was driven by an ambition for farmers to get more money for their animals, and for Ireland to be competitive when selling meat and milk internationally. She suggested that cloning does not violate the integrity of animals, as they have been bought and sold and used for foods and other purposes since records began.

A5. Tom and Anne Kelly - Dairy Farmers: Farmer Tom Kelly and his wife Anne have had a dairy farm for the last 25 years. They have always used an artificial insemination (AI) company to fertilise their cows, and have always been happy with the results. They have a great relationship with the dairy they supply to and even though times are tough and milk prices are not what they used to be, they have consistently supplied the same amount of milk. On his last visit, the rep from the AI company suggested that they can now offer AI from the best milk producing cattle in the world because cloning has increased the supply and reduced the cost. Tom and Anne are impressed and interested but are unsure how the dairy or the dairy's consumers would react to the using it.

A6. Dan Hart: Animal Welfare Policy Officer: Dan Hart works as a policy officer with a farm animal welfare organisation. Having researched the statistics on farm animal cloning, he and his organisation have published a research paper and a press release highlighting the high failure rate and cruelty of cloning. As an organisation that protects the interests of farm animals they believe that stress on the surrogate mothers and the loss of life should prohibit the use of cloning for farm animals. The organisation believes using a technology that will cause suffering fails a 'duty of care' that people have to farm animals. Dan is unsure how the public will react to the messages

7.2. Food-Bio QUIS: Round A

The factual story-cards which featured in the first round of Food-Bio QUIS attempted to provide a balanced and representative sample of cloning 'stories' that would permit the participants to rapidly engage with this topic. In all groups, participants were somewhat surprised that cloning had progressed to the level where it was being considered for use within an agri-food context; one person professed to have heard nothing about cloning since the announcement of Dolly. This reinforces the finding obtained among the KOLs regarding poor awareness as to the developmental stage of the cloning of food animals.

> *I didn't realise until I read these (Food-Bio QUIS) cards that it is as widespread as it actually is. I thought it was still at the experimental stage.*
>
> **Emma, 43 (C2DE)**

Further free-ranging discussion featured aspects such as questioning the utility of cloning in food production (compared to 'conventional' agriculture), and the recurring theme of animal welfare. The story card relating to Dolly appeared to produce a strong resonance across many groups, possibly because there was a pre-existing recognition aspect that was absent in many of the other examples. The low success rate of cloning, and concern for the offspring of Dolly, featured prominently in such discussions. Initially cloning was not rejected outright on the basis of principle, and rather a more utilitarian dialogue was catalyzed which inferred an apparent willingness to consider mechanistic aspects of the technology from a neutral standpoint. There were also indications that improvements in the

cloning success rate may influence the acceptability of this technology in food production (C2DE 30-44 female and ABC1 25-34 male groups).

However, deployment of prompt questions[43] to further stimulate discussion on key issues revealed deeper concerns based on links with past food scares and perceived undesirable 'factory-farming' practices. Two individuals highlighted that they felt it was difficult to know if there would be long-term repercussions – such as those seen with BSE – in consuming food from cloned animals.

Across all groups, the concept of nature or producing food naturally was raised for discussion. In this respect, cloning for food purposes was viewed as an affront to 'natural processes', 'the natural selection', 'natural competition' and 'the natural way by which everything is created'. One individual suggested that historically, when we (man) go 'against nature', it always has adverse consequences.

[43] Why do you feel animal breeders are looking at technologies like this for the production of food? What sort of limits should there be to the type of technologies that can be used? If the food safety authorities say this is safe, what other considerations should there be? There was an article there that referred to the 'integrity of animals', I think the person was referring to what was right and what was wrong in terms of the way we treat animals. In terms of food, what kind of rights do you feel animals have? How might cloning interfere with the 'integrity of animals'?

7.3. Food-Bio QUIS: Round B

The second round of 'information-cards' presented selected facts that attempted to clarify and further explain the meaning of cloning and its potential uses in a wider sense (Fig 7.4). There were twelve cards in total, two each for participants to read aloud (each read one aloud in a clockwise fashion, and then read the other). In most cases, the ensuing discussion within round B was dominated by considering cloning within a human context, with volunteers often drawing on reference points from popular culture. Echoing responses in round A, human assisted reproduction and genetic modification were also dominant themes, and such elements then underpinned the perspective regarding the safety of prospective cloned produce.

Science-fiction movies were a key resource for participants as they warmed to the subject of cloning. This may initially have been prompted by information card B4, which dealt with the cloning of extinct animals: some individuals suggested that such animals might be cloned from the blood of a mosquito trapped in fossil, as depicted in 'Jurassic Park'[44]; Others drew on the cloning technology depicted in Avatar[45]. Among other movies mentioned were: 'Moon'[46], 'The Boys from Brazil'[47] and 'Multiplicity'[48]. In retrospect, it is quite understandable that participants should seize on the chance to share common

[44] Jurassic Park is a 1993 Stephen Spielberg movie in which during a preview tour, a theme park suffers a major power breakdown that allows its cloned dinosaur exhibits to run amok.
[45] The Avatar movie (2009) depicted lead actor Sam Worthington's genetically-tailored amanuensis, a Pan-like creature initially seen as a prosthetic in a type of incubation tank.
[46] Moon is a 2009 British science fiction drama film about a man who experiences a personal crisis as he nears the end of a three-year solitary stint mining helium-3 on the far side of the Earth's moon and discovers that he is a clone.
[47] The Boys from Brazil is a 1978 film in which ageing Nazi hunter Ezra Lieberman (Laurence Olivier) must discover and thwart a plan by surviving Nazi death-camp doctor Josef Mengele (Gregory Peck) to resurrect Adolf Hitler through cloning.
[48] Multiplicity is a 1996 comedy film in which Doug Kinney (Michael Keaton) finds his time stretched to the limit between his wife, career and family, until he meets a helpful scientist who offers to clone him.

experiences in this manner, and this is an issue for the moderator in judging the extent to which it should be permitted in future work.

Fig 7.3: Food-Bio QUIS. Round B. Cards 1-12

B1. Animal Breeding: Assisted reproduction has been used for some time to improve the value of farm animals for the benefit of mankind. Such improvements result in higher milk yields, as well as more efficient and better quality meat producing animals.
B2. Animal Cloning Technology: Animal cloning is a form of animal reproduction without mixing male and female genes. The genes from an egg are replaced with the genes of the animal to be cloned. An electric pulse fuses the cells and the embryo grows as normal.
B3. Clones in Nature: Many animals – including fish, frogs and mice – had been cloned before Dolly the sheep in 1996. Plants are often cloned – taking a cutting produces a clone of the original plant. (Human identical twins have the same DNA but are not considered clones).
B4. Cloning extinct species: In January 2009, scientists from the Centre of Food Technology and Research of Aragon, in Zaragoza, northern Spain announced the cloning of the Pyrenean ibex, a form of wild mountain goat, which was officially declared extinct in 2000.
B5. Offspring of cloned animals: In the United States, if agricultural breeders use cloning it is to produce breeding animals. Consumers are likely to never eat an animal clone; rather, meat and milk products for sale will come from the offspring of animal clones.
B6. Cloning in the US: The food safety authority in the USA (the FDA) has found no science-based reason to require labels to distinguish between products from clones and products from conventionally produced animals.
B7. Food from the offspring of cloned animals: Both the US and EU food safety authorities have concluded that the make-up of food products from cattle, pig, and goat clones, or from the offspring of these animals, is no different from that of conventionally bred animals.
B8. Cloning vs. Genetic Modification: Animal cloning involves copying an animal's DNA; the clones will be exact genetic replicas of the animals they were cloned from. Genetic modification of animals involves altering an animal's DNA.
B9. Cloning Worldwide: Research into animal cloning has been ongoing for a number of years in almost 40 countries including the USA, China, Japan and Argentina.
B10. Cloning since Dolly: The first cloned farm animal was Dolly the sheep. Since then other animals to be cloned include cattle, horses, rodeo-bulls, Spanish fighting bulls, deer, pigs, goats, cats, dogs and monkeys.
B11. The Future for Cloning: Whether the cloning of farm animals will actually bring us closer to a situation in which human reproductive cloning is practiced is hard to say. There is a possibility however that, from a technical perspective, the development of the technology for non-human animals will make it easier to clone humans.
B12. Cloning in the EU: The European Union have proposed to stop animal cloning for food production in member countries for a period of five years until more research and policy decisions can be achieved. The opinion of EU citizens will be very important.

While sharing these experiences might be viewed as a limitation of the Food-Bio QUIS method, it did appear to serve as a confidence-building measure for some participants in terms of engaging with the group, and acted as a gateway to more serious issues which were subsequently raised in discussions, such as human rights; how cloning might be used by an egotist; identity theft and perceived problems of generating clones-from-clones. A noted downside of the participants calling on the products of Hollywood as a reference point relates to the prevalence of inaccurate portrayals of the cloning process within films, and the almost uniform depiction of cloning as being something which is intrinsically bad and unsympathetic.

A minority of participants had heard of biotechnology innovations through television news reports or documentaries, and could make a link with cloning:

> *Did they (scientists) do something with an ear as well?*
>
> **Ciaran, 41 (ABC1)**

This example relates to the so-called 'Vacanti mouse' (Vacanti *et al.,* 1991), which was widely publicised after an appearance in a television documentary in 1998 (Bennett, 1999). The mouse was pictured with a human ear growing from its back, and two participants asked if cloning was anything to do with it. This is a type of cellular cloning, intended to be used as a graft in cases of accident. This prompted a suggestion by some respondents that such types of organ cloning could eliminate the need for organ donation, and thus save

lives. This produced an anchoring bias when considering the technology. In line with other studies, (McNeil and Williams, 2002; Eurobarometer, 2010), participants could envisage support for cloning within this medical context.

As found in Round 1, participants often drew a comparison of cloning with IVF or AI used in humans. Some suggested that a difference in attitudes to such technologies and cloning may be down to a lack of familiarity with the latter. Perhaps unsurprisingly, this was in contrast to some of the 'expert' opinion, where cloning was considered a radical departure from conventional reproductive technologies.

> *I'm not saying it's the same as IVF, but maybe (it is), because we haven't been given as much information - do y'know?*[49] *[sic]. Would it be more acceptable if we had more information? Like [sic], similar to the way IVF would have been when it first came out?*
>
> **Aine, 30 (C2DE)**

Indeed, IVF appeared to form a common reference point to conceptualize the current low success rate with cloning (respondents spoke of the several 'rounds of treatment' needed in IVF). Louise Brown – the first so-called 'test-tube' baby – was raised by the 45-59 year old women. They noted that the social stigmas that were initially associated with this technology had diminished with time, and were willing to contemplate a similar future for cloning.

[49] 'Do y'know?' is an Irish colloquialism meaning 'do you understand?' or 'do you follow my logic?'

While most of the groups saw the benefit of IVF as a fertility treatment, one woman from the 60+ age group suggested that it was 'fiddling around', and cited a woman in America that had many children using the treatment, and recalled that four of them had autism; autism among the IVF children was considered to a be a result of interference with natural biological processes. In comparing IVF and cloning, one participant suggested that the former was natural (*i.e.* combining a sperm and an egg), but cloning was unnatural because it was using DNA to make the exact same animals. The interpretation of this finding is that the term 'DNA' may trigger negativity through associations with over-stepping physical boundaries, or not being able to control consequences.

Participants questioned how the cloning procedure might be carried out, and tended to interpret it as changing DNA or 'messing with genes'; others thought that the creation of a clone was altogether a more radical step. One individual asked if it was like a 'sheep in a test-tube', while another was unsure how a clone came-to-be. This is a testament to the informational hurdle that must be overcome to allow people with no technical training to understand cloning.

> *Like [sic] where do they go? Like [sic], how do they…. become [sic] born? I'm sure they're not 'instant sheep' like [sic]*
>
> **Aisling, 18 (C2DE)**

The concept of animal breeding was introduced via information-card B1 (Animal Breeding) and it was evident that this concept resonated with participants. The initial context of this discussion was similarities being drawn between cloning and other assisted methods of animal breeding. One respondent suggested that cloning animals was the same concept as breeding miniature (Vietnamese pot-belly) pigs as pets. Another individual suggested that if pit-bull terriers were not bred with other pit-bulls, then 'they'd be running around like wolves or something'; this was used by a participant as an example of the control which breeding exerts over animal phenotypes. Respondents also suggested that cloning would lead to the type of problems seen in pedigree animals (dogs in particular). These problems included poor vision; aggressive temperament; high mortality rates and 'animals that can't breathe properly'. In looking at the context of these assertions, the indications were that participants were considering cloning as another method – in a long line of methods – of 'man' exerting control over animals, ultimately to their detriment. It was also evident that participants struggled to separate-out what was farming or breeding, and what could be considered 'natural selection'.

> *For all these [sic] centuries and centuries, the world just went on, and cows went on without (human) interfering [sic]. I know there were all these wonderful scientific advances, but nature was able to keep on doing it without any help from cloning and all the rest.*
>
> **Theresa, 60, C2DE (Egalitarian & Fatalist)**

Apart from the more obvious biases, the data had several examples of individuals who showed reluctance to the concept of cloning, but were unsure why. Typically, responses were subtle, but occurred across all groups.

> *I don't know. I would be hesitant. I know one of the (Food-Bio QUIS) cards said there is no difference, but like [sic], it's just a bit weird.*
>
> **Clodagh, 20 (Egalitarian, Fatalist & Individualistic)**

Individuals suggested they would have reservations about consuming meat from the offspring of cloned animals, or they would just 'put it back on the shelf'. Other participants mentioned that their 'gut reaction' would be negative, or that they would be instinctively against it. These findings suggested that the 'affect heuristic' (Slovic *et al.*, 2007) was a strong element of decision making among some participants; instead of an open trade-off between various Food-Bio QUIS card positions, this group were more likely to make their minds up relative to the overall positivity or negativity toward cloning. From the facilitator's notes, respondents often shrugged or shook their head, indicating negativity. It was evident that participants felt the negativity was difficult to articulate in such instances.

Several individuals associated cloning with eugenics, and alluded to concepts of an Aryan race, Hitler and 'horrific stuff that went on during the war'. The following example was typical of discussions in this round.

Well, whether it's right or wrong, the first thing I think of is humans.

Amy, 19 (C2DE)

In considering the associations, heuristics and biases expressed by participants, the methodology must be considered. The Food Bio QUIS format introduced information to participants from all sides of the debate. While this engagement approach was an attempt to gain insight into opinion on broad ranging policy issues, undoubtedly some information had greater resonance with participants than other information. For example, Dolly the sheep was mentioned during initial reactions – before story cards or information-cards were introduced – but subsequent Food-Bio QUIS cards acted as a confirmation bias for participants to suggest that cloning would be a failure (admittedly one card outlined that Dolly had premature arthritis when she died, but this outweighed any other information). This confirmation-bias was evident when individuals largely ignored the current success rates and used the 277 attempts to clone Dolly as a means to further their arguments.

An over-arching theme evident across different groups was the viewpoint that a cloned animal would be inherently flawed, but that such problems may (in the short-term) be at an unobservable level.

All it takes is one of them (the cloned animals) with one little defect to develop cancer later in life, or whatever, that can be passed on (through genetic inheritance). Like [sic], photocopy something twenty times and there is going to be some sort of mark or something on the page.

Thomas, 29 (ABC1, Individualistic, Hierarchical and Fatalist)

There was a fear that by 'making copies', the defects in the original animals would 'get enlarged'. One respondent suggested that cloning was a loss in 'genetic variability', and it was this genetic variability that helps keep animal populations healthy.

I think that's where the fear is: we're going to shift away from this natural state. How far are we going to shift? And what unforeseen problems is [sic] that going to cause? Like [sic], if you need some genes that you can't find anymore?

Barry, 35 (ABC1, Individualistic and Fatalist)

This language of evolutionary science was evident in some cases. Cloning was thought to 'rule out competition' and 'dilute the gene pool'. One respondent suggested that there was 'no natural selection' with cloning, while others theorised that animals have been evolving naturally for thousands of years and cloning was changing this cycle of evolution. There was evidence that participants struggled to separate farming from what 'happens naturally'.

I think (that) if you over-clone you could lead to extinction of the animals. Like [sic] your gene-pool reduces. We evolve all the time, y'know [sic], become immune to disease and become susceptible to others that haven't been invented yet. So if you have a cow in 200 years that is a clone-of-a-clone-of-a-clone, they might not be able to survive. Like [sic] instead of letting cattle evolve slowly through nature like [sic].

Kate, 39 (C2DE, Hierarchical & Fatalist)

Individuals suggested that nature was 'finely balanced', and that cloning could upset this equilibrium. Respondents compared the introduction of cloning to what might happen if you 'removed mosquitoes' or 'got rid of the scorpions'. The examples expressed indicated that the notion of disturbing an eco-system was a risk they associated with cloning. This concern ignores the domestication of animals for farming, where such eco-systems do not feature. These aspects of natural and nature were not prominent among KOLs on the issue of cloning.

In response to an information-card that suggested that certain types of cloning are common (Card B3: Clones in Nature) a number of individuals expressed the belief that SCNT (Somatic Cell Nuclear Transfer) cloning was completely different. The main argument pertained to 'DNA' being involved. There was one incidence where cloning was not thought to be radical, a participant (ABC1 25-34 male group) suggested that 'putting DNA into an egg, was not really creating anything new'.

The aspect of human interference also featured among respondents. Individuals believed that the technology was 'manipulating and hurrying along nature'. Cloning was thought to be 'just against the norm'. One respondent adduced that even though the animals were DNA replicas, they were different because they caused suffering to the surrogates and had various abnormalities. The association with being 'in a lab' was a modulating factor in its being against nature.

> *I think the thing about cloning is (that) most peoples' perception is (of) a group of 'white coats' (scientists) in a lab dealing with very high [sic] complex medical scientific matters that could go horribly wrong.*
>
> **Carl, 31 (ABC1, Individualistic & Hierarchical)**

It was conveyed that because cloning was created 'under the microscope' this made it unnatural. However, one respondent acknowledged that while IVF was carried out in a laboratory, and indeed under a microscope, it was still considered 'a natural process in the body'. Thus, while connotations with the laboratory setting were negative, perhaps the objection may be better understood as a perceived association with explorative and experimental trials, as opposed to routine procedures.

A delayed impact was a perceived risk associated with cloning for a number of individuals. Cloning was considered to be no more than a 'leap of faith', and the opinion was voiced

that it may be creating 'faulty batches of animals' in the future. Some of the most prominent concerns to emerge questioned how 'anyone' could tell if cloning was safe into the future. This was despite card information outlining the position of the US and EU food safety authorities (B7: Food from the offspring of cloned animals).

Responses highlighted that information on the nature of the risk did not reduce the perceived risk, and furthermore, some participants had no idea who would be in a position to predict cloning safety. At a practical level, this would indicate that a new technology such as cloning will struggle with public acceptance until several generations of animals are proven to be healthy. Individuals questioned the health of the clone progeny, and raised concerns that prolonged eating of clone-derived food would manifest in a food risk. The comments highlighted that one of the greatest fears among this cohort was that eating products from clones could have a delayed negative effect.

> *Is there definitely no difference? Like [sic] say in the long run? Like [sic] say, you were eating meat for like [sic] five or ten years, would it be the same as normal things (potential risk), or does anyone know? Like [sic] has it been around long enough for them to find out those things (potential risk)? You always hear of medicines and stuff that people brought out, and they were like [sic] 'ah ya, it's grand'[50] and then ten years later people have (health related) problems.*
>
> **Aisling, 18 (C2DE, scoring below the mean for worldview)**

[50] 'Grand' is typically Irish colloquialism and means 'ok' or 'fine'.

In the same context – and again from initial reactions to story cards – there were strong arguments from four participants against cloning that posited it in the context of 'mad cow' disease. The main objection referred to how meat was initially considered safe, but subsequently contained damaging effects.

> *They (scientists) said that meat was grand, and you have all those people dying of Mad-Cow disease. I'm not being funny like [sic], you're dealing with peoples' health!*
>
> **Grainne, 62 (C2DE, Hierarchical, Individualistic & Fatalist**)

When considering the risks that participants associated with cloning, their orientation reflected the risks as described by Slovic and colleagues (1979). Cloning was seen to be a novel risk, something that was unobservable, unknown and with the potential to have delayed unforeseeable consequences. It also emerged that cloning was seen as a chronic 'toxicity' risk with biases anchored in 'mad-cow' disease. The element of control with respect to the risk from cloning also emerged. This may be further clarified with respect to risk attenuators and amplifiers, but a participant questioned if anyone was currently qualified to understand or quantify the risk. In addition to the perceptions of risk outlined by Slovic and colleagues (ibid), elements of risk such as naturalness and human-interference (Sjöberg, 2000) also featured prominently.

7.4. Food-Bio QUIS: Round C

Socio-cultural influences on perceived risk associated with cloning

In examining an individual's perspective of risk, the literature suggests that an attempt should be made to understand the accompanying ideological factors (Marris, 2001); it is thought that deep-felt concerns often persist and develop. In this way they help to shape people's understanding of the world, which is then used to determine views about other issues.

The following section builds on individual biases and how the risk associated with cloning is defined by participants; these perspectives are contextualised with respect to worldview, socio-demographics and other sampled criteria. These were initially to be examined with the third round of Food-Bio QUIS (referred to as issue-cards by the facilitator), but several of these factors emerged before this stage. As in round two, the twelve 'issue-cards' that participants read aloud in the third round reflected the views expressed by KOLs during previous in-depth interviews. The aim was for participants to identify issues that were important to them and thus indicate KOLs they saw as relevant to the cloning debate. The issues-cards are outlined in figure 7.4.

Fig. 7.4: Food-Bio QUIS. Round C: Cards C1-12

C1. More than Science?: It has been argued that when food from cloned animals is considered, it should be based on a range of issues about the importance of scientific information for regulation compared with other kinds of knowledge, such as cultural, social and religious values.
C2. Advantages for farmers: Cloning may offer an advantage for farmers whose livelihoods depend on selling high-quality food. The breeding technique could allow farmers to select and breed the best animals i.e. beef cattle that have lean but tender meat, and are disease-resistant.
C3. Creatures with feelings: Many people believe that farm animals are creatures with feelings and individuality. Do we have a right to use a technology that is likely to cause suffering for animals? Do we have a right to make copies of animals that already exist?
C4. Animal Welfare: Caesarean sections (or C-sections) are common for surrogate animals as clones can grow to be quite large in the womb. Abnormal development is common, with frequent death at various stages of pregnancy.
C5. Quick enough improvements?: The cloning procedure has improved in the 14 years since Dolly's birth. Continuing improvements have reduced health problems seen in early attempts but the success rates are still lower than other reproductive techniques.
C6. Cost of Clones: Even though the cloning of farm animals may benefit farmers' profits, the cost at the start may be too much for smaller farmers. Farmers that do not use the technology may be at a disadvantage.
C7. Religious Opinion: The Catholic Church, in its "Reflections on Cloning," says "there is a place for research, including cloning, in the vegetable and animal kingdoms." However, the Church of Scotland have researched the area extensively and believe that it goes a step too far in the industrial model of animal reproduction.
C8. Testing for Clones: At present there are no specific tests that can reliably distinguish between food from cloned animals and food from their non-cloned counterparts. However, clones may be identified using a tagging system.
C9. Ireland's exports: If cloning was to be used in Ireland, there is a possibility that it may damage our reputation for being green and natural.
C10. Two-Way Communication: Scientists suggest that it is impossible to talk to the general public about technology such as cloning because they think the public relate everything to science fiction and movies.
C11. Against Evolution?: Producing a clone of an already existing animal is in itself unnatural. The usual mixture of genes from two animals is left out, and the mechanism of evolution – based on the continuing mixture of genes from the best–adapted animals – does not apply.
C12. Development of Agriculture: It can be argued that developments from the very first attempts to farm wild animals, to today's attempts to clone animals can be seen as one long process of farming development. It no longer holds any surprises for scientists – only technical challenges.

World view was not a criterion that was quota-sampled, but it was recorded such that it may give another dimension as to how participants perceive cloning. The literature suggested that world view may be more significant if the hazard relates to a food or an environmental risk (Marris *et al.*, 1998). The following example suggests how world view was present in the data and how it can be interpreted alongside individuals' opinion.

> *It (meat from cloned animals) wouldn't be for sale if it wasn't safe. It would have to be passed (assessed and declared safe).*
>
> **Declan, 65 (C2DE Hierarchal & Fatalist)**

Within this particular example, 'Declan' exhibited that his particular world view places control of food risks in the hands of a governmental hierarchy. Within the data, world view was seen to be relevant with respect to certain types of risk. For example, some participants believed that cloning would inevitably be abused when it 'gets into the wrong hands'. There was a suggestion that the technology would be safer in the public sector; what was implicit was that cloning would be a safer technology if used by government rather than private enterprises. The suggestion was that the private sector was more likely to be unscrupulous and lured into carrying out human cloning. One participant suggested that scientists were a 'law unto themselves', while another suggested that 'brown envelopes[51]' are used to bribe public officials. The common theme for individuals expressing these

[51] A 'brown envelope' refers to the practice of politicians receiving illegal payments (in brown envelopes) in exchange for favours.

views was that they all exhibited fatalism as a component of their world view. This suggested that 'fatalists' were predisposed to seeing cloning negatively and this influenced how they interpreted information. World view also featured with respect to labelling of clone-derived foods. As participants acknowledged the difficulty in scientifically identifying clones (Card C8: Testing for Clones), the presumption was that cloning would then be used regardless (this view was only shared by 'fatalists'). While associations with fatalism and negativity toward cloning were present in the data, other world views did not highlight any significant trends, and thus overall, world view was seen to be a poor contributing factor when contextualising risk.

Two of the screened criteria were found to have minimal correlation with perceptions of cloning. Firstly, 'meat consumption level' was a poor indicator of perceived risk or intention to consume food from cloned animals; if vegetarians or non-meat eaters were included in the study, this variable may have had greater significance[52]. The other factor – pet ownership – only correlated with one factor related to cloning. This was a tangential argument among participants which concerned the character of animals and whether this could be cloned. Several respondents suggested that a dog's personality could not be replicated; the common factor among this cohort was that they all owned a pet. It can be inferred from this finding that those with a pet may be more likely to be concerned about the observable behaviour of clones.

[52] A position of non-meat consumption could be due to principled based objections to the treatment of animals in agri-food systems generally.

Of the screened criteria, socio-demographic factors of age, gender and social class were observed to correlate with differing perspectives on cloning. For example, arguments against cloning that posited it in the context of 'mad cow' disease were all from female participants in C2DE groups (world-views were divergent) and centred on delayed negative impacts. Furthermore, C2DE groups exhibited less perceived control over the possible uses for cloning in the agri-food industry. A female participant (Amy, 19: Fatalist and Hierarchical) suggested that no matter what her view was, 'they are going to do it (approve cloning) anyway'. From the 60+ C2DE group, two participants similarly believed that the technology would be approved by governments, despite their concerns. These individuals had particular concern (in reference to an information card) regarding first generation clones being considered safe to consume, but kept out of the food-chain (this was also evident in the C2DE 30-44 female group).

The perceived lack of control within C2DE groups was contrasted with varying suggestions on how the technology could be regulated by ABC1 groups. All ABC1 groups expressed a preference for more dialogue and discussion before approving technologies. From the evidence in this group, there was a preference for an 'informed consent' approach. This higher perceived control may be related to greater knowledge of how such technologies could be regulated or indeed greater uptake of the Food-Bio QUIS information among the ABC1 cohort.

It is important that it is brought to the people. You know, you don't want to push it (cloning) through and then all of a sudden (adverse) things are happening. There is a huge need for people to be educated; in schools, they (educators) should be talking about these sorts of things.

Katie, 51 (ABC1, Egalitarian)

Two women from the ABC1 45-59 age group suggested that cloning was a natural progression when considered in the context of other assisted reproductive techniques, while another suggested that it was not against nature, as the information indicated that it did not change anything (the DNA). Within the 60+ C2DE cohort, there was a belief that there was a natural order and cloning with its ability to perpetuate sets of genes was contrary this.

I just think it's (human existence) a cycle. The cycle of life: part of nature, part of life. Y'know [sic], life and death?

Maura, 61 (C2DE, Individualistic, Egalitarian & Hierarchical)

In response to prompt questions[53] on the issue cards, this group individuals questioned why cloning might be used, as nature is able to 'keep working without help from cloning'. Although perceptions of 'upsetting nature' or being 'against nature', was evident across all

[53] In round three responses to prompts: what do you think nature means? What does natural mean with regard to the food choices we make? Why do you think nature is important/ not important?

groups, further articulation pertaining to the notion of ecosystem or environmental balance was confined the ABC1 male groups.

Within the ABC1 female group there was evidence of scepticism with regard to cloning, and this type of technology development. The opinion from this group centred on the developers and food industry only being motivated by profits and efficiencies. This cohort also highlighted how detached society is from the food they eat, and proposed that this could be a reason for people being surprised when they find out about the technologies being used. From this group there was also a suggestion that cloning would be used as substitute for good husbandry practices. This was offered in the context of the recent Irish pork-dioxin product recall, such that if animals are going to be 'fed plastic bags', cloning will somehow make them immune to this type of malpractice.

Several individuals associated cloning with something that was intrinsically man-made, that had huge potential for good, but ultimately something that could lead to disaster. Such dialogue was limited to ABC1 groups and compared cloning to 'splitting the atom' and nuclear power in general. The dialogue highlighted the difficult position of regulators to participants; on the one hand they encourage scientific endeavour and technology that benefits society, and on the other, they manage and communicate the associated risk. Participants alluded to nuclear meltdowns, 'Hiroshima' and the concept of technological stigmatisation that can impact on individual perceptions of risk.

I'd liken it almost to people having that irrational fear of nuclear energy type thing [sic]. As soon as you hear of nuclear energy, it's like 'oh my God we can't have that, because it's nuclear'. When they (society) hear of genetic modification or cloning, they think of sci-fi films.

Peter, 30 (Individualistic & Hierarchical)

The significance of this finding was that several of the ABC1 participants believed in an 'us-and-them' system of novel-technology acceptance. This finding may be characteristic of a NIMBY (not-in-my-back-yard) attitude, such that individuals believe a technology may be useful, but not for them, or perhaps they believe they are better positioned to interpret risk communication.

The interpretation of religious influence with respect to cloning highlighted a significant gender and an age divide among participants, as well as differences among social groupings. C2DE 60+ participants considered that cloning may result in a type of retribution for technology developers, as they viewed it as violating God's handiwork.

I think they're (scientists) messing with the natural order of things. Scientists don't know (what they are doing). They're not God, they don't know everything. Further down the road people could be paying the price for their ignorance. I'll stick to me [sic] soya milk.

Stephanie, 64 (C2DE, Egalitarian, Fatalist, Individualistic & Hierarchical)

Religious influence was also seen within other groups, but interpretation of dogma differed[54]. Participants suggested that 'a God' created 'heaven and earth', while others alleged that cloning was disrespectful to the creator. These views emerged from the ABC1 25-34 year old males and females in the C2DE 18-24 year old group. These respondents clarified their position by saying cloning was 'against creation' rather than religion. Of the participants that argued that cloning was not 'playing God', they suggested that it was 'just alien'. Another participant suggested that 'playing God' was just a 'turn of phrase'. It was offered by several participants that when 'playing God' is evoked, it is when the public fail to understand a scientific advance. Furthermore, ABC1 participants from the 45-59 female and 35-44 male groups alleged that the 'playing God' argument has 'no basis' as advanced medical breakthroughs that have life and death impacts are readily accepted by the public.

> *No, I don't think so (cloning is playing God). As we advance and (we) learn more (through scientific endeavour) [sic]. Like [sic] I'm sure when we first started taking blood, and doing blood transfusions, that was seen as 'playing God'.*
>
> **Ena, 53 (ABC1, Egalitarian and Individualistic)**

With the exception of the 60+ C2DE group – who believed that cloning violated their religious beliefs – participants had divergent views in acknowledging the role of religion in

[54] This emerged during initial reactions to story cards and subsequently to prompt questions in the third round: In one of the cards it said considerations about cloning should be more than science based, what do you think this meant? (For example should religion or the broader environment be considered? Why/why not?)

the acceptability of cloning. The arguments for acknowledgement centred on various food prescriptions (participants discussed Halal for example) and 'respecting people's religious views'. The ABC1 25-34 males came out strongly in favour of scientific analysis and individual decision-making, while they articulated that biotechnology was beyond the remit of religious organisations. In response to the position of the Catholic Church (C7: Cloning and Religion), C2DE individuals were taken aback to learn it acknowledged a role for cloning in the animal kingdom, but stated that their anti-cloning position would not be changed irrespective of the fact.

7.5. Risk Amplifiers and Attenuators

The following section examines the role of various bodies or groups that may be in a position to amplify or attenuate the risks outlined by participants[55]. This section begins with the role of technology developers and also looks at the role of farming and animal welfare actors. These responses were established throughout discussions, and during the various rounds. One such example related to how information on cloning was described. Towards the end of the third (issue-card) round (with the female ABC1 40-59 group), one individual stated the fact that 'a clone is not genetically-modified' should be part of any communication with the public.

> *I thought (that) when you cloned, you messed around [sic] with the DNA, or altered the DNA. I didn't think it was that simplified.*
>
> **Ena, (ABC1 Egalitarian & Individualistic)**

Cynicism with respect to the actual utility of new technologies was a feature of ABC1 males in both the 25-34 and 35-44 age groups. Individuals within these groups suggested strong lobby groups are used to gain approval for technologies like cloning and they do little to solve issues of food shortages. One respondent suggested that all 'western' countries over-produce, and issues of supply were far more complicated. These opinions were in contrast to C2DE groups, who suggested that the technology could be used to feed

[55] The literature outlined that it is the transfer and interpretation of information regarding risk that feeds into the 'social amplification of risk' (Kasperson et al., 1988; Freudenburg and Pastor, 1992).

developing countries. ABC1 males questioned the source and motivation for scientific research, and suggested that much of the research is clandestine.

> *You see, I'd be a bit sceptical of scientists coming out and saying it was safe, because who's [sic] been paying for their research could have a vested interest as well. Not that I wouldn't believe them (pause), you'd just have to be a bit sceptical, like [sic]. Who's funded their research for the last 20 years?*
>
> **Kevin, 37 (ABC1, Individualistic and Fatalist)**

This finding would support the argument for more directness with respect to the development of novel food technologies, and indicates that promulgated applications affect perceptions. While many novel technologies may be able to solve global food shortages, stating this as a primary motivation would appear to elevate scepticism among some. Despite this cynicism, the 'ABC1 male cohort' positively rationalised cloning with respect to reducing the cost of food, but indicated that it would represent a trade-off (any unease would be off-set by a lower price).

> *If you're a mother with five kids and you have to go to the shop to pick up dinner for five kids, you're not going to say 'that's cloned I'm not eating it'. You're going to look at it and say 'I can feed all five kids with this'.*
>
> **Kenny, 30 (ABC1 Individualistic, Hierarchical & Fatalist)**

Within ‘ABC1 25-34’ and ‘35-44’ groups, arguments for cloning were contextualised within a growing global population where technologies that can produce foods in a ‘cleverer’ way must be embraced. This did not necessarily equal cloning acceptance, but getting the maximum return from ‘finite’ resources was agreed to be the primary motivation for novel food technology development.

The impact cloning may have on small-scale farming – such as the technology only suiting large scale food systems – appeared to resonate with participants. Individuals across several groups believed that the cloning technology would drive smaller farmers out of business. Within this context, participants mentioned the role of multi-national companies applying pressure on producers, and hence cloning technology was a solution to maximise efficiencies. From the data, males from ABC1 groups were influenced by a recent television documentary called ‘Hugh’s Fish Fight’, which highlighted the pressure exerted on fish suppliers by supermarkets[56]. In terms of elevating risk for individuals, the presence of groups campaigning against cloning to protect small holdings or small-scale producers may hold significance. While overall contribution of these organisations to food production may be small, the threat to small farms and by extension their way of life resonated within the sample groups.

[56] In October 2010 Hugh Fernley-Whittingstall filmed a Channel 4 series (called Hugh's Fish Fight) on sustainable fishing and where fish comes from. The series was in three parts, broadcast on subsequent nights on Channel 4 from Tuesday January 11, 2011. It was part of Channel 4's 'Big Fish fight' season. The campaign benefitted from the use of social networking sites Facebook and Twitter as well as its own website. Before the programme came to air, the campaign had received 13,000 signatures, the day after the final episode there were over 320,000 signatures

One of the greatest restrictions to the use of cloning relates to issues of animal welfare. In articulating their concerns, respondents used 'battery chickens' as a byword for poor animal welfare standards. Several individuals framed the likely welfare standards for clones with that associated with battery chickens. For example, participants compared clones to the choice people face with regard to 'free range' or 'battery' chickens and eggs (mentioned in all groups, but prevalent among ABC1 45-59 women and C2DE 30-44 women). It was inferred that through food choices, the public indirectly supports farming practices in which animals may suffer.

With some exceptions, there was evidence that the commoditisation of animals for food was more acceptable to male participants. Male participants were more likely to suggest that clones were 'only animals' and to regard them as a commodity. This was seen in the ABC1 groups and males in the 18-24 C2DE group. One participant suggested that:

> *Animals are bought and sold for meat and money. What difference does it make [sic] cloning them?*
>
> **Killian, 20 (C2DE, Egalitarian, Individualistic & Hierarchical)**

This was not to say that male respondents within this cohort did not express any regard for a duty of care to animals. Individuals acknowledged that there is a certain level of suffering that is acceptable, but believed that animals should be afforded certain welfare

considerations. One participant suggested that if the suffering was in-line with other farming practices, cloning would be more acceptable.

> *I think it (animal welfare) has to be at a level where the suffering (to the surrogate animals) is no worse than a cow being de-horned…*
>
> **Peadar, 34 (ABC1, Egalitarian and Individualistic)**

The males from the C2DE 60+ group differed from males in other groups, such that they both believed that the technology was cruel, and that the low success rate was 'unsettling'. There was one exception from C2DE group, who believed that dogs had 'personality' (but were separate from farm animals, which he considered commodities). From the data collected there was some evidence that suggested that the issue of animals and feelings was modulated by the group dynamic. The evidence surrounded the language that individuals (males aged 18-24; 25-34 and 35-44) used; for example, participants within this cohort made jokes regarding 'animals' feelings' and were more likely to make flippant remarks. Typical responses were that individuals did not care as long as it was a 'tender bit of steak', or that it was 'only' a farm animal. Such comments often drew laughter from other participants, and encouraged the individuals to carry on in the same tone. This finding must be considered due to the group dynamic; arguably without other participants, individuals may not have continued in this fashion.

Overall female participants were more sympathetic toward animals, and believed that the process of cloning was less acceptable than their male counterparts. The exception came from two participants in the C2DE 18-24 age group, who questioned if one could 'feel anything for an animal you were going to eat', and despite the trauma they may go through, you were 'going to eat it anyway'. From this evidence it could be argued that animal welfare issues have less resonance with younger people (the exception was the remaining girl from the 18-24 C2DE group, who believed that animals had 'feelings').

The implications of the concerns articulated by individuals showed that animal welfare may have a significant bearing on the acceptance or rejection of cloning. The issues of animal welfare and cloning elevated concern and brought discussions into the area of industrial-scale food production practices. Participants compared associated welfare issues with cloning to other known animal cruelty issues, indicating both an anchoring bias and the potential for animal welfare groups to feature prominently in public debate. The finding is significant, as associated animal cruelty may represent a prohibition from a principle-based-objection perspective, and also on the basis that poor animal welfare can draw associations with reduced food safety (Harper and Makatouni, 2002).

The associated welfare issues with cloning may also be putting emphasis on the use of animals for food production, in a way that participants may not have considered before. While individuals canvassed passively supported animals being used to produce food (all participants consumed meat), the responses in many cases suggested that cloning was beyond what they considered to be 'natural' with regard to food production. While the

literature highlighted that ‘naturalness’ could be considered an element or a type of risk, responses from the group indicated that it is in itself a type of belief system with respect to food (Sjoberg, 2000). Certainly, from a technological development perspective, if innovation is considered ‘un-natural’, it is then considered to be detrimental. This may stem from food marketing, where ‘natural’ is widely used as a byword for pure or ‘no added ingredients’. In any case, further research is warranted into what ‘natural’ means in a food context and perhaps additionally, if this correlates with a lack of understanding with respect to the orthodoxy of how food is produced.

7.6. Conclusions

This chapter must be contextualised within the methodology being used; while examining public perceptions of cloning is a means in itself, the nested approach allows the views of the public to be understood within the meta-narrative of an Irish commercial and policy position (*i.e.*, mirroring views in a broad national debate). The Food-Bio QUIS cards endeavour to introduce findings from KOLs to participants, the facilitator then seeks reactions and debate from those participants and it is these interactions from which insight is interpreted.

The results indicated differences in 'cloning perception' between sample groups in terms of age, gender and social-class; this may indicate there may be room for further research with regard to market segmentation (for example, for ABC1 males 'getting the most from finite resources' was considered an acceptable motivation in developing new and perhaps more controversial food technologies). There was limited opportunity to examine what individuals knew about cloning without using the card-prompt methodology. The technology was not unheard of, and Dolly emerged as a point of reference in the various discourses. This may indicate that regulators and technology-developers alike will need to reconcile their communication strategies with the legacy 'Dolly' has established for public perspectives on cloning.

The interpretation of the data to examine perceived risk associated with cloning highlighted several issues with regard to the grounded literature. The work of Slovic and colleagues (1978) did establish a method to consider risk (the psychometric paradigm) and this method

will still hold relevance for many risks, but within the context of a novel food risk – such as cloning – perceptions draw heavily on elements which were not outlined originally. Sjoberg (2000) does describe aspects of naturalness and human interference, which featured prominently with respect to this research. This correlates with the most recent Eurobarometer poll which stated that 'if "unnaturalness" is one of the problems confronting GM food, this concept appears to be an even greater concern for animal cloning and food products' (EB, 2010). While the additional aspects aided the overall articulation of the perceived risk associated with cloning, it did highlight that the area could benefit from additional research. With future food and agricultural development[57] a method of understanding of perceived risk as it relates to novel foods will be of great importance; technology-developers and policy-makers will be key benefactors as they seek transparency and citizen engagement in their risk management processes.

[57] *In vitro* meat, food applications of nano-technology, products designed around nutri-genomics for example

8. Conclusions

This research set out to canvass the views of Irish key opinion leaders with respect to the use of animal cloning for food production purposes as well as those of the Irish public. Specifically this research aimed to gauge the current levels of awareness among specific groups and examine their likely acceptance. The contribution of this research is an indication as to the receptivity of cloning within the Irish agri-food sector, and contributory factors for perceived risk associated with cloning, among members of the Irish public. This final chapter gives context to findings with respect to recent developments within the Irish agri-food industry. This is followed by a critical reflection of the research design, a brief overview of the key results and the areas identified for future research.

8.1 Recent Developments within the Irish Agri-Food Industry

The impetus for conducting the present study arose from the commercialisation of agri-food cloning in the USA and the potential of this technology to add value to the beef and dairy sectors (both of which form a central part of Ireland's total food exports). Maintaining and growing these export standards has been identified as a key component of Ireland's economic recovery (Irish Government, 2012). To this end, recent developments have brought into focus the potential for a technology such as cloning. For example, by April 2015, the quotas which currently limit the amount of milk that Irish farmers can produce will be removed (Council Regulation [EC] 1234/2007). Currently the export value of Irish dairy sector is worth €2.8bn in export sales (projected figure for 2011, an increase of 20% on 2010), and representing close to one third of total food exports (An Bord Bia, 2012). As

producers begin to plan in advance of the era of a 'post-quota dairy sector', organizations such as co-operatives and private companies (encouraged by state agencies) will begin to compete for long term contracts to service a de-regulated milk sector (O'Brien, 2011). With this opportunity to the fore, the Irish government has committed to achieving 50% growth within this sector by 2020 (DAFF, 2011).

Further to growth within the dairy sector, the Irish government has also committed to growing the Irish beef sector by 20% by 2020. The Food Harvest 2020 document for agri-food sector growth (ibid) outlined that this should be achieved through combination of better quality cows and breeding, achieving slaughter carcass weights at a younger age and better carcass quality. In addition, it stated that genetic advances offer the potential to deliver greater profitability at farm level through enhanced productivity and disease resistance. In looking at these growth targets for the dairy and beef sectors, perhaps one way of increasing output, is to increase output from individual animals through the early adoption of a technology such as cloning. It is in the context of these ambitious growth targets that the results of 'Insight into Animal Cloning and Food Chain' can be considered.

8.2 A Critical Reflection of the Research Design

Central to the design of this research was an aim to generate a greater understanding of agri-food cloning in an Irish context. The research questions reflected this and at the core of the study was the interactive model of research design, which tested the components of the research process (fig 5.1). It acted as a guide and a reference point for the challenges posed in canvassing the views of Irish key opinion leaders and the Irish public. The study was

fraught with challenges, most notably how to interact with members of the public with low awareness of the subject matter and when the literature indicated that the technological complexity would act as a barrier to successful interaction. The solution chosen was as a result of not finding a solution in the established qualitative methods. The research instrument that was developed took two established methodologies – DEMOCs and focus groups – and developed Food-Bio QUIS. The novel method was an attempt to bring the issues identified by the key opinion leaders on the phenomenon in question and refine them to 35-word-snippets that could be discussed by members of the lay public. The concern with the novel methodology and the results generated – to quote the interactive model of research design – was 'what are the plausible interpretations and validity of these and how will you deal with these?'

In terms of the plausible interpretations of the Food-Bio QUIS results, these must be considered with respect to the design of the instrument and the quality of the information used. The component parts of Food-Bio QUIS are a contemporary focus group and a DEMOCs model. It is reasonable to suggest that focus groups are well established within qualitative literature, and industry bodies such as MRS add rigour to the elements of selection criteria and best practices. In terms of the aims of this study it was important that the focus group components used added structure and a qualitative rigor to the selection criteria and the interpretation of the results. From the literature it was possible to identify the cross sections of the Irish public that would contribute most to the study and using the orthodoxies set out in the qualitative journals and guides it was possible to validate these

selections. This was not a feature of the DEMOCs model, and one of the contributing factors to developing the novel methodology.

The DEMOCs component of Food-Bio QUIS served a specific function such that it allowed discussion on a complex subject matter, negating one of the barriers to engagement with the Irish public. One of the key success factors for DEMOCs was the quality and careful selection of information that would be used. In this regard, advice was taken from the creator of the DEMOCs game with respect to the filtering of key issues and the flow of information-provision over three rounds *e.g.* some of the information may be divisive or polarising and it was suggested that this was left until later in the game. Furthermore, advice was taken with regard to the language used, and the length of the information snippets. One of the other success factors for DEMOCs in the area of citizen engagement is that it aims to get a consensus on how complex technologies should be dealt with and governed; this was not an element incorporated in Food-Bio QUIS. The aspects of debating the key issues and encouraging a range of opinion is a key part of the DEMOCs game, but taking another step and refining options to get consensus among group members is not something that Food-Bio QUIS set out to do. The use of Food-Bio QUIS was an instrument to canvass the views of the Irish public with respect to the use of animal cloning for food production purposes.

In terms of the quality of the information used for Food-Bio QUIS – and considering how this may be plausibly interpreted – this relates to the quality of the results from the in-depth interviews and structure of the nested qualitative in qualitative research design. The

approach to identifying the salient issues with regard to the agri-food cloning in Ireland was to identify the key opinion leaders and to canvass their opinion. Before these people were identified their relative importance was validated in a number of ways. The first was through the literature to see where the contentious policy areas have been in European and US thus far; this gave likely professions or positions from where these key opinion leaders (KOLs) are likely to be *e.g.* food safety, animal welfare or consumer groups. The second was to establish criteria to insure that the responses from the KOLs would be significant *i.e.* in the event that there was national debate on agri-food cloning, that these key opinion leaders would be likely to feature. Arguably there are KOLs that did not participate that would fulfil the criteria; to deal with this, three individuals were identified for each profession or position and in all cases at least one participated.

With respect to the information generated via the KOLs which was subsequently incorporated into Food-Bio QUIS – and how this may be plausibly interpreted – the methodology used is an established qualitative technique. Using an in-depth interview methodology it was possible to use a semi-structured guide to canvass opinion on the salient issues. There was some variation in the guides to allow for greater detail in a KOLs area of expertise, but the themes discussed were consistent with all participants. Perhaps where the greatest level of scrutiny can be applied is with respect to the interpretation of the data. From the interview scripts generated, coding helped to separate out the key messages from the dialogue. Using the coded dialogue, the key messages were grouped into themes which were cross referenced across all scripts. In terms of the validity of these themes, they were debated, reworked and agreed as salient by the research team. The validity of these

key themes was further validated through a peer-reviewed publication on the in-depth interviews in AgBioForum in 2011 (Murphy *et al.*, 2011; also appendix B).

With the establishment of the appropriate information to generate insight via the DEMOCs element of the Food-Bio QUIS game, the shift in plausible interpretation moves to the mechanics of the game. The validity of Food-Bio QUIS as a method of generating data can be subject to criticism as it is ultimately an experimental technique. The research question aimed to canvass the views of the Irish public and the conceptual framework for interpreting these results was based in the area of perceived risk. Within the perceived risk literature the areas of heuristics and biases featured prominently and in affect, the methodology introduced a number of biases. In reconciling the biases generated through the introduction of KOL opinion, the barriers to engagement with the Irish public must be considered *i.e.* low awareness and difficulty discussing complex technologies. The success of DEMOCs is in the understanding of the key themes, quality of debate and discussion generated on complex issues; this was the aim of incorporating 'the DEMOCs way' into Food-Bio QUIS. Another element of bias with respect to Food-Bio QUIS is with respect to the facilitator. The novel methodology means that simple and clear explanations will allow the participants to start listening and then debating on the topic after each round. The role of the facilitator is important to get the initial debate started. This may involve watching for non-verbal cues while a particular information snippet is being read out and asking a subtle open-ended question to get the conversation going. The role of the facilitator – or indeed any moderator in a similar setting – is to make sure that everyone gets to contribute and

keep the conversation moving. Undoubtedly, this is a skill that improves over time and this will have a bearing on the quality of the data generated.

The interpretation of Food-Bio QUIS data is therefore relative, and only valid with respect to the salient information provided by KOLs to the members of the Irish public. The basis for dealing with transcripts generated was to analyse the data using focus group methodology and best practice in this regard. The handling of the data was subject to all the rigour of conventional qualitative research, which differentiates the experimental Food-Bio QUIS from DEMOCs. The data was coded and themes were generated in the same fashion as the transcripts from the in-depth interviews. The presentation of results from Food-Bio QUIS in this study can be interpreted therefore as, the views of the Irish public with respect to salient issues identified by Irish key opinion leaders.

8.3 Key Results

On the basis of the findings from Irish key opinion leaders, cloning will not be a technology adopted to drive the Irish beef and dairy sector targets moving towards 2020. The purported benefits of cloning outlined within the chapter describing the state of the art of farm animal cloning do not appear to be driving widespread uptake of agri-food cloning generally. Increasing output and value of Irish animals through cloning was not a top of mind topic for the Irish key opinion leaders interviewed. Indeed when the government growth targets for the agri-food sector are considered, cloning – with the potential to increase superior genetic traits leading to increased milk yield and better beef yields implementable over one generation – would surely represent an enticing value proposition

for both breeders and farmers. Furthermore, given the remit of state agencies to investigate biotechnologies that could add value to the agri-food industry (DAFF, 2010) it is surprising that there was no discussion on these aspects of cloning among pertinent KOLs.

In looking at reasons for low awareness in an Irish context, the evidence from the first chapter suggests that cloning is not a marketable technology – with low success rates and high costs proving to be barriers to more widespread adoption. From an animal welfare and a cost perspective (see Faber et al., 2003) there is an imperative to improve the methodological and procedural technique for cloning. However, the evidence of the in-depth interviews suggests that the greatest barrier to adoption is the lack of a distinct value proposition. Farming and meat sector representatives outlined the need for economic models for the cost-benefit of cloning to Irish industry. They suggested that if cloning resulted in a reduction in food costs, this may even ease public acceptance. This cohort focused on the market performance of the technology in the USA. The successful adoption of cloning in other markets represented a key investment criterion for these stakeholders; on the basis of this research, the purported benefits are not yet apparent.

Key findings from this study indicated that KOLs were unaware of commercialisation of agi-food animal cloning in the USA. Indeed only one Irish interviewee was aware of the cloning debate in the European Commission. When the progress of the EC is considered – specifically to include cloning in the Novel Food Act, in respect of EFSA finding that cloning does not pose any risk to health or the environment – this reflected a low perceived utility by decision makers; indeed when this step was contextualised in the context of the

single interviewee who was aware of the actions of the EC, this move was framed as an attempt to prevent its use. It is noteworthy then, that the prospect of agri-food cloning for Europeans has been rejected on two occasions by the European Parliament (September 2008 and July 2010 on the basis of protecting animal welfare and consumer confidence), without the knowledge of Irish key opinion leaders.

Irish key opinion leaders predicted that responses from the public to the use of cloning technology would be negative. A regulatory advisor suggested that deontological objections would be a common response (the examination of views of the public only found this to be true for the 60+ age group). KOLs also suggested that the public would perceive cloning as 'unnatural', which was subsequently confirmed in discourses with the public. One university scientist questioned the validity of 'natural' within a food context and asserted that it was likely to reflect what 'our parents' believed to be acceptable.

With respect to the Food-Bio QUIS element of this study, the key findings among the majority of the public suggest that cloning was considered to be unnatural and cruel to animals. This concept of 'unnatural' had different connotations for participants with some suggested cloning would upset a type of natural balance that exists with respect to ecosystems, others suggesting that cloning would never happen 'in nature'. This finding must be contextualised such that – for the most part – this was based on limited knowledge with participants suggested that 'natural methods' were preferable, but expressing little understanding of modern farming.

Individuals referred to 'natural selection' and other 'Darwinian' terms, which indicate they were quite removed from the processes used in the modern agri-food industry. By its very essence, agriculture manipulates processes that once occurred in nature to produce food; in definition, agriculture is unnatural. Where the concerns of participants can be reconciled it is such that cloning is removed from a traditional view of farming (this point regarding an arguably romanticised notion of farming among the lay public was identified correctly by a university scientist interviewed). This concept of naturalness was identified in the IDIs and is a feature of the latest Eurobarometer poll on biotechnology. The 2010 Eurobarometer outlined that 'The natural superiority of the natural' captures many of the current trends in European food production – organic, local and food-miles[58] for example. It suggested that 'unnaturalness' is one of the problems confronting GM food and outlined that this appears to be an even greater concern for animal cloning and its resultant food products (Eurobarometer, 2010). This highlights the need for this topic to be understood in greater detail, both for cloning and for future novel food technologies.

The information provided via Food-Bio QUIS also outlined that – in its current form – SCNT cloning has a number of associated welfare problems both for the clones and for the surrogate dams. The response from the public with regard to this information highlighted the second key finding: these cloning problems are regarded negatively for the production of food. The additional insight generated showed that cloning was closely associated with other breeding techniques and practices associated with modern farming. While the welfare issues associated with cloning did represent an objection, they also showed that they are

[58] Food miles is a term which refers to the distance food is transported (and the fossil fuel expended) from the time of its production until the time reaches the consumer.

rationalised with respect to known ‘symptoms’ of modern food production. When contextualising this result, it must be considered that the sample of the public was deliberately selected to give their views on cloning; they consumed meat regularly. Some individuals suggested that if cloning resulted in cheaper food, this may make it an attractive proposition. However, there were more instances of people reacting negatively to the use of cloning technology. When this finding is compared to other farming practices which the public considered to result in animal suffering, this aspect may not present a barrier. As the literature highlighted, what individuals say cannot always be reconciled with their purchasing actions. Whether cloning suffering will be similarly passively tolerated in future remains to be seen.

One possible barrier to the acceptance of the technology, were the associations cloning engendered. While the participants were given information pertaining to the technical aspects to cloning and the likely applications, there was tendency within all sample groups to focus on the subjective aspects of cloning risks. Despite the FDA and EFSA information outlining that cloning does not represent a risk to human health or the environment, aspects of these risks were discussed at length. Cloned animals represented a ‘dreaded risk’ for some; the prospect of consuming food that would manifest itself in a delayed unforeseen consequence was mentioned by several individuals. Participants also discussed animal cloning relative to the prospect of cloning humans and there was evidence that this concept appeared to be very closely linked for some individuals. In considering the influences for these areas of perceived risk, the legacy of BSE and science-fiction movies were cited as examples of possible negative outcomes from cloning.

8.4 Future Areas of Research

In terms of future areas of research, there are several areas that may warrant additional investigation. Of immediate interest are a series of economic assessments of the potential of animal cloning to the Irish agri-food sector and indeed a commercial analysis of cloning globally. Specific to findings within this study, other areas of investigation include: understanding public views on the concept of 'naturalness' as it pertains to animal cloning and novel food technologies; a quantitative examination of elements of risk that contribute to the public perception of cloned animal being used to produce food in Ireland; the role of science-fiction in the acceptance of novel food technologies and; an examination of sources of information influencing ethical food decisions among the Irish public. These areas would build on the research started here and clarify key aspects of animal cloning debate.

From the experimental design used in this research, it would be of interest to seek greater validation for Food-Bio QUIS. Controlled sample groups could be used to compare Food-Bio QUIS to other methods of generating qualitative insight. Moreover, Food-Bio QUIS could be used to examine other complex food biotechnologies such as genetic modification or indeed nanotechnology as it relates to the agri-food sector.

This research has highlighted that early-stage identification and evaluation of the commercial and regulatory aspects of a new food technology will have a vital bearing on its future success. To this end, the development of a 'food futures group' – spanning government, semi-state organisations, private enterprises, universities and Non-

Government Organisations – with a specific remit to seek out and discuss such food technologies and perhaps with a role for Food-Bio QUIS could be considered.

8.5 Final Comments

The future for agri-food cloning in Ireland remains unclear. The growth targets for the meat and dairy sectors are ambitious and government proposals of embracing biotechnology as a driver for this growth have not included cloning. Despite the approval of EFSA, the FDA and its adoption in the United States the technology is not registering a value proposition for Irish industry leaders. Moreover, the general unease with which the Irish public perceive cloning may mean that even with a green-light for the early-stage development of cloning, sustained objections – as evidenced with GM crops (Grey, 2012) – may eventually lead to commercial failure.

This research has highlighted the importance of an early-stage understanding as to the elements of risk perception with regard to how cloning was framed in the minds of the Irish public and socio-cultural influences shaping their opinion. Incorporating these views into early stage risk assessment for key opinion leaders is a vital cog for their individual positions and indeed their organisational direction. In the case of cloning, animal welfare issues which may prevent regulatory approval have a precedent within European legislation. However, potential public rejection on the basis of a pseudoscientific or erroneous belief highlights the need for further work in this area.

If the European Commission sets proposals for the European Parliament to block the use of cloning on the basis of 'consumer confidence' this needs to be reconciled with other losses. If new food technologies are to be rejected on the basis of them being 'unnatural' – particularly if this is judged against an inaccurate view of where food comes from – this will be of concern to those looking to biotechnology as method of improving the food sector. To this end, the views of various KOLs and the public need to be carefully considered as this will need to be balanced against the withdrawal of funding to areas that may be key to future food supply in Ireland, Europe, and further afield.

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Appendix A: In-Depth Interview Guide

Good afternoon name

Firstly I would like to sincerely thank you for taking the time out of your busy schedule to meet me.

Before we begin, let me give you a brief over-view of the project.

The research project involving Teagasc-Ashtown and Dublin Institute of Technology seeks to examine stakeholder views and attitudes toward the application of new technologies in the beef and dairy food chains.

The first phase of this project will gather the opinion of technology developers, regulators, funders, lobby groups, consumer voice and potential users. This is a piece of discrete work but some findings will inform a focus group study with the public which will in turn feed into a consumer questionnaire[59]*.*

This research will test the likely acceptance of these novel technologies and determine what factors are likely to influence decisions. The findings will be of interest to all major stakeholders but also to actual and potential developers to access the market potential.

As a representative of X, a key stakeholder in the animal production chain, your participation in this research is of considerable importance to the Irish food industry.

I do not anticipate the meeting will exceed one hour and your opinions would add great value and depth to the project

Do you mind if this interview is recorded -for my analysis only-?

Are you ready to begin?

g) *I want to start off by asking you a little bit about you day to day work and where in industry you have most interaction?*

h) *Has this changed in any way over the past few years?*

i) *In terms of your role in xyz and the food industry in Ireland, what do you think will be the most important issue on your agenda over the next year?*

[59] The project originally proposed to carry out a survey but took a different course (the development of Food-Bio QUIS methodology).

2: Stakeholder Knowledge

A. *I now want to move onto the Irish food industry and its future development. Do you think our concept of what food is has changed over the years?*

    i. *Has that influenced your role as a xyz?*

B. *What factors do you believe influence peoples food choices in 2009?*

C. *A key aspect of this project is foods developed using new technologies. Here, I'm thinking about functional foods like cholesterol-lowering spreads and foods with added Omega fats. Could you outline your own personal views on the need and future of these foods?*

D. *Do you think the development foods such as these are important to the future of the food industry in Ireland?*

E. *What is your understanding for GM food?*

F. *Would you say there was any conflict between the development of such foods and say the organic farming movement?*

G. *What do you think the future will be for GM foods here in Ireland?*

H. *Can you think of any emerging food-related technology that you think will pose a major issue for the Irish public?*

I. *What is the role of information and education in helping the public to understand technology?*

    i. *Are there any other ways to engage and inform the public in new technologies? Who should be responsible for this?*

J. *Occasionally new food technologies come about that the Irish public may struggle to understand, or may even disapprove of - genetic modification (already mentioned) and food irradiation spring to mind.*

    i. *What is your perception of public trust in your organisation regarding the safety of such technology?*

K. *How much influence should public feeling have over the types of research that are carried out in public institutions?*

3: Stakeholder Perception:

A. *I now want to turn to technology involving the animal products food chain. What level of concern do you think the Irish public has about the treatment of animals in our food chain?*

    i. *What aspects of this do you think would represent specific areas of concern?*

B. *How would you rate your understanding of animal cloning?*

    iii. *Would you consider it to be an extension of existing animal reproductive techniques?*

    iv. *Where you see the main uses for this technology?*

C. *In your opinion, what do you see as the long term risks/ benefits associated with animal cloning?*

    i. *For which groups do you see the risks outweighing the benefits and vice versa?*

D. *In your opinion, as a research strategy, should Ireland be investing to see if animal cloning could improve the safety or profitability of the beef and dairy industries?*

E. *In terms of anticipated public response to cloned farm animals, how do you think the public will react?*

    i. *Do you see any precedence for this? When?*

F. *In your opinion, what stance should Ireland take on the import of breeding stock derived from cloned animals?*

G. *Does animal cloning need any specific regulation?*

H. *Not relating to a specific technology – but if a technology is judged to be safe by national safety authorities, should governments promote the further development and use such technologies?'*

I. *This project primarily deals with the animal products food chain, but some technologies are equally applicable to human health and associated sectors. One innovation would combine the two – producing pharmaceuticals in the milk of farm animals.*

   i. *What do you think the prospects would be for such a venture here in Ireland?*

   ii. *In the case that such a venture was rejected by the Irish public, yet judged safe and ethical by independent assessment, should the government support such ventures in spite of public sentiment?*

J. *In your opinion, are there any areas where agricultural animal science and bio-medicine may be mutually beneficial?*

   i. *In your opinion, is it feasible for medical or pharmaceutical researchers to collaborate on a cross functional animal science project that would benefit agricultural animal science?*

   ii. *What barriers would you perceive in a project such as this?*

4 Aspects affecting decisions:

C. *When you think of animals being used to produce food, can you think of any existing areas that may represent ethical difficulties?*

D. *When you think of such ethical considerations, what do you think are the primary influences for you -as a xyz- in forming an opinion?*

   iii. *Do you think the 'ends-justify-the-means' when it comes to ethics and developing a new technology, or should the 'means' be given equal consideration?*

   iv. *Do you think it is possible to a construct a set of principles that might allow you to judge the ethical acceptability of technology, or must technology be assessed on a case-by-case basis?*

E. *I want to explore the issue of the different animals we use as part of the food chain.*

   i. *Would you discriminate between any of them in terms of their intelligence?*

ii. *What about their welfare considerations – should we be more cognisant of the needs of cattle rather than those of chickens?*

F. *In the public surveys around agricultural biotechnology it is not uncommon to see interviewees describe this type of technology as 'playing god'. In your opinion should religion be an issue when considering new and novel technologies?*

G. *In your opinion should the views of any one specific faith be taken into account when considering the development of a new technology?*

i. *To what extent would the views of the Catholic Church impact on the development of new technologies?*

H. *In the small global village we now inhabit, would it be acceptable to develop a technology in one country, and to exploit this technology in a different country, perhaps where a different ethical climate might be in operation?*

I. *I want to get your views on some specific technology innovations, some of which extend beyond food technology. Are there perceived ethical difficulties with any of the following:*

i. *(as per your comments earlier) GM foods?*

ii. *Assisted reproductive technologies in animals?*

iii. *Selecting animals on the basis of their genetic make-up for disease resistance or production value?*

iv. *Moving human genes into animals so that their organs might be used in human transplants?*

v. *Manipulating the genetic make-up of animals for disease resistance or production value? Making a genetic copy of that animal?*

vi. *Cloning of animals for food?*

vii. *Cloning of pets?*

5: Commercial Positions:

A. *In your opinion how important are the life-sciences to the future economic development of Ireland Inc.?*

    i. *Is it being over-played?*

    ii. *What areas do you think hold the greatest promise?*

B. *The success of Irish biotechnology has centred on human health, should we be using this expertise to stimulate the agricultural sector?*

C. *Do you think, as part of the national development programme for biotechnology, that funding should be made available for indigenous technology development in the area of animal cloning and associated technology?*

D. *In your opinion, would development of animal cloning for the purposes of food production enhance or detract from the reputation of the Irish beef and dairy industries abroad?*

E. *Public resistance notwithstanding, in your view should work on animal cloning for food purposes be funded in Irish laboratories using public funds?*

F. *Do you have any professional links or collaborations with national or international colleagues involved in any way with the issue of cloning of animals?*

    i. *Do such collaborations actually or potentially involve the cloning of animals for food?*

    ii. *Are you able to provide any details of this work?*

    iii. *As a part of your professional activities, have your views been sought on the issue of the cloning of food animals?*

    iv. *Are you able to give some non-confidential details about this'?*

I would like to thank you for your time and reiterate that I will keep you updated on any literature or reports for publication.

Appendix B: Publications