Ethics in the Minutiae: Examining the Impact of Daily Laboratory Processes on Ethical Behavior and Ethics Education

Ethics discussions typically have two different aspects: the ability to discern right from wrong, and the commitment to do what is right (Maxwell 2003: 23 - 24). The latter commitment to action, and to the identification of modes of behavior that facilitate "doing what is right" have come to play an important part in all aspects of modern ethics discourse. Amongst others, the life sciences have become increasingly engaged with developing and teaching aspects of responsible behavior amongst scientists.

In modern life science research, much of the interactions that scientists have with "life science ethics" are in the form of guidelines or expectations on their behavior within research. Thus, much of ethical discourse that scientists regularly engage with is not, in fact, concerned with the underlying moral questions of right and wrong, but rather how they should act within specific situations. In this way, scientists are presented with a description of "ethical behavior" within scientific research where types of misconduct are clearly identified.

This focus on actively guiding behavior amongst scientists has become an important topic of discussion, and there has been increasing support for the development of ethics education modules to address these issues. Although it is recognized – similarly to other streams of ethics pedagogy – that the most effective forms of ethics education encourage engaged discussions amongst students and educators (Clarkeburn 2002), the limitations of capable teaching staff, budgets, space in curricula and other similar problems present considerable problems to the emerging field of life science ethics pedagogy. Indeed, current international levels of education continue to remain woefully low (Rappert 2007a). The scarcity of dedicated ethics modules means that a large number of scientists are getting ethics training from online modules, through funding requirements, or from codes of conduct or statements of priorities.

In these initiatives the deontological approach is commonly used to discuss responsibility in scientific research. This approach combines the identification of a set of formal principles together with the identification of duties that translate these principles into practices for daily research (Heimer 2012). By virtue of this, the approach tends to focus less on the contextual elements involved in implementing these duties in daily research practices, instead promoting a more "globally applicable" approach.

Although these deontological initiatives play a vital role in improving access to, and awareness of, life science ethics amongst the global scientific community, it is important to question whether they are the best possible approach for a fostering ethical science behavior around the world. The presentation of decontextualized principles and duties without the possibility of contextualizing discussion may understandably cause considerable confusion amongst the recipient scientists. In particular, this confusion is fostered by a common idiosyncrasy in ethics discourse: that the duties presented to the scientists - which are best understood as contextually informed "role responsibilities" reflecting a specific society's relationship with scientific research - are instead presented as globally applicable.

The absence of contextual discussion about the research environment in which these duties are to be implemented may thus cause considerable problems for scientists when attempting to understand the duties presented to them in the course of their education. This is further complicated if these duties are transported out of their original context, as it is possible that certain aspects – social, regulatory and physical – of the recipient environment will complicate attempts of compliance amongst scientists.

Although previous research has examined aspects of non-compliance as a result of social and regulatory factors, few studies have focused specifically on the influence of the physical research environment both on the issues of duty compliance and also on the development of ethical discourse. In order to do so, the paper asks two specific questions: firstly, what are the implications of presenting contextually informed role responsibilities as

"globally applicable duties"? Will such an approach cause difficulties amongst scientists working within foreign physical research environments? Secondly, does the physical research environment play an active role in the establishment and perpetuation of discourse on ethical behavior, and if so, how can these influences be effectively addressed within ethics education?

The paper begins by describing current trends within life science ethics education, highlighting the lack of discussion about different research environments. It then goes on to summarize some of the issues that may arise from the de-contextualized approach currently being employed in many of the educational modalities mentioned above. These issues are then further interrogated using empirical data gathered from a series of visits to laboratories in the UK and Africa. The fieldwork highlights the impact that a lack of sensitivity to the physical research environment may have on the development of ethical discussion amongst scientists in non-Western laboratories. Finally, the paper concludes by offering some suggestions on how current educational modules may be strengthened in the future to avoid such scenarios.

1. Focusing on Duty Rhetoric in Life Science Ethics Discourse and Education

As mentioned above, international levels of ethics education for life scientists remain low. A lack of consensus regarding what should be taught, to whom it should be taught and by whom (Rappert 2007a) have further complicated these problems of capacity. Although there have been a range of different attempts to readdress the deficiency in educational roll-out, many have yet to make a mark on the global life science population.

By far the most influential of these initiatives have been the develop of deontologically-focused ethics roll-out, through online modules, funding requirements, or from codes of conduct or statements of priorities. This approach prioritizes a number of formal principles as the basis for all behavioral guidance. These principles inform a number of duties that guide

daily behavior. Fulfilling these duties is presented as an ethical obligation for scientists, and this obligation is often extended to the regulations, legislations and behavioral expectations that they inform.

Thus, these duties could be understood in two different ways: either as globally applicable statements of behavioral expectations that are practically applied through legislation, or as culturally constructed interpretations of very broad ethical principles and thus intimately connected to the context in which they are created. It is the latter interpretation that this paper favors - the reasons for which will be detailed below.

If a more contextual ethical system is favored over a system of "global scientific ethics" it is therefore no longer sufficient to view these duties as globally applicable rules of behavior but rather cultural interpretations of the broader ethical principles. Instead, it may be suggested that these specific rules and regulations are better understood as "role responsibilities" – a concept that is able to combine the moral responsibility of the scientist with specific expectations arising from a society's understanding of the role of a scientist and the duties attached to it (Mitcham 2003)[i].

Thus, these role responsibilities are constructed not only as a statement of societal priorities, but also as a reflection on how a scientist is perceived within society. This is an important consideration because it implies not only that these responsibilities reflect perceptions of how scientists work and to what end, but also *where scientists work and what systems support them.* Thus, discussions on contextuality should not be limited to broad social differences, but how and why scientific research environments are constructed on social and physical levels.

Although the variations in national legislative approaches have been influential in spearheading the recognition that "one size does not fit all" within science education and governance (NRC 2011), this recognition of contextual variation has predominantly emphasized that different pedagogical styles and approaches may be necessary to ensure the

maximum utility of educational initiatives. In contrast, it must be noted that the contextual aspects of role responsibilities and the implications that these may have for the discourse on ethical behavior are rarely discussed in any particular detail. This presents an interesting dilemma. Although life science ethics discourse and education are often said to be "contextualized" due to the recognition that national priorities and preferences influence both the manner in which ethics is discussed and also how it is applied practically to behavioral guidance, it may also be suggested that this is not enough. That much ethics discourse is in fact largely de-contextualized and that further recognition should encompass the assumptions that are made within role responsibilities about the social and physical research environments. It is this opinion that this paper will argue.

In particular, two additional important issues relating to contextuality thus need to be considered:

1. As role responsibilities are informed by contextual perceptions of what it is to be a scientist, and that they are coherent only within the context in which they are developed. Therefore, they should not be mistaken for globally applicable duties and transported beyond their cultural borders without accompanying discussions about the donor and recipient contexts.
2. If contexts inform how collective ethics develops (as may be suggested by the variations in regulatory styles), it is also feasible to suggest that they influence how individual ethics develops. This follows current developments in business ethics[ii] that suggest a considerable inter-activity between the individual's ethical development and the working environment.

Based on these considerations, it therefore becomes important to ask whether it is feasible to assume that the laboratory merely acts as a backdrop against which these "global ethical duties" are enacted, or whether it plays a much more dynamic role of co-creation of ethical behavior and understanding. Is the research environment an intimate component in the

transition from prescribed to actual behavior and from ethical teaching to "ethical doing"?

If the research environment plays an important role in the creation and perpetuation of ethical behavior, as suggested above, it becomes important to thus question what happens when role responsibilities are transported out of the context that provides them with meaning? It is indeed possible to suggest that failure to address these issues may give rise to considerable problems for any attempt to build capacity in ethics awareness. Could making assumptions about the research context result in a situation where behavioral expectations are presented to scientists that cannot be realized due to variations in the research environment?

These problems - although not strictly ethical issues - may ultimately manifest as themselves as ethical dilemmas, and cause considerable distress, confusion or conflicts of interest ultimately individuals to dissociate themselves from the broader ethical discourse [iii]. Therefore, it seems important to consider whether the minutiae of daily laboratory life may play an important role in the development of ethical identity amongst scientists. It is logical to extend such concerns further to suggest that a lack of attention to this in ethics education may therefore significantly affect the success of any pedagogical initiatives.

This situation, while already complicated, becomes particularly pertinent when one considers the recent emphasis on the importance of promoting a global culture of awareness and responsibility within the scientific community (NSABB 2006). This has been facilitated by support for the development of ethics education by institutions and governments *in situ*, and the creation of online (or packaged) courses, check lists and teaching resources for use in countries that may currently be less able to address these issues.

Although it is extremely important to include non-Western countries in international dialogue on life science ethics, the utility of the current

approach to build capacity in these countries must be questioned. In light of the discussion above, can educational modules and discourse – in the absence of robust discussion on contextuality – avoid the danger of presenting *role responsibilities* as *globally applicable duties*? In this manner, could they (at least in some sense) be suggested to be doing more harm than good?

2. Contextuality and the Variability of Research Environments

These observations raise important questions about whether ethical behavior in science can indeed be understood as the result of the influence of "top-down" rules and regulations, or whether the behavior is (at least in part) built from the "bottom-up" by the environment in which the research takes place. This, of course, necessitates that the ethical implications of the interaction between individuals and the research environment be investigated in more detail.

In some ways, this is already starting to be addressed. In recent years there has been increasing attention to the influence of the social aspects[iv] of the research environment on ethical behavior. A growing body of literature has emphasized that variations in the social environment of laboratories have the potential to significantly influence the individual ethical behavior of scientists, fostering misconduct as well as the manifestation of a number of "misdemeanors" which all detract from the integrity of scientific research (Korenman 1998 Martinson 2005, Anderson 2007a, Anderson 2007b).

The highly influential Institute of Medicine publication *Integrity in Scientific Research* (2002) further emphasized the contributions that the institutional environment makes towards ensuring research integrity. The report highlighted the need to consistently and effectively provide training, policies and procedures as well as tools and support systems to facilitate responsible conduct within research (Institute of Medicine 2002: 4). Thus, scientists co-create environments of research integrity through constant two-way interactions with the social research environment.

It is important to note that within this literature there is a growing recognition of the considerable variations[v] that exist between the social environments of laboratories, and that there can be no "one size fits all" when it comes to fostering integrity within scientific communities (Institute of Medicine 2002). Thus, fostering an awareness of how social aspects for research environments may be strengthened to support individual behavior has become a key focus for initiatives to strengthen research integrity.

Such studies – and particularly the variations noted in the social environments - are already placing strain on the de-contextualized approach to ethics promoted in much life science pedagogy. It is becoming increasingly apparent that in order to make ethics pertinent to individual scientists, issues relating to their work environment need to be examined and discussed in detail. Failure to do so may result in *ethical erosion* (Sture 2010), where the disjunction between ideal and actual behavioral patterns causes ethical education to gradually be diminished in importance.

Nevertheless, social aspects are only one element of the research environment that may cause ethical problems for individual scientists. I suggest that the research environment is best described as a combination of social, regulatory and physical features, all of which may vary considerably between laboratories and have considerable influence on ethical behavior. In comparison to the other two, little (if any) discussion focuses on how these characteristics of the physical research environment may influence the ethical development of scientists, and it is this that provides the focus for the rest of the paper. In order to understand both the origin of the concern and the reason for its current under-examination, it is important that what I refer to as the *physical research environment* (PRE) is clearly elucidated.

Within laboratories the daily practices of scientists include a flurry of bureaucratic and practical tasks including ordering (and following up orders of) reagents (often involving customs and cross-border requirements); maintaining or organizing maintenance of equipment; writing, administering

and following up grant applications; submitting ethics approvals; and complying to a myriad of regulatory requirements stemming from institutional, governmental, funding or international policies.

In addition, most scientists have to deal with the little mentioned minutiae of laboratory duties, including sorting, bagging and disposing of waste; storing and documenting samples; maintaining numerous registers – including accident reports, health and safety checks, reagent lists, and dangerous materials lists. Thus, in contrast to a relatively tranquil picture of the "scientist at his bench", a peak into any laboratory will instead present a picture of constant activity in this dynamic PRE that makes many demands on the individual scientist.

As this environment is heavily dependent on national and international funding, extra-laboratory infrastructures, and national preferences in legislation (amongst other things) is thus feasible to suggest that the physical elements of any research environment may vary considerably between laboratories. If the PRE, as suggested, is made up of a plethora of different processes, then it stands to reason that each laboratory will have unique features in its research environment based on the plethora of combinations available.

This variable PRE therefore becomes an important aspect to consider in ethical discussions. Because the recognition of the high degree of variation destroys any possibility of making use of a notion of "homogenous research environments", it becomes necessary to critically interrogate the implicit assumptions made about PREs in the framing of role responsibilities and duty discourse. If, as suggested above, these role responsibilities reflect the expectations for scientists within a specific context, and these contexts vary so much, what are the implications of transporting these responsibilities outside of their original area for application? In this manner, the PRE becomes a vital element in discussions on the *creation and perpetuation* of ethical behavior, and a crucial element of consideration for ethics pedagogy. If these minutiae of daily research life may have a profound influence on

how responsibility discourse is framed, disseminated and perpetuated, they become a vital component for the success of any ethics pedagogy and the establishment of ethical cultures.

These considerations, of course, become all the more pertinent in the current absence of discussion about PRE variability around the world. This is particularly relevant when considering the burgeoning scientific research occurring in many low- and middle-income countries. Within these laboratories there are a number of key characteristics that differentiate these PREs from the commonly accepted "Western ideal". These include poorly developed waste disposal mechanisms; bad electricity, water and telecommunications infrastructure; lack of core funding to cover daily laboratory operations and many other challenges (Fine 2007). Thus, if role responsibilities are transported from Western contexts and presented (without further discussion) as "globally applicable duties" will the contrast between conceptualized and actual PREs be potentially problematic?

Importantly, it cannot be assumed that because the PREs of these laboratories differ considerably from the norm that is implicitly promoted in ethics discourse (ie. A functional and integrated Western laboratory) that the work being conducted in these laboratories is unethical. Indeed, many of these laboratories have high standards of responsibility and integrity in their work. The rest of this paper considers situations in which the ethical expectations presented to scientists differ considerably from their daily research practices and experiences *in which they may not be acting unethically*. It questions how and why this may be a considerable problem for ethics education uptake and perpetuation.

3. Empirically Examining These Issues: Using Dual-Use as an Example

As mentioned above, the ethical principles presented during ethics education are often accompanied by the introduction of more specific role responsibilities (and often the related legislation that encapsulates them). Thus, for example, an obligation of honesty in research is usually translated

into pragmatic duty requirements such as commitment to avoid FFP (falsification, fabrication and plagiarism) behavior, obligation to whistle-blow on perpetrators of misbehavior, and so forth.

However, what the educational modules do not often discuss is that these role responsibilities reflect behavioral expectations within a specific research context and thus may present difficulties when represented to communities of scientists without accompanying discussion on how they are applied in daily research. Thus, assigning a duty to whistle-blow needs to be accompanied by an awareness that the PRE will make provision for whistle-blowing and that the social research environment will support it. Although most scientists will acknowledge that whistle-blowing is an important element of scientific research, is it equally feasible to present whistle-blowing as a non-negotiable duty of scientists working in environments where there is no provision for whistle-blowers or where their job security, research or personal safety may be compromised?

Furthermore, is it possible that the presentation of these duties is presented as a moral responsibility within ethics education and not as contextually dependent issues makes the fulfillment (or not) of these duties becomes a moral issue *instead of a situational interpretation of the overarching responsibility.* Thus, although within other environments integrity in research is preserved through different approaches, individuals in these contexts may experience ethical distress and result significant implications for the uptake and perpetuation of ethical teaching *despite conducting their daily research in an "ethically coherent" manner.*

It is, of course, easy to over- as well as under-state the potential for such problems. This paper, thus, presents some data from a study designed to investigate these issues empirically. This study, as will be described below, investigated the implications of ethics education and interaction when taking the current approaches from a Western to a developing country setting. In particular this study questioned whether the considerably

different PRE in the developing country laboratories impacted on the manner in which the scientists interacted with the ethical debate.

3.1. Defining the Parameters of the Study

In designing an empirical study to investigate these issues, it was important to select an ethical issue as a "focalizing topic". Limiting discussions to one particular ethical topic, including the manner in which it is presented in current educational initiatives and the regulation that surround it made any analysis stronger and more pertinent.

The "focalizing topic" for this study was the issue of dual-use. This topic refers to the idea that beneficial scientific research has the potential to be misused by a third party for nefarious means (Miller 2007). It has become an increasingly discussed issue in relation to the life sciences as interested parties attempt to grapple with how such a potential in beneficial research may be mediated and minimized. In particular, since the Anthrax and 9/11 attacks in 2001 there has been a rising concern of the potential for beneficial research to be misused by sub-state parties for the development of biological weapons (Kuhlau 2008).

Much of the discussion surrounding the concept of dual-use has thus focused on possible methods of control. In particular, there is a growing recognition that a "silver bullet" solution for the dual-use problem will not be found. Instead, there is rising support for the national implementations of a "web of prevention" model that sees security, health, science and governmental agencies collaborating together to produce a multifaceted system of control and response (Rappert 2007b). This US-led drive towards developing this "web of prevention" has (amongst other things) led to the promotion of initiatives to strengthen and develop existing biosafety and biosecurity regulations. Thus, issues as diverse as improved biosafety regulations (including waste disposal and sample management), improved border controls, heightened security within laboratories and better control of the in- and out-puts of scientific research have all received considerable

scrutiny and new developments particularly aimed at controlling the dual-use potential of research have started to emerge.

A field of dual-use bioethics has gradually been emerging along side these discussions. A 2006 endorsement by the NSABB for the international development of a *"common culture of awareness and a shared sense of responsibility"* (NSABB 2006: 5) has been highly influential in promoting this field. Thus, there has been a lot of support for improving ethics education and dual-use awareness, although it is regularly recognized that this remains "patchy and unstandardized" around the world (NRC 2011).

Despite problems with capacity, however, dual-use ethics education is rapidly developing a number of characteristics. Scientists are primarily taught about their moral obligations towards drawing attention to the possible dual-use potential of their work as well as participating in the emerging multifarious controls which aim to strengthen a "web of prevention" to deter dual-use events from occurring (Rappert 2007b, Kuhlau 2008). Thus, it may be suggested that the moral obligation towards promoting beneficence and avoiding maleficence is closely linked to certain responsibilities that scientists are attributed in the web of prevention.

Within dual-use ethics discussions the moral duty of scientists to comply with these heightened safety and security regulations is strongly endorsed (Kuhlau 2008). Nonetheless, it has been recognized that: "*[a]lthough bioterrorism might be perceived as an imminent threat ... it is beyond the responsibility of most life scientists either to prevent or to respond to.* (Kuhlau 2008: 477). In this manner, the emerging field of dual-use bioethics has come to be identified with a number of "expected duties" for scientists that may be understood as role responsibilities as they reflect the contextual devolution of an obligation to beneficence. These include duties to prevent bioterrorism, engage in response activities, consider negative implications of work, restrict publication of sensitive information, oversee and limit access to dangerous materials, and report activities of concern (Kuhlau 2008: 483 – 486).

Of course, such role responsibilities are conceived for developed countries and rely on the provision for biosafety and biosecurity controls, whistle-blowing facilities, adequate bioterrorism response mechanisms and many other requirements. However, despite their utility in these regions it cannot be assumed that they may be exported wholesale out of these environments to those with markedly different PREs. Without robust discussion about what environmental support is needed to realize these duties, it must be questioned whether the promotion of such role responsibilities as "global duties" (as they indeed are within many dual-use educational initiatives) is actually useful for engaging developing country scientists.

The fieldwork was therefore designed to discuss these issues with African scientists[vi] – particularly their perceptions of the "duties" assigned to them within the web of prevention and dual-use ethics discourse. In order to ensure that scientists were cognisant of the current developments in dual-use ethics and dual-use control, the fieldwork was initiated by an introductory lecture, in which these responsibilities and the "web of prevention" were presented to scientists in a manner similar to current dual-use educational modules.

After the introductory seminar, four to six weeks were spent at each site conducting semi-structured interviews and focus groups [vii] in which scientists were encouraged to discuss their attitudes to dual-use (as it was presented in the introductory lecture), and to relate their endorsement or rejection to issues within their research environment. Furthermore, extended periods of unobtrusive observations were conducted[viii] in order to facilitate an understanding of how the PRE was constructed and what idiosyncrasies it possessed in comparison to laboratories in high-income countries. In this manner, it was possible to interrogate where scientists had problems with the current manner in which dual-use is presented, why these problems arose, and how they related to the specific PRE of the laboratories.

3.2. Analysing the Data

The project received ethical approval from the University of Exeter Research Ethics Committee. All subject participants signed an informed consent form prior to participating in the surveys and focus groups, and anonymity was pledged to participants and participating fieldsites as far as was possible[ix]. All recordings and transcripts were anonymized and kept under password protection for the duration of the project and analysis.

Through the fieldwork it became apparent that these fieldwork laboratories had PREs that were distinct from the accepted Western norm. To varying degrees these included poor extra-laboratory infrastructures, such as provision of water, electricity, and internet access; poor waste management and disposal infrastructures; poorly regulated export and import controls; corruption, mismanagement and institutional rigidity; and lack of governmental support, funding and control.

A thematic analysis of the fieldwork transcripts for references to elements of the PRE revealed important considerations:

- The ability to comply or not comply with the role responsibilities associated with dual-use were regularly linked by participants to specific elements in their PRE.
- The participants' perceptions of their ability to comply with role responsibilities (or not) was subsequently linked to their discussion of the ethical concept of dual-use and the responsibilities that they bore it.
- That the acceptance or rejection of the concept of dual-use or the notion of a global responsibility towards dual-use control was often supported by issues arising from the disjunction between the proposed role responsibilities and the participants' understanding of their PREs.

These responses were then contrasted to fieldnotes made on the PREs at each site, as well as a further analysis of institutional and governmental regulations and science policies.

4. Considering Some of the Responses

Two strongly representative issues that arose in the fieldsites are detailed below together with further analyses. The first issue arose from individuals perceiving elements of the "web of prevention" as unduly complicating their daily working life due to poorly developed regulatory infrastructures within their environments. The second issue arose from individuals suggesting that even if they were to follow the duties prescribed in the "web of prevention" that they would not make a difference on the larger scale due to problems existing in the extra-laboratory support systems. These two issues ultimately had considerable impact on the individuals' perceptions of the dual-use debate

a. Conflicting Behavioral Expectations Causing Ethical Erosion

One of the concerns regularly repeated in the fieldwork discussions was how the expectations of dual-use control and the "web of prevention" rhetoric were unfeasible in the participants' research environment. These concerns strongly suggested that there was a disjunction between the interpretation of the PRE within the role responsibilities and the PRE in which they were to be applied.

As mentioned above, the presence of a disjunction such as this was viewed as a cause for concern as the continually experiencing behavioral patterns that are known to be at odds with the desired ideal had potential implications beyond the pragmatic obvious. In particular, it was questioned how such situations impacted on the ethical perceptions of scientists. Such concerns became particularly apparent during the fieldwork discussions on export and import controls and the potential for dual-use issues to increase their stringency.

In recent years, in response to dual-use concerns, there has been considerable international support for strengthening and improving current export and import controls for samples, reagents and equipment. This has led many countries to regulate the export of biological materials, equipment and technology as part of their effort to prevent the proliferation of weapons of mass destruction, including biological weapons (Rappert 2007b), and indeed a number of countries have recently passed legislation to combat terrorism that introduces new criminal offences relating to export (Clevestig 2009: 14). In order to comply with these increasing regulations, professional handling is vital for most long distance transfers where the sender cannot personally supervise the transfer of the materials, and in most developed countries certification is needed to ensure that the shipping company has a valid license for handling dangerous goods.

In contrast, African countries have not been as involved in this international climate of heightened security (Clevestig 2009: 14), and the development of stricter border security remains (in many cases) a work in progress. Nonetheless, as import and export of materials involve inter-national regulations, African border controls are increasingly being confronted with the heightened security regulations from developed countries.

Issues relating to import and export, especially in the post-2001 research environment, came up in nearly all the interviews and all focus groups at the four African fieldsites. Many interviewees related personal experiences with border control issues, such as the following exchange:

*"*Participant*: Getting stuff through customs and shipping has been difficult on occasion. Recently one company, "dangerous goods international" just refuses to ship DNA – doesn't matter what it is – they want a whole lot of supporting documentations like MSDSs [material safety data sheet], but you don't get MSDSs for plasmids. So that's been a bit difficult. And then we imported a lipid and it took us almost two months to get it out of customs. They wanted more and more information. And the system for getting things*

in the country … and there are no documents explaining things to the lay person who's not involved in import export, so you go to the customs clearing house and they say that you're not an agent so you can't take it out – even if you pay the duties.
Interviewer: *So the customs officials are following the rules to the letter ..*
Participant: *.. even if they don't know what they're about. And recently you're not allowed to ship dry ice, even if you want to ship cells that you want to send overseas then you have to find another way. You have to revive them and hope that they survive the trip."* (Site 4: PhD student).

This quote raises two important points that were repeatedly mentioned by participants in all four African fieldsites. Firstly, as discussed in the quote, there are obvious difficulties that arise from not being able to produce the documentation that is required by foreign companies and research facilities presents a considerable challenge to researchers. The second problematic area was the difficulties arising from poorly briefed customs staff. The difficulties of getting reagents and samples through customs was a regular complaint in all the labs, with many statements such as: *"[i]f you need to order a restriction enzyme that you need to use urgently, it can take six weeks … it really is an impediment to progress"* (Site 4: HoD). Another participant at another site elaborated on the problem, suggesting that: *"[t]he huge problem is that they [the customs officials] see something and don't understand what it is, and keep it at customs for months. So that's .. and we always wonder why we wait so long. And a lot of the companies don't have reps here, but have little independent companies that represent them, so that's another problem. We're going from dealing with the company to third party really"* (Site 1: PhD student)

Most of the participants mentioned that any international attempts to improved export and import on a global level would hinder, rather than help, their attempts to carry out research. It is feasible to suggest that increasing international regulations without adequately training national customs officials and harmonizing national regulations may just exacerbate these existing problems. As one PhD student succinctly put it: *[i]t already*

takes four to six weeks to get a delivery through, so any extra restrictions will make it even worse" (Site 4: PhD student).

There was a frustration evident amongst most participants when they discussed current problems with export and import regulations and the problems that would arise from increasing strigency as a result of dual-use concerns. The perception appeared to be that things were not working well at the moment, and that further regulations would simply add complications without benefits.

Although these perceptions may of course be challenged, they nonetheless remain crucial to discussions on dual-use as they accompanied statements on the *ethical concept of dual-use* and the feasibility of concern for such issues. In many cases participants followed up discussion on "web of prevention" controls and the role responsibilities that accompanied them with statements such as the following: "*it's just huge amounts of money that go into fighting this phantom threat where I feel like we have more important things to do here as we're in the middle of a huge HIV and TB epidemic and we just want to get on with doing the research. It was not an issue that I'd ever considered before, and quite frankly I don't feel it's very relevant*" (Site 1: PI). In such ways, issues relating to problems with implementing role responsibilities were linked to moral statements on the validity of the dual-use concept. Such statements often culminated in broad rejection of the dual-use concept, with statements such as: "*I thought it was totally irrelevant and paranoid on the part of the Western world*" (Site 1: PI).

These observations may of course be linked to the existing medical ethics studies focusing on ethical erosion (Christakis 1993, Feudtner 1994, Hundert 1996). This research, conducted with medical students, showed that ethical training received within formalized educational courses has the potential to be undermined by conflicting behavioral patterns of peers and superiors within daily life in a hospital setting. These studies suggest that this "hidden curriculum" of alternative priorities can considerably erode the

ethical training received by students during the course of their medical education, and result in the adoption of these unethical behavioral patterns within their own work.

Recently, the concept of ethical erosion has been introduced to discussions on ethics education for life scientists. Authors such as Judi Sture have promoted awareness about the possible presence of "hidden curricula" of conflicting priorities present in laboratories (Sture 2010). Such suggestions correlate with research on scientific misconduct, which suggest that competition, poor mentoring and similar social influences play a considerable role in unethical behavior amongst scientists (Anderson 1994). Thus, it would seem that ethical erosion as a result of nefarious social influences within laboratories is just as pertinent a consideration for ethics education in science as it is in medicine.

Nonetheless, it is also possible that ethical erosion may occur through influences other than hidden social curricula (Bezuidenhout 2012). Indeed, conflicts between the role responsibilities taught in classrooms [x] and accepted patterns of behavior within daily research may cause significant ethical erosion amongst life science students. As demonstrated by the fieldwork, regular and repeated interactions with issues such as export/import that not only caused considerable frustration amongst the staff but often led to cases of misconduct where staff members were known to have circumvented appropriate modes of behavior, such as bypassing export and import regulations for samples and materials[xi].

In such cases the personal rejection of the obligations expected of them, and the perception of similar attitudes in others cannot be said to be limited to some incidences of misbehavior. Instead, many participants mentioned the idea of "fighting the system" that was stopping them from conducting their research. This contrast between the importance of the research and the frustrations of bureaucratic delays on it were regularly used as a justification for the rejection of the concept of dual-use outright. Thus, participants transitioned very quickly from a discussion of the feasibility of the practical

implications of the expectations arising from the "web of prevention" to a moral statement on the concept of dual-use. Such behavior was evident in many participants – from PIs down to graduate students – making the possibility of ethical erosion as a result of a hidden curriculum a significant possibility.

It is highly likely that such situations are, at least in part, due to the manner in which the role responsibilities were presented – as "globally applicable duties" and not contextual interpretations of dual-use ethics. The lack of sensitivity to PRE variations both in the development of role responsibilities as well as within ethics discourse therefore may be suggested to have profound implications for international efforts to foster dual-use awareness.

b. Ethical Distress

Another symptom of ethical disjunction between expected duties presented by ethics education and the laboratories in which they are to be implemented may be viewed as ethical distress, which is closely linked to the ethical erosion discussed above. It is possible that ethical distress may arise from scientists not being able to act in a legitimate manner that satisfies their understanding of ethics, but instead are forced to make "ethical compromises" in order to ensure that their research is conducted.

In the fieldwork this was most apparent in one particular area of the PRE: waste disposal. One of the fundamental aspects of biosafety in laboratory research is ensuring the correct disposal of the waste products generated during the course of research, something that requires input and coordination on national, institutional and individual levels. Many laboratories around the world utilize very similar waste disposal protocols, and the WHO manual on laboratory biosafety provides a good overview of these processes. In this manual, waste is defined broadly as "anything that is to be discarded", and also includes the process of decontamination of wastes (WHO 2004)[xii] in this definition.

In order to safely dispose of waste materials a separation system is commonly used in laboratories. Using differently coloured bags, waste is separated into non-contaminated (non-infectious waste) that can be disposed as household waste, contaminated (infectious) "sharps" (hypodermic needles, scalpels, knives, broken glass and sometimes pipette tips) which are collected in puncture-proof containers with fitted lids, contaminated materials for decontamination by autoclaving and thereafter washing and reuse or recycling, contaminated materials for autoclaving and disposal, and contaminated materials for direct incineration (WHO 2004: 17).

Once the waste is correctly bagged and decontaminated within the laboratory, it is usually passed to an external company to dispose of correctly. "Sharps", for example, should not be discarded in landfills. Neither should contaminated materials destined for incineration – even after decontamination (WHO 2004: 18). If the research facility is unable to incinerate its own waste, it is also important that the incineration of contaminated waste must meet with public health and air pollution guidelines (WHO 2004: 18).

Despite these clear guidelines, it has previously been observed that the disposal of laboratory waste in Africa is problematic. In 2008, for example, Katongole-Mbidde wrote that: *"[i]t is not uncommon, in developing countries, to see medical waste disposed of in a very unsatisfactory manner. Where attempts at incineration are made, one sees smoke in the sky because the technology used is inadequate. In some cases the waste and ashes are disposed of in a manner that allows the chemicals to seep into the ground and contaminate the water"* (Katongole-Mbidde 2008: 2). Such anecdotes are tragically common, and I personally have heard similar comments in the formal presentations and informal communications of participants at many biosafety-related conferences.

Being in situations such as these necessarily present problems for practicing scientists who, within the confines of the laboratory, are conforming to good

biosafety practices. This is perhaps well illustrated by an observation from my field journal from Site 3:

"During the time I have spent in the laboratory I have carefully examined the waste disposal procedures. To my knowledge, within the laboratory they all seem correct and meticulously upheld. However, at lunch today I walked around the medical school and hospital grounds and observed that all the waste (red, yellow and black bags) was stacked together at the back of the building in an area open to the public. Furthermore, I saw these bags being loaded onto the back of an unmarked van together without separation. When I tried to follow the van, I saw the evidence that one or more of the bags had spilled, as there were syringes and tubes on the ground."

This rather cavalier attitude to waste disposal resonated with an earlier experience at other research site in the same country where I had observed similar practices. The issue of waste disposal (perhaps not unnaturally) came up repeatedly in the interviews at Site 2, with many comments such as the following: *"[h]ere I think it's fine, but if you go to the rural areas they get samples and if they can't process them they throw them away. ... Like here at [the medical school] they process samples and then throw them away. Maybe others even throw in land or water, and that is dangerous"* (Site 3: MSc student).

Another participant in particular elaborated on issues relating to caveats in waste disposal protocols. An exert of the conversation included the following: "Participant*: Disposal is also a challenge. How do you dispose? You realize that no one cares. You can throw it in water, in the dustbin. Nobody cares. It is a problem and no one likes investing in that, but I think that is where biosafety affects people.*
Interviewer*: That is a caveat in many grants – the funders assume that such issues like waste disposal are well defined and regulated.*
Participant*: Yes, it's a challenge. If you discover that things are not properly disposed of .. there is no credible company that will be 100% sure that what they've taken will be handled properly. They will give you*

paperwork and a certificate, but practically, you can't deny it happens. People don't know what to do with the waste. Someone has the contract but doesn't know what to do with the waste. It is general confusion all the way. I think that we don't have good disposal procedures" (Site 3: postdoc).

Thus, in many cases it appeared that despite observing waste disposal regulations in the laboratory, the scientists were aware that their compliance had little bearing on what ultimately happened to the waste. As was regularly mentioned in discussions, once the waste left the laboratory it was out of the scientists' control and any changes in the system would be very difficult to affect. It was apparent that this situation was personally very concerning to all those who mentioned this subject.

A perpetuation of such a system, where well-intentioned regulations are being undermined by outside influences, appears to run the risk of spawning two different sets of problems. Firstly, by observing that their actions ultimately do not produce the desired effect scientists may become blasé about following regulations. Alternatively, it is possible that scientists may feel morally obliged (or obligated by funding requirements) to take on responsibility for waste disposal issues. Ultimately, these added burdens – often unsolvable by the individual scientist – may cause significant ethical distress. By being placed in a position in which they must act unethically or turn a "blind eye" to what is going on around them, scientists may experience considerable discomfort. Without explicitly addressing these issues, they might feel that they are "on their own" and unable to make any active changes to alter the situation.

This was evident in many of the discussions I had with participants, with individuals regularly asking: *"what they could do"* in their situation. This evident bewilderment and distress was usually followed by variations on the theme of *"I can't do anything so it isn't really my problem"*. The rejection of the dual-use concept due to perceived lack of agency for properly fulfilling the role responsibilities presented to them was a common theme throughout the fieldwork and appeared – in light of many of the many areas

of considerable differences between the PREs and those implicitly assumed in dual-use education – to be an area for extreme concern.

5. Consolidating the Problem

The fieldwork above clearly demonstrates that the PRE has a considerable effect on how dual-use regulations and the ethical implications of the concept are discussed within African laboratories. The data presented above highlights a number of different issues, including:

- In my observations of daily laboratory life in these facilities, I was impressed with the integrity and responsibility of the scientists and the conscientious manner with which they went about their daily routine.
- Nonetheless, their daily behavior in many areas varied markedly from the usual behavioral norms expected in Western environments. This was largely due to idiosyncrasies in the PREs in which they were working.
- Presenting dual-use in a de-contextualized manner in which specific role responsibilities were not discussed in relation to the PREs they were created for often resulted in perceived disjunctions between the proposed styles of behavior and the way in which daily research was conducted in these laboratories.
- Due to the absence of discussion regarding the translation of the role responsibilities into duties that would reflect their specific PREs, African scientists tended to react negatively to the role responsibilities.
- This negative reaction was seen to translate into a wholesale rejection of the dual-use education.

These observations thus raise some important considerations for discussion, most importantly the roles of PREs in ethics education and the development of ethics cultures. While it may be self-evident to suggest that variations in PREs may influence the manner in which role responsibilities are acted

upon, it is also important to turn this observation on its head and suggest the following: lack of recognition of the role that PREs play in the execution of ethical duties, and poor understanding of the assumptions made about PREs in ethical discourse may significantly alienate scientists from engaging in ethical discourse.

6. Investigating Alternative Approaches for Life Science Ethics Education

These observations raise questions about current models of life science ethics pedagogy and discourse. The data from the fieldwork clearly supports the concerns raised in the preceding sections: that the lack of discussion of the heterogeneity of research environments impacts considerably on developing cultures of responsibility. Not only, it must be noted, does the lack of sensitivity affect how scientists interact with (foreign) regulations and behavioral expectations, but it also affects how they construct ethical awareness and perceptions of responsibility.

Particularly in relation to low- and middle-income countries, it must be asked whether ethics education and regulations actually do more harm than good when contextually informed role responsibilities are presented as "global ethical duties". In such cases, the lack of discussion on the variations in the research environments often places developing country scientists in difficult positions, and the frustration of these scientists is often eminently understandable. In such situations, it is important to question what could be done to ameliorate some of these problems by potentially reframing the manner in which ethics education is presented to scientists.

Of primary importance is reconsidering the strongly deontological approach currently promoted in life science ethics. As demonstrated above, the predominant tendency towards fostering a "global life science ethics" that facilitates harmonization and standardization is not without its problems. Most significantly, as this paper suggested, is the tendency for such an approach to underplay contextual differences between research

environments and the influence that these variations may have on the development of ethical behavior within laboratories.

As the fieldwork strongly suggested, recognizing the fundamental role that the social, regulatory and physical research environments play in the development of ethical scientists cannot be overstated. It would therefore appear that discussions on these influences, as well as the variations between laboratories should be a basic element of life science ethics pedagogy. This, of course, is easier said than done - however a number of preliminary observations can be made.

Firstly, it is often recognized that scientists are educated to follow rules – in SOPs, in laboratory duties, in upholding the myriad of regulations and legislations guiding their research. However, scientists are also fundamentally creative and pragmatic in their ability to address and solve problems on a daily basis. It would therefore be both feasible and beneficial if future ethic pedagogy was able to tap into this ability to "trouble-shoot", and thus avoid becoming bureaucratic detail to be followed unquestioningly. Is there, one must ask, a manner in which responsibilities can be presented – particularly through online courses and codes of conduct - that does not rely heavily on "rule based rhetoric"?

Such an approach, of course, means a new approach for ethics education– one that fosters a "practical wisdom" in scientists to enable them to critically evaluate and mediate the ethical requirements of their environment. The concept of developing a "practical wisdom" to deal with daily life stems from virtue ethics and emphasizes that "becoming good" (as opposed to merely understanding what good might be) requires a great deal of experience and pragmatic knowledge. Fostering the ability of scientist to approach diverse ethical expectations and the physical limitations of their research environments with "practical wisdom" may indeed assist them in navigating the issues discussed above.

Indeed, opening up discussions on responsibility in science to include the concept of "practical wisdom" will suit discussions on variations in research environments and the difficulties of balancing the variety of pressures that are placed on individual scientists. Importantly, within virtue ethics a virtuous adult is not considered infallible (Pellegrino 2007), and on occasion it is possible that they may fail to do what was intended through lack of knowledge or opportunity. Such an approach, in comparison to more deontological approaches, might encourage scientists to discuss how they might ethically and practically adapt their behavior to their environment – instead of living in fear of failing to follow a set of (unreasonable) rules.

Secondly, the observations made in this paper point towards the need to critically evaluate the assumptions currently made about research environments in ethics discourse. Even the briefest survey of life science research around the world highlights the necessity of not boxing research environments as "right" or "wrong" in the current binary fashion. Instead, ethics discourse should be open to viewing research environments as being under a continual active process of creation. Thus, more discussion is needed on the variations of research environments, how they influence ethics behavior, and how they evolve to reflect the needs of the communities that work in them. Because an environment is not "Western" does not make it unethical – and it is vital that future ethics discourse reflects this point.

Thirdly, it is important to facilitate awareness amongst scientists that disjunctions between the expected and actual behavior in laboratories are a topic for discussion and not for shame. In many informal conversations with scientists in low- and middle-income countries I have observed that they are often unwilling to discuss the problems associated with their PREs for fear of appearing as "second class scientists" in comparison to their Western colleagues. It is highly likely that the presentation of these scientists with a list of role responsibilities will heighten this perception, as they become aware of the disjunction between the "ideal" behavior and what they are able to do in the course of their research. It is possible that by

facilitating discussion about the variations present within PREs, and how role responsibilities reflect a *specific* interpretation of these environments, that scientists may feel more empowered to discuss these issues, to highlight the problems within their environments and the contrast between their research and those of their colleagues.

Thoughts on how such issues may be incorporated into ethics education include the following:

- Life science ethics educational modules need to reflect a sensibility of the variations of PREs. Thus, presenting any deontological duty or role responsibility needs to be accompanied by a discussion of the environment in which it is expected to be applied.
- Ethics education needs to address the need to build a critical awareness of the social, cultural and physical environments in which research is conducted. Thus, ethics education ultimately needs to foster a generation of scientists that are able to critically unpack the ethics underpinning regulations and ethical requirements to separate the ethical obligations from any assumptions made about their research environment.
- Ethics literature needs to be more sensitive to the impact of the PRE on ethical behavior. It needs to develop sensitivity towards understanding ethical and unethical behavior in a manner that does not rely on "global rules".

All in all, however, it is important to question the manner in which fostering ethical behavior is normally understood. Are we able to foster ethical behavior amongst scientists by introducing them to a set of rules that will guide their daily research? Alternatively, should we be more aware of the environment that the scientists are working in, and recognize that the rules are only one element of the cohort that is needed to facilitate ethical behavior. Instead, should we view the establishment and perpetuation of ethical behavior as the culmination of a plethora of tiny interactions that scientists have with their physical, regulatory and social environment, all of

which gradually shape the manner in which they act. Thus, as this paper questions, shouldn't all aspects of the research environment be at the heart of any discussions on life science ethics pedagogy?

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[i] The notion of role responsibilities emerged from legal studies and was first introduced by H. L. A Hart. It refers to the specific duties attached to a distinctive place or office in a social organization (Hart 2008). These duties provide for the welfare of others, or in some way advance the aims or purposes of the organization. The individual is said to be responsible for the performance of these duties, or for doing what is necessary to fulfill them.

[ii] Studies from business ethics have also raised such concerns, and their findings might prove particularly useful in the life sciences. These studies highlight the considerable involvement of the social, regulatory and physical environments on the creation and development of ethical behavior (Treniño 1986, Treviño 1990). Using this research, it is therefore possible to suggest that the research environment plays an active role in the *creation* of ethics within a community, and does not serve simply as a *backdrop for the implementation of ethics.* Thus, it is important to question whether the research environments, instead of being passive backdrops for the application of deontological rules, actually mold and shape ethical behavior within laboratories.

[iii] In this, I make use of the work of Daniel Chambliss. In his 1996 book *Beyond Caring: Hospitals, Nurses, and the Social Organisation of Ethics,* Chambliss examined ethical agency amongst nurses in hospitals. He proposed that many problems seen as ethical dilemmas actually arise when groups of two professions clash; when occupational groups have different motives; or when "the system" thwarts the efforts of certain people to do what they see as their job. Therefore he suggests that when considering problems that may appear to be ethical in nature it is important to consider the groups involved in the problem and their motives.

[iv] Influential research by many sociologists including Bruno Latour and Sharon Traweek have highlighted the highly social nature of laboratory life, and the considerable variation between national cultures of research (Latour

1986, Traweek 1988). These studies have highlighted the integral part that social aspects of laboratory life play in routine scientific procedures.

[v] Despite a rising international endorsement for improving the integrity of scientific research environments, how they are fashioned on a national level remains markedly varied. Indeed, as Latour commented, although there has been considerable support for the notion that national styles in science – particularly amongst developed countries – have largely disappeared in the 20th century, recent research has shown that these national styles are often more resilient than they were first thought to be and have continued to be perpetuated. Indeed, he observed that these national styles are often manifested in the social structure of research organizations (Latour 1986: 143). Such observations have been upheld by subsequent comparative studies of research environments. Studies, such as those conducted by Sharon Traweek, have demonstrated marked differences in the social construction of research organizations in different countries and the important role that they play in the manner in which research is conducted. Research such as this emphasizes the variability of the social environment of laboratories, and suggests that these variations often reflect cultural differences between nations (Traweek 1988).

[vi] Four laboratories were visited in four countries: South Africa (sites 1 and 4), Uganda (site 2), Kenya (site 3). Laboratories in the UK were also visited for comparison, although the data gathered from these laboratories are not reported in this paper.

[vii] At least 10 interviews with researchers, students and technicians and one focus group per site.

[viii] As the author has a previous training in life science research, a considerable amount of time was spent observing daily laboratory routines, how experiments were conducted, and what differences existed between the laboratories involved in the fieldwork.

[ix] Due to the relatively low number of research facilities within some African countries, there was always a remote chance that some aspect of the reported data would contain sufficient data for facility identification.

[x] Or presented in standard operating procedures, grant agreements, memoranda of understanding or internationally endorsed guidelines such as (WHO 2004).

[xi] These possible (indeed, probable) complications in export and import that would result from improved international dual-use regulations often elicited sighs, shrugs, and eye rolling from the fieldwork participants, demonstrated the difficult situation in which the scientists found themselves. Furthermore, at least five participants at Site 1 and Site 3 mentioned anecdotes in which scientists circumvented legal customs procedures in order to avoid the bureaucracy surrounding sample transport [xi]. One participant at the KY1 site mentioned that: *"[p]roblems are diverse .. in our scenario they don't do what they are supposed to do. Over time you find people walking in and carrying away tissues and no one raises a concern"* (Site 3: technician).

It was interesting to note that when I was told these stories the participants, while acknowledging that the behavior of the protagonist was wrong, expressed sympathy for them and believed that that they were acting with "beneficial intentions" at heart. It appeared that they viewed the need to conduct research as more important than dealing with a bureaucracy that was perceived as obtuse, poorly regulated and non-reflective of the needs of the science population.

[xii] In addition, dealing with waste also involves reusing and recycling large amount of glassware, instruments and laboratory clothing, as well as decontaminating, autoclaving or incinerating all infectious material within the laboratory (WHO, 2004: 17).

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