

# **Learning Experiences during Postgraduate Studies in the Sciences: Exploring Variations and Outcomes**

**by**

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## Ethics Statement



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or

- b. advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University

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## **Abstract**

This dissertation documents a range and variation of postgraduate science students' experiences in terms of degree experiences and post-graduation outcomes from a Workplace Learning perspective.

Study one is a narrative study of six Canadian science doctoral students over two and a half years. Narrative analysis of data, including logs and interviews, identified three case-pairs related to overall affordances/supports received and anticipated career outcomes. They were termed: positive-professional, positive-academic, and challenging-uncertain. Three affordances of interest were also identified across the cases: research projects, supervision, and colleagues. Variations in affordances and their relationship to the case-pairings were explored.

Study two is a mixed-methods study of the experiences of nine Canadian science doctoral students at two institutions over four years. Narrative analysis of data including logs and interviews resulted in three case-groupings related to career outcomes/outlooks: positive outcome, positive outlook, and uncertain outlook. Quantitative analysis of the logs identified three metrics which related to these outcomes/outlooks: number of publications per year, percentage of logs reporting research difficulties, and percentage of times supervisory help was received when needed. The relationship between these metrics and the case-groupings were then explored thematically.

Study three is a primarily quantitative study that examines the experiences of thirty-six masters and doctoral students across the UK. The data were comprised of surveys and follow-up interviews. Principal components analysis and Spearman correlations were used to analyse the surveys. This analysis resulted in multiple factors, including two project descriptions based on the subject of study: social-case and cognitive-physiological. In turn, each related to a pattern of research practices (e.g., quantitative, qualitative) and affordances (teamwork, supervision, mentorship) more typically described for the social sciences and the sciences, respectively, as opposed to one broad set of practices and affordances across the discipline as has been more commonly described. Interviews were used to contextualise these findings.

**Keywords:** graduate education; postgraduate education; science education; higher education; workplace learning; employability

*To my friends, family, and colleagues*

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## **Chapter 1.**

# **Learning Experiences during Postgraduate Studies in the Sciences: Exploring Variations and Outcomes**

## **1.1. Overview**

The need to better understand, and improve science postgraduate education is an issue of both national and international importance, and is of interest to both policy-makers and academics (Association of Universities & Colleges of Canada, 2008; Craswell, 2007; Gilbert, Balatti, Turner, & Whitehouse, 2004). The policy focus has come from a broad interest in the postgraduate degree's presumed economic role, and is often focused on postgraduates' "employability skills". Academics have overlapping concerns, but tend to place a greater emphasis on the need to improve students' academic research skills to meet current and ongoing research challenges (Ampaw & Jaeger, 2012; Association of Universities & Colleges of Canada, 2008; Golde & Dore, 2001a; Henson, Hull, & Williams, 2010; Lovitts, 2001; Pallas, 2001). Despite disagreement on the relative importance of these goals, there is general agreement that improvements in postgraduate education are needed (Craswell, 2007; Cumming et al., 2009; Gilbert et al., 2004). Research on postgraduates has often highlighted this need, showing high attrition rates, and finding that postgraduates often do not feel prepared for academic work (Brew, Boud, & Namgung, 2011; Golde & Dore, 2001a, 2001b; Lovitts, 2005) or other employment more generally (Manathunga, Pitt, & Critchley, 2009).

In order to improve the effectiveness of current postgraduate learning (e.g., coursework, research work) and policies (e.g., degree requirements, learning outcomes) there is a need for evidence-based research to guide those who work with postgraduates, and postgraduates themselves, to improve postgraduate experiences and outcomes. There is a particular need for greater clarity around the present

effectiveness of postgraduate educational practices and outcomes in terms of careers. Presently faculty and students commonly express a lack of knowledge of career possibilities and the means of achieving or preparing for these (Golde & Dore, 2001b; Maher, Feldon, Timmerman, & Chao, 2014; Sauermann & Roach, 2012). While there are significant policy efforts and employability goals set by some governments intended to address this, concerns have been raised about how well they align with actual needs, and whether/how they can be achieved in practice (Blaj-Ward, 2011; Craswell, 2007; Cumming et al., 2009; Wagner, Garner, & Kawulich, 2011). In general, much of the rhetoric and information around postgraduate education is not evidence-based, and often relies on potentially incorrect assumptions about postgraduates' goals, lived experiences, and contexts. This is particularly true within the sciences where there has been relatively less research than other disciplinary areas (Craswell, 2007; Leonard, Metcalfe, & Evans, 2006; McAlpine & Amundsen, 2012).

This dissertation, comprised of three studies, draws upon two sets of data from Canada and the United Kingdom (UK), respectively. The overarching goal of this work is to closely examine science postgraduate learning experiences and outcomes in order to document a range and variation of experiences, and compare these with existing assumptions and understandings. These studies aim to meet this goal by inductively studying postgraduates' lived experiences using both qualitative and quantitative research designs, and by conceptualising the postgraduate experience as workplace learning. This document broadly describes the commonalities between the three studies in terms of goals and theoretical foundations, as well as their collective findings and implications.

## **1.2. Important Notes**

### **1.2.1. Terminology**

Several notes are made regarding the main topics of study:

- The term “postgraduate” as used here refers to post-secondary study pursued after completion of a Bachelor Degree. The term “postgraduate” is more

commonly used internationally, whereas the term “graduate” is more common in North America.

- While much of the wider research on postgraduate education focuses on, and typically uses the term “doctoral” education, the broader term “postgraduate” is used here. While studies one and two of this work do exclusively examine those who began the study as doctoral students, study three also includes some master’s students.
- Study three focuses on postgraduates in Psychology, a discipline that is often categorised as a social science, but that also shares significant similarities with the sciences (Donald, 2002). As described in study three, research has often focused on, and described, subareas and experiences within Psychology that are more similar to the sciences than the social sciences. Thus, unless stated otherwise, general references to the sciences here are typically meant to include Psychology, whereas references to the social sciences and humanities are meant to exclude it.
- As these studies draw upon the workplace learning perspective outlined by Stephen Billett (2001, 2004, 2006), the terms “learning” and “work” are used interchangeably here, and throughout the three studies as they are considered inextricable. The term “workplace” as well, unless otherwise stated, refers to the context in which postgraduates work during the degree doing research work. The term “affordances” as used in this perspective, is used here as well, and this is taken to mean that certain elements of the workplace (e.g., projects, supervisors, team-members) “afford” (i.e., allow, encourage, and/or support) particular work or activities.

### **1.2.2. Postgraduates in Canada and the United Kingdom**

Differences between the postgraduate contexts of Canada (studies one and two) and the UK (study three) were not explicitly studied in this research. In considering the three studies as a whole, there was significant resonance between the findings, and no clear differences were noted which were relevant to the focus of these studies. However, their particularities are described here to provide context.

Canada’s post-secondary system is relatively decentralized, unlike that of many other countries. For instance, there are no common national or provincial policies or standards around completion times, quantity or content of coursework, or learning goals (Shanahan & Jones, 2007). A master’s degree in the arts or sciences is generally a two-year research-focused degree requiring a thesis. A master’s degree is largely separate from, and a pre-requisite for, a doctoral degree, though it is not uncommon for those in the sciences to transition directly from one to the other without a clear distinction

between the two. Most doctoral degrees take four years to complete at a minimum, and require further research work and a dissertation (though this is the official term, it is common to use the term thesis for this as well). It is common for postgraduate studies at both master's and doctoral levels to take longer than the nominally stated time to complete the degree (Canadian Association of Graduate Students, 2014).

By contrast, in the UK, there is significant government regulation and centralisation of postgraduate education. For example, there are specific metrics and standards regarding elements such as completion time and coursework. In the UK, master's degrees are generally a year-long degree which can be research-focused with a dissertation, or a taught degree which focuses more heavily on course work, typically with a project towards the end. Should students plan to pursue a doctoral degree, they typically transfer directly into a PhD from their master's degree, and this is sometimes done via a research-focused Master of Science degree. PhD degrees require a thesis and typically take three to four years to complete and this timeline is typically adhered to as it is monitored and regulated (Craswell, 2007; Gilbert et al., 2004; Quality Assurance Agency, 2004).

## **1.3. Research Contribution**

### **1.3.1. Goals**

This collection of studies aims to mainly accomplish two overlapping goals: 1) study postgraduate experiences from students' own perspectives; 2) explore and document the variation and range of postgraduate experiences from these perspectives, and to compare these to existing conceptions.

All three studies examine postgraduate education from the student perspective. At present, there is relatively little research that takes this focus (Craswell, 2007; McAlpine & Amundsen, 2011; McAlpine & Lucas, 2011). Generally, students' perspectives tend to be backgrounded in favour of the perspectives of those of supervisors and policy-makers, often only making assumptions about students' goals and/or needs (Collinson & Hockey, 1997; Craswell, 2007; Gilbert et al., 2004; McAlpine

& Amundsen, 2012; Wagner et al., 2011). This work aligns itself with the growing body of work that focuses explicitly on student perspectives, illuminating elements of postgraduate education which have largely remained under-examined and/or unquestioned (Hopwood, Alexander, Harris-Huermann, McAlpine, & Wagstaff, 2011; McAlpine, Amundsen, & Turner, 2014a; Raddon, 2011).

The three studies here also aim to explicitly question and re-examine the broad aggregate patterns and assumed commonalities which have been typically used to describe postgraduate experiences by inductively examining individual experiences to create groupings which better represent the range and variation of experiences. This approach is in contrast with other research on postgraduates that tends to simply aggregate experiences across the entire set of participants, often setting these within disciplinary cultures and/or groupings (e.g., the sciences). Specifically, in studies one and two, individual cases were first examined, then inductively clustered into groups of cases according to the observed range and variation of learning experiences and related career outcomes/outlooks. Study three drew from a quantitative survey dataset and used an inductive quantitative technique, principal components analysis, to cluster similar responses together prior to further analysis to examine variation within the discipline of Psychology.

### **1.3.2. Relationship to prior research**

The focus in this research on student perspectives and on the variation and range of experiences aims to contribute to, and/or contrast with, several overlapping areas of research and interest regarding postgraduates. They can be broadly categorised as postgraduate: supervision, students' choices and experiences in learning and careers, and variations in learning environments.

#### ***Supervision***

Most existing research about supervision, like other aspects of the postgraduate experience, has been largely investigated from the perspectives of those other than the postgraduate student. This is the case even though the aim of this research has typically been to describe and/or understand supervisory practice in order to inform and improve

it (Åkerlind, 2008; Bastalich, 2015; Franke & Arvidsson, 2011; Kiley & Mullins, 2005; Pearson & Brew, 2002). In this literature, two “styles” of supervision are often described. One style is an apprenticeship model, which is said to be more common in the sciences. In this style, supervisors work closely and collaboratively with their students on common projects. A second style is a mentorship style of supervision which is said to be more common in the social sciences and humanities. In this style, a student does not work on common projects with their supervisor, and the supervisor may not necessarily have extensive knowledge on or involvement in, their students’ research. The supervisor’s role in this style, in contrast to the apprenticeship style, tends to be focused on administrative support and general advice. For the most part, the former is described as being a more positive and supportive learning experience than the latter (Chiang, 2003; Franke & Arvidsson, 2011; Smeby, 2000).

While characterizing supervision in these two broad styles provides some insight, the result can produce an overly simplified view of practice and experience. Firstly, students’ perspectives of supervision are often missing. This omission creates inherent limitations in understanding postgraduate learning as students often learn independently and/or outside of the direct view of their supervisors (McAlpine & Amundsen, 2011; Pearson, 1996). It undoubtedly also fails to provide a full account of difficulties that students experience, as students may not reveal these to their supervisors. Research has suggested that students sometimes intentionally avoid interacting with their supervisors with matters they view as trivial, or difficulties which they feel could make them (the student) appear incapable (Flores, 2011; Heath, 2002; McAlpine & Amundsen, 2012). Additionally, conceptually, these broad “styles” of supervision may be self-fulfilling in that they become the frame of reference for inquiry and aggregation, with research often reifying, rather than questioning, these existing conceptions. The need for questioning seems clear particularly when considering the overly positive description of science supervision (Chiang, 2003; Leonard et al., 2006). Given that supervisors are probably unlikely to describe or even perceive instances they have performed poorly, it seems reasonable to believe that students may express a greater range of experiences.

Thus, for a full account of the range and variation in both students’ activities and in supervisory practices, it is essential to also study students’ perspectives. Studies one

and two show how within the sciences, contrary to common aggregate depictions of science supervision as positive apprenticeships (Chiang, 2003; Franke & Arvidsson, 2011; Smeby, 2000), a range of systematically different experiences, both positive and negative, are observable. These studies also document a range of activities that take place outside of a supervisor's view, including work outside the academic workplace and sometimes chronic difficulties which largely occur outside of the supervisor's focus. Study three closely examines supervision within the discipline of Psychology, and shows that within this single discipline, at least two supervisory "styles" exist, contrary to the current depiction of particular supervisory styles as a discipline-wide trait.

### ***Choices and experiences in learning and careers***

The three studies focus on the variation in individual students' learning experiences and career outcomes, which contrasts with research conducted from the perspective of the relatively common "socialisation" perspective (Flores, 2011; Gardner, 2010; Hakala, 2009; Holley, 2009; Laursen, Thiry, & Loshbaugh, 2012). Socialisation is a theoretical perspective that conceptualises postgraduate learning as a process of "enculturation", the adoption of a particular community's norms, values, and practices (Weidman, Twale, & Stein, 2001). In this framework, successful learning occurs as individuals come to align their own values with those of the surrounding academic community. The assumption is that if individuals have difficulty aligning their own values with those of the community, they will have difficulty learning and are likely to leave and/or disengage from that community (Gardner, 2010; Holley, 2009; Stubb, 2012). Socialisation, however, has been criticised for reducing individual experiences to broad generalities about context alone, and backgrounding the role that individuals play in directing their own learning. In other words, socialisation focuses overly on structure (i.e., culture/community) without a consideration of individual agency. These critics argue that structural elements and agency must be considered together and that individuals can exert choice within the structures they find themselves, even if their values do not align. Thus, a range of outcomes, aside from enculturation or lack thereof are possible. For instance, individuals may decide to define new learning goals and/or effect changes in the context(s) they find themselves in (Archer, 2000, 2003; Billett, 2001; Hopwood, 2010a).

One particularly interesting area of postgraduate choice concerns careers. Studies have shown that many postgraduates, while being aware of the difficult job market(s) that face(s) them, often do not explore, plan, or prepare for careers during their postgraduate studies (Golde & Dore, 2001a; Laudel & Glaser, 2008; Laursen et al., 2012; National Academy of Sciences, 2014; Sauermann & Roach, 2012; Thiry, Laursen, & Loshbaugh, 2015). Correspondingly, postgraduates are often described as feeling unprepared for careers in academia or industry, and often have trouble finding or adapting to work afterwards. Some research, including that taking the socialisation view, argue that this is partly because the culture and knowledge of alternative careers is not available or valued within the academic context (Brew et al., 2011; Crossouard, 2010; Golde & Dore, 2001a; Maher et al., 2014; Manathunga et al., 2009; Sauermann & Roach, 2012). Other research, however, also finds that postgraduates commonly identify themselves as the main drivers of their own learning and progress (McAlpine & Amundsen, 2011; McAlpine, 2012a). Postgraduates have been found to often purposively select and engage in challenging work in order to meet self-identified learning goals (Kasworm & Bowles, 2010), including in some instances, to prepare for potential future careers (Golovushkina & Milligan, 2012). Thus, this begs the question: what influences students' choices regarding career preparation during the degree? Or, alternatively why do some students prepare adequately for post-graduation employment and/or have better outcomes than others?

To understand realised choices and outcomes, there is a need to understand how and why particular choices and outcomes arise in the interaction between individual agency and the surrounding structures. Studies one and two show how students sometimes exerted choice independently of the contexts they found themselves in, pursuing professional learning goals and/or careers outside of their immediate cultures. By contrast, these two studies also show how structures can powerfully guide and influence personal choice. Broadly, positive experiences enable and support choices amongst a range of career outcomes, whereas challenging experiences can limit choices by redirecting efforts towards overcoming difficulties and making particular choices less desirable and/or viable.

### ***Variations in learning environments***

A third area of focus for these three studies is the exploration of assumptions made about postgraduates along disciplinary lines (e.g., Psychology, sciences). Research on academic work and postgraduate experiences, often using a socialisation lens, typically aggregate findings across disciplines or even wider disciplinary groupings. In general, science postgraduate learning is said to be highly positive, and well supported by a range of affordances. Among these are the supervisory styles described earlier. In addition, it is common to describe the sciences as typified by close teamwork with peers and lab-mates who serve as collaborators and mentors. Additionally, while daily research challenges are commonly described, postgraduates are said to learn that the sense of discouragement that they feel with these difficulties eventually gives way to an understanding that these challenges are a common and instructive part of scientific work. Through persistence and support, postgraduates are said to inevitably produce results and gain self-confidence and acceptance of the vicissitudes of scientific work. On the occasion that research difficulties are intractable for postgraduates, supervisors are said to address this risk by helping to identify alternative “do-able” projects and/or allocating multiple projects so that complete failure does not occur. This broadly well-supported and positive trajectory is frequently described in contrast to the independent and often isolating work that is said to typify experiences of those in the social sciences and humanities (Chiang, 2003; Cumming, 2009; Delamont & Atkinson, 2001; Holley, 2009; Stubb, 2012; Vekkaila, Pyhältö, & Lonka, 2014).

As with supervision, however, it is possible that these existing views are self-reinforcing as they have become the standard framework from which to aggregate and examine postgraduate experiences. Upon close examination, there are strong reasons to challenge these broad assumptions. Firstly, those who study disciplinary cultures themselves frequently qualify that disciplines are in fact, not monolithic entities, and that the generalisations made are useful, but never correct in all cases (Becher & Trowler, 2001; Donald, 2002; Stubb, 2012). Secondly, while the broad descriptions of science postgraduates are of largely positive and supportive experiences, exceptions have been reported, but are not often emphasised within broader findings. These include instances of less involved supervisors, little interaction and/or mentorship between lab-mates, and variations in individual relationships within labs (Flores, 2011; Kemp, Molloy, Pajic, &

Chapman, 2013; Walford, 1981, 1983). Thirdly, larger systematic variations have already been identified within biology, where close examination of particular experiences show that those engaged in field research (i.e., not in a lab), in contrast to lab research (which is said to be the “common” setting for biology research), worked independently from their supervisors and peers, and had significantly less rigid research practices (Bowen & Roth, 2007; Cumming, 2009; Roth & Bowen, 2001).

There is thus a need to look more closely at exceptions within larger aggregations and assumptions in order to better understand the range of experiences that exist. It seems likely that important experiences and insights are concealed or underrepresented when described in the aggregate across a large group and/or a discipline or disciplinary grouping. Studies one and two examine how affordances vary systematically for particular students within the sciences, showing that a range of positive *and* challenging experiences exist in science postgraduate experiences. Study three, analogous to the work done in the biology field sciences described above, examines variations with the discipline of Psychology and shows how at least two distinct and identifiable groupings with different projects, practices, and affordances can be outlined within what has often been described in largely monolithic terms.

## **1.4. Theoretical and Methodological Stance**

### **1.4.1. Narratives and larger study**

Studies one and two draw data from, and share a conceptual basis with, a larger narrative study (McAlpine et al., 2014a). This larger study examines the construction of academic identities over time by using data that includes biographic questionnaires, bi-monthly logs, and yearly interviews over the course of ten years. The present body of work also used these data sources, but drew only from those participants who began the study as doctoral students in the sciences, whereas the larger study also included data from individuals in the social sciences and those who began as postdoctoral fellows and pre-tenure career academics. Epistemologically and methodologically, for studies one and two, the data are fundamentally narrative data, and the qualitative analyses are thematic analyses of narratives (Riessman, 2008). Participants’ narratives were taken as

socially constructed accounts that provide insight into the meaning and causality of events as understood by participants as they unfolded over time. Consistent with the narrative research tradition, the emphasis was firstly on individuals' narrated and intact stories (i.e., cases) over a period of time, and then subsequently, to theorise across the cases studied (Elliott, 2005; Riessman, 2008). As in the larger study, multiple cases with longitudinal data were used to construct these narratives, as opposed to the relatively fewer cases collected in a relatively brief amount of time as is more common in narrative research (McAlpine, Amundsen, & Turner, 2014b). The long-term data collection and rigorous nature of data collection helps support the trustworthiness of these reconstructions and every effort was made to ensure that the accounts are accurate to participants' accounts (Coulter & Smith, 2009; Creswell, 2007; McAlpine et al., 2014b),

The larger study sets participants' narratives within a conceptualization of identity termed the "identity-trajectory" (McAlpine et al., 2014a), which examines the interplay between personal lives and how three strands of academic experience: intellectual (e.g., publications, papers), networking (e.g., drawing on peers for support), and institutional (e.g., resources, responsibilities) come together to shape individual identities and experiences. Studies one and two share with the identity-trajectory the stance that it is important to consider student agency and intentions as they navigate the structures they find themselves in (McAlpine, 2012b). Studies one and two, however, differ from the approach taken in the identity-trajectory study by foregrounding daily work experiences. As compared to the identity-trajectory, this focus overlaps most with the identity-trajectory's strands of networking (i.e., supervision, teamwork, mentorship) and intellectual (i.e., publications), while largely backgrounding personal lives.

The focus of studies one and two on career outlooks and outcomes also overlaps with two notions from the identity-trajectory, "horizons for action" and "opportunity structures". As defined by McAlpine & Amundsen (2014), opportunity structures are, "an individual's structural knowledge at any point in time about career opportunities... [and] this knowledge may be inaccurate, out-of-date or incomplete but provides the context in which personal intentions are negotiated" (pp. 959). And, horizons for action, "represent... the options viewed as attractive or viable within the perceived opportunity structures... [and] emerge from past experience, personal intentions and relationships..."

as well as the intertwining of the personal with the academic” (pp. 960). Relative to the identity-trajectory, which takes a holistic view over the lifespan and includes personal lives in studying horizons for action and opportunity structures, the present study aims specifically to relate regular daily work experiences to career outcomes and outlooks.

The largest methodological contrast in assembling the narratives relative to the larger study, is study two’s use of quantitative data (study three also used quantitative methods, but not to assemble narratives). In study two, descriptive statistics were used to uncover patterns in the logs which were then closely examined in the qualitative data. Given that narratives necessarily must focus on particular events, typically significant ones (Coulter & Smith, 2009), the use of the quantitative data provided a means to examine daily experiences over a long period of time to guide further qualitative analysis. In other words, “extensive” quantitative methods were used to identify relationships, whereas “intensive” qualitative methods were then subsequently used to identify potential mechanisms and attributed meanings for these relationships (Elliott, 2005).

#### **1.4.2. Workplace Learning**

All three studies draw from the workplace learning perspective as outlined by (Billett, 2001, 2002, 2004). Hopwood (2010b) and McAlpine & Mitra (2015) have previously drawn upon workplace learning to examine other aspects of postgraduate experiences, namely journal editing and physical locations where work was conducted, respectively. The studies contained here extend the use of a workplace learning perspective to examine postgraduates’ daily workplace learning more generally through the degree. Studies one and two examine how daily work participation, which occurs through mediation between individuals and their workplaces, related to a range of emerging and realised: learning experiences, career outlooks, and career outcomes. Study three examines how particular “kinds” of research work projects within Psychology relate to particular workplace practices and affordances, in contrast to the aggregate disciplinary depiction often described.

As noted earlier in the discussion on “choices and experiences in learning and careers”, Billett believes that both structure and agency are essential to examine. Billett’s perspective is that learning occurs through work participation, and that this is mediated in interaction between an individuals’ own attributes (e.g., knowledge, participation, values) and affordances in their workplace (tools, access, values, norms). Further, in a workplace, there are no meaningful differences between work and learning, or between formal and informal learning. Individuals regularly learn through their daily activities in the course of work, rather than primarily through intentional and discrete learning environments/situations (e.g., coursework). Even, routine or mundane work tasks are significant, in that they serve to practice, or reinforce, existing workplace practices (i.e., learning). However, it is through engaging in novel work, supported by adequate affordances in the workplace that opportunities to extend individual knowledge and ways of knowing are provided. Accordingly, lacking sufficient opportunities and/or supports and affordances for successful workplace participation is likely to lead to disengagement and confusion and can serve as an inhibition to learning and future engagement (Billett, 2001, 2002, 2004, 2006).

The understanding of postgraduate experiences as intentional engagement in work is a good reflection of the actual lived experience of postgraduates. An examination of the duties and responsibilities of most postgraduates shows that they more closely resemble those of faculty and academic staff than undergraduate students (Boud & Lee, 2005). And, while terms such as “postgraduate school” or “postgraduate education” imply a primarily didactic learning process through coursework and/or other formal means, this does not reflect the learning process most postgraduates follow. Multiple studies have found that coursework itself is frequently considered to be insufficient training for actual research by students and faculty (Aiken, West, & Millsap, 2008; Golde & Dore, 2001a; Henson et al., 2010; Keselman et al., 1998; Lovitts, 2005; Smeby, 2000). Postgraduate coursework and training is also said to be particularly meaningless and ineffective when abstracted from students’ own perceived needs (Cumming et al., 2009; Moley & Wiles, 2011). Correspondingly, students, particularly in the sciences, commonly identify their primary and most important source(s) of learning as being trial and error and through their actual research work (Delamont & Atkinson, 2001; Pole, Sprokkereef, Burgess, & Lakin, 1997; Pole, 2000; Raddon, 2011).

Of particular interest to studies one and two are the differences in realised work participation as a result of the process of mediation between individuals and their context(s) (Billett, 2001, 2002, 2004). In a workplace learning perspective, variation in work participation and outcomes is expected, given that the interaction between individuals and their context(s) are seen as a negotiation between the two. Thus, while individuals are influenced by their culture, they can also exert significant choices with regards to the larger culture, as well as influence that larger culture. For instance, the degree to which individuals “appropriate” (embrace and integrate cultural practices and knowledge), “master” (only learn to sufficient competence to perform a task), or simply reject learning, can vary based on the alignment between individual and workplace values. One example, from study two, is the participant, Sam, who eventually “settled” on completing his degree requirements despite his lack of satisfaction with the results of this work. Sam also sought out policy work through an internship that was not directly related to, or supported by his doctoral program during his degree. Thus, it could be said that Sam performed sufficiently to “master” his doctoral research and diverted his efforts towards his personal goals elsewhere. Additionally, workplace learning argues that workplaces vary in the affordances they offer to specific individuals within that workplace. For instance, varying levels of participation and support might be afforded to a worker based on seniority, social relationships, and/or the different physical requirements of particular tasks (Billett, 2001, 2004, 2006, 2009). The finding in studies one and two that supervisors provided different levels of priority and support to students within the same lab provides an example of this. The individual negotiation of goals in the case of Sam and/or the differences in experiences within ostensibly similar environments in studies one and two would be difficult to explain from a socialisation lens. Firstly, socialisation broadly describes only two possible outcomes: enculturation or rejection of local norms, explained and assessed solely through alignment between an individual and their context(s). Secondly, the socialisation lens also describes cultures as uniform and acting on members largely similarly, rather than examining the variation in supports and affordances to those within a culture.

The workplace learning perspective is well aligned with, and informs, the focus of the present studies. Namely, it aligns with these studies’ focus on understanding the range and the variation in both daily experiences/work participation and in realised

outcomes. Studies one and two examine how workplace participation can differ and vary based on the affordances available, including: difficulty and productivity of research projects, supportiveness of supervisors, and/or helpfulness of teams and peers. These two studies also show that individuals' choices and outcomes relate to these workplace differences, either expanding or limiting their options and choices. Also highlighted is the role of individual choice, showing instances where students engage in intentional choices to guide their learning towards particular careers and goals and identify and seek specific types of work, even if their own contexts were not supportive of this choice.

## **1.5. Study Summaries**

### **1.5.1. Study one**

#### ***Workplace Learning during the science doctorate: what influences research learning experiences and outcomes?***

This published study examines the experiences of six science doctoral students at one medium-sized Canadian institution using data collected over two and a half years. The data included biographic questionnaires, bi-monthly activity logs (6-10 logs per participant), and pre-interview questionnaires and interviews (two per participant).

The data were analysed qualitatively, focusing first on individual cases, using a thematic analysis of narratives with workplace learning as a theoretical lens. This process identified three workplace affordances of interest: research projects, supervision, and colleagues. Following this, an examination of variations in experience of these affordances, as well as their anticipated or realised career trajectories/outcomes resulted in three inductively derived case pairings of two cases each termed: positive-professional, positive-academic, and challenging-uncertain. These labels refer to the overall experience of workplace participation and affordances (positive or challenging) and anticipated/realised career outcomes (professional, academic, uncertain), respectively.

Multiple variations from established notions of science postgraduate learning were found and discussed. Most notably, while those in the positive-academic pairings

described supportive and socially oriented workplace experiences similar to those typically described in the sciences, the other pairings did not. Those in the positive-professional category showed differences in their daily work (often working outside the academic context) and goals (envisioning potential non-academic careers) from those in the positive-academic category whose work more closely resembled “typical” science work (lab work) and goals (i.e., academia).

## **1.5.2. Study two**

### ***Research difficulties, supervision, and publications: workplace affordances that influence students’ postgraduate career outlooks and outcomes***

This manuscript examines the experiences of nine science doctoral students at two Canadian institutions using data collected over four years, a longer time period than in the first study. Five participants from study one were included (one was excluded for having less than three years of data) in this second study, and three participants from a second institution were added. As in the first study, the data included biographic questionnaires, bi-monthly activity logs (4-14 logs per participant), and pre-interview questionnaires and interviews (3-4 per participant). Relative to study one, study two had a greater emphasis on the log data, and therefore on daily experiences.

Analysis began with a qualitative construction of cameos for each participant to create groupings as in the first study. The cameos focused more heavily than the first study on realised outcomes in terms of careers, facilitated by the passage of time (i.e., most students had graduated). This analysis resulted in three groupings of three cases each. These groupings were: positive outcomes, positive outlook, and uncertain outlook. These labels refer to the overall envisioned career trajectory for each grouping. The first part of the label refers to the current prospects (positive or uncertain) and the second part of the label refers to realised and likely long-term careers (outcomes) or as of yet to be determined long-term careers (outlooks). As in study one, this variation in outcomes/outlooks between the pairs, brings into question the notion of consistently strong affordances for learning in postgraduate sciences.

Quantitative analyses of the logs were then done and compared to the aforementioned groupings to uncover relationships between these. It was found that number of publications per year, percentage of logs with research difficulties when collecting or analysing data, and percentages of logs where supervisory help was provided when needed, related to the observed three outlook/outcome groupings. Using these, the qualitative data were re-examined with a thematic analysis of narratives to further explore the significance of the quantitative metrics and their relationship to the groupings.

The findings of study one and two further demonstrate that affordances can differ more widely than often described in research on postgraduate sciences, and can have a strong relationship with differences in outcomes/outlooks. Those with positive outlooks and outcomes had affordances that supported productive work and careers, whereas those with uncertain outlooks often had hindering experiences.

### **1.5.3. Study three**

#### ***Exploring Disciplinary Variations in Postgraduate Research Projects, Practices, and Affordances within Psychology***

This manuscript examines the experiences of 36 master's and doctoral postgraduates studying Psychology in six universities across England. Data were an initial questionnaire, designed for this study, and subsequent interviews with eight participants.

The initial quantitative data analysis used principal components analysis to create factors out of the items for three sections of the survey: research project description, research work practices, and research work affordances. Four research project descriptions were identified and labelled based on the item loadings: case-application, cognitive-physiological, theory-generalise, and social-case. Three sets of research work practices were identified and labelled based on the item loadings: quantitative-frequency, qualitative-frequency, other skills frequency. Three sets of research work affordances were identified and labelled based on the item loadings:

teamwork, supervisor, mentorship. Four cases were identified from the interviews to contextualise the quantitative findings.

An examination of the inter-correlations between these factors revealed several meaningful relationships. Most notably, it was found that social-case project descriptions most resembled established conceptions of the social sciences and humanities in terms of work practices and affordances. This includes using qualitative methods in one's thesis, and negative correlations with the quantitative frequency, teamwork, and supervisor factors. Further, cognitive-physiological corresponded with existing conceptions of Psychology, and the sciences more generally in terms of work affordances. This included correlations with "other skills", the use of quantitative methods for one's thesis, investigating similar topics within research groups, the teamwork factor, and negative correlations with the qualitative frequency factor.

This study showed both conceptually and methodologically how systematic differences within a discipline can exist, even if the discipline has been typically described in the literature as having particular practices and characteristics.

## **1.6. Collective Findings and Discussion**

### **1.6.1. Workplace affordances and outcomes**

The three studies collectively identified and described several overlapping postgraduate workplace affordances pertaining to postgraduate experiences and career outcomes/outlooks. They were: research projects/difficulties (all studies), supervision (all studies), and colleagues/teamwork (studies one and three). While each of these have been previously identified and studied within research on postgraduates, these three studies emphasise the range and variation within these affordances for particular lived experiences (studies one and two) and for subgroups within a discipline (study three). This is in contrast to research such as that from a socialisation lens which typically emphasises the common experiences across entire groups. Broadly, the main findings are discussed here as they relate to research projects and social relationships (i.e., supervisor and peers).

## 1.6.2. Research projects

In common, the three studies highlight the centrality of research project work in postgraduate learning, and how variations in this work relate to experiences and outcomes. Research work included thesis or dissertation work as well as additional research work such as side projects or work whose inclusion in a thesis or dissertation was yet to be determined. It was found that projects varied significantly in terms of their difficulty and productivity (e.g., difficult or unproductive projects afforded less learning opportunities) and the particular learning and career goals they afforded (e.g., academic or professional). Importantly, it seems that for particular students, the inherent difficulty and/or productivity of research work afforded to them was relatively consistent across time within individuals (e.g., those with challenging work consistently described it as such) but differed between them. In turn, this deeply affected their learning and subsequent outcomes over time. This was evidenced by the observed alignment between challenging projects and challenging learning and career outcomes, as well as the converse with more positive experiences (studies one and two). As well, research projects were found to vary in topic and subject within the discipline of Psychology (study three). Some research projects were similar to descriptions (i.e., cognitive and physiological), affordances (i.e., supervision & teamwork) and practices (i.e., quantitative) associated with the sciences. By contrast, other research projects were found to bear far more resemblance to the social sciences and humanities in description (i.e., social and case-based), affordances (i.e., individualistic), and practices (i.e., qualitative). Together, this highlights the importance of examining variations, and challenging commonly held assumptions and generalisations often made about the positive nature of science research (studies one and two) and the consistency of projects and epistemologies within a discipline (study three) (Delamont & Atkinson, 2001; Golde & Dore, 2001a; Leonard et al., 2006).

The three studies support the notion that postgraduate work is best understood in terms of students' agency and intentionality given their ability to exert choice to direct their own learning within their context(s) (Hopwood, 2010a, 2010b, 2010c; McAlpine et al., 2014a). While it was clear in these three studies that postgraduates were deeply affected by the structures which surrounded them, as evidenced by the strong

relationship between project work and outlooks/outcomes, there was also a consistently strong element of individual agency/intentionality. Students for instance, were found to intentionally engage in learning for particular projects by consulting resources such as books, the internet, or peers (study one). Importantly, while it was found that students were deeply affected by the work available to them, they also exerted significant choice in how they engaged in this work and what work they would engage in. For example, several students were able to engage in professionally relevant work in contexts outside of the university such as government agencies and hospitals (studies one and two). One extreme illustration of this is Sam, as noted above, who was not afforded strong work opportunities in his doctorate. Sam instead engaged in an internship that was largely separate from his research work. This internship better aligned with his career goals, and ultimately supported his ability to transition into a job after graduation (study two).

### **1.6.3. Social relationships**

While both the sciences, and the discipline of Psychology, are typically described in the literature as being characterised by supportive and collaborative apprenticeships with supervisors (Chiang, 2003; Cumming, 2009; Golde & Dore, 2001a; Leonard et al., 2006; Pyhältö, Stubb, & Lonka, 2009), this research found nuances and variations that were revealed upon closer examination. While some participants did describe the majority of their experiences in this way, others in otherwise similar contexts, instead systematically described supervision that was often neglectful and even hindering (study one and two). Additionally, it was found that close supervision was not a common feature across the discipline of Psychology. Rather, it varied by subgroup, with only those whose topics related to cognitive and physiological (cognitive-physiological) phenomena having close and frequent contact with their supervisors, like that attributed to the sciences. By contrast, those studying social and case-based phenomena (social-case) tended to have less frequent and less satisfactory supervisory relationships, more similar to those described in the social sciences (study 3). In considering studies one and two it was particularly notable that those postgraduates who experienced difficulties with their projects also tended to also have less supportive supervision. Thus, while previous research has often described how supervisors are said to mitigate the “risk” of projects by selecting and managing projects to ensure all students have the opportunity

to produce positive results (Campbell, 2003; Delamont & Atkinson, 2001), this assumption was shown to have important exceptions. The experiences of those in the challenging-uncertain (study one) and uncertain outlook (study two) groups show that while this may perhaps be a frequent feature, it is not a universal one. And so, while research has previously noted instances where supervisors did not offer the kind of close feedback and support in the sciences as expected (Flores, 2011; Maher, Gilmore, & Feldon, 2013), this research shows that these challenging instances could be quite common, impactful, and persistent within particular lived experiences.

A second, more subtle variation observed was that the qualitative nature of supervisory and peer relationships did not seem to always correspond with the collaborative depiction that is relatively common in the literature (Cumming, 2009; Leonard et al., 2006). In studies one and two, it was found that these relationships seemed less collaborative and more strategic and purposeful than has been typically described in the sciences, similar in these respects to how they have been described in other disciplines such as the social sciences and humanities (Boud & Lee, 2005; Hopwood, 2010c; McAlpine & Amundsen, 2011). Further, while it was true that frequent informal contact was sometimes described, even those with highly positive experiences did not always describe frequent *meaningful* contact with their supervisors. While they tended to see their supervisors as generally supportive (in contrast to those with challenging experiences), those with positive experiences commonly had extended periods of relatively little actual contact with their supervisors. Across all groupings of experience, it also wasn't unusual for postgraduates to often work alone on projects, and to describe some or all of their work as being relatively isolated or independent of other projects in the lab.

Importantly, the perceived quality of supervision not only varied, but was also *not* directly linked to the availability of, or contact with, the supervisor. While frequent contact and availability is often cited as the explanation for the more positive experiences of supervision in the sciences (Chiang, 2003; Smeby, 2000), this did not seem to be a fully satisfactory explanation. Study two showed that students actually varied in the frequency with which they needed, and subsequently sought out, their supervisors. This frequency itself, however, was not strongly associated with particular kinds of experiences,

outlooks, or outcomes. What was associated with different experiences was the relative frequency of helpful feedback/contact from their supervisor when it was needed *and* sought (study two). These crucial junctures where help was critically needed notably did not equally include all aspects of postgraduate work, and tended to most involve help with writing and administrative tasks (studies one and two). Interestingly, in contrast to what might be assumed in an apprenticeship, it was observed that needing help with actual research work/difficulties was most associated with having generally challenging learning experiences and uncertain outlooks, as well as not receiving the help that was desired. Together this suggests that it is broadly the ability to productively engage in research work, rather than explicit instruction or social enculturation, that is the main driver of postgraduate learning (study two).

These studies also showed that contrary to the description that peers are frequently consulted and collaborated with in the sciences (Heath, 2002; Manathunga, Lant, & Mellick, 2007), significant peer interaction is not always common. There were even cases where a lack of social help and support were the norm, and instances where peers could be outright hindering (study one). Study one further uncovered that not all labs had a mentorship structure as has sometimes been described (Flores, 2011; Heath, 2002; Leonard et al., 2006) and study three showed mentorship was not always present, and seemed an independent phenomenon from teamwork. That is, the explicit apprenticeship and mentorship structure from senior lab members, to more junior ones is not a given, even in the presence of a team structure. Perhaps most surprising, it was relatively common for individuals, even in positive groupings, to note that since their projects did not always overlap significantly with those of their peers, they could not provide significant support or advice to one another on their projects. It was much more common for peers to serve as a “sounding board” or sympathetic ear, rather than an explicit source of research advice. Collaboration with peers, as noted above, was also only infrequently described, and when they were described they were typically relatively temporary and often limited to one or two collaborators within a lab (studies one and two).

Study three, showed how these social affordances can differ based on the particular projects one is engaged in, seemingly representing different research

environments and cultures within a single discipline (i.e., Psychology). In line with prior research on Psychology generally, supervisors were more closely involved with students who were engaged in cognitive-physiological projects (which were more similar to the sciences). However, in contrast to prior research on Psychology, supervisors were less involved with students who were engaged in social-case projects that were more similar to the social sciences and humanities. For instance, social-case was negatively correlated with teamwork and supervisor involvement at the  $\rho=-0.33$  level ( $p<0.05$ ). Cognitive-physiological was positively correlated with teamwork  $\rho=0.48$  level ( $p<0.05$ ). That these correlations are moderate rather than high correlations, does, however leave significant room for variation even within these two broad groupings of experiences. That is, while these relationships represent a trend, there are a significant number of cases with exceptions and variations from this trend. Thus, in general, while characterisations about the cultures and affordances which surround particular “kinds” of work may be largely correct, variations and exceptions from the trend may also be relatively common as well, and should be given due consideration.

## **1.7. Theoretical and methodological insights and implications**

### **1.7.1. Workplace Learning**

Broadly, the workplace learning perspective (Billett, 2001, 2002, 2006) drew attention towards individual engagement and workplace affordances in daily postgraduate work. As described earlier, this shifted the specific focus and perspective away from other commonly emphasised elements of the postgraduate experience such as supervision and/or cultural contexts and practices. It also drew attention to how and why particular experiences could differ within those elements studied, focusing on variations, rather than describing a more general aggregation as has been more common. Workplace learning was particularly useful in studies one and two as a means to theorise how daily experiences may have contributed to long-term differences in experiences, career outlooks, and career outcomes (i.e., the groupings). Namely, that the ability to work productively was facilitated or hindered by consistent variations in affordances, and ultimately, individuals made individual and intentional choices in

relation to these which affected their future work engagement. For study three, workplace learning contributed by helping to conceptualise variations within a discipline through differences in daily participation and affordances (Billett, 2001, 2004, 2009).

Conceptualising postgraduate education as work also supported some specific findings in relation to other research on workplace learning. It firstly supported the notion that workplace participation in particular work and workplaces supported specific goals. Several participants were found to work in multiple distinct workplaces, each supporting different work and learning goals. For example, Storm and Epsilon worked in both university and medical contexts, learning academic and professional work in each of these, respectively. Sam worked in a university lab as well as in a government office performing policy work, with each presenting distinctly different projects and learning. This resonates with McAlpine & Mitra (2015) who also employed workplace learning and found that science postgraduates worked in a range and variation of physical locations (e.g., office, lab, libraries), each with different social and physical attributes and/or resources. Using workplace learning also supported the notion of postgraduates as intentional workplace learners who could drive their work and learning, both within their main contexts and more independently to pursue their own personal goals (Hopwood, 2010b). Finally, there was also particular resonance with the notion that workplaces do not afford all workers equal affordances, even in the same or similar workplaces (Billett, 2001, 2002, 2004).

Thus, as others have found, workplace learning is indeed a meaningful and useful perspective with which to consider postgraduate education and experiences (Hopwood, 2010b; McAlpine & Mitra, 2015). These are owed both to its theoretical stance(s) as well as more specific insights drawn from work that has employed this perspective. More specifically, the three studies collectively could be said to extend, and draw attention to, the use of workplace learning to examine daily experiences within postgraduate experiences.

### 1.7.2. Examining variations

The three studies highlight the importance of deeply examining a range and variation in experiences, and propose a methodological means to do so. Importantly, this work *does not* suggest that the established norms and depictions in the literature, such as of the sciences, or of Psychology, are incorrect per se. Instead, what is suggested is that we must recognise that to develop a fuller understanding of postgraduates in any context, an explicit look at the range and variation in experiences is crucial. In brief, whereas previous research has broadly and successfully described the features of postgraduate experiences across large groups of individuals, describing “norms” for given groups of disciplines (sciences) or specific disciplines (Psychology), this research shows that when looking specifically for variation, important and not necessarily uncommon experiences emerge. In contrast to generally positive and untroubled long-term experiences that large aggregations have tended to depict in the sciences, studies one and two identified multiple cases where systematic challenges occurred in daily work which also seemed to relate to challenging long-term career outlooks and outcomes. These challenging experiences are important to document to develop a “fuller” understanding of postgraduate education to help inform policy and practice beyond current assumptions (McAlpine & Amundsen, 2011, 2012).

Similarly, in contrast to discipline wide descriptions of projects and affordances, study three showed that important subgroups can exist within a given discipline. These findings emphasise the significance of the frequently stated caveat by those studying disciplines - that they are not monolithic entities. Specifically, the subgroup of projects within Psychology that were most “scientific” in topic and subject also had affordances and practices in line with the sciences. Likewise, the most “social” projects also had affordances and practices as often described in the social sciences (Becher & Trowler, 2001; Donald, 2002). While this showed that some of the general characterisations about Psychology were not uniformly true, they did lend support to the notion that practices within a discipline do emerge from their questions and epistemologies. Perhaps then, an alternative to understanding academic research work in terms of disciplines is to focus first on commonalities in research projects and/or epistemologies rather than ostensible or broadly-defined disciplinary affiliations. It seems that this

approach may be more accurate generally, and increasingly so given the growing inter-disciplinarity of research (Association of Universities & Colleges of Canada, 2008; Eisenhart & DeHaan, 2005; Pallas, 2001; Sung et al., 2003). Such a nuanced understanding of disciplinary work is also likely important in efforts to inform policy and practice. Namely, attempting to effect changes or policies across a discipline uniformly based on inaccurate generalisations is likely to poorly serve subgroups that may have different practices and/or needs.

It is important to recognise that forming aggregations across groups being studied is both inevitable and helpful as it is impractical to discuss research only in terms of specific cases, or, to describe all specific exceptions across a population. These necessary aggregations, however, will always conceal some variability. This research proposes a methodological middle ground: taking an initial exploratory and inductive step to map out the range and variation in common experiences prior to aggregation to create *more* accurate aggregations. The three studies here, rather than looking for commonalities across all participants as is typical in research conducted from a socialisation perspective, or with large-scale quantitative surveys, first created inductive groups of similar experiences prior to further analysis. By having this first exploratory step, the participants' actual and varied experiences became the frame of reference, ensuring that a range of experiences and voices were represented. In studies one and two this was accomplished through the creation of case pairs prior to further analysis, allowing an examination of a range of experiences, outcomes, and outlooks. In study three this was done through the use of principal components analysis of survey responses to separate the data into inductive groupings of project descriptions, practices and affordances prior to further analysis. This latter quantitative analytic procedure may be particularly helpful for future studies that use survey methodologies which have been quite common in postgraduate research, but have tended not to describe the variation in participants' experiences well (Golde & Dore, 2001a; Sauermann & Roach, 2012).

### **1.7.3. Student perspectives and agency**

Studies one and two emphasise the theoretical importance of individual perspectives and agency. In particular, the relevance of particular workplace affordances were often best understood in relation to a particular individuals' goals and experiences. For instance, research work was best understood in terms of its ability to support students' learning and goals. For some students, an exclusive focus on academic research was highly desired and supportive of careers goals. However, for others, the lack of professional opportunities within their degree work hindered or failed to meet their long-term goals. Similarly, supervisory help could not be understood purely in terms of its frequency. Instead, it was best understood in terms of how supervisory interaction met, or failed to meet, a specific student's needs and/or work. Altogether, this supports the earlier described notion that both agency and structure should be considered together to best understand phenomena rather than focusing almost exclusively on structure as has been more commonly done (Archer, 2000, 2003; Billett, 2001, 2002, 2009).

Relatedly, this conceptual focus highlights the importance of students' goals in defining and determining successful postgraduate outcomes. Postgraduate policies, and some studies, have often defined desired outcomes and success relatively simply and without reference to students' own goals, for example via degree completion or ability to find work of any kind (Ampaw & Jaeger, 2012; Lovitts, 2001; Quality Assurance Agency, 2004; Vitae, 2011). This work shows that particular outcomes, and what constitutes "success" can greatly differ by individual. For instance, Storm takes longer than necessary to complete her degree and may have been counted as "unsuccessful" by some metrics. However, this was an intentional choice on her part to work on publications and other opportunities that ultimately likely supported the career she achieved. Conversely, Funkymonkey, "successfully" began a postdoctoral fellowship and may have been considered successful. However, his personal goal was to leave academia and he only took the postdoctoral position because he had no clear alternatives aside from unemployment or underemployment. Together these examples emphasise the need to listen to, and consider student voices in informing policy and practice to define desired outcomes (Craswell, 2007; Gilbert et al., 2004).

Agency also particularly contributed to analysis and theorisation of challenging experiences. Agency was notably present even for those in challenging/uncertain groupings. Importantly, their low productivity and more challenging outlooks were *not* due to a lack of agency or effort relative to other groupings. Instead, Claude, Funkymonkey, and Sam all showed significant agency, persistence, and effort in completing their degrees *despite* a lack of supportive affordances. All three directed substantial efforts towards completing their degree work and overcoming difficulties, perhaps partly at the cost of productivity and other potential work engagement. These cases echo what have been described as “untold stories”. Difficult stories such as these are often left “untold”, since postgraduates, due to their own agentic efforts to succeed, can silently overcome significant difficulties. However, significantly, this often leaves intact a myth that institutional supports are sufficient and/or equitable, even if they are not, preventing needed recognition of systemic problems and needs (McAlpine, Paulson, Gonsalves, & Jazvac-Martek, 2012). This may also partially explain why some students better prepare for careers than others. Maher et al. (2014) previously described a general propensity for postgraduates to focus on their degree work rather than career development. Given that those with challenging experiences seemed to often require more time and energy to complete their degree work due to weaker affordances and/or more difficult experiences, it also seems likely that they would be particularly inclined to put off career development, exploration, and/or preparation during the degree. Indeed, Funkymonkey and Claude, in common reported far more hours in the lab than others, and described being overwhelmed by their work. As well, neither described significant exploration or preparation for future careers during their degrees. Thus, an examination of agency provides us with a more nuanced and detailed understanding of how and why individual experiences may differ, as well as how difficulties may affect students.

## **1.8. Educational implications**

The three studies draw particular attention to the vital importance of facilitating productive work for which supports postgraduates’ ongoing and emerging learning and career goals. The policy and practice recommendations that emerge encompass two

main practical areas: 1) support postgraduates' goals and choices; 2) conceptualising research work as pedagogy

### **1.8.1. Support postgraduates' goals and choices**

There is a need to ensure that students can engage in work that supports their goals. It is informative to consider Sam's experience, who while completing the requirements of his degree, ultimately felt that his degree work was potentially wasted time as it did not ultimately link with his career goals at the time and/or eventual career outcome. Reflecting post-graduation on this he said: "It makes me question if I have wasted many years in my PhD when I could have been doing this work sooner and moving up the ladder". By contrast, others in positive groupings (e.g., Storm and Epsilon) were able to engage in, and explore, a range of professional and academic work during their degrees, allowing them to consider and prepare for their post-graduation career paths. There is thus a need to ensure that students can intentionally select and engage in postgraduate work that supports their learning and career goals. To this end, postgraduate programs, students, and supervisors could aim to actively identify and craft opportunities to explore and engage in work which links to potential future careers, including internships, industry partnerships, and/or academic work (e.g., journal reviewing, grant writing) as appropriate. It would be especially beneficial, as Sam likely would have preferred, to provide students with the means to transition towards non-academic careers through their doctoral work should they wish to do so, rather than post-graduation such as through postdoctoral fellowships as is currently common (Laursen et al., 2012; National Academy of Sciences, 2014; Sauermann & Roach, 2012; Vitae, 2011).

To facilitate linking students' goals and postgraduate work, there is a need to gather and provide accurate and useful information to support students' choices. At present, students frequently lack clear knowledge of the degree work they will engage in prior to admissions or potential post-graduation career possibilities (Golde & Dore, 2001a; Maher et al., 2014; McAlpine & Emmioğlu, 2014; Sauermann & Roach, 2012). Non-academic career paths in particular, tend to be particularly poorly understood by both students and faculty (Laursen et al., 2012; Sauermann & Roach, 2012).

Postgraduate programs should aim to systematically collect and provide clear and accurate information to address this. Such efforts could begin with collecting and documenting alumni's career outcomes, as well as what postgraduate experiences would support the pursuit of these careers during degree study (McAlpine & Emmioğlu, 2014; Sauermann & Roach, 2012). In addition to this broad understanding, students should also be provided better information on specific work projects and context(s) they may engage in and choose from. It was observed in study one that those in the challenging-uncertain group all began their degrees with relatively little information on their prospective supervisor and workplace(s). By contrast, those in other groupings all had prior experience with, and thus better knowledge of, a given supervisor and/or research workplace prior to beginning the doctorate. Thus, it seemed that a contributing factor to challenging experiences was a lack of information on prospective degree work and workplaces. One means to address this would be through providing opportunities to learn more about potential supervisors and/or research groups prior to admissions and/or at the outset of the degree. This could be as simple as allowing students the opportunity to talk with existing students so that they may make more informed choices (Golde & Dore, 2001a). For instance, Funkymonkey in the challenging-uncertain group describes the research in his lab as follows: "I would say compared to some stories I've heard from my post-doc, I'm not the worst off because he has told me stories where he knows students who spend seven years and they didn't get a [result]". In situations such as these it would be beneficial for students to know the potential risks prior to committing to a line of research, rather than partway through the degree. Even if students accept these risks, they could aim to prepare contingency plans to ensure completion of the degree within a desired timeframe. Another possibility would be an early exploratory period after admissions, providing students with the opportunity to engage in a "rotation" of prospective research groups and/or supervisors so that they select work which best suits them.

In summary, students' choices are critically important to their learning and eventual outcomes. While students can intentionally drive their own learning and career development, they need to be supported in this pursuit. To this end, postgraduate students should have both the opportunities and information to enable choices that support their goals.

### **1.8.2. Conceptualising research work as pedagogy**

While the current focus of postgraduate policy and practice has often been on formal training (Craswell, 2007; Cumming et al., 2009; Gilbert et al., 2004), these studies support the notion that the so-called informal elements of the degree deserve significant intentional consideration as well (Hopwood, 2010a, 2010b; McAlpine & Amundsen, 2012). In particular, studies one and two draw attention to how particular work experiences can facilitate learning to support academic and/or non-academic careers. Study three also shows how particular practices (e.g., qualitative or quantitative), and thus learning outcomes, relate heavily to the type of work engaged in (e.g., social-case or cognitive-physiological). There is thus a need to consider research work as an essential pedagogical element of postgraduate education. At present, research work, particularly in the sciences, is often driven primarily by a supervisor's research needs (Franke & Arvidsson, 2011). Instead, there is a need for intentional discussion and negotiation between postgraduates and their supervisors/programs to explicitly conceptualise and select research work within students' learning and career goals. Some specific means to support student learning in this regard include requiring the explicit articulation of the knowledge and skills that are anticipated for particular research projects/work (Bastalich, 2015) and formal learning agreements (Manathunga et al., 2007).

To support learning, there is a need to also ensure that postgraduate work is relatively consistent in progress and productivity. While the sciences have been often described as having generally supportive and productive work environments, these studies showed that this is not a consistent feature. Studies one and two highlighted how challenging project work with long-term difficulties and low productivity exist within the sciences. This was also found to likely inhibit learning and long-term career outcomes/outlooks. Conversely, those with more positive experiences, not only had fewer difficulties and more consistent progress, but they also typically had relatively early successes in their degree to build upon. For instance, in study two it was found that those who had productive publication records early on also had greater productivity throughout their degrees. As Epsilon suggests:

I think one of the mistakes I made with my PhD is I started projects that were huge at the start and then had to whittle them down to get them done in time and get something published. Whereas, I think if you started simpler things, get those published, build on that... that would probably be a more beneficial way of doing things

The importance of these early successes are likely particularly important in the sciences given the iterative nature of scientific disciplines (Donald, 2002). Thus, it is important to ensure that postgraduates have consistent success and productivity, preferably from relatively early on in the degree. This should be accomplished by providing adequate supports as well as having appropriate policies and procedures to help ensure this.

Having adequate workplace affordances/supports is crucial to productive work engagement. Even those with successful outcomes recognised that supports were crucial to their success and that these were also not equally afforded to all postgraduates. SAY described how: "I have met a lot of really brilliant people who don't necessarily succeed because things just have to fall into place at the right time". Thus, rather than assume that all postgraduates are afforded similar supports as has often been the case, there is a need to take an intentional approach towards ensuring that postgraduates have adequate workplace affordances/supports. In the sciences, this partly requires ensuring that established best practices are consistently afforded and intentionally supported (e.g., through professional development). For instance, it should be ensured that supervisors actively and appropriately monitor and manage students' projects for progress. Similarly, intentional consideration should be given towards determining when peer interaction is beneficial, and how to foster positive peer interactions and collaborations (Boud & Lee, 2005; Campbell, 2003; Delamont & Atkinson, 2001).

Policy and oversight should also be employed to support postgraduate work engagement. Rather than focusing on simple outcomes as previously described, having clearly outlined practices and standards for postgraduate supports/affordances would be likely more helpful for students. For instance, clear guidelines on expected times for writing feedback, and/or defining the resources and supports expected in research work environments would be helpful for ensuring that all students have adequate support. Along with this is a need to have external monitoring and oversight (McAlpine &

Amundsen, 2011). There could be, for example, a requirement to clearly outline milestones and timelines at the outset of project so that progress could be tracked. Another similar means may be through the use of logs. Study two identified a range of potentially useful indicators of progress and/or difficulties including: publications per year, times supervisors were helpful when help was needed, and percentage of times when research difficulties were encountered in data collection. Used program or faculty-wide these could identify and/or avoid situations where postgraduates are silently and interminably “stuck” on difficult projects as was observed in some cases in studies one and two. When progress and/or productivity are identified as concerns, additional support and/or external intervention could be brought to assist.

In brief, there is a need to carefully consider the pedagogical properties of work students engage in. To ensure that this work can support postgraduates’ learning and career goals, there is also a need to ensure that this work is productive. As a part of this, work needs to be intentionally supported through proper supports, policies, and procedures.

## **1.9. Future Work**

These three studies provide both a theoretical and methodological means with which to further study postgraduate experiences. There are also some specific directions and limitations which future research could aim to explore.

Quantitative work could continue the development of the instrument in study three. Study three, due to its small sample size and exploratory purpose, would be well served by additional confirmatory and replication work. As well, such work could employ other statistical techniques, particularly factor analyses, which are better suited to uncovering latent constructs. Using these, the instrument could also be further refined, studied, and validated using larger samples and other populations. Further study on the correlational relationships between projects, affordances, and context could also be done. Larger samples would also allow more complex relationships to be explored, such as by using multiple regression or log-linear analysis.

Additional qualitative research would also be invaluable as there are inherent limitations to any narrative. Namely, a narrative is fundamentally a co-construction (Sfard & Prusak, 2005) using a limited number of experiences in that period of time without a true closure to the analysis or ongoing nature of particular narratives which continue past the study period (Thomson & Holland, 2003). Further, the narrator can only portray what he or she knows, and thus the trustworthiness of a narrator's account necessarily depends on how much information they have at hand (Coulter & Smith, 2009). Thus, studies one and two, as narratives, portray specific perspectives and experiences, supporting exploration, interest, and questioning towards phenomena, rather than striving for objective "truth" or generalizability. Therefore additional studies can always help contribute to our further understanding by providing additional perspectives and experiences to consider (Coulter & Smith, 2009; Elliott, 2005).

Future studies in either methodological mode could also expand the analysis to further groups and/or aspects of the postgraduate experience as this work was, of course, not exhaustive. Additional studies drawing on the methods outlined here could aim to examine other groups of interest such as programs, disciplines, and/or larger contexts such as national ones. They may also aim to identify further meaningful affordances, outlooks, and outcomes, as well as variations within these. For instance, future studies could focus on formal learning, or, particular career goals/outcomes. National contexts and the role of formal learning may be particularly interesting to explore. While nothing across this set of studies found gross differences in postgraduate experiences in Canada and the UK, they did not completely overlap in their areas of focus. Had the role of formal training, for example, been examined more closely, it is possible some differences may have emerged given differences between these contexts.

## **1.10. Conclusion**

In summary, the overall goal of this work was to closely examine science postgraduate learning experiences and outcomes. The specific aim was to focus on students' experiences and perspectives in order to document the range and variation in actual experiences in contrast to prior research on aggregations across entire groupings

and/or broad contexts. By documenting, and subsequently demonstrating the relevance and importance of these variations, it is hoped that these studies collectively raise further awareness and conversation around postgraduate learning experiences. This intent and purpose is well-articulated by Funkymonkey:

When you go into grad school...it is not just knowing one person, it is actually best to know several people. Someone who has succeeded, someone who—I don't want to say fail, but had trouble or struggled. I think at least you need two extremes...to get a good idea about what it is really about...

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## **Chapter 2.**

### **Study One: Workplace learning during the science doctorate: what influences research learning experiences and outcomes?**

#### **2.1. Citation**

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## **Chapter 3.**

# **Study Two: Research difficulties, supervision, and publications: workplace affordances that influence students' postgraduate career outlooks and outcomes**

### **3.1. Introduction**

Postgraduate<sup>1</sup> education, particularly in the sciences, is an area of focus for both research and policy within Canada, as well as internationally. This is driven in large part by concerns about the employability of graduates as well as the perceived need to improve scientific research, often for economic reasons (Association of Universities & Colleges of Canada, 2008; Craswell, 2007; Gilbert, Balatti, Turner, & Whitehouse, 2004). Little evidence-based research exists about postgraduate education which can adequately inform policy and curriculum decisions; instead, decisions are often based on taken for granted assumptions which may be inaccurate (McAlpine & Amundsen, 2012). This is particularly true of the sciences where there has been relatively less research than other disciplinary areas such as the social sciences (Leonard, Metcalfe, & Evans, 2006).

Postgraduates often feel underprepared as researchers and typically do not have a strong knowledge of alternative career options outside of academia (Golde & Dore, 2011; Thiry, Laursen, & Loshbaugh, 2015). This, despite an increasingly competitive academic job market and the fact that most will have to pursue careers outside of

<sup>1</sup> The term “postgraduate” here is identical to the use of the term “graduate” often used in Canada (i.e., degree study after an undergraduate degree). This study focuses on doctoral (PhD) students specifically.

academia. One outcome is that many postgraduates experience difficult career transitions after graduation. There is thus a need to better understand how students' postgraduate experiences and learning during their degrees relates to their ability to pursue meaningful careers. There is also a need for a better and more detailed understanding of students' career transitions after graduation, as relatively little is known about this (Manathunga, Pitt, & Critchley, 2009; Sauermann & Roach, 2012).

Thus far, efforts to improve postgraduate education have often been predicated on a "deficit" top-down model of education around generic and/or employability skills, focusing on formal training. This approach, however fails to recognise the importance and predominance of so-called "informal" elements of the degree program which arguably have a much greater influence on students' learning and outcomes. To inform this latter approach there is a need to develop an understanding of the specific lived experiences and career trajectories of postgraduate students. Specifically, we must shift the focus to students' own perspectives to understand their needs and goals so as to better understand how career development and outcomes actually develop in the interplay between individuals and their academic context(s). This approach provides a contextualized and holistic understanding of actual doctoral and postgraduate experiences which can then better inform practice, as well as institutional and national policy (Bastalich, 2015; Craswell, 2007; Gilbert et al., 2004; Hopwood, Alexander, Harris-Huemmert, McAlpine, & Wagstaff, 2011)

### **3.2. Theoretical framework**

This work draws on two broad theoretical and methodological frameworks. It employs a narrative methodology (Elliott, 2005; McAlpine, Amundsen, & Turner, 2014; Riessman, 2008), framed within a workplace learning perspective (Billett, 2001). In common, these two frameworks aim to understand the interaction of individual agency within structural contexts, making them ideal in developing understanding of the relationship between students' goals and their daily lived experiences.

It is informative to contrast this approach to related research on the socialisation of postgraduates. The socialisation perspective is often used to study postgraduates,

including science postgraduates, and focuses on the social environment and how postgraduates come to be encultured within a given community's norms, values and practices (Weidman, Twale, & Stein, 2001). Socialisation, however, has been criticized as privileging structure over individual agency, for instance, insufficiently accounting for instances where individuals resist the structures that surround them and/or define their own goals that differ from their immediate context(s) (Billett, 2001, 2006; McAlpine et al., 2014). Further, by focusing on structure, this and other work on science postgraduates has not adequately described differences within scientific contexts in which students work. Past research on science postgraduates has typically described science work as being a productive and collaborative environment where supervisor-student relationships are a close apprenticeship marked by frequent contact and support (Cumming, 2009; Leonard et al., 2006). However a closer examination of specific circumstances (Hum, 2015) and disciplines such as the field sciences (Bowen & Roth, 2007) has shown that significant important variations exist. This research, using a narrative and workplace learning framework focuses on individual perspectives, agency, and lived-experiences, and aims instead to document and explore these variations.

This research is part of a larger project also based in narrative methodology, but instead focusing on the interaction between personal and academic lives in constructing identities using a framework entitled the *identity-trajectory* (McAlpine et al., 2014; McAlpine & Amundsen, 2011). The overlap between the perspectives of this study and the larger identity-trajectory project is seen in the interpretation of narratives, framing of the cases, and focus on agency. Firstly, narratives are understood as socially constructed accounts by participants that provide insight into their goals and agency. Narratives also provide personal interpretations about the meaning, causality, and chronology of events (Coulter & Smith, 2009; Elliott, 2005; Riessman, 2008). While certainly this understanding of causality is not generalisable in the broad, quantitative sense, it does not *preclude* some kind of transferability by inviting the reader to evaluate the transferability of findings to other settings (Elliott, 2005). Additionally, multiple cases are examined longitudinally, as opposed to a few cases examined over a relatively brief amount of time, as is more common in narrative research. This approach is ideal for this study's emphasis on understanding how career outcomes and outlooks develop over the course of the postgraduate and after graduation. The focus on agency and an

individual's efforts to navigate the structures in which they find themselves, particularly the goals set and actions taken is critical in framing this study. In the identity-trajectory framework, these are framed as *opportunity structures* (i.e., knowledge and beliefs about career opportunities) and *horizons for action* (i.e., perceived viable options for careers). Where this study differs from the larger project is in backgrounding personal lives in favour of a foregrounding of the role of daily work. It also aims primarily to link *daily work* experiences with career outcomes and outlooks (i.e., horizons for action and opportunity structures), whereas the identity-trajectory takes a more holistic view and concerns itself with identity construction more broadly, both personally and academically.

The workplace learning perspective is used here as a theoretical lens to help understand daily work. While terms such as “postgraduate school” or “postgraduate education” imply a primarily didactic learning process, science postgraduates are well documented to learn primarily through engagement in authentic scientific work (Delamont & Atkinson, 2001; Pole, Sprokkereef, Burgess, & Lakin, 1997; Pole, 2000) and typically have duties and responsibilities more similar to academic staff than undergraduate students (Boud & Lee, 2005). They are thus well-suited to be conceptualized as workplace learners according to Billett's (2001, 2004, 2006) workplace learning perspective. In the workplace learning view, there is no meaningful distinction between workplace participation and learning, as all work, even routine work, presents opportunities for new learning or to reinforce existing knowledge and practice. The interplay between individuals and context is not deterministic, but rather relational. Individuals may choose to selectively engage with and/or resist workplace practices and seek to change work practices or redefine their own goals relative to existing practices and norms. Outcomes in work participation and learning can vary and are understood as mediated between individuals and their workplace. Not all individuals in the same context may opt to participate in workplace learning opportunities or adopt workplace values to the same degree relative to others based on their own preferences and prior experiences. Conversely, workplaces do not provide equal *affordances* for work participation to all individuals. Depending on the consonance in goals, norms, and/or affordances between individuals and their workplaces, a variation in realised work participation and learning occurs (Billett, 2001, 2004, 2006). Hopwood (2010) and McAlpine & Mitra (2015) have previously drawn upon workplace learning to examine

informal learning through journal writing and places (e.g., laboratory, office, airport) where postgraduates performed their work to better understand their daily work experiences and productivity

In brief, this work is narrative research, using the workplace learning framework. The intent is to better understand individual lived experiences in daily postgraduate work over time and the relationship of this to how students develop towards and transition to different careers.

This study centres on two main research questions:

1. What meaningful groupings of individual experience, during and after postgraduate studies, related to career outlooks and outcomes can be identified?
2. How do different daily work experiences during and after postgraduate studies relate to different career outlooks and outcomes?

### **3.3. Data Sources**

This research takes place within Canada. Unlike many other countries, Canada's post-secondary system is relatively decentralized, and aside from determining funding priorities, the federal government largely does not regulate or determine the day-to-day affairs of universities. For instance, there are no national or universal standards/regulations around completion times, coursework, or training and development more generally (Shanahan & Jones, 2007). A master's degree is generally a two-year research-focused degree requiring a thesis. A master's degree is largely separate, and a pre-requisite for, a doctoral degree, though it is not uncommon for those in the sciences to transition directly from one to the other. Doctoral degrees typically take four years and require further research work and a dissertation (though this is the official term, it is common to use the term thesis for this as well). It is common for postgraduate studies at both master's and doctoral levels to take longer than the minimum stated time to complete the degree (Canadian Association for Graduate Studies, 2004).

As previously mentioned, this study draws from a larger research project. The larger project examined the experiences of doctoral students, postdoctoral fellows, and

pre-tenure academics at two Canadian universities over four years. The subset of participants examined in this study are those who began participation in the research study as a doctoral student and remained in that role at least one full year before moving on to other roles (e.g., postdoctoral fellow). A summary of the data used in this study is given in Table 1. All participants chose their own aliases.

**Table 1. Data source summary.**

Participant	Institution	Years to complete degree	Years in study	# of PhD Logs	Year of study that degree was completed	# interviews	Age	Program	Outcome
Storm	A	5	4	7	4	4	30-33	health sciences	tenure track
SAY	A	6	4	4	2	4	26-29	biology	postdoc
Julius	B	3	3	5	2	3	26-29	engineering	professional
George	B	6	4	8	3	4	30-33	computer science	postdoc
Flora	B	6	4	10	3	4	26-29	biology	postdoc
Epsilon	A	7	4	14	*	4	26-29	computer science	postdoc*
Funkymonkey	A	8	4	8	2	4	30-33	biology	postdoc
Sam	B	6	3	10	3	3	34-37	biology	professional
Claude	A	6	4	10	4	4	26-29	biology	see cameo
total				76		34			

\*graduates after the study period

Institution A is a medium-sized “comprehensive” university with emphases on both research and teaching and Institution B is a larger research-focused university (see Table 1). Annual data collection included demographic and biographic questionnaires (e.g., age, past work/degree experiences). Every two months, participants were asked to submit activity logs (e.g., what they did, who they interacted with, difficulties) for a week of the participant’s choosing. Towards the end of each year, a pre-interview questionnaire was completed in preparation for a semi-structured interview. The interview aimed to develop a deeper understanding of participants’ experiences as reported in the logs.

### **3.4. Data Analysis**

In the first analysis step, cameos for each participant were created to facilitate analysis based on outcomes and outlooks (Riessman, 2008). This was done by reading and re-reading all the log and interview data for each participant across all years of their participation, including some follow-up correspondence after the study’s completion. Extracted from this data, with as little interpretation as possible were: their studies or careers prior to pursuing postgraduate study, career goals, perceived career prospects, and stated expected career outlooks and/or actual outcomes. These cameos were then grouped into emergent groupings based on similar career outcomes and outlooks to facilitate analysis in the following steps. Three groupings emerged. The second author, who also extensively read the data, verified these cameos and groupings, and changes were made according to this verification. Shortened versions of the cameos are provided here.

The second step examined daily workplace experiences over time using the log data as a starting point to support the qualitative thematic analysis in the third step. As described by McAlpine & Amundsen (2015, p. 14), logs represent a “detailed image of the day-to-day ‘frustrations’ and ‘disasters’ of advancing research”. A range of descriptive statistics was calculated, using frequencies, averages, proportions, and percentages where appropriate to summarize log data. Statistics were calculated *within* each case (rather than averaging across all cases) to create a summary of individual

experiences over time. Quantitative analysis as a starting point for further analysis provided an “extensive” lens to support the “intensive” qualitative examination in the third step. Whereas the quantitative analysis helped *identify* relationships between daily experiences and outcomes/outlooks, the qualitative, narrative data provides the perceived meaning and potential causality that underlies these relationships (Elliott, 2005). The calculated statistics were then compared with the three groupings made based on career outcomes and outlooks in step one to find areas where the quantitative data corresponded with the qualitative groupings. Three sets of these (publications, research difficulties, and supervisory help) were found to correspond with the groupings and selected for further qualitative analysis in step three.

In the third step, using the three sets of statistics identified in the second step (publications, research difficulties, and supervisory help), the data were re-examined to look for detail on, and potential causes for, the relationships between the sets of statistics of workplace experiences and groupings based on career outcomes and outlooks. Following this, a thematic analysis of narratives (Riessman, 2008) was conducted where each set of coded segments pertaining to publications, research difficulties, and supervisory help for each individual, were examined. These were then compared first within, then across groupings, to form an understanding of the similarities within groupings and how these workplace experiences differed from other groupings. These interpretations were then verified by the same second researcher from step one.

### **3.5. Cameos and Groupings**

Cameos are organized in the three groupings described above. Each cameo begins with a general description of the participant’s background and research degree pursued. Following this are accounts of their career goals, perceived employment prospects, and/or realised career outcomes throughout the study. Career goals were primarily assessed through questions on a pre-interview questionnaire completed each year through questions that queried past (before enrolling in the doctorate) interest in an academic career, current interest, and future interest in the type(s) of positions they “hope to hold immediately after” their current position. Statements from the interviews and follow-up correspondence after the study were also used where relevant.

### **3.5.1. Positive outcomes: strong alignment between stated goals and present outcomes (Group one)**

These participants largely maintained consistent career intentions, and had a positive view of their career options and potential. By the end of the study, they were highly optimistic about the future, having achieved their goals and/or being well on their way.

Storm pursued a health-sciences degree where her research took place primarily in an office-like environment and required some field work. She was a medical professional in her country of origin, and moved to Canada with her partner who obtained an academic position. During the study, she consistently reported being interested in pursuing a tenure-track academic career. However, she also sought to make herself competitive for other careers, finding work in medical and government contexts and working part-time in a government organization in her first year. She believed her fellow students also had good career possibilities but that “rarely graduate students are told about that, is that what options are on the market”. She completed her degree in year four, having put a lot of emphasis on publishing her research during her degree. Her husband also found an academic position in another country. While spousal hires were not common in this institution, her CV was circulated nonetheless. After giving a presentation she found that “they practically asked me to choose which school I would like to join because they both wanted me”. Upon embarking on her tenure-track position after graduation, Storm reported that she and her partner “are very happy about our work prospects”.

SAY pursued a biology degree in the same traditional science lab he had been a member of since his undergraduate studies. During the study, he consistently reported being interested in pursuing a tenure-track academic career. Prior to completing his degree, he recognized the competitive nature of this choice and said that while he expected to do a postdoc next, he wouldn’t do more than one and “after three years I’m going to... critically evaluate whether I think the next step [a tenure-track position] is going to happen or not”. SAY intended to transition to a different subfield after his doctorate due to personal interest and career advantage, saying, “It is a young discipline and so a lot of universities are still sort of developing programs and things like that and

so there are more positions available”. He subsequently completed his degree and started a postdoc in his intended subfield. In the second year of his postdoc, he remained confident, saying, “I’d like to hopefully find a tenure track job... I do remain positive that it will happen”. By the end of his participation in the study, he had begun successfully publishing his postdoctoral work and was planning to begin searching for tenure-track jobs within a few months.

Julius pursued a degree in engineering where his research involved working in an engineering materials lab. He had previously worked as an engineer, and decided to pursue a graduate degree after becoming unemployed with the intention of starting a consulting company. During his degree, he was primarily focused on starting a business, stating that “I basically give myself a year or so to see if I can get things running... [if] it is not going to pan out... [I’ll] start applying for a job elsewhere”. He graduated in three years, and had already started his business before graduating. In the first year after starting his business, he noted that while “I’ve had some small jobs. I haven’t had any major jobs at this point”, he remained hopeful the business would succeed, adding, “I have something coming up... [and] I think I might have some stuff in the future...” and was considering hiring additional staff. He saw his degree as helpful to his business, saying, “Some clients will see a PhD in [engineering field], you’ve done a lot of extra to become an expert in the field and you should know that field... I believe it helps... my credibility in the field”.

### **3.5.2. Positive outlook: goals remain open, are optimistic their degree will support future ability to pursue fulfilling work (Group two)**

These participants held multiple and/or changing career intentions during the study. By the end of the study they had not yet settled on a clear future career, but had largely optimistic outlooks regarding their future.

George moved to Canada to pursue graduate studies in computer science, working in a computer lab to complete his research. During the study he remained open to a variety of careers in and out of academia, but began to focus more on tenure-track academic careers towards the end of his participation in the study. During his degree,

George expressed a reticence to work in industry, saying that instead, “I’d enjoy working for a research institute... aspects that I find very important... like energy, the environment, social equity”. While interested in academia, he was unsure of his prospects, saying, “I’m still on the fence about it...if I manage to get in the next couple of years some good publications, then that might change”. After graduation, he started a postdoc at the same institution, but in a different subfield. He needed the job while his partner finished her studies, but noted that he would “like to work on something that I feel do[es] something to better society and I’m not sure I am doing that right now”. These values confirmed his interest in an academic career because he wanted “to investigate the environmental impact of [industry] and put aside any profit considerations ...you can have the freedom to say what you think”. While he remained “not confident at all in my publication record”, he was generally optimistic about his future and planned to pursue another postdoc in the same city his partner was moving to. He had begun talking to a professor about a possible postdoc; someone he liked “as a person and as a researcher” and who better aligned with his values as this professor “specifically doesn’t want to work for industry”.

Flora pursued a degree in biology, working on research which took place in a traditional science lab and which required field work. She had gone directly from undergraduate study to graduate study. During the study she was consistently “unsure” about pursuing a tenure-track academic career and was open to a variety of careers involving research or teaching in academic and non-academic contexts. However in years three and four of the study, she had begun to consider tenure-track careers. Flora, during her degree, already knew that she did not want to move cities after graduation as her partner already had a good job locally; she recognized this hindered her academic career prospects, saying, “It is already so competitive... if you do a post-doc in the same city you’ve done your undergrad and... your PhD, it is not... good for you on your CV...”. After graduation, she began a postdoc at another institution in the same city, having gotten no responses from applications to teach at local colleges. Of the post-doc she said, “A lot of people encouraged me to at least try it” and it “would open more doors” as it was in an applied area where there are more jobs. She expressed a lack of confidence about her ability to successfully transition to this new area, but when she was awarded a competitive fellowship in the second year of her postdoc, she said, “Now I feel more

comfortable with doing things, so I think this year I will be more productive than the last year". Looking forward five years, she hoped that she would find a permanent job at a local institution as a principal investigator, but would "be happy with that too" if she got a job as a "lab manager or something".

Epsilon pursued a degree in computer science, working primarily in a computer lab, but also working with clinicians in clinical settings during his degree. During the study, his interest in a tenure-track academic career fluctuated, only considering it in years one and three of the study. In year three of his degree, he was most open to non-tenure track careers involving research in and out of academia and especially wanted to work in an applied medical context saying during his degree that he "likes to work in a clinical environment... the last two people out of our lab got jobs along those lines so I am hoping to follow the same path". He later reiterated this in the following year, saying he wanted to be, "Working closer to the clinical side of things...". He noted that academic careers didn't have an appeal after observing his supervisor and "seeing the amount of things that I just didn't really want to do... marking/teaching/dealing with... bureaucracy". He was optimistic about the career prospects in his field which was "just starting to create this buzz". However, by year five of his degree, his degree progress slowed when the last paper comprising his thesis was rejected for publication. Due to this he said, "I haven't looked seriously at future career paths until I get this last project...I'm still sort of in my own little world". Following up at the end of the study, however, Epsilon had finally managed to complete his PhD after seven years, and was set to begin a postdoc with an industry partner overseas, which he was excited about.

### **3.5.3. Uncertain outlook: goals remain open, are not certain that their degree will support future ability to pursue fulfilling work (Group three)**

These participants all shifted away from a main intention to pursue academic careers, feeling these careers were no longer desirable and/or obtainable. By the end of the study they remained unsure how their postgraduate studies would be applicable to potential non-academic careers, and/or were relatively certain they would not be able to clearly link their postgraduate work to their future careers. Though they were able to

pursue some reasonably fulfilling work after graduation, they all remained uncertain what their long-term careers would be.

Funkymonkey pursued a degree in biology, working in a traditional science lab. After working as a lab technician in industry, he pursued graduate studies with the initial intention of an academic career. From at least year six of his degree (year one of the study) however, he consistently reported a lack of interest in an academic career, thinking he would not be sufficiently competitive and preferring a research career in government or industry, saying, “Initially I was planning to do a professorship...so for me right now the option is industry”. He was unsure of the importance of a PhD given this new goal, and at the same time felt he did not have sufficient information about industry career prospects. He graduated the following year and was unemployed for nearly half a year before finding a postdoc position after an industry interviewer suggested his background was best suited to this. He hoped this would be helpful for his career prospects, but remained unsure if this would be the case in the last year of his degree, and said, “I kind of thought well maybe it is a good idea for me just to do the post-doc, get experience, learn some new skills and who knows where it might take me after”. He noted, however, that he still remained unsure how to best prepare for his industry career goal or even where to find accurate information. In the final year of the project and the second year of his postdoc, he admitted, “It is kind of strange that even though I have done so much research [work], I still don’t know exactly what I want to do” and “I haven’t found that passion for a specific subject area ... that people have ... it kind of makes me sort of maybe second guess if that is what I want to do for the rest of my life”. At the end of the study follow up, he was struggling to get good results in his postdoc research, his contract was shortened due to funding, and he had resumed an active job search.

Claude pursued a degree in biology, conducting her research in a traditional science lab with the intention of an academic research career. During the study, however, she consistently wavered in her interest in an academic career, and also considered non-tenure track research careers in the university or government. Early on, in year two of her degree (year one of the study), she doubted her academic career prospects saying, “My plan is to do a post-doc but that doesn’t guarantee that I’m going to get the job that I wanted... and [there’s] no jobs in the science field... plus I’m not

having the best publication record”. By year three of her degree, she became interested in a hobby, which compared to her PhD work “it’s very human centric... the actual result means something”. She became generally disillusioned with academic science, saying, “Research these days is a lot about...who is better at talking, not necessarily who is better at doing research... I see people ... don’t do [their] experiments very rigorously... I can’t be confident that what they [find] is actually what is truth”. She planned to only stay in research for the “short-term maybe” or take other part-time work so she could pursue her hobby full-time. After completing her degree in six years, she moved back to her country of origin where “what I was doing with my PhD is... not possible because we don’t do that kind of research here”. At the end of the research study, she reflected that even though her PhD will not be directly relevant to future work, “I learned from it ... I actually appreciate a lot. And I am glad that I did it...the skills...that I learned... I can use for other things—not immediately, but...that it is part of how I work now.” At last contact, she was engaged in a range of projects in her country of origin, primarily related to her hobby, along with a small contract doing some work related to science research.

Sam pursued a degree in biology, working in an area requiring field work. He worked for a government organization before beginning graduate studies. While he originally intended to pursue an academic career, during the study, he consistently said he was not interested in an academic career. In the third year of his degree (year one of the study) he said, “I do enjoy a lot of aspects of academia... but just looking at the job market out there...there just aren’t that many jobs available..., so I’m trying to keep my options open”. He was interested in government policy work, saying, “I have always been sort of interested in policy but I’ve never invested the time to learn a lot about it because I felt it was a distraction from what I was supposed to be doing”. While he knew of other students who pursued this career path, his supervisor was not supportive of this goal. In year two he began an internship with a non-profit working on a policy-related area unrelated to his degree work, which he did not feel his supervisor approved of or supported. Graduating after six years in the degree, the final year of his participation in the study, he then took a full-time position with the same non-profit. Reflecting on his PhD, he said, “I felt like I was investing a lot of energy in things that turned out not to be really useful in the long term” and “my supervisor...would often tell me ‘you’ve got to stop doing this student government stuff’ and yet...that’s what helped prepare me for

where I am today”. While he was temporarily satisfied with his position, he felt it was insecure, noting, “It wouldn’t surprise me to next March to go and have a meeting with someone and be told I’m not working there anymore”. Asked about his five year horizon he was still considering new options, saying, “Hopefully I’ll get promoted...I could also see myself doing other things like moving into a more of a policy area, or maybe I’ll be teaching...one of the exercises I have been doing...is...identifying what are the dream jobs I could have... and I realize teaching is actually something I wouldn’t mind exploring”.

#### **3.5.4. Significance of the cases and groupings**

It is important to note that these are *all* stories of success and agency. The completion of the degree alone is a significant accomplishment given that postgraduates often have long completion times and high attrition rates (Ampaw & Jaeger, 2012; Hopwood et al., 2011; Lovitts, 2001). Across groupings, all completed their degrees successfully, and all but three (one per grouping) finished the degrees in a similar period of time (5-6 years). Further, while they varied in their outlooks and outcomes relative to their postgraduate work, all were employed in some capacity relatively soon after graduation. The most important defining characteristic between the groupings, especially the uncertain outlook group, is the (in)ability to clearly link postgraduate experiences with satisfying careers. That evidently different levels of satisfaction and actual outcomes underpin these superficially similar experiences supports the notion that simple quantitative metrics, and completion time in particular, are insufficient measures of success as they do not capture the content of how postgraduate degree time is spent and later applied (Hopwood et al., 2011).

As will be shown subsequently, an examination of daily postgraduate work shows that differences in outlooks and outcomes can be partly explained by differences in work engagement and workplace affordances. In common, those with positive outcomes maintained relatively consistent goals throughout and were able to pursue them after degree completion, having been afforded, and participated in postgraduate work which supported these goals. Those with positive outlooks in the second grouping had some sense of the goals they wanted to achieve and were able to engage in productive work,

but had yet to link their postgraduate work with a specific career goal. Conversely, those in the third grouping with uncertain outlooks all shared the experience of having moved away from the goal of an academic career, yet at the same time were unable thus far, to find a way to link their postgraduate work with a satisfying long-term career goal.

### **3.6. Workplace Affordances**

The discussion now turns to how academic productivity (publications) along with daily work experiences and affordances (research difficulties and supervisory help) during the postgraduate relate to the three groupings.

#### **3.6.1. Publications**

Participants were asked the number of peer reviewed publications they had published at two points in the study, once at the beginning of the study on the demographic form, and once again in year three of the study on the pre-interview questionnaire. These publication counts and resultant approximate publications per year are given in Table 2. It can be seen that publications per year strongly follows the groupings, with the most per year among the positive outcome grouping, the least per year in the uncertain outlook group, and the positive outlook group largely in the middle. The main exception was Julius for whom no count exists in year 3 of the study. Notably, the percentage of logs where students indicated they were “writing for publication” did not seem to correspond strongly to the number of publications, suggesting that other factors than simply time on task or effort accounted for these differences.

**Table 2. Publications produced per year.**

Participant	Grouping	# Publications in year 3 of study	Approximate years since start of PhD at count	Publications per year	# instances of writing for publication	%
SAY	positive outcome	9* (6)	5*	1.80	3	75.00
Storm	positive outcome	9	4	2.25	3	42.86
Julius***	positive outcome	1	1	1.00	1	20.00
George	positive outlook	4**	5	0.80	3	37.50
Flora	positive outlook	6	5	1.20	5	50.00
Epsilon	positive outlook	10**	6	1.67	6	42.86
Claude	uncertain outlook	2	5	0.40	3	30.00
Funkymonkey	uncertain outlook	3*(0)	7*	0.43	5	62.50
Sam	uncertain outlook	4	6	0.67	5	50.00

\* includes approximately 1 year after graduation, count at year 1 in brackets

\*\*are peer reviewed conference proceedings as these are equivalent to peer reviewed journal publications in computing science

\*\*\*numbers used are from year one due to non-response on this item in year 3

The qualitative data below help contextualise these numbers, showing clear differences in the perception and experience of publication. Specifically, they show that publications are linked heavily with the concept of academic work productivity and have a commensurate relationship with realised career outlooks and outcomes.

### ***Experiences of publication***

Publishing is an expected and anticipated outcome of successful research projects according to participants. For example, George reported in a log that “articles are arguably the standard output of an academic”. Asked what it means to “be productive”, Flora responded: “Having a project that I can put together as a whole...and make a paper”. Between the three groupings, however, realised publication productivity and perception of the process of publication varied greatly.

For those in grouping one with positive outcomes, publication was a positive and affirming experience. SAY described how “it’s a hard slog but there is nothing better than that feeling when it finally appears published and you get feedback from people in the field...that’s pretty cool-that’s one of my favourite parts about science”. This is also seen to positively impact career prospects and outcomes. SAY noted: “The more publications in good journals you have, the more doors that will open”. Storm described how she was able to “skip” having a postdoc before obtaining a pre-tenure position because “I already have more publications than they [people with postdocs] have, even if they are in like first or second of their post-docs”. Even Julius, who worked outside of academia and intended to publish his PhD research in industry journals noted the usefulness of this from a marketing perspective for his business.

For others in grouping two with positive outlooks, publications were described in more ambivalent terms. Epsilon preferred industry as “I like the idea of being able to push something from the theoretical to the practical. I find here you sort of push an idea to the point that it gets published, and then it just sort of stalls [at the theoretical stage] because the publications are the end goal.” George described during his degree how his job prospects and confidence will be shaped by his publication success moving forward

as “if I’m really productive I could also try to find a faculty position”. Soon after graduating he said, “I am already starting to feel maybe enough pressure has been building up [to move me to publish] ... that will affect basically how confident I feel in my abilities to say get grants or get a certain kind of position...”.

Those in grouping three, with uncertain outlooks described publications most negatively, expressing that their inability to publish didn’t provide sufficient recognition for the unpublished work they had done and that this would negatively affect career prospects. Claude described how “what people see is your productivity... it doesn’t matter like how much you learn. But if you don’t have things to show...I don’t think it would be called a good PhD if you can’t publish anything”, also noting, “I think ... PhD students should be judged based on their critical thinking skills and what they have learned more than merely on the record of their publications”. This was echoed by Funkymonkey who said, “That’s how they judge, that’s your merit. If you don’t have a publication... you are not competitive or you are not productive, like that is how I am starting to see academia. It’s no longer research for the sake of science or understanding the truth”. Sam similarly related that “I go to a lot of PhD defenses and a lot of them ... have their little publications...and sometimes all of them are accepted or at least submitted, so you feel a little bit...like a failure if you haven’t achieved that same level of sort of success”. The inability to publish widely was recognized to limit job prospects. Claude describes during her degree how she has “insecurity because I’m not sure... what would happen to me after the PhD... I’m not like having the best publication record”. Similarly, Funkymonkey, in his postdoc, had been rejected from post-doctoral funding saying, “One of the main things they said was lack of publications”.

### ***Discussion***

That groupings aligned with publications per year is not surprising given that in the sciences publications are a common opportunity and overt goal for postgraduates (Brew, Boud, & Namgung, 2011; Golde & Dore, 2001). The link to career outlooks and outcomes follows reasonably, since, as in other academic areas, numerous publications support the pursuit of academic careers in the sciences (Golovushkina & Milligan, 2012; Raddon, 2011). It is notable however, that all participants, regardless of grouping or career intention commonly saw publication productivity as the product and validation of

successful work, rather than simply academic currency as evidenced by Julius, Epsilon, and all those with uncertain outlooks, who aimed to publish despite not having (or no longer having) academic career intentions.

Importantly, as will be shown subsequently, this productivity as assessed by publication did not necessarily correspond with perceived effort or personal goals. Rather, work affordances or hindrances (i.e., supervisors, research difficulties) mediated how “productive” a student was in terms of publications. This productivity in turn, helped influence career outlooks and outcomes. The discussion now turns to two elements of the postgraduate workplace: research difficulties and supervision, exploring how these relate to the groupings of career outlooks and outcomes both in relation to, and independent of, publications.

### **3.6.2. Research difficulties**

Participants were asked on each activity log to indicate whether they had engaged in data collection and/or analysis during the period of time examined. They were separately asked in an open ended question to “please indicate any difficulties you encountered this week”. The percentage of times participants indicated they were collecting or analysing data *and* also described difficulties related to data collection or analysis in their short answer responses are calculated in Table 3.

**Table 3. Logs where students reported data collection or analysis and had difficulty.**

<b>Participant</b>	<b>Grouping</b>	<b>Data collection or analysis</b>	<b>Difficulty with research</b>	<b>%</b>
SAY	positive outcome	4	2	50%
Storm	positive outcome	1	0	0%
Julius	positive outcome	2	1	50%
George	positive outlook	3	0	0%
Flora	positive outlook	6	0	0%
Epsilon	positive outlook	9	3	33.33%
Claude	uncertain outlook	7	4	57.14%
Funkymonkey	uncertain outlook	7	5	71.43%
Sam	uncertain outlook	6	5	83.33%

It can be seen that those with uncertain outlooks had the most difficulties when collecting or analysing data in the course of their research work. Those with positive outcomes and outlooks showed varying relative percentages across both groups. While Julius and SAY had positive outcomes and relatively high percentages, they also had the least logs as doctoral students (4 and 5 respectively), and so these may not be indicative of longer-term experiences. Overall, those with the most frequent difficulties related to research when collecting or analysing data were those with uncertain outlooks.

The qualitative data show that underlying these numbers were differences in the perception of difficulties, differences in projects to afford positive results, and resultant effects on publications.

### ***Differences in difficulties and attitudes***

For those in grouping one and two with positive outcomes and outlooks, they largely either logged no difficulties (Flora, George, Storm), or when they did log them, described difficulties that were largely characterized as expected, routine, and surmountable (SAY, Julius). For example in a log SAY described how he “had a few difficulties with specific experiments” and addressed this as he “found useful information in the literature”. SAY described his experiments as follows: “It is certainly up and down. You certainly go through stretches where nothing works, but then you go through these amazing stretches where everything you think—it works really well... it is important not to always just not get too low or get too high”. Julius described a difficulty getting access to an apparatus he needed and “it delayed my testing start”; he overcame it by helping the student using the apparatus complete his experiment. Julius was asked whether he had a “smooth doctoral journal” in an interview as he rarely reported difficulties. He responded: “Compared to many students I know, I think I did... there were regular difficulties that you come up to in work...those are just things that happen... in my project we had delays... but nothing that wasn’t possible to be dealt with”.

By contrast, those with uncertain outlooks in grouping three, in addition to having more frequent difficulties over time also described difficulties without ready solutions thus inhibiting progress. Claude for example described a difficulty with a technique “which I have never succeeded [with] before” and she could only have “tried again”.

Claude described how “a disproportion[ate] amount of my time is preparing the agent... it took me... a few months already and I’m [only now] starting to get ready for the real experiment”. Funkymonkey commonly logged difficulties like “experiments were not working out” and he could only “repeat the experiment and figure out ways to optimize it”. These difficulties were not temporary or easily overcome according to Funkymonkey, saying, “You can try to troubleshoot at each step but you don’t always identify the exact problem...all you can do is just to retry again and that is when it makes it really frustrating because you don’t know what to change and whether or not the changes you made are actually helping or making it worse... you can be stuck on it for months”. Sam logged that he had “uncertainty about how to proceed with some analyses”, but did not get helpful suggestions from his supervisor and had no solution so “I do what I can, and wait for someone to tell me I’ve done something horribly wrong”.

Further, those with uncertain outlooks also, in contrast to the other groupings expressed a sense of disappointment and/or frustration with their work. Claude once related emotionally two years before the completion of her degree that “I actually had a bit of a panic attack a few days ago ‘cause I really don’t know when I can finish.... Funkymonkey, asked about creativity in his work describes how “sometimes when you get really frustrated with something it is really hard to think what else to try or how to be more creative because you are just so bogged down in the fact that it is not working”. Sam reflected on his PhD work and said, “I never felt like I was able to make the sort of broader theoretical or conceptual contribution that the other people make...I was constantly preoccupied or stuck dealing with just tons and tons of samples and not having a time to get through them....it is hardly a motivator when I am just looking at these little minutia details and getting stuck on those instead of doing something that was a bit more rewarding”.

One can see variation within an individual in the case of Epsilon, with a positive outlook (grouping two) who had different experiences with difficulties, and thus, varying attitudes over time. Early on in his degree he reports no serious difficulties, describing them as routine as did others with positive outlooks/outcomes. He wrote in a log in year three of his degree for example: “Made a few minor computer programming mistakes in setting up one of my experiments, but nothing major... mistakes were discovered and

corrected by myself though the use of conventional debugging and testing techniques”. By year four of his degree, however, he logs that a mysterious “massive loss of data” and had to “restore as much data off backup drive as we could” and begins to find “the results haven’t been panning out”. Similarly, in year five: “Things started to get difficult and slow down and slow down... it just sort of seems like I am in the same spot I was in three years ago”. Reflecting on this in year six, still feeling stuck, he notes that “you get a little bitter, I guess, after awhile, which is why I want to finish off and get out there” and “you sit there thinking, I could make so much more money putting my mind to far better use than changing this little number here or this little number here. And yet this is my life”. He would only finish his degree approximately a year after this.

### ***Differences in project affordances/difficulty***

There seemed to be inherent differences in projects, resulting in a different frequency and quality of difficulties experienced by individuals. Several of those in groupings one and two with positive outcomes and outlooks generally described their projects as having a good start. Storm’s research required extensive fieldwork that required two years of data collection, but she was able to “switch it to a PhD as the project was too big for a masters”, and so what started as a challenge, proved to be an asset. Similarly, Flora described how “when I started my PhD we already had animals... like I didn’t have to wait until field season to get animals... I could just start right away... getting the experiments running”. Julius who completed his degree fastest (three years) had a well-defined project from the outset. He credited “having a project that could be quickly defined” as supporting his progress, explaining in an interview that “for my particular project... this organization had been trying to get someone to do a given project so a bit of the project was already identified”.

By contrast, those with uncertain outlooks in grouping three described challenging project starts and important changes in project direction. They also seemed somewhat isolated from other work in the lab, and, as well, described their work as inherently laborious and uncertain. For instance, Sam had a difficult first field season:

...the first time I was up there the whole time even though I had originally planned to be up there for three to four weeks... it just

turned into a whole summer just because things didn't quite work out, there were delays in getting materials up there and so on

Later on, back in the lab, challenges continued and Sam logged that "the sample processing I am doing seems to take longer than I had planned" and he also logged that "I have recently begun feeling increasingly disconnected from my research, disappointed by the fact that results do not fit the original design". Funkymonkey described how he relied on a "random and challenging technique" with "a lot of trial and error" and "lots of bottlenecks". He said of his longer than originally planned completion time that "part of it has to do with my project, "I think I have been working pretty hard in the lab, I usually pull longer hours". He noted also that "I'm not the worst off because he [lab postdoc] has told me stories where he knows students who spend seven years and they didn't get a [result in the end]". Asked if he was the only one in his lab with these challenges he said, "I am the only one working on [this topic]... I am not as related as the other lab members" and its "mostly just me for my lab... the other people didn't have to do those kinds of experiments". Claude in year three of her degree had to change research direction, describing how "our collaborator actually suggested that the method that I'm using might not be optimum... I found out that it is true... I have to find a different method... because it's a new method... I'm not exactly sure if it's going to work or not". Her research also required collaboration with a lab in another country as "there are like three or four labs in the world that... use this particular technique". This slowed her work as "it is not going to be their top priority" and ultimately, in the following year (year four of the degree), "the student who used to do the experiment for us actually graduated and the lab [does] not have enough staff to do it now, so basically it is on hold until I don't know when". Claude, like Funkymonkey also said that her "project is a bit more independent... than some of the other projects".

### ***Publications and research difficulties***

For those with positive outcomes and outlooks in groupings one and two, the affordances and success of their work facilitated publication. Successes generally seemed to build upon one another and several worked on multiple projects in parallel. Julius described how "my project included some master's students... I depended on their work... both could probably produce at least one paper... I'll write the papers and they

will be first author”, also noting that “earlier I was taking credit for some of their things”. Storm described in her fourth year how she could have finished her degree already as she already had her dissertation “data analyzed and stuff, but like I didn’t have a single paper written, so I decided to prolong it [time in the PhD]” and take time to write. This time “off” also allowed her to work on a range of additional projects and with other organizations including collaborators in a government organization and at a university in another country, noting that “I met wonderful people” and also realized some publications. Early success was beneficial, SAY described how in year four of his degree “we got [a paper] published in a decently high impact journal... it was kind of a continuation of a study that I had previously published that took the first years of my PhD and then this was the logical continuation” and he was given first authorship. Flora similarly described how “we had two projects in the lab that were published in [a top tier journal]... it means that I could do the same with my work... that has a lot of impacts”. Flora described how she works on “big group collaborations” where she was able to publish with her supervisor and lab-mates which facilitated publication. Epsilon similarly described multiple projects, “three of them are with myself and my supervisor... and then...I’ve got two projects with clinical collaborators”. George was not able to publish much during his doctorate, but he anticipated being able to do so afterwards as his dissertation was already formatted in a way that is easy to convert to journal publications and so he anticipated he would “look at the parts that can be just transferred and then I just transfer them and make some minor edits” and “I just needed to find the journal and make it in”.

Conversely, for those in grouping three with uncertain outlooks, difficulties with experimentation simply meant fewer publications, with little recourse. Sam said in year four of his degree: “I had always envisioned that I would have several chapters accepted and published before submitting my thesis, but I am instead having to come to terms with the fact that I simply will not have time for that, and that I need to finish my thesis, however crappy”. While attributing this difficulty to his project in the fifth year of his degree, he remained hopeful, saying, “I couldn’t really publish anything during the first three years of my PhD because I was still doing experiments and collecting data... I try to remind myself of that, to kind of allay the feelings of disappointment, but it is always going to kind of be there. Now I have time and hopefully I can focus on that”. In the

following sixth year of his degree, and having recently graduated, this was ultimately not realized and he noted: “It is a little frustrating having done all this work around the thesis and not have any publications to show for it”. Claude related ruefully that “our department doesn’t have a requirement for publication so in theory I can graduate without any publications”. Her ability to work productively and produce publications were hindered both by poor results and affordances in the workplace. Claude describes how “I have the data back and it is negative so it is kind of disappointing... so we just gotta go with the negative data” noting that would mean a lesser chance at publication, particularly in a high impact journal.

Flora and Funkymonkey in grouping two and three respectively both described having less than ideal results during their doctorate that hindered publication and so this necessitated further work after graduating. This caused some difficulty, and was largely only possible because both remained in the same city post-graduation. Funkymonkey said, “I was actually hoping to publish it before I left, but then... it took her [supervisor] awhile before she actually thought it [results] was enough to publish... I had to work my regular post-doc work and... I had to kind of go back and forth or coming on weekends”. The same happened with Flora describing how “one thing that has been ...harder than I expected...is to kind of finish...things at [previous university]... because things are still ongoing and we still have [a] publication and my former advisor...he is not the type... [to] publish this in a smaller journal to just finish it. No, he grabs on...you should keep working on that”. Adding to the difficulty is that she feels her current postdoctoral supervisor was not happy with the distraction of finishing up previous work.

## ***Discussion***

It has been well documented that difficulties are an inherent feature of all scientific work (Delamont & Atkinson, 2001; Roth & Bowen, 2001). However, research examining these difficulties has typically treated all difficulties as largely equivalent and reported that students, through enculturation, come to understand that difficulties in science work are normal and not typically a serious impediment to scientific work in the long-run (Delamont & Atkinson, 2001; Hakkarainen et al., 2014). While this may be true in many cases, in the cases presented here, even if the degree research was successfully completed, the specific experiences of research difficulties varied.

Especially for those in the uncertain outlook group, large research difficulties were experienced early and remained a source of anxiety and impediment to productivity well into the late stage of their degrees. Further, the relative quality of “final” results for projects differed, with some having to continue to work on projects after graduation. Instead of all groupings coming to find science work easier as time progressed as is often described, those with uncertain outlooks described relatively more frequent and serious barriers to their work which required sustained and long-term effort and persistence to overcome, and oftentimes still did not produce unambiguous results, impeding publication. Conversely, those with positive outcomes described early, relatively trouble-free and productive projects which typically resulted in more publications over the course of the degree. Thus, research projects within the sciences have varying affordances in terms of their difficulty and ability to produce results, and this has a significant long-term effect on attitudes/outlooks and productivity (i.e., publications).

### **3.6.3. Supervisory help**

Several log questions related to supervision. They included: “this week with regard to my supervisor(s) I feel that I ...” which was followed by checkboxes to indicate whether they needed/wanted help or didn’t need help. This was followed by a description of what they wanted/needed help with, including the question “did you get the help you needed”? In this question students described to varying degrees, the help they received (or did not). Responses here were categorised into three categories: whether they “got help” (e.g., indicating “yes), got “mixed” help (e.g., “mostly”, “sort of”, “not really), or didn’t get help (e.g., “no”). These were tabulated as shown in Table 4.

**Table 4. Instances where students wanted or needed help from their supervisors.**

Participant	Grouping	% logs when help was wanted/needed & participant indicated they got help	Wanted/needed help from supervisor and:			Total	% logs where help was wanted/needed across all logs
			Got help	mixed	Didn't get help		
SAY	positive outcome	100%	3			3	75%
Storm	positive outcome	100%	2			2	28.57%
Julius	positive outcome	100%	2			2	40%
George	positive outlook	71.43%	5	2		7	87.50%
Flora	positive outlook	60%	3	1	1	5	50%
Epsilon	positive outlook	75%	3	1		4	28.57%
Claude	uncertain outlook	16.67%	1	1	4	6	60%
Funkymonkey	uncertain outlook	0%		2	6	8	100%
Sam	uncertain outlook	0%		3	4	7	70%

Two percentages are shown. The last column on the far right shows the percentage where help was wanted/needed across all logs. It can be seen that students varied widely on how much help they wanted/needed across groupings, though those in the uncertain outlook category somewhat more commonly needed/wanted help as a group. Additionally, those who worked at least part of the time in traditional labs (SAY, George, Flora, Claude, Funkymonkey, Sam) most consistently needed/wanted help. A statistic that was found to correspond exactly to the groupings was the percentage in the first numerical column on the left, showing how often students got help when they needed/wanted help.

The qualitative data show that different experiences of supervision underlie these numbers. Further, that links can be drawn between these experiences of supervision, perceptions of supervision, and productivity and publications.

### ***Experiences of supervisory help***

Those with positive outcomes (group one) all described getting the help they needed/wanted whenever it was needed. SAY and Storm both describe needing help related to writing or publication and receiving help. For example Storm “needed advice on the quality of the data and whether we have enough data to submit” and SAY “need[ed his] supervisor to read sections of the thesis”. Those with positive outcomes generally did not ask their supervisors about research difficulties (in contrast to other groupings), with only Julius describing a more general issue on how he needed his supervisor to “deal with [the other] lab” he was working with because they would “recognize his [supervisor’s] authority”.

Those with positive outlooks (group two) each described generally receiving help when they needed it, regarding writing, administrative issues, and some research difficulties. When they couldn’t get help this was described as temporary, or they found help elsewhere. For instance George wanted/needed help on “how to best write the paper” as “she [supervisor] is a good writer” and reported receiving help. Flora also describes an instance where she “needed him to comment on my annual report” and Epsilon needed his supervisor to “put me in touch with possible collaborators”, with both getting help in these matters. There were, however some instances of “mixed” help.

George describing how he “needed feedback on the experiment design” but only “partly” got the help as his “supervisor was away... additionally she is not that familiar with the type of statistical research I am engaged in” but finding help from a post-doc he knew. Epsilon similarly wanted to “flesh out the methodology of this current research project” and got help “for the most part” as “we still haven’t come to an agreement on certain details”, getting some help instead from “a fellow student” like George. Flora had a single instance of not getting help as she wanted to have a “discussion about my results for publication” but her supervisor was “on sabbatical... I couldn’t really get a Skype chat time with him... I have to wait”.

By contrast, those with uncertain outlooks largely got mixed help or did not get the help they wanted/needed. Firstly, this was common with research difficulties encountered. Funkymonkey for example described how “experiments were not working” but only “sort of” got the help he wanted, with his supervisor offering “suggestions to try”. Claude described a worse situation, where “experiment results are confusing” and her supervisor “didn’t have any idea”. Similarly, Sam described a situation where he wanted help identifying a specimen but in response to whether he got help he said, “Not really... I managed to get his attention for about 5 minutes... I later decided his assessment had been incorrect”. These experiences were notably all problems with research projects themselves, and where supervisory help was apparently limited or unhelpful. Funkymonkey described this as a limitation in how much help could reasonably be provided as “my supervisor can provide me with some additional help and ideas” but her help is inherently limited as “the overall procedure, is quite standard so there shouldn’t be too much variation there... but as with a lot of things in science there is no guarantee, there is some trial and error involved”. Sam attributed his supervisor’s lack of helpfulness to poor feedback, logging, “He rarely offers anything useful or feasible, and usually ends up suggesting entirely new approaches that I don’t have time to learn, and he doesn’t take the time to teach me (in many cases, he doesn’t even understand them himself)”. Claude’s difficulties seemed to most often stem from her supervisor’s lack of availability regarding administrative issues related to experimentation. For instance, Claude wanted to purchase equipment on one occasion and on another, permission to run costly experiments, but says her supervisor “didn’t know enough about the paperwork” and, in another instance that “he was on vacation”.

Those with uncertain outlooks also commonly described situations where they did not get help they needed regarding writing and administrative issues. Claude described how she wanted to “write up a paper” but her supervisor “didn’t reply to my e-mails”, adding, “I feel like he slows down my progress, which is already running behind schedule”. Funkymonkey logged in the final year of his degree that “I wanted more help on my writing... and wanted more help/input” but felt he only “sort of” got the help he wanted as she “provided some ideas but also left a lot for myself to figure out” and “my supervisor may not have had many other ideas either”. In the following interview he said that he only got feedback on his thesis “once for some sections, twice for other sections” and as he described in his interview, her feedback was slow, and he said, “I spent a month on this already and now you tell me it is too detailed!”, having felt that faster feedback would have saved him unnecessary writing and re-writing time. Sam similarly described in logs how he only “sort of” and “not really” got the help he wanted regarding feedback on his thesis as “he’s a little slow with feedback” and “he did nothing to address my overall feelings or confusion”. After he graduated, Sam attempted to publish a paper and “I needed his input to help decide how to address some of the comments”, but indicated “no” when asked if he got the help he needed as “he never got back to me”. Sam also felt his supervisor was not helpful on administrative issues related to his thesis. Sam needed help regarding a manuscript and a deadline but only “sort of” got the help he wanted and he got “very little with regards to the deadline issue”. In another instance, he “wanted reassurance about my timeline and that he would be available when I needed him to provide adequate feedback” but his supervisor only acknowledged receiving the e-mail, and Sam said of this that “his short response did not address any of my concerns nor even acknowledge them”.

### ***Perceptions of supervision***

Groupings were associated with different perceptions of supervisors and supervision received. Those with positive outcomes described their supervisors as supportive and available, offering moral support and encouragement. Storm logged even when she didn’t need specific help that her supervisor was nonetheless the individual most significant to her progress due to “constant support and encouragement”. Similarly, for SAY, in a log he did not need his supervisor’s help but indicated his supervisor as “most significant” to his progress as “he provided advice and helpful suggestions”. He

indicated in response to what had facilitated his progress: “Very good guidance from my supervisor”. Julius responded similarly saying, “Having an organized supervisor supporting my work”. Those with positive outcomes saw their supervisors as being effective sources of support, and two explicitly recognized that not all other postgraduates were in the same situation. Storm reflecting back over her degree in her final year said, “I can say I lucked out because I had a fantastic supervisor, because usually I hear some horrid stories from students”. SAY similarly said, “I certainly wouldn’t be anywhere near here right now without my supervisor... I see a lot of different supervisor-student relationships and I can certainly see how the selection of the appropriate supervisor or the right supervisor can really change your career. I have been certainly lucky there that is for sure... I always feel like he is looking out for my best interests”.

Those with positive outlooks in grouping two had more mixed descriptions of supervision received. Epsilon generally spoke positively about his supervisor, but also noted that he “will meet with us maybe weekly or biweekly...now as a senior student I rarely meet with my supervisor anymore... I have had one meeting with him since Christmas” saying, “At this point in my PhD career [I should] be able to almost fend for myself”. George said in year one how “one of the biggest things that I had to learn during my PhD was how to motivate myself to work and how to find directions for myself ‘cause my supervisor wasn’t telling me what to do”. Flora described having to work around her supervisor who did not match her own work ethic and said, “I get kind of anxious when I do things at the last minute but my supervisor does not seem to care very much and is continuously late”. Likewise, after her degree her supervisor remained chronically slow with feedback and so “we are still publishing papers together and I have to tell him I would like to have your feedback by that date... I have to take that into account”. Relatedly, she felt that her supervisor was not always actively working on research, saying, “He’s there in the day... on the weekend, but he is not working really, he is talking to his mom... the bank... his wife... when I’m here I’m actually working”.

Those with uncertain outlooks in grouping three all described not being prioritized, and feeling unsupported. Funkymonkey did not feel prioritized by his supervisor for his thesis and said, “I was the last one of the three of us and I think I kind

of got pushed back—I got the least time...I mean I know she did try her best, but at the same time like it was already kind of late”. Claude similarly noted that “it seems my project is not on his priority list... he always has grants and also classes.... [and] this other student that he is more close to... they get to push their project more”. Sam had much to say about the supervision he received, particularly during the fifth year of his degree. Sam logged that “I rather feel that he has written me off, has no interest in my personal academic success” and that “I have reached a point where I was unsure how to proceed, but because I felt as though I had no substantial progress to report, I felt uncomfortable asking my supervisor. However, my supervisor has made no attempt to contact me, or check on my progress, increasing my sense of isolation”. In contrast to those with positive outcomes who described feeling supported, Sam said, “I would expect them to have some interest in my progress... I was expect[ing] it a lot more, a supervisor who would actually ask for feedback or who would check up on me once in awhile”. To address this, Sam sought “help from a previous lab-mate... on how to manage my relationship with him” in the fourth year of this degree, but this situation did not seem to improve in subsequent years. Like Flora he questioned his supervisor’s productivity and availability, logging in the fourth year of his degree that “he is not on campus very often, and is rather distracted by a new child... and many upcoming travels and meetings (for him, not me)”.

### ***Supervisory help and publication***

Supervisory help was related with publishing and learning to write grant proposals. All those with positive outcomes and outlooks (except for George) all explicitly described situations where they published through co-authorship and collaborations with, and facilitated by their supervisors. For instance, SAY logged during his degree that his supervisor was significant as “we were writing a manuscript together”, and later described how he eventually got a high impact journal article paper as first author with his supervisor and other authors. Flora similarly described how she worked on, and was co-author on “this series of papers... two of them were [with] the whole lab”. Supervisors could also help students learn academic writing more generally. SAY described in an interview how his supervisor was “submitting a grant proposal for funding... he was kind enough to allow me to assist... get some first-hand experience and see how that is done... it ended up being funded”. Flora likewise noted that she “felt

like an academic” in a log when “my supervisor is writing two important grants for the lab. He is asking us to monitor his progress and to give our suggestions” noting also “I feel that my advice is being taken into account and it helps to see how grants are actually being written”. In the subsequent interview she related that she valued this experience as “it was nice to see how the whole process works and I think he also made efforts to really show us the different steps”.

By contrast, those with uncertain outlooks all described a frustration at not having had much opportunity to work with, or learn from their supervisors in this respect, and/or their supervisors not prioritizing their collaborative writing projects. Funkymonkey said in an interview months after his graduation that “I would have learned more if I went more back and forth” on the writing of his thesis. Claude said how “I tried to write up the papers I have been writing, but my supervisor was not on top of it... if he wants to publish... I’ll do something about it after I finish the thesis ‘cause I can’t just wait for him to work on the paper and do the thesis”. Sam also described how “they forget what it is like to be a PhD student... to assume that I know how to write something for publication or anything like that”, elaborating that “ he [his supervisor] publishes in [top tier journals]... that was one of the things I was hoping to learn... and we just weren’t getting that”. When Sam attempted to publish with his supervisor after graduation, he didn’t get a response to his e-mail for feedback on the peer reviews for a paper they were co-authoring. Sam logged of this that “my work is so low on his list of priorities that he can’t be bothered, and I’m on my own” and at the interview, said, “My supervisor is busy with other things and it is probably not a priority for him anymore...I don’t know if it is going to feel worth my time to put in a lot of time on these and constantly just not get these published...that gets frustrating and I don’t really know if my supervisor will help me with that”.

### ***Discussion***

Research on supervision in the sciences has often described supervisor-student relationships as close apprenticeships with frequent contact and consistent support. However, these findings show that *meaningful* contact is relatively infrequent, suggesting science supervision may be in some respects more similar to the social sciences than sometimes assumed (Chiang, 2003; Cumming, 2009; Heath, 2002; Leonard et al., 2006;

Smeby, 2000). While, as in the social sciences, a science postgraduate's need for supervisory help may vary over the course of the degree (Pole et al., 1997), these findings show how it is the provision of help when needed at any point of a degree that is the most meaningful measure of the quality of supervision received. As in the social sciences, students seemed to most rely on, and need their supervisors at critical junctures, for instance, as institutional "gate-keepers" for key administrative issues or thesis approval (Jazvac-Martek, Chen, & McAlpine, 2011). As others have suggested not all science research groups are headed by supportive supervisors (Flores, 2011; McAlpine & Amundsen, 2015; Walford, 1983). Instead, as in the social sciences, problematic supervision is not uncommon, and is most frequently due to neglect and unavailability, rather than more overt problems or a breakdown in the relationship (McAlpine & McKinnon, 2013; McAlpine, Paulson, Gonsalves, & Jazvac-Martek, 2012).

That writing and administrative issues are particularly important elements of supervision corresponds with what others have found about supervision in the sciences and more generally (Jazvac-Martek et al., 2011; Maher, Feldon, Timmerman, & Chao, 2014). However, while it has been said that students in the sciences generally do not consult their supervisors for daily research problems (Maher, Gilmore, & Feldon, 2013; Smeby, 2000), an important variation emerged here. There were cases, especially within the uncertain outlook group, where students *did* request help on research challenges and these requests were often unfulfilled as their supervisors were unable to help or unavailable. These seemed to mark particularly difficult experiences and this issue is further discussed below.

### **3.7. Overall Discussion**

In summary, an examination of the cases shows that the three groupings of experiences are largely related to sets of academic work experiences and affordances. A close look here at career outlooks and outcomes, the initial rationale for the groupings, shows important differences in lived experiences and in eventual outlooks and outcomes which were in turn underpinned by a series of interconnected work affordances and/or challenges. While each case is unique in its own way, it seems that what defined positive outcomes, and to a lesser extent, positive outlooks, were good workplace

affordances in terms of few significant research difficulties, and help from supervisors when needed/wanted. This in turn afforded publications which were a sign of productive work and directly enabled careers, especially academic ones. Conversely, for those with uncertain outlooks, and occasionally for those with positive outlooks as well, there were more serious research difficulties, and they did not always receive help from supervisors when it was needed, often regarding these research difficulties. In part, as a result of these hindrances, or lack of affordances, these students also had fewer publications and less favourable career outlooks. This work supports the notion that while it is assumed that postgraduate degree completion can be credited to institutional or supervisory support, this is not always the case. Students may succeed *despite* hindrances they encounter through their own efforts and agency (McAlpine et al., 2012). This study reaffirms that we should not assume similar postgraduate experiences underlie successful degree completion or particular completion times. Additionally, in the larger project from which this study drew, it was found that “individuals felt able to handle the day-to-day relatively well and to cope with many existential ones [challenges], though structural ones, particularly, challenges related to their futures, seemed more intractable” (pp. 15) (McAlpine & Amundsen, 2015). This study shows that in fact, long-term sustained day-to-day challenges and struggles can have long-term costs in terms of career outcomes and outlooks, and may also contribute to structural challenges.

The cost of regular difficulties likely goes beyond the obvious limitation of career potential from low productivity/publications. It has also been noted that students do not look into, or have good knowledge of other career non-academic careers in the sciences and elsewhere until near the end of the degree or after graduation (Laursen, Thiry, & Loshbaugh, 2012; McAlpine et al., 2014; McAlpine & Amundsen, 2015; Thiry et al., 2015), and this seemed especially true for those in the uncertain outlook group. Storm, in the positive outcomes group provides some insight into how difficulties may relate to career outlooks and outcomes, noting that “the majority of my colleagues...they are just focusing on a single project. And then you can’t kind of broaden your horizons as much... of course, they are more determined they want to stay in academia. They didn’t explore other options”. Laursen et al. (2012) found that students often backgrounded career exploration in favour of completing degree requirements. Those with uncertain outlooks all reported feeling overwhelmed by their work, and dedicated significant time

and energy towards overcoming difficulties they faced and this may have limited their will and ability to explore and/or develop towards alternate careers. For Claude and Sam, these difficulties and lack of consonance with the values of their postgraduate work may have led them to redefine their goals and seek careers independent of their postgraduate work. For Funkymonkey difficulties he encountered seem to have inhibited his desire and ability to explore alternate careers outside of academia in the short-term.

It is significant that supervisors seemed rather unhelpful when students encountered serious difficulties with their research. While projects have been typically described as carefully and closely chosen in collaboration with students and actively supported and managed by science supervisors to ensure projects make consistent progress (Campbell, 2003; Delamont & Atkinson, 2001), this is evidently not always a feature of science postgraduate experiences. While postgraduates are ostensibly being trained, faculty members also need students to complete projects for their own research agendas and this can lead to situations where a supervisor's research needs take precedence over a student's educational needs (Thiry et al., 2015; Walford, 1981). Commensurate with the workplace learning perspective, the affordances available to different workers, even in the same workplace may differ (Billett, 2001). Those with uncertain outlooks consistently reported feeling isolated and low priority relative to peers, and seemed to need to spend more time and agency actively managing their relationship with their supervisors. This suggests the possibility that some supervisors may intentionally focus their attention only on projects that are succeeding. Maher et al. (2014) recount a supervisor's assertion that his students' work was a proxy for his own professional identity and that he would not want his name associated with substandard work. The experiences of Funkymonkey and Flora who had to return to the lab at their supervisor's behest to conduct further research after their dissertations were complete provide further examples of this notion. Given the differences in research project difficulties previously noted, this is especially troubling as it seems that students with difficult projects who are struggling may find themselves continually mired in challenging situations with relatively little support or alternate avenues.

### 3.7.1. Educational implications

Together, these findings emphasise the need for a greater shift in postgraduate educational practice towards the specific projects students are working on. As previously noted, policy and practice has often focused on top-down and formal considerations when considering postgraduate learning and employability instead of the “informal” and arguably predominant learning experiences of the science postgraduate (Craswell, 2007; Gilbert et al., 2004; Pole, 2000). These findings draw attention to the centrality of the individual student’s research project in structuring both learning and career outlooks and outcomes. As with the workplace learning perspective, all work has inherent pedagogical properties. Workers have the strongest development when they are afforded rich learning opportunities, but as suggested by workplace learning, not all students in the same workplace are afforded equal opportunities to engage in productive work. Working *only* in routine work, or overly difficult work, provides few opportunities to advance learning. Additionally, lacking sufficient supports with novel tasks which can be an opportunity to learn, can produce confusion which inhibits learning (Billett, 2001, 2002, 2004). These insights apply to the findings of this study in that the ability of postgraduates to pursue meaningful and productive work (i.e., free of significant challenges and with adequate supports) heavily influences their development.

In particular there is a need to challenge the narrative that science postgraduate work environments are inherently positive and supportive environments. These findings that affordances and experiences can differ radically, and some students may become unreasonably stuck on difficult and unproductive projects. Importantly, supervisory methods to mitigate risks, such as addressing unproductive projects by providing multiple manageable projects or changing projects if a project is going poorly, seem well known in the sciences (Campbell, 2003; Delamont & Atkinson, 2001). However, this study shows that this evidently doesn’t always occur and is not an *automatic* feature of the sciences as is sometimes depicted. This suggests a need for there to be clear standards and external oversight for projects and supervision to ensure that the students can engage in project work that is reasonably productive and which ultimately helps them meet their long-term goals.

Based on the findings of this study, it was seen that it is possible to some extent to extrapolate long-term outcomes and outlooks from daily work experiences, particularly over time. For those with uncertain outlooks and positive outcomes in particular, experiences, whether positive or negative, generally remained fairly consistent over time. These situations unfolded over several years of a degree, rather than suddenly, and it seems clear that early success helps support later success. In part, this may be due to the iterative nature of science work where successful projects are needed to build further successes during the PhD and for the post-graduation period (Laudel & Glaser, 2008). Students who are not afforded an early opportunity to produce work to build upon, and instead struggle with projects are simply not afforded the same opportunities to engage in publication and/or productive work. There is thus value in early identification and intervention when appropriate, to avoid situations where a student may become mired early and persistently in difficulty. One potential approach may be to use a system similar to the logs used in this study as a reporting tool to help identify students who have problematic projects or supervisory relationships to facilitate intervention. These could include number of publications, frequency of serious research difficulties, and times supervisory help was not received. Perhaps future studies could assess the validity of these metrics as well as identify new ones.

### **3.7.2. Theoretical implications**

The workplace learning perspective provided a powerful means with which to conceptualise and consider the interaction between individuals and their workplace, providing at least two main sets of insights. It firstly helped draw attention to the importance of the daily and routine elements of work participation and affordances, and, how students agentially navigated these structures. Secondly, workplace learning also helped draw attention to how students' agency and goals were both shaped by, and in turn shaped the work they chose to engage in.

This study provides further detail into how daily experiences contribute to students' views of possible career opportunities in the future (opportunity structures), and what they see as viable (horizons for action) (McAlpine et al., 2014). This expands on McAlpine & Emmioğlu (2014) who described how individual intentions for careers

changed over time, focusing on personal circumstances (e.g., relationships, moving locations for careers). This study further shows that what students see as possible can also be facilitated or inhibited by daily work participation, which can influence the ability to engage in preferred work, and in the long-term, positively or negatively affect the accumulation of work experience and productivity that supports particular long-term goals and/or careers.

### **3.8. Conclusion**

It is notable that SAY and Storm both use the term “luck” in referring to both research and supervision. SAY said, “You have to get lucky and have all of your experiments...published at the right time”. Similarly, as previously described, Storm said, “I can say I lucked out because I had a fantastic supervisor”. This research showed that while all students asserted their agency in either productively seizing upon work affordances or navigating the difficulties they faced, their career outcomes and outlooks were guided and shaped by their relative experiences. Broadly, there is a distinct need for policies and practices which can help ensure that all students are afforded similar supports and opportunities, and thus reduce the element of “luck” involved regarding where postgraduate work efforts are channelled and how productive these efforts are.

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## Chapter 4.

# Study Three: Exploring Disciplinary Variations in Postgraduate Research Projects, Practices, and Affordances within Psychology

### 4.1. Introduction

Improving postgraduate<sup>1</sup> education through empirical research is an area of current international interest and focus. Research and policy related to postgraduate education has often relied on taken-for-granted assumptions and there is a need for work which critically re-examines these assumptions (McAlpine & Amundsen, 2012). In particular, there has been insufficient research regarding student experiences and preferences that are grounded in the actual lived experiences and perspectives of postgraduates themselves (Craswell, 2007; Gilbert, Balatti, Turner, & Whitehouse, 2004; Leonard, Metcalfe, & Evans, 2006).

It can be said that there currently exists a common set of assumptions about postgraduate learning experiences for particular disciplines. These result in a simplified view of postgraduate experience that does not account for important variations in actual lived experiences *within* a discipline. Presently, a large proportion of research on postgraduate education is heavily focused on common disciplinary attributes, describing findings across broad disciplinary labels such as “Psychology”, “Education”, or “Chemistry” (Chiang, 2003; Stubb, 2012). Even larger disciplinary groupings and generalisations are also common, such as the “life sciences” (Sauermann & Roach, 2012), “sciences”, “humanities”, “social sciences” or “Psychology” (Gardner, 2010;

<sup>1</sup> The term “postgraduate” here refers to degree study after the undergraduate (i.e., master’s and doctoral study). The term “graduate” is also frequently used in North America.

Heath, 2002; Wiles, Durrant, De Broe, & Powell, 2009). These broad categorisations, however, conceal, and leave unquestioned a range and variety of experiences within them.

One particularly common distinction made in the literature on postgraduate learning is broadly between the hard/natural sciences (hereafter referred to as 'sciences'), and other areas which include the "soft" sciences, social sciences, and humanities (hereafter referred to as a whole as 'social sciences') (Leonard et al., 2006). A distinction is often made which describes the sciences as predominantly lab-based, and based on an apprenticeship model of training and supervision. Research projects are often described as a collaborative endeavour conducted with lab-mates (other postgraduates, postdoctoral fellows) and supervisors who share common goals and labour, along with significant informal contact and interactions. Lab-mates are also assumed to provide mentorship and guidance as the work progresses. By contrast, students in the social sciences are often thought to work on projects which do not overlap with their supervisors', and to work on their research projects largely independently. Instead of an apprenticeship, students in the social sciences tend to regard their supervisor as a mentor or a guide who is seen relatively infrequently and primarily in formal meetings. Their work is also not seen as involving close work with peers or colleagues. As a consequence, students in the social sciences have been reported to feel more isolated and less supported than their peers in the sciences (Chiang, 2003; Cumming, 2009; Golde & Dore, 2001; Leonard et al., 2006; Pyhältö, Stubb, & Lonka, 2009; Smeby, 2000). For example, Chiang (2003), in a typical study, describes the "teamwork" structure in Chemistry and contrasts it with the "individualist" structure in Education, describing those in the latter as feeling less supported and more isolated than the former. Similarly, Franke & Arvidsson (2011) describe two supervision styles. A "research practice-oriented" one where student and supervisors work on common research practices and have a close apprenticeship style relationship, and another which is "research relation-oriented" where there may more often be a lack of common research practice, and students work more independently. The majority of students in the former type of supervision context were from medicine and technology fields and the majority of the latter were from the social sciences and humanities. The accuracy of these generalities is important as each of these modes likely entails a

different definition of “good supervision” and commensurately likely requires different kinds of supports and policies (Chiang, 2003; Franke & Arvidsson, 2011).

While these broad groupings are useful and correct for many, there are strong reasons to believe that variations exist within a discipline, particularly for larger groupings like the “sciences” and “social sciences.” Indeed, those who study postgraduates, and disciplinary differences more generally, recognise that disciplines are not uniform and “monolithic” in terms of disciplinary attributes such as research practices and supervisory styles. However, this heterogeneity, while acknowledged, is not typically specifically examined. For instance, it is widely acknowledged that the “social sciences” in particular contain a wide range of disciplinary practices and contexts, but this broad disciplinary grouping is nonetheless commonly used without further qualification (Becher & Trowler, 2001; Flores, 2011; Gardner, 2010; Stubb, 2012). A clearer understanding of the accuracy of these broad generalisations is important, and should they be inaccurate, an understanding of when they apply or when they may not is needed.

One area where variations within a discipline have been previously documented is within the biological sciences. In particular, “field research” in Biology does not adhere to the typical science model (lab-based with apprenticeship-style supervision). Rather, it has been found from studies of individual lived experiences, that field research, relative to lab research, puts a much greater emphasis on independent work and improvisation given the need to work alone in the field without supervision (Bowen & Roth, 2007; Cumming, 2009; Roth & Bowen, 2001). In essence, the field sciences are, in many respects more similar to being “research relation-oriented” than “research practice-oriented” (Franke & Arvidsson, 2011). Biology has also been said to be particularly diverse in terms of epistemology and practice, emerging from the wide ranging phenomena it studies. Biology, however, is far from the only discipline which has this attribute (Becher & Trowler, 2001; Donald, 2002) and thus an examination of other, similarly diverse disciplines is likely to uncover other important variations.

This study aims to study the variations in practices and experiences within the discipline of Psychology. Psychology forms an ideal case to examine the variation within

a discipline since, as with Biology, it is often described as a singular discipline in research on postgraduates, but actually constitutes a diversity of research areas and practices including “a range of hard to soft subareas [and] range of pure to applied” (p.29). This can include cognitive or social phenomena more similar to “soft” areas, neurophysiological study more similar to “hard” areas, and even applied research such as clinical Psychology (Donald, 2002).

## **4.2. Research context**

This research was conducted with postgraduate participants in the United Kingdom (UK). In the UK, Master’s degrees are generally a year-long degree which can be research-focused with a thesis, or a taught degree which focuses more heavily on course work, typically with a project towards the end. Should students plan to pursue a doctoral degree, they typically transfer into a PhD from their master’s degree, and this is often done from a research-focused Master of Science degree. PhD degrees typically take three to four years to complete (Craswell, 2007; Gilbert et al., 2004; Quality Assurance Agency, 2004).

## **4.3. Research questions**

This study aims to inductively (re-)examine assumptions within the discipline of Psychology using particular lived experiences described in surveys and interviews in order to:

- Identify and categorize meaningful common experiences of workplace projects, practices, and contexts within the discipline of Psychology across multiple individuals.
- Determine if actual work engaged in is a better indicator of overall experience than established disciplinary-based assumptions or understandings by comparing our findings with established conceptions.
- Examine how the developed categorizations of projects, practices, and contexts relate to one another and student experiences more generally.
- Illustrate these through individual narrative accounts of these experiences.

## **4.4. Theoretical framework**

### **4.4.1. Disciplinary conceptions of Psychology**

Disciplines have often been described as academic “tribes” or “cultures” which share common epistemologies and research practices. Frequently, they are classified and examined along hard/soft and pure/applied dichotomies. In the first dichotomy, they are often divided into “hard” fields such as the natural or engineering sciences, or “soft” fields such as the social sciences and humanities, with the former being more concerned with atomistic, objective, and naturalistic phenomena, and the latter tending toward the more holistic and interpretive, often being human-centric. They are also commonly divided into “pure” and “applied” fields, with pure fields focused on the development of basic knowledge, and the latter being focused on pragmatic, complex, and professional questions. In turn, these result in different, and definable questions and modalities of inquiry. For instance, the hard fields such as the sciences often need collaboration given the large-scale of projects (Becher & Trowler, 2001; Biglan, 1973; Donald, 2002).

Psychology, typically categorised broadly as a social science, is often described in the research on postgraduates as a soft and pure/applied field (Gardner, 2010; Stubb, 2012). However, upon closer inspection, it is actually relatively difficult to cleanly classify. Emblematic of this, Psychology departments are included in Faculties of Sciences in some institutions, and in Faculties of Arts in other institutions. Psychology, while often concerned with phenomena in line with the soft sciences (e.g., human social phenomena), is also frequently described as sharing important similarities to the hard sciences, including some potential subjects of study (e.g., neurology). Relative to other social sciences (e.g., education, sociology), epistemologically, there is a predominance of the scientific method across the discipline of Psychology, valuing coherence, internal consistency, and empirical evidence (Berliner, 2006; Donald, 2002). Perhaps this is why, contrary to its frequent social or soft sciences label, research on postgraduate experiences in Psychology more often describe disciplinary features and practices that much more closely resemble the sciences. Namely, that psychology postgraduates work in close apprenticeships with their supervisors in a team-oriented research environment, and with similar realised outcomes as the sciences. For instance, Golde & Dore’s survey

(2001) describes the normative strategy in Psychology of selecting a supervisor prior to beginning a program, and providing the opportunity to “take progressively responsible roles in research projects” (p. 15) making it similar to many of the sciences surveyed (Golde & Dore, 2001). Gardner (2010) describes how as a discipline, Psychology has relatively low attrition rates, crediting this to mentorship from other students, an attribute often associated with the sciences. Another group of studies examined it under a larger category of “behavioural sciences”, encompassing educational sciences, Psychology, cognitive science, and speech sciences (Pyhältö et al., 2009; Stubb, Pyhältö, & Lonka, 2011; Vekkaila, Pyhältö, Hakkarainen, Keskinen, & Lonka, 2012; Vekkaila, Pyhältö, & Lonka, 2014). This work described, among other findings, that Psychology students were amongst the most highly likely to perceive themselves as members of a scholarly community at rates similar to Medicine (a science), in contrast to Education (a social science) which was the least likely of those surveyed (Pyhältö et al., 2009). Psychology also tends to be discussed in terms of its emphasis on quantitative research methodologies, which are also often associated with the sciences. Those within the field of Psychology themselves frequently discuss their field in terms of quantitative methodologies (Aiken, West, & Millsap, 2008; Belia, Fidler, Williams, & Cumming, 2005; Donald, 2002). Wiles et al. (2009) described how in their survey of postgraduates, Psychology, had 56% who reported using quantitative methods in their daily work as opposed to 23% for the social sciences surveyed as a whole.

Embedded within Psychology, however, are other traditions which are known to be quite different from the sciences in terms of research subjects and/or practices, but are less described in research on postgraduates and disciplines more generally. Distinctive differences, for instance, exist between experimental psychologists who tend to more closely follow scientific traditions, and applied/professional psychologists who often have different sets of practices more similar to the humanities and social sciences in general (Berliner, 2006; Donald, 2002). Methodologically, as well, there is an important minority who emphasise qualitative research practices. There has been a longstanding effort to increase the use and status of qualitative and case-based methodologies in applied areas of Psychology, such as within educational Psychology (Berliner, 2006). Wiles et al. (2009)’s survey found 19% of Psychology postgraduates used primarily qualitative methods in contrast to 56% for the social sciences surveyed as

a whole. This research thus seeks to explore the possibility of categorising and identifying subgroups based on this known variation, and uncovering the extent to which subgroups within Psychology do, or do not fit existing conceptions or the common exceptions outlined.

#### **4.4.2. Workplace Learning and projects**

Research on postgraduate experiences have frequently been based on a socialisation framework (Weidman, Twale, & Stein, 2001), studying the enculturation of postgraduates into disciplinary cultures and norms (Delamont & Atkinson, 2001; Hakala, 2009; Laursen, Thiry, & Loshbaugh, 2012). Much of the aforementioned research on disciplinary differences draws upon this perspective, and research about postgraduates generally, as previously noted, has typically focused on identifying broad “norms” across and within disciplines. A focus on structure, characteristic of a socialisation framework, however, tends to background variations within a given context and is less well-suited to understanding cases which deviate from the larger norm. To better understand these variations, as in the aforementioned work in the biological sciences, there is a need to form an inductive understanding of particular experiences within a discipline without prior assumptions and grounded in individual experience (Cumming, 2009). This study draws from the workplace learning perspective to accomplish this.

This research takes the perspective that postgraduate education and learning is a process of *workplace learning*. In this view, there is no meaningful difference between work and learning, as workplace tasks guide learning needs and practice, and even routine work and tasks can serve to reinforce learning. Further, neither individuals nor structure wholly account for differences in workplace learning, and variations in both individual preferences and work engagement, as well as in affordances to particular individuals within a workplace are essential for understanding the range of experiences in a workplace (Billett, 2001, 2004, 2006). Workplace learning is particularly well-suited towards understanding postgraduate experiences since postgraduates, despite their “student” status, typically engage in authentic academic work, including research (Boud & Lee, 2005). Workplace learning has been previously used as a framework to study the localities where postgraduate research is conducted (e.g., a lab or office) (McAlpine &

Mitra, 2015), postgraduate learning through journal writing (Hopwood, 2010), and science postgraduates more generally (Hum, 2015).

Importantly, research has shown that students themselves identify so-called “informal” elements of the degree such as in authentic work and research projects (e.g., thesis work) as the primary means through which they learn, rather than the formal elements of the degree such as coursework (Craswell, 2007; Cumming, 2009; Gilbert et al., 2004; Pole, 2000; Raddon, 2011). In large part, particularly in the sciences, this is because students tend to direct their primary efforts towards learning the disciplinary and technical skills needed to address immediate challenges and tasks related to research project work (Laursen et al., 2012; Pole, 2000; Pritchard, MacKenzie, & Cusack, 2009). Coursework is frequently not sufficiently related to a student’s project needs to be effective (Flores, 2011; Moley & Wiles, 2011; Wagner, Garner, & Kawulich, 2011). Thus, understanding postgraduate learning through research work project engagement provides a way to conceptualise and contextualise the range of activities which play a role in a postgraduate students’ work engagement and learning (Hopwood, 2010; Hum, 2015; McAlpine & Mitra, 2015).

This study proposes that variations within a discipline can be better understood by closely examining variations in research project work. More specifically, variations within the discipline of Psychology are examined here in terms of the research project work students engage in, which are theorised to then relate to sets of research practices (e.g., quantitative, technical), and affordances (e.g., supervisory help, relationship with other lab members).

#### **4.4.3. Statistical approach**

A large proportion of the work that has supported current conceptions of the sciences and social sciences has been survey based (Chiang, 2003; Golde & Dore, 2001; Heath, 2002; Pyhältö et al., 2009). By their nature, most common statistical methods frequently assume and describe a common and fixed reality over many individuals, usually across entire sampled groups. However, not all methodologies make this assumption (Elliott, 2005). It is for this reason that principal component analysis, an

exploratory technique which inductively assembles data into similar clusters, rather than requiring fixed assumptions about their organisation (Fabrigar, Wegener, MacCallum, & Strahan, 1999) was used in this study. In essence, this allows student survey responses to be categorised into similar sets of experiences without prior assumptions on the exact structure of the data to identify potentially meaningful sets of projects, practices, and affordances. The additional subsequent use of qualitative interviews in this study to supplement the quantitative analysis also provides us with essential further understanding of the underlying relationships and meaning of the quantitative data (Elliott, 2005).

## **4.5. Methods**

### **4.5.1. Data collection**

A survey questionnaire was created to gather postgraduate students' perceived research practices and experiences. The items of relevance to this study were questions on demographics (e.g., age, coursework), description of the main (e.g., thesis) research project, research work practices, and research work affordances, and some related additional items (see *results* for specific questions). The questionnaire also included other questions not used in this analysis. The questionnaire was drafted by the first author based on earlier studies (Hum, 2015), a review of literature, and personal familiarity with research work and postgraduate experiences. This survey was then piloted and revised multiple times with Canadian students and researchers familiar with the subject matter and included: two PhD students and one professor from the Learning Sciences, one professor from Education, two PhD students from Educational Psychology, and two PhD students from Psychology.

Participants were recruited from Psychology programs in universities across Southeast England. Six Psychology programs agreed to forward the invitation to participate in the questionnaire. In total, 36 completed surveys were returned.

A final question on the survey asked participants if they were willing to be identified and interviewed about their responses (by providing an e-mail address). In

total, eight participants from two institutions agreed to be interviewed. A semi-structured interview was conducted, focusing on probing more deeply into a participant's questionnaire responses to develop a deeper understanding of the trends and lived experiences behind the questionnaire responses.

#### **4.5.2. Questionnaire analysis**

The questionnaire items of interest in this study were first analysed statistically. In the first phase of analysis, where appropriate, items were first converted to numerical equivalents beginning with '1' (e.g., not at all=1 a little=2 somewhat=3...). Following this, three principal component analyses were used to create variable aggregates for three sections of the survey concerning research projects, research practices, and research work affordances. Items within each section were first correlated to one another and items which correlated to no other items were excluded from further analysis. The Kaiser-Mayer-Olkin (KMO) index was then used to determine suitability of principal components analysis for each section on the remaining variables which all met the criterion of  $KMO > 0.5$ . The number of factors to extract was determined by examining the Scree plot. A Varimax rotation was subsequently applied and factor loadings with a value  $> |0.3|$  were examined. Using the item factor loadings at the 0.3 threshold and an examination of interview transcripts (see following), factors were named and defined. Following this, the Bartlett method was used for the calculation of individual factor scores for each participant. Spearman correlations were then used to examine the ordinal relationship between the factor scores and other items as detailed subsequently.

Interviews were audio recorded and transcribed. Using the factor scores across all 36 questionnaires, the top third of factor scores for each factor were used to identify four interviews which represented high scores on the four project description factors (see below). These interviews were then examined in order to contextualise the survey responses.

## 4.6. Results and Discussion

The results and discussion are divided into three sections. The first presents the demographics of the participants, the second provides the three sets of factor structures and labels along with a brief discussion of each individual set of factors, and the third examines the factors in the context of relationships uncovered using Spearman correlations and the qualitative interview data.

### 4.6.1. Questionnaire demographics

The category of institution and number of participants from each of the universities studied are in Table 1. Russell Group universities are an alliance of 24 highly ranked UK public research institutions. Old Universities refer to universities not included in the Russell group that were founded prior to 1992 and typically have a significant focus on research. Post-1992 universities are commonly former Polytechnics that were expanded and given university status after 1992 and tend to emphasize both teaching and research.

**Table 1. Universities studied.**

<b>Institution</b>	<b># Participants</b>
Old University A	8
Russell Group A	13
Russell Group B	1
Post-1992 A	9
Old University B	2
Post-1992 B	3

**Table 2. Demographics of questionnaire participants.**

		Mean	Median	Minimum	Maximum
Age	Masters	29.4	30.0	21.0	44.0
	PhD	38.0	35.0	26.0	58.0
Months enrolled in postgraduate studies	Masters	7.2	4.0	1.0	39.0
	PhD	25.0	15.0	2.0	76.0
Completed Research Methodology Courses	Masters	2.6	2.0	0.0	6.0
	PhD	4.9	4.0	1.0	15.0

n=36

Further demographics are provided in Table 2. In addition to these, it was also found that: 26 participants (72.2%) were female and 10 (27.8%) were male, 25 (69.4%) were masters students and 11 (30.6%) PhD students. Twenty-four (66.7%) described themselves as in research-focused degrees and 12 (33.3%) in primarily course-focused degrees. Thirty-three (91.67%) were currently working on a research project and all anticipated working on at least one research project before completing their degrees. These demographics were used to test the factor scores as detailed in the subsequent discussion of the factors.

#### **4.6.2. Factors**

##### ***Factor set one: Research project description***

This first set of factors sought to understand how participants perceived the attributes of their research projects based on subjects and emphases within Psychology. Participants were asked: To what degree do the following describe the research project(s) which you are currently, most recently, or will be primarily involved in and/or focused on? Response categories were: not at all, a little, somewhat, very much, completely. Four factors that accounted for 77.1% of the total variance were extracted.

**Table 3. Research project description.**

Item	Factor			
	1	2	3	4
Detailed description and/or analysis within specific individual contexts and/or cases	0.80			0.31
Application, applicability and/or policy/practitioner use	0.76			
Individual cognitive and/or mental phenomena and/or data		0.85		
Physiological, neurological, and/or behavioural phenomena and/or data	-0.38	0.80		
Developing, testing, an/or refining (a) theoretical idea(s), conception(s), framework(s), and/or explanations			0.85	
Generalizable and replicable findings which apply widely to a large population and/or contexts	-0.45		0.68	
Group, social or cultural phenomena and/or data				0.96

Only factor loadings > 0.3 or < -0.3 are displayed

Based on the loadings, factors were labelled:

- Factor 1: Case based and application oriented (case-application)
- Factor 2: Cognitive and physiological (cognitive-physiological)
- Factor 3: Theoretical and generalizable (theory-generalise)
- Factor 4: Social and case/context (social-case)

Factors 1 and 3 seem to relate most strongly to the intent of research (i.e., applied or basic research respectively) whereas factors 2 and 4 seem to relate most strongly to the subject of study, whether at the low-level of cognitive or physiological data, or, data relating to higher-order data involving social or cultural data in specific contexts or cases. As shown subsequently, it is this latter set of factors relating to the subject of study (factors 2 and 4), which are most related to sets of affordances and practices. These factors broadly show, as suggested by the literature, that Psychology postgraduates have a range of intentions and subjects of study which are definable and separable, ranging from those most similar to the scientific (factors 2 and 3) to the applied and social (factors 1 and 4) (Berliner, 2006; Donald, 2002).

### ***Factor set two: Research work practices***

This second set of factors sought to examine research practices related to skills and methodologies commonly used in Psychological research. Participants were asked: For the research work that you are currently and/or most recently engaged in, how frequently do you use the following categories of skills/knowledge? Response categories were: rarely, less than yearly, yearly, every 6-11 months, every 2-3 months, monthly, weekly, daily. Three factors that accounted for 80.8% of the total variance were extracted.

**Table 4. Research work practices.**

Item	Factor		
	1	2	3
Other software/computer skills not included in data analysis/design	0.88		
Quantitative data analysis	0.84		
Quantitative data design	0.79		
Qualitative data design		0.96	
Qualitative data analysis		0.87	
Fieldwork and assessment skills			0.85
Technical and lab skills	0.36		0.82

Only factor loadings > 0.3 or < -0.3 are displayed

Based on the loadings, factors were labelled:

- Factor 1: Quantitative-frequency
- Factor 2: Qualitative-frequency
- Factor 3: Other skills-frequency

That quantitative and qualitative items cleanly separated into two separate factors shows the presence of at least two definably different and separable methodological practices. Indeed, postgraduates, and academic researchers more generally, commonly select between and focus on one set of these methodologies (Moley & Wiles, 2011; Wiles et al., 2009). Interestingly, both technical and lab skills as well as “other” software/computer skills not included in data analysis/design loaded onto the quantitative-frequency factor but not the qualitative-frequency factor. This may be due to quantitative-research more frequently using “scientific” tools which require specialised software and skills. As described subsequently, two of the interview participants who engaged in quantitative research used brain imaging software to extract and interpret data from brain scanners.

### ***Factor set three: Research work affordances***

This third set of factors sought to examine the work affordances that postgraduates, particularly in the sciences, are reported to typically receive. Participants were asked: To what extent do the following statements generally apply to your experiences within your primarily research group and/or supervisory relationship? Response categories were: not applicable, strongly disagree, disagree, neither agree nor disagree, agree, strongly agree. Three factors that accounted for 71.38% of the total variance were extracted.

**Table 5. Research work affordances.**

Item	Factor		
	1	2	3
I often get useful advice from others (aside from my supervisor) within my research group	0.91		
I work closely with other members of my research group (aside from my supervisor)	0.86		
I have a friendly relationship with other members (not including supervisor) of my research group	0.52		
My supervisor personally participates in the day to day research work and activities of the research group		0.82	
I work closely with my supervisor		0.81	
I often get useful advice from my supervisor		0.71	
I am/was mentored, supported, and/or taught by more senior members of my research group (not including my supervisor)			0.95
I mentor, support, and/or teach more junior members of the research group			0.44

Only factor loadings > 0.3 or < -0.3 are displayed

Based on the loadings, the factors were labelled:

- Factor 1: Teamwork
- Factor 2: Supervisor
- Factor 3: Mentorship

Each of these sets of affordances are typically associated with practices in the sciences. As shown by the emergence of factors, however, and subsequent analyses, these practices independently vary in the degree to which they apply to particular postgraduate experiences within Psychology. The emergence of teamwork and mentorship as separate factors is particularly notable. Studies on the sciences have described that lab-mates, including other students and postdoctoral fellows are co-workers who often collaborate and offer assistance to one another, providing advice and moral support (Delamont & Atkinson, 2001; Gardner, 2010; Heath, 2002; Kemp, Molloy, Pajic, & Chapman, 2013; Pole, Sprokkereef, Burgess, & Lakin, 1997; Smeby, 2000). This is typically described in common with the practice of having more senior students or postdocs supervising, training, and mentoring newer students, often being the primary source of advice, rather than the supervisor (Delamont & Atkinson, 2001; Golde, 2005; Kemp et al., 2013; Vekkaila et al., 2012; Walford, 1981). The emergence of these practices as separate factors suggests that working in collaboration (teamwork) and the direct mentorship of newer lab-members are different sets of affordances which do not always co-occur and should be differentiated. This supports the same observation made in Hum (2015).

### ***Testing the factors***

Given the small and heterogeneous nature of the sample, t-tests were used to compare the mean differences in factor scores for each of the identified factors for three subgroups to determine if there were any large systematic differences in responses between them. The three subgroups tested were between PhD and Masters students, research-focused and course-focused degrees, and post-1992 universities versus research focused universities (Old Universities and Russell Group) for each of the seven factor scores (21 comparisons total). Only two out of thirty comparisons were significant at the  $p=0.05$  level. Both significant comparisons were between the post-1992 and

research university comparisons. The first was on the social-case factor scores ( $t=-2.905$ ;  $df=34$ ;  $p=0.006$ ) with post-1992 universities scoring more highly than the other groups. The second was on the quantitative-frequency factor scores ( $t=2.456$ ;  $df=34$ ;  $p=0.019$ ). Given that the overwhelming majority of comparisons were non-significant, there are no clear indications of a large scale systematic bias in survey responses between subgroups.

### **4.6.3. Examining the factors in context**

Spearman correlations were used to examine the relationship between project descriptions and other items/variables to understand how particular “kinds” of projects might relate to specific sets of practices and affordances. Project descriptions are the central focus for two reasons based on the theoretical framework: firstly the workplace learning perspective suggests that it is the nature of work participated in that shapes interactions and affordances (Billett, 2001, 2004, 2006); and secondly, that it is the nature of disciplinary inquiry that influences and shapes disciplinary practices (Becher & Trowler, 2001; Biglan, 1973; Donald, 2002). This section begins with a presentation of the correlations, followed by discussions of these within the context of each of the four identified project descriptions (i.e., case-application, cognitive-physiological, theory-generalise, and social-case). Within each of these four project descriptions, qualitative data from each of the four identified interviews are compared to the correlational findings.

Spearman correlations ( $\rho$ ) were used to explore the ordinal relationships between the project description factors (factor set one), the research practice factors (factor set two), and research workplace affordance factors (factor set three) (Table 6). Project descriptions (factor set one) were then compared to four additional individual items from the survey which relate to stated differences between the sciences and social sciences (Table 7).

The four additional survey items analysed in Table 7 are as follows and their abbreviated item names are given within the [ ]:

1. What research methods are you using, or plan to use, in your own thesis research? [thesis methods]
2. My current, or anticipated thesis work closely relates in topic to other research project(s) in my research group (including those of my supervisor). [topic similarity]
3. I am satisfied with my supervisory relationship. [supervision satisfaction]
4. I am satisfied with research group as a community [research group satisfaction]

Question 1's response options were: Quantitative only, mostly quantitative with some qualitative, qualitative and quantitative equally, mostly qualitative with some quantitative, qualitative only. In this case "quantitative only" was coded '5' with numbers descending to qualitative, coded '1'. Thus positive correlations with this item indicate an association with quantitative projects and negative correlations indicate an association with qualitative.

Questions 2-4 each had the response options: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree. Spearman correlations between the factor scores and these three items were done and given in Table 7.

As above, to rule out large scale differences on these items in terms of the demographic categories described earlier, t-tests were used to compare mean differences on these items on three subgroups: between PhD and Masters students, research-focused and course-focused degrees, and post-1992 universities versus research focused universities (Old Universities and Russell Group). None of these comparisons were significant at the  $p=0.05$  level.

**Table 6. Spearman correlations between project factors and research practice/workplace affordance factors.**

		Research Practice Factors			Research Work Affordance Factors		
		Quantitative-frequency	Qualitative-frequency	Other skills-frequency	Teamwork	Supervisor	Mentorship
<b>Case-application</b>	Spearman $\rho$	-.081	<b>.382</b>	.183	-.006	-.028	.054
	p	.638	<b>.021</b>	.285	.970	.870	.755
<b>Theory-generalise</b>	Spearman $\rho$	.012	<b>-.349</b>	.190	.023	.064	.057
	p	.943	<b>.037</b>	.268	.896	.709	.740
<b>Social-case</b>	Spearman $\rho$	<b>-.379</b>	.203	-.072	<b>-.333</b>	<b>-.338</b>	.245
	p	<b>.023</b>	.235	.675	<b>.047</b>	<b>.044</b>	.150
<b>Cognitive-physiological</b>	Spearman $\rho$	.247	<b>-.381</b>	<b>.383</b>	<b>.483</b>	-.076	.212
	p	.146	<b>.022</b>	<b>.021</b>	<b>.003</b>	.658	.214

n=36; values significant at p=0.05 level are in bold

**Table 7. Spearman correlations between project factors and additional items.**

		Thesis methods	Topic similarity	Supervision satisfaction	Research group satisfaction
<b>Cognitive- physiological</b>	Spearman $\rho$	<b>.504**</b>	<b>.34</b>	.02	.17
	p	<b>&lt; .01</b>	<b>.05</b>	.92	.39
	n	<b>36</b>	<b>33</b>	36	28
<b>Social-case</b>	Spearman $\rho$	-.27	-.33	<b>-.37</b>	<b>-.63</b>
	p	.11	.06	<b>.03</b>	<b>&lt;.0001</b>
	n	36	33	<b>36</b>	<b>28</b>
<b>Theory- generalise</b>	Spearman $\rho$	.22	-.05	-.07	-.02
	p	.19	.78	.73	.93
	n	36	36	28	33
<b>Case- application</b>	Spearman $\rho$	<b>-.429**</b>	.03	-.05	.11
	p	<b>.01</b>	.87	.80	.53
	n	<b>36</b>	36	28	33

values significant at  $p=0.05$  level are in **bold**

The factors relating to the intent of the research (case-application and theory-generalise) have fewer correlations than the factors relating to the subject of research (cognitive-physiological and social-case), suggesting the latter is a more reliable method of categorising sets of affordances and practices than the former. These latter two, cognitive-physiological and social-case are especially meaningful given their apparent link to both the subjects as well as different sets of practices and affordances often attributed to the sciences and the social-sciences respectively, as illustrated subsequently. The factors relating to intent are discussed first, followed by the factors relating to subject of study below. Each section begins with a general discussion of the significant correlations and relationship with established conceptions of science and social science research areas, followed by qualitative illustrations from particular interview cases who scored highly on a given project description factor.

### ***Case based and application oriented (case-application)***

The positive correlation between case-application and the qualitative-frequency factor (Table 6) as well as qualitative thesis methods (Table 7) match with what has been observed for soft-applied fields. Namely that they tend to use case-based methodologies as they are well suited to understanding contextualised and/or professional practice (Becher & Trowler, 2001). This type of research has been previously noted to exist as an important minority within Psychology (Berliner, 2006; Donald, 2002).

An interviewed participant, "A", scored highly on this factor, and is a strong match for these relationships. A was studying for a doctorate in cognitive Psychology and technology. A's research was exploratory, using interviews to better understand how individuals remember to perform an important task. The anticipated outcome of this project was to provide design suggestions on how to build a technology to support this. A has professional goals and would like "to work in a research institute like in Microsoft".

### ***Theoretical and generalizable (theory-generalise)***

The negative correlation between theory-generalise and qualitative frequency (Table 6) corresponds with the lesser emphasis on generalisation within qualitative

research (as opposed to quantitative methods). This conception generally matches how Psychology is often described in terms of its scientifically influenced epistemology (Donald, 2002). The lack of a positive correlation between quantitative methods and theory-generalise is somewhat unexpected, however. This either suggests that not all quantitatively-oriented participants saw their work as generalisable, as might be expected, or, alternately, that this factor requires further refinement.

An interviewed participant, “B”, scored highly on this factor, while scoring low on qualitative frequency, fitting what this factor seems to capture. B is studying for a doctorate in “cognitive neuroscience”, using brain scanning technology to understand how human brain activity corresponds to sensory perception. In contrast to A, this participant’s work is *not* qualitative, exploratory or applied, but aims to contribute to scientific theory. B describes the appeal and focus of this work: “you can get a really nice well-defined problem... design a really elegant experiment which asks a question [and then] you have enough information from that to then rule out several other options of how the brain works”.

### ***Cognitive and physiological (cognitive-physiological)***

The cognitive-physiological project description most resembles the sciences and the commonly described conception of Psychology in terms of the subject of study, as well as resulting research work affordances and practices. Its subject, emphasising the human brain and physiology, in contrast to social-case, is arguably a more “scientific” focus. Commensurately, other relationships also resemble the sciences and current conceptions of the sciences. The correlations with other factors (Table 6) show positive correlations with “other skills” which include technical skills and teamwork work affordances. This emphasis on technical and craft skills as well as teamwork are commonly described in the experiences of postgraduates within the sciences. The negative correlation with qualitative methods similarly reflects the sciences’ lesser emphasis on these methodologies. The correlations with individual items (Table 7) show a propensity to use thesis methods which are quantitative, and to investigate a research topic similar to other research projects within one’s research group. This emphasis on teamwork and common work, as opposed to a more individualistic orientation to research, is a commonly described feature of the sciences (Becher & Trowler, 2001;

Cumming, 2009; Delamont & Atkinson, 2001; Leonard et al., 2006; Smeby, 2000). This resemblance to the sciences may have emerged from the common need between cognitive-physiological psychological research and traditional 'scientific' research to share instrumentation and common space (Becher & Trowler, 2001; McAlpine & Mitra, 2015). In these environments, students may also necessarily have to work with others to share expertise and/or labour with costly and complex instruments, and work together to accomplish specific research tasks, affording common work and collaboration (Flores, 2011; Heath, 2002; Kemp et al., 2013; Maher, Gilmore, & Feldon, 2013). This trend has also been observed as a feature of quantitative research more generally (Henson, Hull, & Williams, 2010).

Exemplifying this is interview participant "C". C was studying for a doctorate in "basic neuroscience" and described research work fitting the overall pattern described here. C used costly brain scanning instrumentation to understand how brain activity corresponds to sensory perception in order to inform scientific theory, much like B (who also scored highly on this factor). C described choosing this research focus in a manner consistent with scientific epistemology, saying how "I kind of liked the scope of the lab... I like that line of research... I thought these are the most rigorous methods". C also notes that he does not use qualitative methods, and uses quantitative methods exclusively. Further, in line with the observed correlations, and conceptions of scientific practices, C's supervisor is aware of, and advises the projects C works on, which are described by C as contributing to the lab as a whole. Namely, C regularly consults his supervisor to set up individual experiments "within the general realms of what the lab covers" and he values that he "can come up with an idea... there's room for that and it'll help the overall productivity of the lab". There are twelve members of his lab which include other postgraduates and postdoctoral fellows. In line with the correlation with teamwork, C describes how he sometimes collaborates on projects with lab-mates and "started working quite closely with one of the postdocs". He describes "finding my interests and overlap between my interests and the interests of other people".

While there were no correlations with the "supervisor" research work affordance factor in this analysis for this project type, C qualitatively described the kind of regular and informal contact with his supervisor that is often attributed to the sciences (Chiang,

2003; Smeby, 2000). As he describes, this is often in a “lab meeting each week... a hang out together time and quite jokey and informal”. C also described times when his supervisor worked with him in a manner similar to the described close apprenticeship style often attributed to the sciences (Cumming, 2009; Franke & Arvidsson, 2011; Leonard et al., 2006). C described how his supervisor “is quite good in reacting to requests if I have a question or if I think I need help with a decision”. Additionally, when he began his postgraduate, his supervisor “was helpful with getting me into [programming computers]... sitting down with me physically for like an hour”.

Similarly, while there were no correlations with the mentorship workplace affordance factor, B described instances of mentorship by other lab-mates as has been described within the sciences (Delamont & Atkinson, 2001; Golde, 2005; Kemp et al., 2013; Vekkaila et al., 2012; Walford, 1981). C described how “one postdoc [I collaborate with] shares [programming] code he’s much more experienced than I am” and that “also the group as a whole can be very helpful when you come across technical issues and problems... we have a lab wiki... and we use the group e-mail list.”

### ***Social and case/context (social-case)***

The social-case project description much more closely resembles what has been described for the social sciences and humanities rather than for Psychology and/or the Sciences. Firstly, its subject of study, emphasising social phenomena and specific cases most resembles the interest of the social sciences and humanities. Following from this are further similarities in terms of research work affordances and practices. The *negative* correlations with quantitative frequency, working closely with their supervisors, and teamwork all match how the social sciences as well as the humanities are often described in research on postgraduates. The negative correlations with both supervisory and research group satisfaction (Table 7) similarly fit with commonly described findings in these areas (Chiang, 2003; Leonard et al., 2006; Pyhältö et al., 2009). For instance, these fit with Pyhältö et al. (2009)’s description of the relatively isolated experiences of those in Education, more so than the more collaborative environment described for the “behavioural sciences” which included Psychology.

Scoring highly on this factor was “D”, who shares the relationships noted above. D was studying for a master’s in Psychology and intending to go on to a doctorate in clinical Psychology. D’s work was centred on social phenomena and individual cases, using interviews with students to understand how their conceptions-of-self developed and changed as they were transitioning to a new culture.

D described work affordances that align with the negative correlations described above, and the relatively independent and sometimes isolating experiences of those in the social sciences and humanities. In contrast to C, D does not get significant supervisory or team help. As is common in the social sciences, D has no lab or peer research group, and is “mainly in a relationship with my supervisor...” who does not share common projects, work, or significant expertise. D described how from the outset of the supervisory relationship: “when I presented my ideas to her she said: yeah, really interesting really good. You’re on your own with finding your participants! [laughs] ... I have the general experience and knowledge to this but it’s your group, not my specific group [of study].” In contrast to the closer support received by C, and more like the supervision described in the social sciences, D receives limited direct supervisory guidance, saying “my supervisor has sent me away to read on qualitative... but it doesn’t help you with the actual construction with the formulation of the questions for what you’re doing”. Notably D does not see her supervisor as necessarily more knowledgeable, or learning directly from her, noting that while she “has been really useful... people see things differently and there’s been a number of things where she’s said I don’t see things this way and I need to go back and think through how I’ve seen it and see whether I’m wrong whether she’s wrong whether I’m right... whether I’ve misunderstood there’s some sort of misunderstanding. Whether there’s some sort of middle ground.” Finally, as is often described in the social sciences and humanities, contact with her supervisor was relatively infrequent, saying that “I probably see her every couple of weeks” (Chiang, 2003; Franke & Arvidsson, 2011).

## **4.7. Theoretical Implications**

Broadly, the workplace learning perspective (Billett, 2001, 2004, 2006) was a useful way to both conceptualise and study postgraduate experiences as well as

variations within a discipline by focusing on the importance of work engagement for postgraduate learning (Hopwood, 2010; Hum, 2015). This study extends earlier work by contextualising work engagement within practices associated with particular disciplines (Becher & Trowler, 2001; Donald, 2002). By taking these together it can be seen that work engaged in can vary significantly and also systematically within a discipline, and these in turn relate to particular sets of affordances and practices. Specifically, when the subject of study more closely resembles those of “another” or particular discipline, the resulting practices will likely resemble that discipline more than the wider disciplinary label.

The definable factors and relationships here show that there are at least two definable traditions within Psychology which are separable first by the subject of work projects engaged in (project description), and in turn, are related to specific and separable work affordances and practices. Together, this contradicts the generalisation of Psychology as a quantitative, highly supportive, and teamwork based discipline similar to the sciences as has been frequently described in the literature on postgraduate experiences. While this conception is fairly accurate for those engaged in cognitive-physiological projects, this did not describe the typical experiences for those engaged in social-case projects. Those in social-case projects, instead, engaged in practices and with workplace affordances typically described by postgraduate research on the social sciences and humanities (Chiang, 2003; Leonard et al., 2006). This supports the need for focused study on these variations within disciplines, which while frequently acknowledged, are not usually specifically studied (Becher & Trowler, 2001; Donald, 2002).

From a research perspective, this study showed how the examination of subgroups can provide more accurate general descriptions of practices within a discipline. As outlined above, a generalised view of Psychology has emerged that does not represent the important minority represented by those engaged in case-applied and social-case projects (and perhaps other traditions not identified here). This may have occurred because some kinds of projects (cognitive-physiological) are more common across the discipline and therefore are often “diluted out” of research on postgraduate experiences. This work shows that instead of assuming disciplines to be wholes, it may

be helpful to instead focus first on the nature of projects engaged in, instead of focusing on wider disciplinary labels. This is especially likely to extend to other disciplines which are by nature, often interdisciplinary, such as Education, and may become increasingly common given the increasing conduct of interdisciplinary or transdisciplinary research, which truly blurs disciplinary boundaries (Becher & Trowler, 2001; Eisenhart & DeHaan, 2005; Sung et al., 2003).

This study provides a methodological framework for better differentiating sets of practices and affordances within a discipline, and this can especially help with increasing the accuracy of large surveys (Golde & Dore, 2001; Pyhältö et al., 2009) for important subgroups. Specifically, by first quantitatively and inductively identifying meaningful subgroups within a discipline using techniques such as principal components analysis or factor analysis, relationships and general statements about common or average experiences can be made more accurate for those subgroups, rather than assuming and describing uniformity of trends across the group at the outset.

#### **4.8. Educational implications**

Differences in knowledge structures, research organisation, and supervisory styles mean that one cannot treat all disciplines the same in terms of policy and practice (Chiang, 2003; Franke & Arvidsson, 2011). Given the findings here, it could be said that this is true within disciplines as well. Specifically, since project descriptions were closely associated with frequency of use (or lack thereof) of particular methodologies (Table 6) or with the methods actually used for one's own dissertation (Table 7), it is clear that the actual learning students engage in is heavily associated with research projects, and not merely formal degree elements, such as coursework. The strong influence of so-called "informal" and authentic elements of the degree (i.e., research project work) supports the notion that it is important to shift the focus away from top-down formal training such as coursework (Collinson & Hockey, 1997; Hopwood, 2010; Pole, 2000) and aim to better support postgraduate learning through a careful consideration of the actual practices students engage in (Craswell, 2007; Cumming et al., 2009). Further, that any formal training that does occur should be adapted and adaptable to a specific student's learning

needs and goals (Moley & Wiles, 2011; Pole, 2000; Wiles et al., 2009) as indicated by research projects engaged in.

The importance of authentic work also emphasises the importance of providing structured opportunities to engage in specific kinds of work, or, a variety of work through experiential learning such as internships (Eisenhart & DeHaan, 2005; Henson et al., 2010; Sung et al., 2003) to meet particular postgraduate learning goals. Specifically, should the goal be methodological and/or disciplinary depth for particular in-demand methodologies (often quantitative) as some have called for (Henson et al., 2010; Pole, 2000; Wiles et al., 2009), ample opportunities should be provided to engage in authentic project work within that tradition. Conversely, should the goal be for greater methodological diversity and/or inter-disciplinarity (Eisenhart & DeHaan, 2005; Pallas, 2001; Sung et al., 2003), then a range of projects should be intentionally chosen. Stated simply, the pedagogical properties of research projects, including the thesis or dissertation, should be considered relative to the intended learning goals for a particular postgraduate student and/or program.

That mentorship and supervision did not positively correlate with any of the project types, including the relatively scientific cognitive-physiological projects underscores the notion that even in scientific workplaces, supportive supervision and/or mentorship from senior lab members is not an automatic feature of science, or science-like environments (Flores, 2011; Maher et al., 2013; McAlpine & Mitra, 2015) as is often assumed (Campbell, 2003; Delamont & Atkinson, 2001; Smeby, 2000). While the qualitative data showed that mentorship and close supervision does occur in specific cases (such as the experiences of “C”), the quantitative data suggests that there are many cases where this does not occur, though it is an expected feature of these environments. This highlights the importance of an intentional approach towards creating policies and practices to support learning, rather than the passive assumption that they are necessarily affordances of certain disciplinary environments or cultures.

It is somewhat unsurprising that there was a negative correlation between social-case and the supervision factor as well as satisfaction of supervision and research groups given that the social sciences are often reported to be isolating in both of these

respects (Chiang, 2003; Cumming, 2009; Golde & Dore, 2001; Leonard et al., 2006; Pyhältö et al., 2009; Smeby, 2000). It remains unclear what best practices in supervision might be when supervisors do not share projects with students, and how to address situations where there exists a large gap in expertise (Franke & Arvidsson, 2011). This research shows how this often difficult situation may in fact be more common than previously reported as it has rarely, if ever, been reported in the discipline of Psychology and was only detected in this study due to the inductive approach taken to analysis. Using the method outlined here, perhaps cases where high satisfaction was shown for social-case project descriptions can be identified and these cases more closely examined qualitatively to determine the features of positive experiences in this style of work and supervision.

#### **4.9. Limitations and future directions**

It is acknowledged that the correlational relationships, cannot conclusively demonstrate causality, or the directionality of relationships (e.g., research work environments might influence research projects). While the inferences made here are triangulated by the qualitative data and supported by prior theory, future and more detailed study into the particular relationships found are needed to confirm them and more closely study the causalities suggested (e.g., that research projects influence different forms of supervision). Additionally, the lack of correlations noted previously, such as the lack of positive correlations with mentorship, cannot conclusively demonstrate the lack of an effect or relationship. Rather it can only be concluded that that no correlation was found *in this study*. It is possible that future studies examining larger sample sizes or other populations may uncover a correlation.

Future studies may aim to use factor analysis rather than principal component analysis to verify the structure of the factors identified here. The latter was used here given this study's low sample size (preventing a determinate calculation of the factors using factor analysis) and the current study's need for calculating factor scores for later analysis. Factor analytic extraction techniques such as Principal Axis extraction are better suited for determining the underlying structure of latent constructs, and latent constructs are best determined with large samples relative to the number of items.

Factors should also be validated using confirmatory factor analyses subsequent to exploratory analyses (as used here) (Fabrigar et al., 1999). The triangulation with the qualitative data, and relatively well-defined and interpretable factors suggest that the solution is likely to be repeatable and a confirmation of the factors would further support this. Future studies may also seek to improve and build upon the items and scales created here, for instance, determining other identifiers or potential factors underlying research project descriptions, work affordances, and/or practices for Psychology as well as other disciplines. It may also be worthwhile to examine the relation between factors, using an oblique, rather than orthogonal rotation as was used here. It is likely some factors, particularly regarding research project descriptions, are correlated to one another. This is particularly true for the research intent and research subject factors where it seems likely that the theory-generalise and cognitive-physiological and case-application and social-case intent-subject pairs may be correlated, matching intent with subject. This may also help further explore the relatively low correlations on the “intent” factors relative to the “subject” factors.

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## Chapter 5.

### Appendices

The first set of appendices are the instruments and protocols used. Note that for the instruments used for studies one and two, these instruments were modified for each year of the study. The instruments in this appendix are samples from year three. For study three, a single survey was used, however individual interview protocols differed slightly based on the responses given on the survey and the included protocol is one representative example. These appendices are:

- Appendix A: Bi-monthly log (studies one and two)
- Appendix B: Pre-interview questionnaire (studies one and two)
- Appendix C: Interview protocol (studies one and two)
- Appendix D: Survey instrument (study three)
- Appendix E: Interview protocol (study three)

The second set of appendices are the ethical approval documents. Namely:

- Appendix F: Ethical approval, Simon Fraser University (studies one and two)
- Appendix G: Ethical amendment for the use of Skype (studies one and two)
- Appendix H: Ethical approval, McGill University (studies one and two)
- Appendix I: Ethical approval, Simon Fraser University (study three)
- Appendix J: Ethical amendment for the use of Skype (study three)
- Appendix K: Ethical approval, University of Oxford (study three)

## Appendix A.

### Bi-monthly log (studies one and two)

#### Doctoral Candidate log of activities and experiences

*Please complete this form by filling in the relevant fields. Please contact me should you experience any difficulties.*

*Areas to type your responses are indicated by a [ ]. Please type your response between the brackets.*

*Filled responses should look like this [response].*

*Thank you again for your participation.*

Week of [ ] (e.g., Oct 4-10, 2010)

Chosen pseudonym: [ ]

1. This week, I spent approximately [ ] hours on academic work that ultimately contributes to my doctorate.
2. Please note the different activities that contributed to this investment of time. (Mark an X to the left of all that apply and provide details.)

[ ] Reading [ ]

[ ] Literature review [ ]

[ ] Obtaining ethics approval [ ]

[ ] Preparing for comprehensive exam [ ]

[ ] Preparing for research proposal [ ]

[ ] Fieldwork preparation [ ]

[ ] Data collection [ ]

[ ] Data analysis [ ]

[ ] Writing up thesis [ ]

[ ] Writing for publication [ ]

[ ] Conference proposal/paper [ ]

[ ] Presented research at conference/ workshop/ seminar (where and on what topic?) [ ]

[ ] Attended a conference/ seminar/ workshop (where and on what topic?) [ ]

[ ] Meeting/ speaking/ corresponding with supervisor(s) [ ]

- Meeting/ speaking/ corresponding with other academics
- Lab group meetings
- Other (please specify e.g. funding applications):

This week I also: (Mark an X to the left of all that apply and provide details)

- Worked full-time in non-academic work
- Worked part-time in non-academic work
- Worked part-time on research not related to my doctorate (if so, who or what was this for?)
- Worked as a teacher, tutor, or instructor (if so, please specify what and where)
- Attended an academic committee meeting (if so, what committee was this?)
- Attended workshops, classes, seminars, or lectures (if so, where and what topic?)
- Acted as a caregiver (for children, spouse, other relatives etc.)
- Other (please list any you think are important, e.g., sport/leisure activities, voluntary work, socialising, travel etc.)

3. Please add any comments/elaborations relating to how you spent your time this week.

4. This week I engaged with the following people to help me with my doctoral work. (Mark an X to the left of all that apply and provided details)

- Student in my research group/team
- Another student(s) (if so, where were they from?)
- My supervisor
- Program director
- Other professors (if so, where were they from?)
- Library staff

Other University staff (e.g., secretaries, careers, computing services) (please specify):

Family

Friends

Other (Please specify):

This week with regard to my supervisor(s) I feel that I: (Please mark an X to the left of the ONE response that best fits your experience this week)

didn't need any help

needed help

didn't want any help

wanted help

*IF you wanted or needed help from your supervisor, please answer the next question; if not, please go to question 8.*

5. If you wanted or needed help, what was your concern? [ ]

a) Why did you feel your supervisor was the best person to help? [ ]

b) Did you get the help you needed? [ ]

c) If 'no' please explain why you think this was the case. [ ]

d) Did you get the help you needed from someone other than your supervisor? Who was that person(s)? [ ]

6. This week the most significant individual(s) to my academic progress (whether positively or negatively) was: [ ]

They were significant because: [ ]

7. If there was a significant event or experience in which you felt like an academic or felt that you belonged to an academic community, please tell us about it. [ ]

Why was this event or experience important? [ ]

8. If there was a significant event or experience in which you did not feel like an academic or felt that you were excluded from or not part of an academic community, please tell us about it. [ ]

Why did this experience make you feel this way? [ ]

9. What things, if any, do you feel you should have or wanted to focus on this week but couldn't? [ ]

Why was this? [ ]

10. Please indicate any difficulties you encountered this week. [ ]

What did you do to try and overcome them? [ ]

11. What career(s) are you considering and what are the major factors are influencing your decision about these choices? [ ]

**Thank you!**

## Appendix B.

### Pre-interview questionnaire (studies one and two)

#### PRE-INTERVIEW QUESTIONNAIRE (Doctoral Students)

Thank-you for continuing in our project. To help us understand your context, and be aware of any changes which have taken place since we last interviewed you, we would like to clarify some basic background information.

For the purposes of this research, in place of your real name, we will continue to use your **alias** of: [ ]

**It is often assumed that scientists do most of their research-related work in the lab, but we have some evidence that individuals, in fact, do this work in many different places.**

**Please take a moment to think back over the year and list below all the places/spaces that you have carried out research-related activities (e.g., the train, bedroom, café, hotel).**

**Please update us as to any significant changes, events, or achievements that have taken place, personal as well as academic, since we interviewed you last time.**

[ ]

Please place an X to the left of any of the following you have completed:

Comprehensive exam submission

Comprehensive exam defense

Dissertation proposal

Dissertation proposal defense/colloquium

Data collection

Data analysis

Dissertation writing

Dissertation defense

Other (please specify):

Towards which of the points listed above are you currently directing most of your work?

Has the focus of your research changed since when you began participating in this research?

Yes

No

If 'yes', please state how.

In the long term, do you envisage or hope to pursue an academic career (e.g. tenure track faculty, university lecturer, etc.)?

Yes

No

What type of position do you hope to hold immediately after completing your degree? (mark with an X)

Pre-tenure at a research intensive university

Pre-tenure at a non-research-intensive university

Postdoc fellowship

Researcher in a university

Researcher in the private sector

Researcher in government

Administrator in a college or university

Administrator or manager in the private sector

Administrator or manager in government

Returning to, or continuing, in the same employment/position as prior to the PhD

Professional (self-employed or in an agency)

Other (please specify)

Where do you intend to look for work after completing your degree? (mark an 'X' against all that apply)

The province you are in

Elsewhere in Canada

US

Another country (please specify)

*If you intend an academic career,*

a) In which discipline(s) do you envisage your future academic work to be?

b) In which areas(s) of study do you envisage your future academic work to be?

What type(s) of financial support are you currently receiving? ('X' all that apply)

Research Council Fellowship

University funded fellowship/ scholarship / award / fee waiver

Scholarship from a private institution (excluding universities)

Employment income

Loans, savings, or other assistance

Other (please specify):

Please indicate how many of the following you have:

Peer reviewed journal publications:

Non-peer reviewed journal publications:

Conference presentations:

Peer reviewed conference proceedings:

Non-peer reviewed conference proceedings:

*Thank you for your time in completing this questionnaire.*

## Appendix C.

### Interview protocol (studies one and two)

Part 1: What does your present role entail, compared with last year? (*data for this year*)

ABOUT 15 MINUTES

Question / theme / prompt	Notes
<p>In the information you gave us before our meeting today you mentioned X, Y and Z as significant changes/ events/ achievements that have taken place since we last interviewed you</p> <p>Please pick the one that you feel is the most significant and tell me about the impact this has had on you.</p>	<p><i>In preparation, please note down all that were mentioned in the pre-interview questionnaire.</i></p>
<p>Could we move on to your role as a doctoral student/ researcher/ lecturer?</p> <p>In one of the logs you told us something about XXX (explain). Can you flesh that out/ fill in the details a bit more for me?</p>	<p><i>REPEAT as useful for other logs bearing in mind time available.</i></p>
<p>Compared with 12 months ago you mentioned in the logs that X, Y and Z were different activities from what you had been doing in the previous year.</p> <p>What do you feel has been the impact of these changes?</p>	<p><i>In preparation, please note down all that were mentioned in the logs.</i></p>

Part 2: Questions specific to what you have told us (*data for last year*)

ABOUT 15 MINUTES

Question / theme / prompt	Notes
I'd now like to ask you about some of the things you told us previously which we find particularly interesting: XXX, YYY, ZZZ etc	<i>In preparation, please note down all that you observed from the first year pre-interview questionnaire, logs &amp; interview.</i>
One of the things you have told us about concerns XXX and how this impacted ..... Can you tell me about this in a bit more detail?	
How has it impacted/ is it impacting on your life now?	
What are your hopes in relation to this for the future?	
Looking back, how do you view this experience/ event/ change etc?  What are your feelings about it now?	

Part 3: research activities and work spaces

ABOUT 20 MINUTES		
Question / theme / prompt	Covered?	Rationale
<i>I'd now like to move on to talking a bit about your choice of work spaces and how they relate to the nature of your research</i>		<i>Challenging the notion that</i>

<p><i>activities.</i></p> <p>In your pre-interview questionnaire you mentioned having worked in a number of spaces/places during the past year.</p> <p><u>Hand over the set of PINK cards: these depict the spaces that have been previously listed by the participant in the pre-interview questionnaire:</u></p> <p>Going through each of these in turn, could you tell me what research related activities/tasks you do in each and why you choose this space/place rather than another place to do that activity?</p> <p>What are some of the impacts/effects of working in this space?</p> <p><u>Ask the above until all cards in the PINK pile are exhausted.</u> <u>DURING THIS ACTIVITY, OTHER PLACES MAY BE NAMED; IF SO, WRITE EACH ON A WHITE CARD</u></p> <p><u>Now hand over GREEN cards: these depict ADDITIONAL commonly reported spaces that have NOT been reported by the participant. Hand over this pile to the participant.</u></p> <p>Would you like to go through these and check if there are additional spaces that you have worked in during the past year but haven't mentioned so far?</p> <p><u>If additional cards selected:</u></p> <p>Could you tell me what research related activities/tasks you do in each space and why you choose this rather than another?</p> <p>What are some of the impacts/effects of working in this space?</p> <p><u>Ask until all GREEN cards are exhausted.</u></p> <p>Are there any other spaces that come to mind but that haven't been already covered by the PINK and GREEN cards?</p> <p><u>If yes, hand over and ask the participant to create a new WHITE</u></p>	<p><i>students usually work in lab spaces to produce results</i></p>
---	--

<p><u>card and talk about this new space as before. Continue in a similar fashion until all new/additional spaces are exhausted.</u></p> <p>Are there any other things that you would consider as research related activities that you haven't mentioned so far?</p> <p><i>(Probe: Other people have mentioned XXX OR</i></p> <p><i>In your weekly logs you mentioned XX activity – would you consider this a research related activity?)</i></p>		
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Part 4: Your future

ABOUT 5 MINUTES

Question / theme / prompt	Notes
<p>Finally, I'd like you to look forward to the future and ask you to imagine what you think your life might look like:</p> <p>In 1 years time</p> <p>Is this how you would like it to look?</p> <p>If not, how would you like it to look?</p>	
<p>In 5 years time?</p> <p>Is this how you would like it to look?</p> <p>If not, how would you like it to look?</p>	

Part 5: Closure

ABOUT 5 MINUTES

Question / theme / prompt	Notes
Is there anything else you think is important or interesting that you would like to talk about?	
Is there anything you'd like to ask us?	
Do you have any comments or thoughts about this kind of interview?	
Would you like to see a copy of the interview transcript?	

# Appendix D.

## Survey instrument (study three)

Section 1: Demographics General Information (Page 1/5)

Gender (optional question)

- Male  
 Female  
 \_\_\_\_\_

Age (optional question) Please provide your answer in years.

\_\_\_\_\_

Which of the following best describes your current situation?

"Work status" here does not include work related to research and/or your degree studies/work, even if paid.

	Not currently working/studying	Part time	Full time
Current student status	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Current work status	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Describe the degree that you are currently enrolled in:

"Title" refers to the type of degree, whether master's or doctoral (e.g., M.Phil, M.A., PhD, DPhil) "Description/area" may refer to a department, program, school, specialization, and/or area (e.g., cognitive neuroscience, language communication, educational psychology, research methods) "Focus" refers to its relative emphasis on research as opposed to clinical or counselling practice (e.g., clinical degree with a research project, research degree with a thesis)

Degree (e.g., PhD) \_\_\_\_\_

Description/area (e.g., cognitive neuroscience) \_\_\_\_\_

Focus (e.g., research degree with thesis; clinical degree with project) \_\_\_\_\_

What subfield(s) of psychology do you consider yourself to be in?

Note that much of this list is drawn from Wikipedia, and you may consult this article for definitions (link should open in another window): [http://en.wikipedia.org/wiki/Subfields\\_of\\_psychology](http://en.wikipedia.org/wiki/Subfields_of_psychology) Select all that apply

- Abnormal
- Biological
- Clinical
- Cognitive
- Community
- Comparative
- Consulting
- Counseling
- Developmental
- Educational
- Environmental
- Forensic
- Health
- Industrial-Organizational
- Legal
- Media
- Neuroscience
- Occupational health
- Personality
- Quantitative
- Religion/spirituality

- School
- Social
- Other(s) \_\_\_\_\_

At present, how long have you been enrolled in postgraduate studies?

This includes both master's and doctoral studies if you are currently in a doctorate degree (enter '0' for none in a category)

Years \_\_\_\_\_

Months \_\_\_\_\_

Approximately how many courses have you completed (including before your present degree) that are/were primarily focused on research methodology?

(e.g., research methods, statistics, qualitative methods etc.)

\_\_\_\_\_

Where are you in your degree?

Select all that you have completed, as well as the stage you are currently on. Leave all blank if "none" (i.e., if you are currently collecting data, select "data collection" in addition to the steps you have already completed)

- All required coursework
- Transfer/upgrade
- Confirmation
- Data collection
- Data analysis
- Doctoral thesis writing
- Other \_\_\_\_\_

In terms of financial resources, which of the following are supporting, or have supported you during your postgraduate studies?

Select all that apply, and leave all blank if "none"

- Government scholarship
- Other scholarship
- Studentship
- Stipend from supervisor(s)
- Part-time work
- Loans
- Other \_\_\_\_\_

Section 2: Research Group and Work (Page 2/5)

For the following questions, and elsewhere in this survey, think of the supervisor/research group/lab/team that you conduct most of your research with, and would consider your primary supervisor/research group/lab/team (referred hereafter to as "research group"). Note that "research group" here can refer to just your supervisor and yourself if you do not work with anyone else.

To what degree do the following describe the research project(s) which you are currently, most recently, or will be primarily involved in and/or focused on?

(Including thesis work) This research is focused on...

	Unsure or Not Applicable	Not at all	A little	Somewhat	Very much	Completely
Developing, testing, and/or refining (a) theoretical idea(s), conception(s), framework(s), and/or explanation(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Application, applicability and/or policy/practitioner use (may be theoretically based or grounded)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Detailed description and/or analysis within specific individual contexts and/or cases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Generalizable and replicable findings which apply widely to a large population (or many populations) and/or contexts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Physiological, neurological, and/or behavioural phenomena and/or data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual cognitive and/or mental phenomena and/or data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Group, social or cultural phenomena and/or data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Approximately how many current regular members are there in your research group aside from yourself (including supervisor(s), post-PhD/DPhil researchers, researchers, technical staff, students etc.)?

If it is just yourself and your supervisor, indicate '1' Indicate '0' if you do not work with anyone.

\_\_\_\_\_

How many different research projects are you currently involved in?

Note that this includes your thesis research if you are currently engaged in it. Indicate '0' if none.

\_\_\_\_\_

What research methods are typically used in your primary research group?

- Qualitative only
- Mostly qualitative with some quantitative (including mixed methods)
- Qualitative and quantitative equally (including mixed methods)
- Mostly quantitative with some qualitative (including mixed methods)
- Quantitative only
- Do not know/not applicable
- Other \_\_\_\_\_

 What research methods are you using, or plan to use, in your own thesis research?

- Qualitative only
- Mostly qualitative with some quantitative (including mixed methods)
- Qualitative and quantitative equally (including mixed methods)
- Mostly quantitative with some qualitative (including mixed methods)
- Quantitative only
- Do not know/not applicable
- Other \_\_\_\_\_

 On how many conference presentations/posters/proceedings are you an author (including those currently accepted but not yet presented, but not including those that are submitted and not yet accepted)?

Indicate '0' for none

In which you are first author \_\_\_\_\_

In which you are second, third, fourth etc. author \_\_\_\_\_

 On how many peer reviewed publications (e.g., journal articles) are you an author (including those currently accepted or in press, but not including those that are submitted and not yet accepted)?

Indicate '0' for none

In which you are first author \_\_\_\_\_

In which you are second, third, fourth etc. author \_\_\_\_\_

Section 2: Research Group and Work (continued) (Page 3/5)

To what extent do the following statements generally apply to your experiences within your primary research group and/or supervisory relationship?

	Unsure/not applicable	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I work closely with my supervisor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I work closely with other members of my research group (aside from my supervisor)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often get useful advice from my supervisor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often get useful advice from others (aside from my supervisor) within my research group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often work in isolation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I mentor, support, and/or teach more junior members of the research group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am/was mentored, supported, and/or taught by more senior members of my research group (not including my supervisor)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My supervisor personally participates in the day to day research work and activities of the research group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel that I am in competition with other members of my research group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a friendly relationship with other members (not including supervisor) of my research group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with my supervisory relationship	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with my research group as a work environment/community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The choice of my thesis research topic (was/will be):

(i.e., how much relative influence did, or will, you and your supervisor, have upon the topic of your thesis research work?)

- Completely my supervisor's choice
- Mostly my supervisor's choice
- Somewhat more of my supervisor's choice
- Equally my own and my supervisor's choice
- Somewhat more of my own choice

- Mostly my own choice
- Completely my own choice

**8.8** To what extent do the following statements apply to your experience within your primary research group and/or supervisory relationship regarding your degree research?

	Unsure/not applicable	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I am satisfied with how my research topic will be, or, was, chosen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My current, or anticipated thesis work closely relates in topic to other research project(s) in my research group (including those of my supervisor)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**8.9** Estimate approximately how many hours per week you typically spend on these research work related interactions, activities, and tasks:

Answer in average hours per week. Indicate '0' for none or not applicable. "Work" here also refers to time spent learning how to do a research work task or project. Divide up the total time if regular activities occur less than once per week (e.g., if you have a lab meeting every two weeks for 60 minutes, put 30 minutes per week for "interacting with peers or colleagues...")

Total work per week (not total of other numbers here)	_____
Working at your primary research group's lab(s) and/or office(s):	_____
Working away from your research group's lab(s) and/or office(s):(e.g., at home, at a café)	_____
Interacting/working with your supervisor/co-supervisor(s) on research related activities (e.g., research work, meetings, journal clubs)	_____
Interacting with peers or colleagues (i.e., not including supervisor(s) on research related activities (e.g., research work, meetings, journal clubs)	_____
Working alone	_____

Section 3: Skills/Knowledge (Page 4/5)

"Research work" here includes both your own thesis work and other research work in your research group

For the research work that you are currently and/or most recently engaged in, how frequently do you use the following categories of skills/knowledge

Select the most frequent option which applies

	Not applicable/never	Rarely (e.g., only once or twice)	Less than yearly	Yearly	Every 6-11 months	Every 2-3 months	Monthly	Weekly	Daily
Quantitative research design and conceptualization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Qualitative research design and conceptualization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quantitative data analysis (including statistical tests, modelling software)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Qualitative data analysis (including approaches software)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other software/computer skills not included in above (e.g., database management, programming languages)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of research focus (e.g. relevant literature, major theories, key ideas)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fieldwork and assessment skills (e.g. interviewing, administering psychological tests to humans)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technical and laboratory skills (e.g. EEG setup, animal handling)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How would you assess your own ability to use the following categories of skills/knowledge as they are needed for your upcoming, current, and/or most recently engaged in research work?

Not applicable/Do not know	Extremely poor or no ability	Poor	Satisfactory	Good	Excellent
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Quantitative research design and conceptualization	<input type="radio"/>					
Qualitative research design and conceptualization	<input type="radio"/>					
Quantitative data analysis (including statistical tests, modelling software)	<input type="radio"/>					
Qualitative data analysis (including approaches software)	<input type="radio"/>					
Other software/computer skills not included in above (e.g., database management, programming languages)	<input type="radio"/>					
Knowledge of research focus (e.g. relevant literature, major theories, key ideas)	<input type="radio"/>					
Fieldwork and/or assessment skills (e.g. interviewing, administering psychological tests to humans)	<input type="radio"/>					
Technical and/or laboratory skills (e.g. EEG setup, animal handling)	<input type="radio"/>					

 Are there any skills/knowledge that you feel you need in order to conduct research in your area which are not covered by the above two questions? If so please indicate what they are below:  
(note: this field may be left blank)

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 Are there any skills/knowledge in particular that you want to, or need to, develop or learn but are unable to do so? If so what are they and why are you unable to do so?  
(note: this field may be left blank) (e.g., I wanted to learn structural equation modeling, which is important for my research, but I don't have the time and no one I know knows how to do it).

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 Is there any formal or semi-formal support or planning for skills/knowledge development in research methods that you make use of, or are required to make use of other than coursework? If so, please briefly describe them below and indicate if they are required or optional.  
(note: this field may be left blank) (e.g., skills portfolio, seminars)

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Section 4: Learning sources and strategies (Page 5/5) (final survey question page) For each of the following skills/knowledge, how helpful are/were the listed sources of learning for attaining your present level of knowledge/ability for your current research work (i.e., how much do you feel they actually impacted your learning)?

"Print resources" refers to resources that are traditionally in print, including those often accessed online. Thus, journal/books should only be considered in this category. The last four sources of learning in each category are mutually exclusive, with priority to those that are higher up in the list (i.e., if there is another lecturer/researcher aside from your supervisor who is also a lab-mate and friend, only respond for "other lecturer/researcher" regarding this person.)

Knowledge of your research focus (e.g. relevant literature, major theories, key ideas)

How helpful was each source of learning in terms of its impact on your learning about your research focus?

	Unsure/do not know	Did not try to learn from this source	Not very helpful or not helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful
Coursework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Short/medium term formal development (e.g., workshops, summer schools)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online/computer based resources (e.g., websites, help files, online forums)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"Print" resources (e.g., books, journal articles, instruction manuals)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personal practice (e.g., trial error, personal experience over time)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Current supervisor/co-supervisor(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other lecturer(s)/researcher(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other member(s) of research group/lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other peer(s)/colleague(s)/friend(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Select a methodology to reference for the following question. Select the methodology that you feel is most/more relevant to your recent research work:

- Quantitative Methods
- Qualitative Methods
- Other \_\_\_\_\_
- Not applicable \_\_\_\_\_

Quantitative OR qualitative data analysis (including software)

How helpful was each source of learning in terms of its impact on your learning of analysis (see above)?

	Unsure/Do not know	Did not try to learn from this source	Not very helpful or not helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Coursework	<input type="radio"/>						
Short/medium term formal development (e.g., workshops, summer schools)	<input type="radio"/>						
Online/computer based resources (e.g., websites, help files, online forums)	<input type="radio"/>						
"Print" resources (e.g., books, journal articles, instruction manuals)	<input type="radio"/>						
Personal practice (e.g., trial error, personal experience over time)	<input type="radio"/>						
Current supervisor/co-supervisor(s)	<input type="radio"/>						
Other lecturer(s)/researcher(s)	<input type="radio"/>						
Other member(s) of research group/lab	<input type="radio"/>						
Other peer(s)/colleague(s)/friend(s)	<input type="radio"/>						

 Select a skillset to reference for the following question. Select the skillset that you feel is most/more relevant to your recent research work:

- Fieldwork and/or assessment skills (e.g. interviewing, administering psychological tests to humans)
- Technical and/or laboratory skills (e.g. EEG setup, animal handling)
- Other \_\_\_\_\_
- Not applicable \_\_\_\_\_

 Fieldwork and/or assessment OR technical and/or laboratory skills

How helpful was each source of learning in terms of its impact on your learning of this skillset (see above)?

	Unsure/Do not know	Did not try to learn from this source	Not very helpful or not helpful	A little helpful	Somewhat helpful	Very helpful	Extremely helpful
Coursework	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Short/medium term formal development (e.g., workshops, summer schools)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online/computer based resources (e.g., websites, help files, online forums)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"Print" resources (e.g., books, journal articles, instruction manuals)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personal practice (e.g., trial error, personal experience over time)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Current supervisor/co-supervisor(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other lecturer(s)/researcher(s)	<input type="radio"/>						
Other member(s) of research group/lab	<input type="radio"/>						
Other peer(s)/colleague(s)/friend(s)	<input type="radio"/>						

 Are there any learning sources which you draw upon that are not included in the above two questions? If so indicate what they are below:

(note: this field may be left blank)

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 Section 5: Career goals Currently, what are your plans after you graduate? How likely are you to pursue the following sets of careers?

	Not at all likely	A little likely	Somewhat likely	Very likely	Extremely likely
Research related academic career (e.g., as a lecturer)	<input type="radio"/>				
Research related career outside of academia (e.g., in government or industry)	<input type="radio"/>				
Clinical or counselling career in psychology which involves academic research	<input type="radio"/>				
Clinical or counselling career in psychology which does not involve academic research	<input type="radio"/>				
A career that does not involve research (other than the previous)	<input type="radio"/>				

 Proceed to next page for the comments and submission page

 Please add any additional comments or observations you have about this survey, or on the learning of research methodology/skills here:

(note: this field may be left blank)

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 Next phase of research:

In the next phase of this research, I (Gregory Hum) will be conducting interviews based on the results of this survey. I would greatly appreciate your participation in being interviewed so that I can learn more about your specific perspective and experiences. If you are interested in being interviewed, please provide your e-mail address below. Note that this is merely to receive information about the interview. You can decide if you wish to participate after receiving this information, and you will not be contacted further if you do not respond. Note that providing your e-mail may disclose your identity to me. However, rest assured that strict confidentiality is being observed and that all e-mails entered here will be deleted once recruitment for the next phase is complete.

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 Please ensure that you press the "submit" button below after having read this page. Once you submit the survey, you should be automatically redirected to a separate survey where you may enter your e-mail address to enter the draw, and/or to receive updates on this research. If you are not automatically redirected to another survey (e.g., due to technical reasons), e-mail me for the link. Thank you once again for your participation

## Appendix E.

### Interview protocol (study three)

#### Current situation:

- Tell me about your current degree in **cognitive neuroscience**. What are its requirements and what are the expectations in terms of research methodology or skills? Is it research or taught or both?
- What brought you to your current studies in this degree at this school? How and why did you select the supervisor and program?
- **You described “other scholarship”**. Can you tell me more about the support you receive and how this supports or inhibits your studies? What do you have to do if anything to receive this funding?
- You said that your career goals are **primarily lecturer**. Why this and not the others? What do you think you will do right after your current degree? How aware are you or were you aware of the options?

#### Description of studies:

- So you described the area your degree is in as: **biological/cognitive/neuroscience** and the research projects you work on as **physiological/cognitive**. Can you elaborate on your answers and talk about how you feel your own projects relate to the larger area of psychology (i.e., are they similar or different? Conceptually or in terms of methods?).
- When and why did you choose this area of research?

#### Description of research projects:

- What are the research projects you are engaged in? This includes your thesis work and other research work. Are they related? **You have 8 at once.**
- What personal and other influences (e.g., supervisor, program) lead you to this or these research questions? **You said it was completely your own choice.**
- How does your own work relate to the work of others such as your supervisor or your lab?
- So what is a typical work week like for you? You mentioned spending **30 hours in lab, 10 hours outside lab. 3 hours supervisor, 5 peers/colleagues, 32 working alone.**
- If you work in a lab, how do you work with them? Why do you sometimes work in the lab or outside the lab? If not in a lab, would you prefer to have a group to work with? **Were mentored.**
- You said you **neither agree nor disagree** that you often work in isolation. What do you mean by isolation and how does its presence or lack influence your learning?

### General methods:

- Can you describe to me what you see as quantitative and qualitative methods? What do you see as the main features and differences of these methodologies?
- So in self assessment, you rated yourself as **good with quant, n/a qual, good techlab**. **Why have did you respond this way for qualitative? Do you plan to ever learn it?**
  - Why do qual people seem to learn both? How well do they know it?
- You described your group's research as primarily using **quantitative** method, and your own research as **quantitative** method. **And your topic as completely your own choice**. How did you come to your own choice and how do you see these link? Did you or will you consider other methods?

### Methods Learning examples:

#### *We will start by talking about quantitative design and analysis*

- You found for analysis **coursework a little helpful, other peers/researchers somewhat/very helpful; print, online, practice, supervisor, other members of research group extremely helpful**.
- You found for design **coursework not helpful, print and online a little helpful**
  1. What particular methods or skills are you thinking of? (give examples) What differences are there between design/analysis?
  2. What motivation did you have to learn this particular method or skill?
  3. Why and how were given sources of learning particularly helpful or unhelpful?
  4. Prior to your current degree studies what preparation for research did you have? How does it help, or not help you presently?
  5. How can you tell how well you learned a given method or skill?
  6. What further development are you planning if any?
  7. Is this how you would like to learn? How would you like to learn ideally?
- How does frequency of use influence your learning of methods? (If relevant: why did you indicate you use **quantitative frequently (daily analysis) and rate good on this. No qual**.)
- How helpful was coursework, what did it cover?

### Skills Learning examples:

#### *We will talk about technical and laboratory skills.*

- How does the analytic technique you use influence or relate to the labtech/fieldwork skills and research area knowledge you need? Also software.
- You found **practice, group members, and peers particularly helpful, coursework, formal, online, print, other researchers only somewhat helpful**. to learn **technical and/or laboratory skills. Also software**.
  1. What particular methods or skills are you thinking of? (give examples)
  2. What motivation did you have to learn this particular method or skill?

3. Why and how were given sources of learning particularly helpful or unhelpful?
  4. Prior to your current degree studies what preparation for research did you have? How does it help, or not help you presently?
    - Why was formal and coursework not as helpful? These more often helpful.
  5. How can you tell how well you learned a given method or skill?
  6. What further development are you planning if any?
  7. Is this how you would like to learn? How would you like to learn ideally?
- How does frequency of use influence your learning of methods?

#### **Formal studies past and present:**

- What stage are you currently in in your degree in terms of requirements and research? What have you previously completed and since you filled out the survey. What strike you as particularly influential learning experiences about methods?
- How do you feel your approach to learning has changed over the course of your degree(s) thus far and/or how do you anticipate it will? In particular, how has coursework been useful or not useful to your research practice?
- The UK policy context has a strong emphasis on research and employability skills. How do you feel these policies have impacted upon your learning and work experiences if at all? Are there any local efforts (you described **online skills portfolio research progress log and “points” for research activities, visiting courses, completing online courses** semi-formal methods) but also said **these are amazingly distanced from day to day research**

#### **Perceived future**

- How much longer do you anticipate your degree will take? How do you feel about this timeframe and what you will have learned and be able to learn knowledge or skills for your career or otherwise?
- Broadly, how do you feel about your learning experiences? How do you feel your learning experiences have supported your ability to pursue your future goals? Are these different?

#### **Wrap up:**

- Do you have any questions?

## Appendix F.

### Ethical approval, Simon Fraser University



#### Minimal Risk Expedited Approval

<b>Date</b>	<b>File</b>	<b>Approval</b>	<b>Principal Investigator</b>
19 Sept. 2011	[2011s0490]	Approved	Amundsen, Cheryl
<b>Title</b>		<b>Start Date</b>	<b>End Date</b>
Developmental trajectories of doctoral candidate through new appointee: A longitudinal study of academic identity construction		19 Sept. 2011	19 Sept. 2015
<b>SFU Position</b>	<b>Department / School</b>	<b>Supervisor</b>	
Faculty	Education	N/A	

Hello Cheryl,

Your application has been categorized as 'Minimal Risk' and approved by the Director, Office of Research Ethics on behalf of the Research Ethics Board, in accordance with University Policy r20.01 (<http://www.sfu.ca/policies/research/r20.01.htm>)

The Research Ethics Board reviews and may amend decisions made independently by the Director, Chair or Deputy Chair at the regular monthly meeting of the Board.

Please acknowledge receipt of this Notification of Status by email to [dore@sfu.ca](mailto:dore@sfu.ca) and include the file number as shown above as the first item in the Subject Line.

You should get a letter shortly. Note: All letters are sent to the PI addressed to the Department, School or Faculty for Faculty and Graduate Students. Letters to Undergraduate Students are sent to their Faculty Supervisor.

Good luck with the project,

Hal Weinberg, Director

# Appendix G.

## Ethical amendment for the use of Skype



Street Address  
Simon Fraser University  
Discovery 2  
Room 230, 8900 Nelson Way  
Burnaby, BC Canada V5A 4W9

Mailing Address  
8888 University Drive  
Discovery 2  
Burnaby, BC Canada  
V5A 1S6

Director 778.782.6593  
Associate Director 778.782.9631  
Manager 778.782.3447  
FAX 778.782.6785

dore@sfu.ca  
<http://www.sfu.ca/vp-research/ethics/>

### Amendment Approval

**Study Number:** 2011S0490

**Study Title:** Developmental trajectories of doctoral candidate through new appointee: A longitudinal study of academic identity construction

**Approval Date:** 2012 December 3

**Principal Investigator:** Amundsen, Cheryl

**SFU Position:** Faculty

**Expiry Date:** 2015 September 19

**Supervisor:** N/A

**Faculty/Department:** Education

**Co-Investigators:** none

**Funding Source:** Social Sciences and Humanities Research Council of Canada

**Grant Title:** Developmental trajectories of doctoral candidate through new appointee: A longitudinal study of academic identity construction

#### Documents Approved in this Amendment:

- Amendment Request, dated 2012 November 19
- Amended Consent Form, Version: Revised November 26

I am pleased to inform you that the above listed Amendment to your previously approved study has been approved by the Associate Director, Office of Research Ethics, on behalf of the Research Ethics Board in accordance with University Policy R20.01 (<http://www.sfu.ca/policies/research/r20.01.htm>).

The approval for this study expires on the **Expiry Date**, or the term of your appointment / employment / student registration at SFU, whichever comes first. **A progress report must be completed every year prior to the anniversary date of approval. Failure to submit an annual progress report will lead to your study being suspended and potentially terminated.** If you intend to continue your protocol to collect data past the term of approval, you must contact the Office of Research Ethics at [dore@sfu.ca](mailto:dore@sfu.ca) and request an extension at least 6 weeks before the expiry date.

If there is an adverse event, the principal investigator must notify the Office of Research Ethics within five (5) days. An Adverse Events Form is available electronically by contacting [dore@sfu.ca](mailto:dore@sfu.ca).

All correspondence with regards to this application will be sent to your SFU email address.

Please notify the Office of Research Ethics at [dore@sfu.ca](mailto:dore@sfu.ca) once you have completed the data collection portion of your project so that we can close the file.



OFFICE OF RESEARCH ETHICS

**This Notification of Status is your official Amendment approval documentation for this project. Please keep this document for reference purposes and acknowledge receipt of this Notification of Status by email to [dore@sfu.ca](mailto:dore@sfu.ca) and include the study number in square brackets as the first item in the Subject Line.**

Best wishes for success in this research.

Sincerely,

Dina Shafey, PhD, MBA  
Associate Director  
Office of Research Ethics

Page 2 of 2

# Appendix H.

## Ethical approval, McGill University

McGill University

### ETHICS REVIEW RENEWAL REQUEST/STUDY CLOSURE FORM

Continuing review of research involving humans requires, at a minimum, the submission of an annual status report to the REB. This form must be completed to request renewal of ethics approval. If a renewal is not received before the expiry date, the project is considered no longer approved and no further research activity may be conducted. When a project has been completed, this form can also be used to officially close the study. To avoid expired approvals and, in the case of funded projects, the freezing of funds, this form should be returned 2-3 weeks before the current approval expires.

**REB File #:** 506-0205

**Project Title:** Developmental trajectories of doctoral candidate through new appointee: a longitudinal study of academic identity construction

**Principal Investigator:** Lynn McAlpine

**Email:**

**Faculty Supervisor (if student PI):**

1. Were there any significant changes made to this research project that have any ethical implications? \_\_\_ Yes \_\_\_X\_\_\_ No  
If yes, describe these changes and append any relevant documents that have been revised.
2. Are there any ethical concerns that arose during the course of this research? \_\_\_ Yes \_\_\_X\_\_\_ No. If yes, please describe.
3. Have any subjects experienced any adverse events in connection with this research project? \_\_\_ Yes \_\_\_X\_\_\_ No  
If yes, please describe.
4. Is this a funded study? \_\_\_X\_\_\_ Yes \_\_\_ No. If yes, list the agency name and project title and the Principal Investigator of the award if not yourself. This information is necessary to ensure compliance with agency requirements and that there is no interruption in funds.

\_\_\_X\_\_\_ Check here if this is a request for renewal of ethics approval.

\_\_\_ Check here if the study is to be closed and continuing ethics approval is no longer required. A study can be closed when all data collection has been completed and there will be no further contact with participants.

**Principal Investigator Signature:** \_\_\_\_\_ Date: \_\_\_ Dec 30 2011 \_\_\_\_\_

**Faculty Supervisor Signature:** \_\_\_\_\_ Date: \_\_\_\_\_  
(if PI is a student )

<b>For Administrative Use</b>	<b>REB:</b> ___ REB-I ___ <input checked="" type="checkbox"/> REB-II ___ REB-III
___ The closing report of this terminated project has been reviewed	
<input checked="" type="checkbox"/> The continuing review for this project has been reviewed and approved	
<input checked="" type="checkbox"/> Expedited Review ___ Full Review	
Signature of REB Chair or designate	Date: Jan. 15, 2012
Approval Period: Jan. 15, 2012 to Jan. 14, 2013	

Submit to Lynda McNeil  
Street West suite 429, fax: 398-4644 tel: 398-6831. Electronic submissions with scanned signatures are accepted but must come from the PI's McGill email.

Research Ethics Officer, James Administration Building, 845 Sherbrooke

(version 10/10)

# Appendix I.

## Ethical approval, Simon Fraser University



Date	File	Approval	Principal Investigator	
2 Aug, 2012	[2012s0596]	Approved	Hum, Gregory	
Title			Start Date	End Date
Doctoral research methods learning in the psychological sciences within and between contexts			2 Aug. 2012	2 UG. 2015
SFU Position	Department / School		Supervisor	
Graduate Student	Education		Amundsen, Cheryl	

Hello Gregory,

Your application has been categorized as 'Minimal Risk' and approved by the Director, Office of Research Ethics on behalf of the Research Ethics Board, in accordance with University Policy r20.01 (<http://www.sfu.ca/policies/research/r20.01.htm>)

The Research Ethics Board reviews and may amend decisions made independently by the Director, Chair or Deputy Chair at the regular monthly meeting of the Board.

Please acknowledge receipt of this Notification of Status by email to [dore@sfu.ca](mailto:dore@sfu.ca) and include the file number as shown above as the first item in the Subject Line.

You should get a letter shortly. Note: All letters are sent to the PI addressed to the Department, School or Faculty for Faculty and Graduate Students. Letters to Undergraduate Students are sent to their Faculty Supervisor.

Good luck with the project,

Hal Weinberg, Director

# Appendix J.

## Ethical amendment for the use of Skype



OFFICE OF RESEARCH ETHICS

Street Address  
Simon Fraser University  
Discovery 2  
Room 230, 8900 Nelson Way  
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Mailing Address  
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Discovery 2  
Burnaby, BC Canada  
V5A 1S6

Director 778.782.6593  
Associate Director 778.782.9631  
Manager 778.782.3447  
FAX 778.782.6785  
dore@sfu.ca  
<http://www.sfu.ca/vp-research/ethics/>

### Amendment Approval

**Study Number:** 2012s0596

**Study Title:** Doctoral research methods learning in the psychological sciences within and between contexts

**Amendment Approval Date:** 2013 February 26

**Expiry Date:** 2015 August 2

**Principal Investigator:** Hum, Gregory

**Supervisor:** Amundsen, Cheryl

**SFU Position:** Graduate Student

**Faculty/Department:** Education

**Co-Investigators:** none

**Funding Source:** None

**Grant Title:** N/A

#### Documents Approved in this Application:

- Amendment Description and Request, dated 2013 February 20
- Study Details, version uploaded: 2013 February 20

I am pleased to inform you that the above listed Amendment to your previously approved study has been approved by the Associate Director, Office of Research Ethics, on behalf of the Research Ethics Board in accordance with University Policy R20.01 (<http://www.sfu.ca/policies/research/r20.01.htm>).

The approval for this study expires on the **Expiry Date**. **A progress report must be completed every year prior to the anniversary date of approval. Failure to submit an annual progress report will lead to your study being suspended and potentially terminated.** If you intend to continue your protocol to collect data past the term of approval, you must contact the Office of Research Ethics at [dore@sfu.ca](mailto:dore@sfu.ca) and request an extension at least 6 weeks before the expiry date.

If there is an adverse event, the principal investigator must notify the Office of Research Ethics within five (5) days. An Adverse Events Form is available electronically by contacting [dore@sfu.ca](mailto:dore@sfu.ca).

All correspondence with regards to this application will be sent to your SFU email address. Please notify the Office of Research Ethics at [dore@sfu.ca](mailto:dore@sfu.ca) once you have completed the data collection portion of your project so that we can close the file.

**This Notification of Status is your official Amendment approval documentation for this project. Please keep this document for reference purposes**

Sincerely,

Dina Shafey, PhD, MBA  
Associate Director, Office of Research Ethics

Page 1 of 2

# Appendix K.

## Ethical approval, University of Oxford

SOCIAL SCIENCES & HUMANITIES  
INTER-DIVISIONAL RESEARCH ETHICS COMMITTEE

Hayes House, 75 George Street, Oxford. OX1 2BQ  
Tel: +44(0)1865 614871 Fax: +44(0)1865 614855  
[ethics@socsci.ox.ac.uk](mailto:ethics@socsci.ox.ac.uk) [www.socsci.ox.ac.uk](http://www.socsci.ox.ac.uk)

Co-ordinator of the IDREC  
Social Sciences Divisional Office



Thursday, 20 September 2012

Gregory Hum  
Oxford Learning Institute

Dear Gregory,

### Research Ethics Approval

Ref No.: SSD/CUREC1A/12-252

#### Doctoral research methods learning in the psychological sciences within and between contexts

The above application has been considered on behalf of the Social Sciences and Humanities Inter-divisional Research Ethics Committee (IDREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to the IDREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly approval has been granted.

Should there be any subsequent changes to the project, which raise ethical issues not covered in the original application, you should submit details to the IDREC for consideration.

Yours sincerely,

Jane Dale

cc: Prof Lynn McAlpine, Oxford Learning Institute  
Dr Cheryl Amundsen, Simon Fraser University  
Sally Jordan, Oxford Learning Institute

JD/EB