

‘Content to be sad’ or ‘runaway apprentice’? The psychological contract and career agency of young scientists in the entrepreneurial university

Alice Lam*
Royal Holloway University of London

Andre de Campos
State University of Campinas, Brazil

*Corresponding author:

Alice Lam, School of Management, Royal Holloway University of London, Egham, Surrey TW20 0EX, UK.

E-mail: alice.lam@rhul.ac.uk

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‘Content to be sad’ or ‘runaway apprentice’? The psychological contract and career agency of young scientists in the entrepreneurial university

Alice Lam and André de Campos

Abstract

This article examines employee agency in psychological contracts by exploring how young scientists proactively shape their careers in response to unmet expectations induced by academic entrepreneurialism. It uses the lens of social exchange to examine their relationships with the professors engaged in two types of activities: collaborative research characterized by diffuse/reciprocal exchange, and commercial ventures, by restricted/negotiated exchange. These two categories show how career agency varies in orientation, form and behavioural outcome depending on the relational context within which their psychological contracts evolve. Those involved in collaborative research experienced a relational psychological contract and responded to unfulfilled career promises by ‘extended investment’ in their current jobs. They use ‘proxy agency’ by enlisting the support of their professors. However, some become ‘trapped’ in perennial temporary employment and are ‘*content to be sad*’. By contrast, those involved in research commercialization experienced a transactional contract and assert ‘personal agency’ by crafting their own entrepreneurial careers. They are ‘*runaways*’ who seek autonomy. The evidence is based on interviews with 24 doctoral/postdoctoral researchers and 16 professors from three leading UK universities. The study extends psychological contract theory by incorporating career agency and sheds new light on changing academic careers.

Keywords

academic scientists, career, career agency, entrepreneurial university, psychological contract, social exchange

Introduction

In a period of rapid organizational change, career expectations are often unfulfilled. Psychological contract theory has much to say about employee reactions to unmet expectations or psychological contract breach (Morrison and Robinson, 1997; Robinson and Rousseau, 1994), however, most research has focused on the withdrawal of goodwill and disengagement (Zhao et al., 2007). The image of an employee depicted in the literature is one of passivity and organizational dependency, with limited scope for choice or career agency. Whereas this pattern may be associated with jobs that give employees relatively little autonomy, the same cannot be said for those in professional knowledge work who often enjoy a high degree of work autonomy and dispose of considerable resources for more proactive responses. Employee agency has been widely researched in career studies (Tams and Arthur, 2010) but largely overlooked in mainstream psychological contract theory.

This article seeks to contribute to our understanding of employee agency in psychological contracts and its manifestation in career adaptive behaviours. It explores how young scientists have sought to craft their careers in response to unmet expectations caused by the transformation of academic careers. Academics are archetypal knowledge

workers operating in a sector where pressures for greater organizational flexibility and growth of contingent work have profound implications for early career progression. In recent years, early career researchers have been squeezed by increased supply and declining job opportunities (Harney et al., 2014; Dany and Mangematin, 2004). This has been exacerbated by the rise of the entrepreneurial university which encourages industrial engagement (Etzkowitz, 2003) and uses large numbers of doctoral and postdoctoral researchers in temporary positions to support their professors' external funding and commercial activities (Lam, 2007; Slaughter et al., 2002; Thune, 2010). In the past, the majority of those who progressed to postdoctoral research could expect to obtain permanent posts after a few temporary contracts. However, the shortage of tenured posts due to 'steady state science' (Ziman, 1994) has made it increasingly difficult for professors to reward the cooperative efforts of young scientists by offering them long-term academic posts. These trends are likely to affect profoundly the psychological contracts of young scientists with many experiencing the frustration of unfulfilled expectations.

This study uses the lens of social exchange (Blau, 1964; Uehara, 1990) and psychological contract (Robinson et al., 1994; Rousseau, 1995) to examine the relationship between young scientists and professors, comparing those engaged in collaborative research with those in commercial ventures. The former represents diffuse exchange governed by reciprocity; and the latter represents restricted exchange governed by negotiated rules (Uehara, 1990). Drawing on agency theories (Bandura, 2001; Emirbayer and Mische, 1998; Sewell Jr, 1992), the study postulates that career agency varies in extent and form, and individuals may respond differently to unfulfilled

expectations according to the relational context in which their psychological contracts evolve. It examines the psychological contracts of young scientists engaged in the two types of activities and explores how the varied relational and cognitive resources associated with them influence their agentic orientations and career behaviours.

The data are based on individual interviews with academics in the natural sciences from three leading U.K. research universities. The interview sample of 40 includes doctoral students/post-docs (24) and their professors (16) of whom four-fifths were matched pairs. A novel finding concerns the divergent responses of young scientists to unmet career expectations. Those involved in collaborative research experienced a relational psychological contract and responded by ‘extended investment’ in their current jobs. They use ‘proxy agency’ (Bandura, 2001) by engaging in a form of gift-giving exchange behaviour, investing heavily in their work in order to oblige their professors to reciprocate. We find that some become ‘trapped’ in perennial temporary employment but are ‘content to be sad’ (interview quote). By contrast, those involved in commercialization experienced a transactional shift in their psychological contracts and sought independence by crafting their own entrepreneurial careers. They assert ‘personal agency’ (Bandura, 2001), using the relationships with their professors to build up the necessary resources in order to breakaway. They are ‘runaways’ who seek autonomy.¹

The study extends the psychological contract framework to incorporate career agency and account for the varied ways in which individuals react to unfulfilled expectations. It also sheds new light on the contemporary debate about the changing nature of academic careers. The entrepreneurial university may have strengthened the two-tiered career structure and restricted opportunities for upward mobility for many. However, it has also

expanded the institutional context in which scientific careers develop and offers scope for some to craft entrepreneurial careers.

The next section presents the conceptual framework, followed by the empirical context, and the research methods and data. The article then presents the findings on how young scientists' psychological contracts evolve over time and their divergent career behaviours. It concludes by discussing the theoretical and practical significance.

The conceptual framework

The psychological contract and unmet expectations

Rousseau (1995) defines the psychological contract as an individual's belief regarding the terms and conditions of exchange between themselves and the employer. It emerges when individuals believe their employer has promised future benefits in exchange for their contribution. Social exchange theory posits that balance in exchange relationships is expected (Blau, 1964) and therefore unfulfilled promises made by employers can adversely affect employees' attitudes and behaviours (Robinson et al., 1994). The term psychological contract breach is commonly used to describe both employees' beliefs that their employer has failed to fulfil its promised obligations and the resulting negative reactions (Morrison and Robinson, 1997). A large body of research has shown that when promissory expectations are unfulfilled, employees are likely to experience negative attitudes (e.g. mistrust and reduced commitment) and work behaviours (e.g. poor performance, absenteeism and turnover) (Conway et al., 2011; Zhao et al., 2007). It stresses employee disengagement and focuses predominantly on organizationally relevant outcomes, leading to a relative neglect of research on individuals' career adaptive

behaviour. One exception is the work of Sturges et al. (2005; 2010), which examines how psychological contract fulfilment or breach in terms of perceived organizational support and leader-member exchange affects employees' career self-management behaviour. According to the authors, high levels of perceived organizational support and leader-member exchange encourage employees to engage in internal career self-management, whereas its absence is associated with external career self-management. Although this work shows the link between the psychological contract and career self-management, it stresses organizational commitment as a mediating factor. As such, employee career behaviour is viewed as reciprocation to the employer's action rather than as self-directed.

The psychological contract literature often portrays employees as victims when career promises are broken. It overlooks individual proactivity in career shaping (Seeck and Parzefall, 2008). This is somewhat surprising given that the psychological contract has been regarded as one of the most useful concepts for understanding contemporary employment relationships where the breakdown of the 'old deal' based on stable organizational careers is seen as giving way to a 'new deal' characterised by greater reliance on individual initiative (Briscoe et al., 2012; De Vos and Soens, 2008). Rousseau et al. (2006) draw attention to the growth of idiosyncratic deals where individual employees negotiate with an employer to adapt work arrangements to their needs and work preferences. The notion of 'boundaryless careers' (Arthur and Rousseau, 1996) highlights a wider range of career forms beyond a single organization, the scope for choice and proactive role of individuals in managing their own careers. Further, Briscoe et al (2012) argue that employees' self-directed protean attitudes may motivate them to engage in active coping strategies in uncertain contexts. One can expect greater

use of career agency in professional knowledge work wherein employees have a high degree of work autonomy and are more likely to assert their preferences and professional goals (Hall and Chandler, 2005).

Although some scholars have argued that individual agency has been over-emphasized in the contemporary career literature (Inkson et al., 2012), it has deep roots in career studies. In vocational psychology, Super's (1981) career development theory and Lent and colleagues' (Lent et al., 1994; Lent and Brown, 2013) socio-cognitive career theory emphasize individual proactivity in career development. Scholars who adopt a sociological perspective suggest the possibility for individuals to draw on interpretive schemes, resources and institutional norms for enacting careers in novel ways despite institutional constraints (Barley, 1989; Duberley et al., 2006). The neglect of career agency in psychological contract theory has limited our understanding of how individuals' work situations and preferences influence their psychological contracts and responses to unfulfilled expectations. It also restricts the scope of the theory to explain the differential effects of unmet expectations and the possibility of more proactive responses.

Three dimensions of career agency: objective, subjective and projective

A central question in career studies is whether careers are the outcome of individual action or social structures. Career scholars have called for a balanced perspective by incorporating both. For example, Dany et al (2011: 972) note that the contrast between the bounded and boundaryless career is simplistic in its viewpoint regarding individual agency and structures, and they propose 'an alternative approach that accounts better for

the simultaneous influences of both individual choices and environmental constraints on careers'. Tams and Arthur (2010) suggest an 'interdependent' perspective for reconciling the independent (individual agency) with the dependent (structural constraints) conceptualization of career agency. This study goes beyond the duality argument to explain how and why individual agency varies in extent and form. It conceptualizes career agency as comprising three elements: objective (socio-relational), subjective (socio-cognitive) and projective (temporal orientation). It postulates that individual agency is relationally and temporally embedded, and that socially patterned selves (e.g. motivations and preferences) and their temporal orientations interact within relational contexts to shape agentic orientations and behaviours.

From an 'objective' perspective, agency concerns the capacity to exert some control over social relations in which one is enmeshed. It arises from actors' control of resources and knowledge of schemas which endow them with the capacity and power to act (Sewell Jr, 1992). In career terms, it refers to individuals' ability to mobilise the necessary resources for career development and actions taken to eliminate environmental constraints to realise their career goals. The notion of career self-management emphasises the control-producing responses of employees to career threats (King, 2004). It involves the execution of various types of control behaviours including: influencing the decisions of key gatekeepers (Judge and Bretz Jr, 1994), positioning oneself for job mobility through investment in human capital and developing networks (Fugate et al., 2004). Similarly, the concepts of 'job crafting' (Wrzesniewski and Dutton, 2001) and 'role innovation' (Nicholson, 1984) emphasise the proactive role of employees in changing the

task and relational boundaries of their work that, in turn, shape their own role requirements and career trajectories.

Agency also entails a 'subjective' component because cognition, motivations and preferences influence action and outcomes. Bandura's (2001) socio-cognitive theory of agency emphasises the self-directedness of action driven by agents' motivation and efficacy beliefs. Research which informs our understanding of career agency from a subjective perspective points to the role of self-efficacy and outcome expectations in career development (Lent et al., 1994), and the influence of self-defined goals (Hall, 2002) and work identities (Ibarra 2003) on how individuals enact careers and respond to barriers. Schein's (1996) notion of 'career anchor' suggests that higher order goals (e.g. possession of a vocational 'calling') drive and constrain individuals' career choices. Arguably, professional knowledge workers are more likely to exhibit a 'calling' work orientation and attach greater importance to subjective career success (Hall and Chandler, 2005). By linking agency to identity and self-actualization, the subjective perspective of career agency accords individuals a much higher degree of psychological autonomy than is often assumed in psychological contract theory.

Agency is also temporally embedded and has a 'projective' dimension in that imagining possibilities for future action may regulate and motivate current behaviour. Bandura's (2001) notion of 'forethought' highlights the temporal extension of agency and suggests that goals operate principally through people's capacity to represent symbolically desired future outcomes. Emirbayer and Mische (1998: 963) conceptualize agency 'as a temporally embedded process of social engagement, informed by the past, but also oriented toward the future and toward the present'. Although they assert that

actors are always living simultaneously in the past, future and present, it is possible to speak of one element being predominant. For example, Tomlinson et al. (2013) show that the career strategies developed by legal professionals were distinctive in terms of their temporality: whereas recently qualified lawyers engaged in more projective, future-focused strategies, older lawyers adopted a compromise strategy. The temporal perspective highlights the projective capacity of human agency, which can powerfully influence individuals' ability to make choices at turning points. Sullivan and Arthur (2006) contend that individuals' 'psychological mobility', defined as the capacity to move on, may influence their response to career interruptions. Further, the notion of 'future work selves' (Strauss et al., 2012) suggests that actors' beliefs about future possibilities or cognitive representations of who they would like to become can provide motivational resources for current agentic choices.

Individuals exercise different degrees and forms of agency which may result in different behavioural outcome. Agency can be more, or less, socially mediated or self-referenced and it may have a stronger focus on the present or future. Bandura (2001) distinguishes 'personal' from 'proxy' agency: the former is rooted more strongly in people's efficacy beliefs and aspirational pursuits, whereas the latter relies on others to act on one's behalf to secure desired outcomes. These two modes differ in their interaction with structural conditions and engagement with future possibilities. Actors who display personal agency regard structural conditions as resources and seek to exploit them for self-development and the creation of new possibilities. It enables temporal extension of agency through intention and forethought. In contrast, proxy agency involves the strategy of influencing those who control the structures to secure the needed

resources. It relies on social efficacy for enlisting the mediative efforts of others, which may result in increased dependency and diminish self-efficacy and capacity to engage imaginatively with future opportunities.

Social exchange, the psychological contract and career agency

This study extends the psychological contract framework by incorporating career agency for understanding variation in employee responses to unmet expectations. At present, the main sources of variation are seen as contingent on the quality of exchange relationships. Typically, psychological contract theory concerns breach in relation to relational or transactional exchange. It is commonly argued that relational exchange allows actors to be more trusting of one another whereas transactional exchange tends to be more *quid pro quo*; therefore, when the exchange is transactional employees are more likely to perceive unmet expectations as psychological contract breach and respond more intensely and negatively (Morrison and Robinson, 1997).

The agentic perspective argues that types of exchange not only influence individuals' perception of unmet expectations, but may also endow them with varied relational and cognitive resources for the enactment of agency. Uehara's (1990) dual exchange theory links forms of social exchange with the dynamics of social support and exchangers' resource mobilization strategies. It distinguishes two types of social exchange - 'diffuse' and 'restricted' - that vary in their norms and degree of relational embeddedness. Diffuse exchange is governed by reciprocity and is embedded in dense networks of social relationships in which particularistic and symbolic resources (e.g. emotional support and status) are exchanged in addition to tangible resources (e.g. money and labour). It

engenders a high degree of solidarity and individuals are more likely to mobilize relational resources for problem solving. By contrast, restricted exchange is more dyadically-based and involves specific relationships in which tangible resources are exchanged in a negotiated fashion. It is characterized by a higher degree of accountability in each partner's behaviour and partners tend to be more guarded in their transaction. Individuals in restricted exchange do not enjoy the same kind of social support as in diffuse exchange. They tend to be more self-reliant and may draw on personal resources for problem adaptation. Accordingly, we expect individuals involved in different exchange relationships to develop different agentic orientations and resource capacities.

Forms of exchange, notably supervisory and mentoring relationships, can also affect career agency through socialization and learning which provide individuals with cognitive resources and competences for career development. The psychological contract literature stresses the influence of supervisory support on organizational commitment, which mediates the effects of psychological contract breach on individuals' responses (Sturges et al., 2010; Zagenczyk et al., 2009). The agentic perspective argues that individuals' career goals and professional self-identity can also powerfully influence their career behaviours. Mentoring exchange can influence individuals' career orientations and identity construction through role-modelling and socialization. Gibson (2004) distinguishes 'global' and 'specific' role modelling, which differ in the extent to which individuals acquire a wide or narrow set of traits associated with a role model. The former may result in fuller socialization and individuals may develop a custodian role orientation and job commitment, whereas the latter may result in partial socialization and individuals may develop more varied career orientations. Thus, whether individuals

engage in internally- or externally-oriented career self-management may reflect their career preferences and not simply organizational commitment.

The psychological contract literature has focused predominantly on how employees' perception of breaches of past promises made by employers affects their attitudes and behaviours. The agentic perspective directs attention to how individuals' future time horizons and projective capacities affect their career behaviours. The psychological contract evolves over time. Its direction of change and how individuals react to unfulfilled promises are influenced not only by their assessment of past or present experience but also by the anticipation of future benefits (Ng and Feldman, 2012). Some employer obligations (e.g. career development and job security) may be on-going and may not be perceived by employees as fully discharged at any particular point in time (Coyle-Shapiro and Kessler, 2002). Individuals may reciprocate future benefits as a way of creating a positive imbalance in the exchange to ensure the realization of future benefits (Blau, 1964). Individuals at early or transitional career stages are more likely to reciprocate anticipated future fulfilment of promises than those in late careers. Moreover, their capacity to envision alternative options may also influence career behaviours.

The conceptual framework situates individuals' psychological contracts within types of exchange that create variability in agentic orientations and capacities, and hence different responses to unmet expectations.

The empirical study

Young scientists in the entrepreneurial university

University scientists provide an ‘extreme case’ (Eisenhardt, 1989) for examining career agency in its three constituent forms. Compared to other workers, they enjoy great autonomy in their work and possess considerable knowledge resources which give them much control over their work relationships and environments. ‘Objective’ career agency should be quite visible in their work. Moreover, scientific researchers are often strongly committed to their work and anchor their self-identity in their profession (Henkel 2005). For many, science is a ‘vocation’ (Weber, 1958) imbued with personal and social meaning. Hence, ‘subjective’ agency can also be central to their career actions. We focus on early career scientists in order to examine the ‘projective’ dimension of career agency. Academic careers in natural sciences are marked by distinct stages and place great emphasis on the attainment of benchmarks at each stage. A conventional career path involves a doctoral qualification followed by a postdoctoral phase which serves as a critical transition to standard academic employment. Actors at these transitions generally exert greater agentic effort than at other times (Hitlin and Elder, 2007).

The entrepreneurial university provides an excellent context for exploring the changing dynamics of psychological contracts and career behaviours of young scientists. In traditional scientific careers, training follows a ‘master-apprentice’ relationship between professors and young scientists which is governed by the norm of reciprocity embedded in the scientific community (Long and McGinnis, 1985). Young scientists are ‘apprentice-learners’ who provide research assistance in return for mentoring and career support. The rise of academic entrepreneurialism with its emphasis on the dual role of professors as scientist-entrepreneurs is altering these relationships (Etzkowitz, 2003). Professors who are heavily engaged in industrial projects often need a large army of

doctoral students and postdoctoral researchers. These young scientists, with their short-tenure and complementary research skills, provide a flexible and highly trained workforce for the academic laboratories. The entrepreneurial university may transform young scientists from ‘apprentice learners’ into ‘research workers’ or even ‘business partners’ in commercial ventures. Intense industrial engagement may also restrict their scientific development and diminish their chances of permanent academic positions. Many are likely to find their academic career expectations unfulfilled and may seek to re-craft their careers.

Exchange relationships between professors and young scientists: Collaborative research versus commercial engagement

This study distinguishes two types of industrial engagement: collaborative research and commercial ventures. They entail different exchange relationships between professors and young scientists, and provide different socialization and learning opportunities. Collaborative research is an open-science channel of industrial engagement governed by an established academic framework and scientific norms of exchange. It is a relational-based, diffuse exchange relationship that builds on the flow of knowledge resources between the parties involved. Involvement of young scientists need not undermine the professors’ teaching/mentoring role (Bozeman and Corley 2004). Indeed, the provision of funding resources may reinforce mentoring and generate a cooperative exchange. Commercial research, by contrast, is governed by the norm of proprietary science with the aim of generating specific outputs that can be appropriated for financial gain (e.g. patenting and spin-off company formation). Industrial sponsors may restrict open

dissemination and publication. The relationship is governed by negotiated rules and it involves flows of financial resources in addition to knowledge. Commercial engagement adds a transactional element to the master-apprentice relationship. The interface is more dyadic and occurs at the boundary between science and business. The role of the professor as business person/entrepreneur may conflict with that of teacher/mentor (Mars et al., 2008). Commercial engagement exposes young scientists to greater scientific career risks while also providing opportunities for entrepreneurial learning (Azoulay et al., 2009).

These two types of activities display the different norms and structures governing the exchange between young scientists and professors. Collaborative research represents diffuse exchange whereas commercial engagement entails restricted exchange.

The psychological contract and mutual obligations: From training to employment

The psychological contract framework can be readily applied to the relationship between young scientists and professors where research collaboration builds on an exchange based on a shared understanding of mutual obligations (Wade-Benzoni et al., 2006). In this article, the concept is employed to examine the perceptions and expectations of young scientists regarding training and career development. It adopts the widely used distinction between 'relational' and 'transactional' contracts (Rousseau, 1995). The former entails broad relationships in which obligations are both economic and socio-emotional, whereas the latter is composed of obligations that are more specific and economic in nature based on limited involvement of the parties.

We examine young scientists at different stages of their careers: doctoral students, and junior and senior postdoctoral researchers. The first two categories are primarily student/learners in training, whereas the last category refers to more experienced researchers in contract employment beyond the initial training period. Although the transition from training to employment is gradual, the psychological contract governing the two differs. In a training context, the mutual obligations between professors and young researchers are loosely specified in an open, mentoring exchange. Doctoral students and junior researchers are at the beginning of their research careers and the acquisition of knowledge and skills for their future careers are central to their psychological contracts. Moreover, given the imbalance of knowledge and power between the two parties, the expectations for exchange symmetry may also be low. The psychological contract is a nascent one, developing but not fully formed. In an employment relationship, the interface between the two parties builds on a more developed psychological contract. Professors, as principal investigators and laboratory managers, are the primary contract makers responsible for the performance and career development of postdocs. Postdoctoral researchers usually aspire to an academic career and see the position as a bridge towards tenured posts. They depend on their professors for career support in return for their cooperative efforts. The academic career promise looms large in their psychological contracts.

The empirical study examines the shift in the young scientists' psychological contracts as they progress from student-learners to postdoctoral researchers and their related career behaviours. We expect young scientists engaged respectively in collaborative and in commercial research to respond differently to unmet career

expectations owing to the different relational contexts in which their psychological contracts evolve and the corresponding resource opportunities and constraints.

Research methods and data

Data collection

Primary data collection involved semi-structured interviews with 40 academics from three major UK research universities, covering the disciplines of biological, computer/engineering and physical sciences where academic entrepreneurialism has been actively pursued. The sample comprises 24 doctoral students/postdocs and 16 professors of whom 13 were supervisors of these young scientists. Given our focus on exchange relationships, we conducted individual interviews where possible with matched pairs of professors-students/researchers. In some cases, we interviewed more than one researcher linked to the same professor. Of the 24 students/postdocs, we were able to interview the corresponding professors in 20 cases. The sample was purposively selected to examine the relationships between professors and young scientists engaged in collaborative research and commercial ventures. We searched the webpages of the relevant departments and examined closely the CVs of professors and identified those with extensive industrial links. The professors interviewed were established academics in their fields and had been involved in industrial links for a substantial period. The doctoral students and postdocs, who had close involvement in their professors' projects, were identified either from the interviews with the professors or through web searches.² Among the 24 young scientists interviewed, 15 were involved in collaborative research and 9 were engaged in commercial projects. These two groups gave us two distinct

windows through which to observe the different exchange relationships with their professors.

The young scientists comprise 6 doctoral students (mostly in their final years), 7 junior postdocs (in their first or second employment contracts) and 11 senior postdocs (three or more contracts) who had been working as contract researchers for the duration ranging from 10 to 23 years. The post-doctoral period provides a transition during which recent doctoral graduates invest in further training. In the analysis, we grouped the junior postdocs with students into one category to indicate their 'trainee' status and distinguish them from experienced postdocs. The sample composition introduces a temporal dimension to the data needed for understanding how accumulated experience affects psychological contracts. The time perspective was also facilitated by using the retrospective accounts of the individuals' career histories, and subsequent tracking of their career moves based on web searches. The interviews were conducted during 2006-07 and we tracked the careers of the young scientists until 2012.

Although we modified the interview questions during the course of data collection to take advantage of emerging themes, each interview covered a set of common questions on the following areas: training experience and career history, work roles and relationships, involvement in their professors' research and industrial activities, learning experience, work motivation, career expectations and preferences (before and after doctoral training, and at the time of the interview), perceived mentoring and career support; perceived future prospects and career development activities. For the interviews with the professors we asked about their industrial activities, funding sponsorships for students/ postdocs, the role of these young scientists in their laboratories, and evaluation

of the influence of industrial engagement on their role as mentors/supervisors.³ Three-quarters of the interviews were conducted jointly by the authors, one of whom was a professor and the other, a doctoral research assistant at the time. The presence of two researchers in different roles should minimize possible bias in data collection. Each interview lasted for about 60-90 minutes and all were recorded and transcribed verbatim.

Table 1 shows the profiles of the 24 students/postdocs and their corresponding professors.

Table 1 about here

Data analysis

The analysis was guided by the broad framework derived from the literature but firmly rooted in the grounded theory tradition that involves analytic induction and deduction (Strauss and Corbin, 1998). We went through three main stages of iteration by moving back and forth between the data and concepts (Eisenhardt, 1989). First, we used open coding to develop first order codes and provisional categories. We used a coding summary sheet for each respondent to record their views and responses. It became clear early on that there were significant differences between the experiences of the young scientists engaged in collaborative research and commercial ventures. The former generally reported positive relationships with their professors, whereas the latter experienced tension. It was also notable that the differences became more apparent as respondents progressed from students/junior postdocs to senior postdocs.

In the second stage, we conducted more systematic comparisons of the two groups by returning to the transcriptions and the literature. When analysing their relationships with

the professors, where possible we adopted a dyadic perspective by incorporating the views of the professors. We extracted all the interview quotes relating to the attitudes and feelings of both parties towards each other, and any incidents or events that appeared to have influenced their perceptions of the relationships. We inferred the properties of the exchange relationships based on the assessments of both parties, and those of the psychological contracts based on the perceptions of the young scientists. This analysis allowed us to detect the variation in the psychological contracts and career behaviours between the young scientists involved in the two types of exchange. Two distinct patterns emerged: those involved in collaborative research continued to invest in their relationships with the professors despite the uncertainties, whereas those engaged in commercial ventures showed a desire to exit the relationship and proactively sought career opportunities outside academia. At this point, we returned to the literature and looked for relevant concepts to capture the divergent career behaviours. We used the term 'extended investment' (van Dam, 2005) to describe the former and 'career crafting' (Wrzesniewski and Dutton, 2001) to describe the latter. We returned to the data to identify the key factors and relational processes that were connected to these two distinct patterns of agentic behaviour. We extracted the relevant evidence and quotes illustrating career agency and matched them with the three constituent elements: objective, subjective and projective.

In the final stage, through writing draft versions and revisiting the literature, we refined our understanding of the connections between the conceptual categories and developed a model to explain the relationships between forms of exchange, psychological contracts and career agency. For example, the model suggests that diffuse exchange

engenders a relational psychological contract and encourages proxy agency, whereas restricted exchange creates a transactional psychological contract and induces personal agency. Once we had identified this pattern, we re-examined the data to check for the accuracy and consistency of our interpretation.

In what follows, we present the two main findings. First, we discuss the divergent patterns of relationships and show how the young scientists' psychological contracts evolve over time. Second, we look at how the two groups enact career agency and respond to unmet expectations by taking two different courses of action: 'extended investment' versus 'career crafting'.

Young scientists in collaborative research and commercial engagement:

Relationships with professors and the psychological contract

For analytical purposes, we classify the young scientists into four categories labelled as 'learner', 'worker', 'extended' and 'runaway' apprentices.⁴ This categorization is based on two dimensions: mode of industrial engagement (collaborative vs. commercial) and career stage (students/junior postdocs in training vs. senior postdocs in employment) (Figure 1). The terms 'learner' and 'worker' are used to indicate the relative dominance, respectively, of scientific research and commercial work in the training and early socialization of students/junior postdocs. The 'learner apprentices' (8 cases) are the students/junior postdocs involved in collaborative research which forms an integral part of their scientific training. The 'worker apprentices' (5 cases) are those who conduct research in their professors' commercial laboratories that may or may not be directly related to their scientific training. The term 'worker' denotes the prioritization of

commercial work over scientific training.⁵ For the senior postdocs, we use the labels ‘extended’ and ‘runaways’ to represent whether they are seeking to remain in academic employment or not. The ‘extended apprentices’ (7 cases) are the senior postdocs involved in collaborative research well beyond their initial training but who displayed strong commitment to their jobs and relationships. The ‘runaway apprentices’ (4 cases) refer to those involved in commercial activities who experienced considerable strain in their relationships with the professors and subsequently sought to break away.

The analysis shows that those engaged in collaborative research held a ‘nascent’ relational psychological contract while they were ‘learner apprentices’ which developed over time into a ‘strong’ one experienced by the ‘extended apprentices’ who continued to cooperate with their professors in the face of career uncertainty. By contrast, the ‘worker apprentice’ involved in commercial activities showed an emerging quid pro quo mentality; the transactional tone of the psychological contract became more apparent among the ‘runaways’ who sought independence by exploring alternative career options.

Table two about here

From ‘learner’ to ‘extended’ apprentice: Diffuse exchange and relational psychological contract

The relationship between the learner apprentices and their professors resembles the traditional ‘master-apprentice’ model of reciprocal exchange where flows of knowledge, provision of funding and socio-emotional support create a social bond between them. The interviews suggest that professors with extensive industrial links were often regarded as

‘strong mentors’. Their laboratories were usually well-funded and they were in a position to provide collaborative opportunities to the learner apprentices who reported positive learning experiences and mentoring support. For example, a recent doctoral graduate described his professor as ‘very supportive and at the same time honest and guiding...’ (case 5). Another saw his professor’s reputation and contacts as important assets for his future career:

‘I think Prof X is a very effective academic... He has been extremely good at producing opportunities for me, first of all he has been very good at getting me the money to do this PhD. And he has got me involved with this project work... *who knows he might create more opportunities for me in the future in terms of helping me to secure a permanent position on my PhD*’ (case 3; emphasis added).

Although the ‘learner apprentices’ are the dependent partners, they are not passive recipients of mentoring support. They provide research assistance in return and help in networking with firms. One of the professors (D) described the links between his doctoral students and industrial networks as a kind of ‘food chain’ because many of his industrial contacts were his former students. Another stressed the importance of having ‘good relations’ with his students/researchers and getting them ‘good jobs’ for the benefit of future collaboration (Professor B). Thus, in the truest sense of an exchange relationship, both parties are dependent on each other for valued resources and support. This anticipation of future contributions and fulfilment of obligations building on the norm of reciprocity is indicative of a relational psychological contract.

For those who aspired to an academic career and continued as postdocs beyond the transitional phase, the relationship with their professors evolved from reciprocal dependence to reciprocal inter-dependence as they took on more laboratory duties. The seven extended apprentices interviewed had been involved in long-standing collaborative research with their professors and reported having trusting relationships. Over the years, the scope of their responsibility expanded from scientific laboratory work to cover a wide range of technical (e.g. grant writing and supervision of doctoral students) and non-technical support tasks (e.g. laboratory administration). They were compliant and willing to go an extra-mile to help their professors and worked flexibly across different projects in return for collaborative opportunities and career support. For example, two who were publicly funded quite happily provided 'free labour' to work on their professors' industrial projects. One stressed the 'symbiotic relationship' with his professor:

'I realised that, you know, he would be instrumental in allowing me that chance to develop so I've never felt restricted in any of my research whilst I've been doing it... I have a commitment to make sure I deliver on what we need to do, you know. And to be absolutely honest you often, hopefully, deliver far more than you're asked to do...' (case 15).

Another described himself as the 'pseudo principal investigator'. He wrote the proposals, supervised the doctoral students and wrote the reports while the professor remained as the formal principal investigator. He reckoned this was 'quite good training because hopefully in the not too distant future I'll be in a position of my own...' (case 14).

The professors also recognised the value of these experienced postdocs and had strong incentives to retain them. The following remark is illustrative: ‘They know the work and they know the system. They are experts. And the temptation is to try and retain them’ (Professor H). Although some expressed concern about the lack of long-term career prospects for the postdocs, many also felt obliged to get more grants to maintain the staff in their labs. In line with Blau’s (1964) social exchange theory, the evidence suggests that both parties strived to create a positive balance in the exchange by engaging in a cycle of conferring benefits on each other. This leads to increased mutual dependency and further strengthens the extended apprentices’ psychological contracts. One, for example, commented on the mutuality of the relationship: ‘I was happy to stay and they were keen to keep me so...’ (case 15). Another said, ‘He wouldn’t look after me if I wasn’t worth being looked after. So it is a mutual thing...’ (case 20). The professor (A) who employed this researcher described him as ‘absolutely invaluable’.

However, the extended apprentices expressed pessimism about the possibility of securing a permanent position, unlike the optimistic learner apprentices. Several pointed out that the short-duration of employment contracts and fragmented nature of research had made it difficult for them to build up their own research profiles. Some felt that prolonged postdoctoral employment had significantly reduced their chance of obtaining permanent positions and closed alternative options. A sense of insecurity and disappointment permeated the interviews. One lamented: ‘... there are no guarantees, each time you keep wondering why you’re doing it because of that uncertainty, so I think I am getting too old to carry on being somebody else’s research postdoc...’ (case 15). This sentiment is echoed by another: ‘I am not exactly sure how the future is going to go...’

(case 14). Some in their late careers concluded that they were unlikely to realize their intended career goals but took comfort from being able to remain in academia (cases 16, 17 and 19).

The extended apprentices appear to have become trapped in perennial temporary employment. However, they remained committed to an academic career and their intrinsic interest in research did not seem to have diminished over time. Many reported high job satisfaction. Case 14 quoted above said, 'I love my job. I enjoy being here and I think it is a good lab'. Case 15 expressed his commitment to the university and affective regard for his professor: 'I'd be happy to commit my sort of medium term to University X ...because I'm excited by the work that I do, you know professor H is a great colleague, a great collaborator...'. These postdocs have clearly developed strong commitment to their jobs and socio-emotional ties with their professors. Their work commitment and perceived continuity of the relationships are indicative of a strong relational psychological contract.

From 'worker' to 'runaway' apprentice: Restricted exchange and transactional psychological contract

Those engaged in commercial activities reported greater tensions. Among the five worker apprentices interviewed, two were doctoral students part-funded by their professors' spin-off companies (cases 9 and 10). Others were paid wages as contract researchers (cases 12, 13) to conduct relevant research for their professors' commercial projects. One publicly funded junior postdoc (case 11) worked alongside other privately funded researchers but without any additional compensation. In all but one of the cases, the industrial sponsors

were the professors themselves who had dual roles as teachers/mentors and managers/business entrepreneurs.

The ambiguous boundary between ‘academic’ and ‘commercial’ research generated various conflicting obligations for the professors. One commented on the complex role relationships with his student with whom he had co-founded a company: ‘There was a time in which he was both my Co-Director and an employee and a student, so I had a relationship with him at all of those levels and had to be very careful about making quite sure that that was dealt with appropriately...’ (Professor C). Others felt the overlap between academic and commercial research was convenient for flexible utilization of student researchers. For example, one professor who had employed a doctoral student to provide part-time technical support in his company, joked about the fact that the amount of time the student could be expected to spend on company activities could be ‘anything between 0-100%’ because of the co-location of the two activities.

The interviews reveal ample evidence of what might be considered as ‘labour’ and ‘intellectual’ exploitation of junior researchers (Slaughter et al., 2002). The worker apprentices reported long working hours and having to perform a wide range of additional support tasks (e.g. patent search, testing prototypes and IT support) related to their professors’ commercial projects. One expressed his discontent: ‘I worked incredibly long hours and I used to run all the computers for them... I wasn’t paid to do that at all’ (case 13). The classic problem of publication restriction was reported by all the interviewees who could not freely disseminate their research results until the patents were issued. None of them had a share of patent ownership generated from the research. Although patent ownership did not appear to be a major issue for them, they were aware

of the potential financial returns based on the collective research outputs. One junior postdoc (case 11), for example, talked about the ‘dollars’ that the professors were getting and was adamant that she was not offered any company shares despite the ‘extra work’ that she had to do for the company. One doctoral student, who co-founded a company with his doctoral supervisor and another professor, complained that the distribution of the company shares did not fairly reflect his contribution:

‘Now, as it turns out for years this equity style does not reflect equal involvement with the company. Me, I am doing almost all of the work. Professor C contributed a little bit but Professor Y was so busy with his other interests that he had time to contribute with nothing. So I wouldn’t say that the structure is very equitable anymore...’ (case 9).

Perceived unequal exchange may prompt a more vigilant and transactional attitude (Morrison and Robinson, 1997). There is evidence of a quid pro quo mentality developing among the worker apprentices. The aforementioned doctoral student (case 9), for example, negotiated for the position of ‘technical director’ in the co-founded company in return for overseeing technological matters. The junior postdoc (case 11), also quoted above, subtly voiced her discontent by pointing out to the professors that it was not within her contractual terms to work for the spin-off company. These incidents suggest the tension lurking within the cooperative relationship. However, in an unequal dependent relationship, the weaker actors cannot afford to adopt too tough a stance. These young scientists may have displayed occasional discontent but were mindful to

avoid overt conflict. Moreover, it also appears that the perceived unfair exchange was offset by the commercial learning opportunities. For example, the same student (case 9) who complained about inequity in share distribution emphasised his positive learning experience and believed that the commercial expertise and contacts acquired would be instrumental for his future career: 'The experience and contacts are worth more in the long term... You know as soon as you're introduced to contacts, they are your contacts, you can then use them to your own career' (case 9). Thus, what may seem like 'exploitation' to an outsider could be seen as 'investment' for one's own career future.

However, the senior postdocs in this category were far less upbeat, reporting growing tensions in the relationships with the professors. The perceived unequal exchange and psychological contract breach ultimately triggered their desire to break away. The four cases of 'runaways' interviewed had been closely engaged in their professors' commercial activities for a substantial period and emphasized the strong influence of the professors on their research and career trajectories. For example, one recalled how his doctoral proposal was 'written up as a paragraph' by his supervisor which subsequently became a component of the research leading to a spin-off company (case 23). He went on to explain, with a sense of resentment, how his supervisor 'persuaded' him to take on three successive postdoctoral contracts with a view that 'I could make it through the academic career path because I would be recognized for my input there'. Similar stories were told by two other postdocs about how their careers had become intertwined with their professors' research and commercialization activities. Cases 21 and 22 followed their professors' job moves to the present universities for project and employment continuity.

The interviews suggest that professors who were heavily engaged in commercial activities relied on the experienced postdocs not only for resolving their ‘time squeeze’ problem but also for risk sharing. Involvement in commercial ventures means less time for academic research. Moreover, company formation is a high risk activity and some of the professors sought to reduce personal risks by delegating the key commercial responsibilities. One of the professors, for instance, stated in the interview that he was ‘fighting not to be a director’ at the time when the company was set up because he felt that he was ‘wearing two hats at all stages’ and ‘had too many responsibilities’ already (Professor F). In the end, the main coordinating role was taken up by the postdoc (case 23). The same applies to another postdoc (case 21) who was initially Chief Scientific Officer and later took over as CEO of the company which he co-founded with his professor. As these postdocs assumed more responsibilities and the interface with their professors became dominated by commercial projects, the relationships took on a stronger instrumental tone.

There is evidence of strengthening of the transactional elements among the postdocs’ psychological contracts. This is manifest in growing vigilance about unfairness in the exchange, equity sensitivity and greater outcome concerns with a sense of entitlement to more benefits and repayment for their contributions (Morrison and Robinson 1997). The interviews reveal three factors underlying these developments. The first is that the postdocs had become more ‘powerful’ employees and sought greater recognition for their contributions as they acquired technical expertise and entrepreneurial acumen. The three postdocs who remained in the relationships at the time of interview believed that their contributions to the work of their professors far outweighed the benefits that they had

received. One expressed his acute awareness of the unequal exchange and the need to be vigilant:

‘You know he has benefited more from me than I have from him, Definitely... Well he has got two strands to his research group, bio-responsive polymers and everything else, and the bio-responsive polymers count for over half of his research but done by me. And one of the reasons that I was looking to get out of university... I mean this is true I would say of every postdoc that they have been undervalued, under appreciated, certainly underpaid... if you are not very careful about it then you end up losing out...’ (case 21).

Another talked about the competitive tension in the relationship with his professor as he sought a more equal partnership:

‘I think he had a vision of me as being somebody whose role was to provide him with support... But I got to the point where I wanted to stand on my own two feet... to have my own networks and grant writing, and he found that very, very difficult... He wanted to keep me as a support and I wanted to build myself up and build my own pyramid’ (case 22).

A second factor underlying an instrumental turn in the relationship is the frequency of disputes over the share of financial rewards. For example, case 21 whose relationship with his professors was clearly under great strain, described an incident which led to the

dramatic deterioration of their relationship:

‘He is a user basically ... Well yes, and he thinks he is doing you favours... But on the other side on the consultancy work that we do with Company X for example, you know the amount of money that he actually pays me compared to what we are actually getting for the contract it just – you know it is totally opposite to that...*It was a good relationship up until the Company X situation and then he basically ripped me off big time and that really probably destroyed eight years of a good relationship*’ (emphasis added).

Finally, the realisation that the academic career path might be closed to them further fuels the tension. Commercial engagement can easily jeopardize the academic career of young scientists by diverting their time away from scientific research and also dampen peer learning. Overtime, these postdocs perceived continued association with their professors’ commercial activities to incur high opportunity and investment costs, and sought to redefine their roles. Having worked hard on their professors’ projects and compromised their own research, the realisation that their contributions might not be rewarded in career terms aroused feelings of injustice and betrayal: ‘There has been very little interest in this department in terms of advancing my career. In fact there is none. They have actively blocked it...’ (case 21). This quote is indicative of the emotion of anger and outrage associated with psychological contract violation (Morrison and Robinson 1997).

Psychological contract theory suggests that individuals within transactional relationships are more likely to perceive unmet expectations as psychological contract

violation, which involves not only attitudinal reactions but also a readiness for action (Morrison and Robinson 1997). Postdocs who believed that their professors had failed to meet their obligations and found the option of an academic career closed sought remedial action. At the time of the study, one postdoc had gained independence by obtaining a five-year personal fellowship (case 24), and the three who remained in the relationships were planning their 'escape routes'. One declared that he no longer wanted an academic career and channelled his effort into the spin-off company as an avenue for future employment (case 21). Another actively pursued consultancy to build his 'portfolio' career (case 22). The third postdoc (case 23) negotiated a 'special deal' with his department enabling him to be on half-time secondment to the spin-off company while retaining his research position. These examples illustrate the active role of the runaways in career-shaping and gaining autonomy.

Unmet expectations and career agency: 'Extended investment' versus 'career crafting'

The contrast between young scientists engaged in collaborative research and those in commercial ventures is striking. Both experienced the frustration of unfulfilled expectations but each responded differently. The extended apprentices remained committed to an academic career and continued to invest in their existing jobs and relationships. We adapt Van Dam's (2005) concept of 'extended investment' to denote their affective and continuance commitment to present jobs and heavy investment in the relationships with their professors in order to oblige them to reciprocate. By contrast, the runaways' desire to pursue an academic career diminished over time and they sought

independence by exploring alternative options. We use the concept of ‘career crafting’ to emphasize their proactive stance in redefining their work and preparing for eventual job mobility. It builds on job crafting (Wrzesniewski and Dutton, 2001) and role innovation (Nicholson, 1984) theories which view employees as active agents who initiate improvements in their work situations to create new career opportunities.

Both courses of action entail career agency albeit in different ways. We argue that the divergent exchange relationships with their professors and the associated psychological contracts influence the young scientists’ agentic orientations and career actions. Diffuse exchange in collaborative research engenders a relational psychological contract and encourages ‘proxy’ agency, whereas restricted exchange in commercialization fosters a transactional contract and induces ‘personal’ agency. Whereas the former is associated with internally-oriented career self-management, the latter is related to an externally-oriented one. The actions of the two groups also display different temporal orientations: the extended apprentices focused on the continuity of the present, whereas the runaways sought to create future opportunities. The two distinct patterns are manifest in the objective, subjective and projective dimensions of the young scientists’ agentic orientations and behaviours.

Objective career agency: Relational versus personal resources

The extent to which individuals are embedded in networks of social relations influences their strategies for mobilizing relational or personal resources for problem adaptation (Uehara, 1990). Young scientists engaged in collaborative research were more deeply embedded in reciprocal exchange with their professors than were those involved in

commercialization, and thus the two categories drew on different types of resources to ameliorate career barriers.

The extended apprentices used an influencing strategy in order to garner the relational resources for ensuring career security. They stressed the importance of 'being cooperative', having a 'symbiotic relationship' with their professors and the 'support of peers' in order to advance their academic careers. Influence behaviours such as ingratiation or organizational citizenship behaviour are proactive tactics used by career aspirants to influence a particular other in order to gain approbation and enhance the probability of receiving desired rewards (Judge and Bretz Jr, 1994). Evidence of these includes performing extra-duties and doing favours by taking over some of their professors' teaching and administrative duties. One commented in the interview that these were considered 'any other duties' which was 'not an obligation and you don't have to do it all' but his professor 'is a busy chap and so we're contributing...' (case 15). Another said, 'there are things I don't want to do but I consider it within my job description to do them so I get on and do it to the best of my ability as always...' (case 14). He also quickly pointed out, 'you know, it is promoting my career as well'. These postdocs were willing to go the extra-mile and in some cases operated like 'helpers': 'you know, professor A says to me you sort that out and I will sort that out.... I'll do bits and pieces...' (case 20). By being exceptionally cooperative, they sought to induce a sense of indebtedness on the part of the professors and also make themselves indispensable. This supervisor-focused influence strategy is a form of 'proxy' agency whereby actors rely on the reward power of significant others to secure their desired career outcomes.

In contrast, the runaways relied on personal resources by actively engaging in job crafting and self-directed learning for enhancing their employability outside academia. Although commercial engagement had constrained their scientific training, it also provided them with opportunities to redefine their job boundaries which can be used as a means of acquiring new skills (Wrzesniewski and Dutton, 2001). Postdocs engaged in commercial ventures experienced greater freedom in their day-to-day work and had more opportunities for job crafting because they often worked outside the academic laboratories. Some initiated role transitions by gradually reducing the amount of laboratory research and allocating more time to supervisory tasks in order to acquire the managerial expertise needed for commercial careers. Others negotiated for special hybrid roles by combining research with commercial activities so as to keep future options open. One, for example, recounted how he went about crafting his own job by establishing a translational research unit linked to the start-up companies that he set up in parallel: ‘...you just write your own job description, just write exactly what you’d like to do and then take it to somebody and convince them that they really want somebody like that ...’ (case 24). Forming start-ups, which was initially used to offset employment insecurity, had subsequently become the focus of sustained learning and career building. One pointed out that he attended more business meetings than anyone else in the team because it was his goal ‘to learn as much as possible during this very lucky period...’ (case 23). Another exploited the ‘freedom’ of his commercial role to build extensive external contacts and acquired an MBA qualification to enhance his mobility preparedness (case 21). These are examples of career positioning and mobility-oriented behaviours (Fugate et al., 2004), preparing the individuals to act on alternative career opportunities. The

runaways are ‘career crafters’ who displayed ‘personal agency’ and took self-responsibility to open up new opportunities.

Subjective career agency: Internal versus external orientations

Individuals in both categories engaged in career self-management but the focus of their actions differed. The extended apprentices’ action was internally-focused, whereas the runaways’ was externally-oriented. Our analysis suggests that the divergent mentoring relationships and socialization influence their career preferences and actions taken.

Young scientists’ academic career aspirations can be strengthened or weakened as a result of early socialization. Professors, as mentors and supervisors, are the primary socialization agents who transmit scientific knowledge and professional values to young scientists through role-modelling and integrating them into the academic community.

Young scientists involved in collaborative research developed strong scientific and social bonds with their professors and academic peers, and were exposed more fully to ‘global role modelling’ (Gibson, 2004) and academic socialization. In addition to scientific knowledge, they acquired role expectations and academic ways of life which defined their professional selves. For example, one doctoral student commented: ‘I definitely learned an awful lot about the way academics work and what you are expected and required to do, to be a successful academic’ (case 3). For those who progressed to postdocs, their academic career orientation was strengthened. With the exception of case 20 who was a former industrial scientist, all the others aspired to an academic career when they embarked on their doctoral studies and this remained unchanged at the time of the interview. Despite career uncertainty, their intrinsic interest in scientific research

remained strong. For example, one said, 'I have never seemed to have lost my interest and motivation to do research' (case 15). Others stressed the 'intellectual challenge' of research (case 17) and 'the excitement that you are going to discover something new' (case 19) as the main motivational drivers sustaining them over the years. The extended apprentices sought to maintain their preferred jobs by engaging in internal career self-management. They risked becoming 'trapped postdocs' but their career actions were also guided by personal goals.

Those involved in commercialization were exposed to the kind of socialization which enabled them to develop more varied self-identities and career orientations that deviated from established norms. Commercial activities usually took place outside the academic laboratories which meant less opportunity for academic acculturation. However, these young scientists were exposed to the 'specific role modelling' (Gibson, 2004) of their entrepreneurial professors and had contacts with many non-academic agents (e.g. business partners and industrial researchers). The early imprinting of academic entrepreneurialism appears to have re-oriented their career aspirations from employment in academia towards start-ups or industry. Many pointed out that an academic career was what they had initially expected but having worked on commercial projects, they would now consider an industrial or hybrid career bridging science and business. One doctoral student said: '...the work that I did in the [spin-off] company might have changed my career expectations more than the PhD itself' (case 9). Previous research suggests that conducting commercial research during the formative years can significantly influence young scientists' motivation and academic identity (Hakala, 2009). The narratives in the interviews show the formation of an entrepreneurial role identity, most notably among the

postdocs. One declared, 'I am very comfortable with the entrepreneurial side of things...' (case 21). Another envisaged his future hybrid career: '...the way I am seeing my future I am going to say I've got these patents, I've got these publications, I've got these consultancies...' (case 22). Entrepreneurial career imprinting encourages these young scientists to explore new options by engaging in externally-oriented career activities.

Projective career agency: Present versus future

The career actions of the two categories also differ in their temporal focus and projective capacity. The accumulation of past experience and direction of change in their psychological contracts influence their future expectations and motivations for current agentic choices. The extended apprentices experienced a strong relational psychological contract and continued to invest in their work in anticipation of possible future benefits in the face of uncertainty. They did not regard employment outside academia as a viable option. For example, one said: 'There's none ... well there's nothing else that I could probably apply my skills directly to...' (case 15). Another echoed a similar sentiment: '...the expertise I have got isn't sellable. I can't go round ...' (case 20). The perceived inefficacy in pursuing alternative career options coupled with their commitment to academic research prompted them to act agentially with regard to temporally proximate goals in maintaining their current jobs. In doing so, they also increased their dependency on their professors and their encapsulation within the established system. Although happy to remain in their preferred jobs, the extended apprentices were saddened by the poor prospect for attaining their desired career outcomes. The following quote vividly illustrates this sentiment: '...I am happy, you know, I wouldn't recommend it to anybody

but *I'm content to be sad*' (case 15; *emphasis added*). The ability of the extended apprentices to distance themselves from the present and engage with future possibilities is constrained by their desire to maintain current jobs and reliance on proxy agency.

The runaways were less constrained by relational obligations and established role expectations and displayed a more projective, future-focused orientation. They experienced a transactional pattern of change in their psychological contracts and no longer anticipated future benefits from the relationships with their professors. The shift in their career preferences away from academia towards private industry enabled them to see alternatives. Moreover, active engagement in self-directed learning enhanced their self-efficacy beliefs and motivations for exploring new possibilities. For example, one expressed his confidence in managing a career transition: 'I know I could leave tomorrow and do something else completely. I have, you know, a great knowledge of my transferrable skills...' (case 23). Their psychological mobility (Sullivan and Arthur, 2006) and imaginative engagement with future work selves (Strauss et al., 2012) gave them a sense of renewed optimism. This quote is illustrative, 'So I don't have any worries about jobs now because *I will be able to do something...*' (case 21; *emphasis added*). The anticipation of future possibilities and assertion of personal agency drive the runaways' proactive career behaviours. Table 3 summarizes the main findings, showing the two responses to unmet expectations and their links to types of exchange and psychological contracts that create variability in agentic orientations and capacities.

The divergent patterns are also reflected in the young scientists' subsequent career trajectories which we tracked over time. The great majority of those involved in collaborative research (13 out of 15 cases) remained in academia, whereas all but two of

the nine cases engaged in commercialization sought employment outside academia (six in start-ups and one in a private firm). Although career outcomes are influenced by a variety of personal and environmental factors, individuals' agentic effort plays a crucial role in shaping them. This by no means implies that individuals have full control over their careers and are able to escape organizational dependency. Agency is situated within multilayered contexts that can enable and constrain careers (Tams and Arthur 2010). Proxy agency is socially mediated, which may result in actors' over-reliance on those who are in positions of control and the restriction of one's own efficacy, as illustrated by the extended apprentices. Personal agency, by contrast, is effectuated more directly through actors' personal choice processes, which enable the assertion of individual autonomy in creating new opportunities, as in the case of the runaways. However, in crafting their own careers, the runaways also drew on established resources to enhance the possibility of success.

Table 3 about here

Conclusions

This study has illustrated how the enactment of particular types of agency is related to forms of exchange underlying individuals' psychological contracts, which influence their agentic orientations and capacities, and reactions to unmet expectations. It contributes to the psychological contract and career literature in three ways. First, in contrast to mainstream psychological contract theory, which stresses employee disengagement when career promises are unfulfilled, our findings present a more varied picture and highlight the scope for proactive career shaping. The extended apprentices responded by 'scaling up' their contributions; the runaways did not just exit the relationship but sought to craft

new careers by drawing value from existing relationships. Both categories assert career agency, albeit in different ways. Our analysis suggests that individuals are capable of exercising agency even when they apparently lack power and resources, as illustrated by the young scientists in unequal dependency relationships with their professors.

Second, the framework developed in this article integrates psychological contract and career agency theories to account for the varied ways in which individuals react to unfulfilled expectations. Although the psychological contract literature recognizes variation in employee responses, it stresses the influence of exchange relationships on organizational commitment, which mediates the effects of unmet expectations on employee attitudes and behaviours. This study stresses employee agency as a source of variation and explains how different forms of exchange endow individuals with varied relational and cognitive resources for career agency. The distinction between ‘proxy’ and ‘personal’ agency adds a new dimension to the debate in career studies, which focuses exclusively on personal agency and the conditions that enable (or deter) it. Our analysis goes beyond this by showing how the enactment of a particular type of agency influences choice of specific career self-management strategies.

Third, our conceptualization of career agency as comprising three elements integrates the sociological and socio-cognitive perspectives, and demonstrates the value of an interdisciplinary approach urged by career scholars (Arthur, 2008; Tams and Arthur, 2010). Although it has been long recognized that careers have objective and subjective aspects (Barley, 1989), we extend this to include the projective dimension. The psychological contract is a temporally embedded concept but extant research stresses the influence of past experience on employees’ current behaviours and deals mainly with

objective time. Our study highlights the importance of the future-oriented (projective) dimension and subjective time by examining how individuals' perceived future prospects and salient time horizons influence their current agentic behaviours. Some career scholars highlight the time perspective as a determinant of career behaviour (Marko and Savickas, 1998), but they have not explicitly linked it to career agency. A more adequate theorization of the temporal embeddedness of agency will greatly enhance our understanding of career behaviours.

The study also sheds new light on the contemporary debate about the changing nature of academic careers and its implications for early career scientists. A significant development in academic employment in the past two decades has been the increased use of contract researchers within a tightly squeezed academic job market, which has restricted opportunities for career progression. The existing literature often highlights the plight of the 'trapped postdocs' and portrays young scientists as victims of the entrepreneurial university. The experience of the 'extended apprentice' clearly illustrates their vulnerability. However, our analysis also suggests that the career trajectories of young scientists have become more diverse and fluid. Moreover, young scientists are not just resources for the entrepreneurial efforts of their professors or universities, but are active agents in promoting the new knowledge regime. The transition of the 'runways' towards entrepreneurial start-ups is a case in point. The entrepreneurial university has expanded the institutional context in which scientific careers develop and offers scope for some to re-craft their careers at the intersection of science and business. Beyond the dichotomous options of employment in *either* academia *or* industry, the blurring of boundaries between the two sectors has led to hybrid options. Recent evidence elsewhere

shows a growing trend of young scientists pursuing careers in knowledge-intensive start-ups (Roach and Sauermann, 2010). This suggests that one way to ameliorate the crisis in career expectations would be to broaden the career promises by including opportunities outside academia. Provision of realistic job previews and more balanced information about career options would also help young scientists make better informed choices. Another practical implication is to make research training more relevant for a wider variety of careers beyond the traditional boundaries of scientific and academic work.

Beyond academia, similar growth of contingent work can also be observed in other knowledge-intensive sectors where intensive competition for entry to high status positions has given rise to extended entry tournaments, with some career aspirants becoming trapped in low status positions (Marsden, 2010). This paper has highlighted the value of studying academic careers for understanding the impact of these employment trends on the psychological contract and career behaviour of individuals. The theoretical and practical insights gained from this study, therefore, have wider relevance. However, a number of qualifications should be noted. First, we examined academic scientists in major research universities who enjoy considerable freedom in their work and hence their scope for individual agency is great. Findings based on those working in more constraining environments may differ. Second, the study was conducted in the research disciplines where the boundaries between academia and industry increasingly overlap, giving rise to new career options across organizational fields. The same opportunities may not exist in other areas. Third, the analysis was based on a small sample of 'pre-tenured' researchers still in academia at the time of the study whose psychological contracts included an expectation of academic careers. Individuals who do not have fixed

or strong initial career expectations may not exhibit the same kind of agentic behaviours. Future research could include knowledge workers from less permissive work environments and individuals at different stages of the whole career spectrum to explore more fully the relational and temporal contexts that influence the psychological contract and career behaviour.

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Notes

¹ This term has been used by Hamilton (1995) to refer to trainees who ran away from their masters in late 18th century North America, which subsequently led to the breakdown of apprenticeship there.

² In most cases, professors had their own research groups and the names of their students/postdocs were listed on the websites, thus making it possible to identify matched pairs. We also examined their joint publications to determine the extent of collaboration, which helped the sample selection.

³ The interviews with the professors were part of a study on entrepreneurial professors (Lam, 2011), which included questions about their relationships with students/postdocs.

⁴ The term ‘apprentice’ refers to those who learn to conduct research or conduct research while working under the direction of their professors/supervisors. It includes the more experienced postdocs who have not yet made a full transition to become a ‘colleague’ or ‘master’ (Laudel and Gläser, 2008: 390).

⁵ Apprenticeship always involves elements of training and productive work, and the balance between the two has been controversial. Ryan (2004), for example, argues that the substitution of productive work for learning during the apprenticeship could be a source of conflict.

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Table 1 Interviewee profile

Case no.	Discipline	Age group	Employment status (duration and no. of contracts)	Industrial engagement	Corresponding professor Case code*	Years as professor
Student/junior postdoc						
1	Biosciences	25-30	Student	Collaborative	A	15+
2	Biosciences	31-35	Contract researcher 7 yrs (2 contracts)	Collaborative	B	10-15
3	Computer science	25-30	Student	Collaborative	Not interviewed	<10
4	Computer science	<25	Student	Collaborative	D	10-15
5	Computer science	25-30	Contract researcher 3 yrs (1 contract)	Collaborative	D	10-15
6	Chemistry	25-30	Student	Collaborative	G	<10
7	Physics	25-30	Contract researcher 2 yrs (1 contract)	Collaborative	G	<10
8	Engineering	31-35	Contract researcher 6 yrs (2 contracts)	Collaborative	L	10-15
9	Computer science	<25	Student /employee	Commercial	C	10-15
10	Physics	25-30	Student/employee	Commercial	E	<10
11	Biosciences	31-35	Contract researcher 3 yrs (1 contract)	Commercial	F	< 10
12.	Chemistry	31-35	Contract researcher 4 yrs (2 contracts)	Commercial	G	<10
13	Physics	36-40	Contract researcher 6 yrs(2 contracts)	Commercial	J	<10
Senior postdoc						
14.	Biosciences	36-40	Contract researcher 15+ yrs (numerous)	Collaborative	H	10-15
15.	Biosciences	36-40	Contract researcher 10+ yrs (6 contracts)	Collaborative	H	10-15
16	Biosciences	40+	Contract researcher 17 yrs (5 contracts)	Collaborative	I	10-15
17	Engineering /Physics	40+	Contract researcher 23 yrs (numerous)	Collaborative	Not interviewed	15+
18	Chemistry	36-40	Contract researcher 15+ yrs (numerous)	Collaborative	G	<10
19	Biomedicine	40+	Contract researcher 18 yrs (5 contracts)	Collaborative	K	15+
20	Biosciences	50+	Contract researcher 10 yrs (previously industrial researcher)	Collaborative	A	15+
21	Chemical engineering	31-35	Contract researcher 10 yrs (5 contracts)	Commercial	Not interviewed	15+
22	Biosciences	36-40	Contract researcher 14 yrs (5 contracts)	Commercial	M	< 10
23	Biosciences	36-40	Contract researcher 10 yrs (3 contracts)	Commercial	F	<10
24.	Biomedicine	36-40	Contract researcher 14 yrs (numerous)	Commercial	Not interviewed	15+

*13 out of the 16 professors were supervisors of the students/postdocs interviewed; three (not listed) were in similar roles but not directly linked to the students/postdocs.

Table 2 Four categories of young scientists: Exchange relationships and psychological contracts

Mode of industrial engagement \ Career stage	Training (Students/junior postdocs)	Employment (Senior postdocs)
Collaborative (Diffuse/reciprocal exchange)	<p>‘Learner apprentice’ (Cases 1-8)</p> <p>Relational PC (nascent)</p>	<p>‘Extended apprentice’ (Cases 14-20)</p> <p>Relational PC (strong)</p>
Commercial (Restricted/negotiated exchange)	<p>‘Worker apprentice’ (Cases 9-13)</p> <p>Transactional PC (nascent)</p>	<p>‘Runaway apprentice’ (Cases 21-24)</p> <p>Transactional PC (strong)</p>

Table 3 The psychological contract and career agency: Two responses to unmet expectations

	Diffuse/reciprocal exchange (Collaborative)	Restricted/negotiated exchange (Commercial)
Psychological contract <ul style="list-style-type: none"> • Mutual obligations • Time frame 	Relational <ul style="list-style-type: none"> • broad, open-ended; trust and loyalty • anticipation of future benefits 	Transactional <ul style="list-style-type: none"> • specific, limited involvement; instrumentality • perceived limited future benefits
Agentic capacity and orientation <ul style="list-style-type: none"> • Objective • Subjective • Projective 	Proxy agency <ul style="list-style-type: none"> • relational resources • internal orientation • present continuity 	Personal agency <ul style="list-style-type: none"> • personal resources • external orientation • future possibilities
Career agency and response action <ul style="list-style-type: none"> • Focus of career self- management 	Extended investment <ul style="list-style-type: none"> • Internal: supervisor- focused influencing strategy 	Career crafting <ul style="list-style-type: none"> • External: mobility- oriented strategy

Alice Lam is Professor of Organisation Studies at the School of Management, Royal Holloway University of London. Her recent research has focused on careers in the knowledge economy, and the relationship between organizational learning, innovation and societal institutions. She also has a long-standing interest in the work and careers of scientists and engineers and of other creative knowledge workers. Her current work examines the changing nature of academic careers and knowledge flows between university and industry. Her research has been published in *Organisation Studies*, *Journal of Management Studies*, *Research Policy* and *Industrial Relations*, Berkeley.

André de Campos is an assistant professor in Public Management at the School of Applied Sciences, University of Campinas – Limeira, Brazil. Dr. de Campos' research interests include university-industry links, the impact of science and technology funding and the careers of young academics. His research has been published in *Brazilian Review of Innovation*. Before returning to Brazil, he worked as an ESRC placement fellow at the Research Councils UK Strategy Unit and was a researcher at Royal Holloway University of London.