Running Title: PhD Supervision Primer

A brief primer on the PhD supervision relationship

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Introduction

Becoming a successful academic and securing a principal investigator (PI) position at a research-intensive university requires many distinct skills (e.g., Wright & Vanderford, 2017; Madan, 2021; Wardell, 2021). Beyond some form of technical skills and domain-specific knowledge, some of these skills include time management, scientific writing, public speaking, and project management. Training prior to the PI position involved some of these latter skills, and perhaps even some degree of trainee supervision, but PhD-level supervision and associated responsibilities do not arrive until one becomes a PI. Many academic skills are learned 'on the job,' but few more so than PhD supervision (also see Kwok, 2018; Ruben, 2020). While I myself have only a few years of PhD supervision experience, I have reviewed the literature on PhD student-supervisor relationship and here present a brief primer.

PhD supervision is associated with a variety of expectations and responsibilities, from both the student and the supervisor, but there is also not a single approach to the supervisor relationship. The importance of the PhD supervisory relationship cannot be overstated—at a minimum, it is a one-on-one relationship of close collaboration that lasts several years and establishes the student's career prospects but may be as critical as setting the foundation for the student's future career as an independent researcher. A 2019 survey by *Nature* of over 6,000 graduate students found that mentorship, specifically the students' supervisor, found that 67% of respondents were happy with their relationship with their supervisor (Woolston, 2019a). For those that were unhappy, students felt that they were not adequately supported with regards to one-on-one meetings or career guidance—or had more serious concerns, such as harassment. Similar concerns have been identified in both the previous *Nature* survey (Woolston, 2017) and the 2019 AdvanceHE Postgraduate Research Experience Survey (Williams, 2019). In some

instances, articles have been written targeted towards PhD students to provide advice on managing their supervisor and getting the most out of meetings and feedback (e.g., Chopra et al., 2016a; Kearns & Gardiner, 2011). The three key topics discussed in this primer include supervisory management styles, expectations in supervision and student satisfaction, and tailoring the supervision experience to student needs—as illustrated in Figure 1.

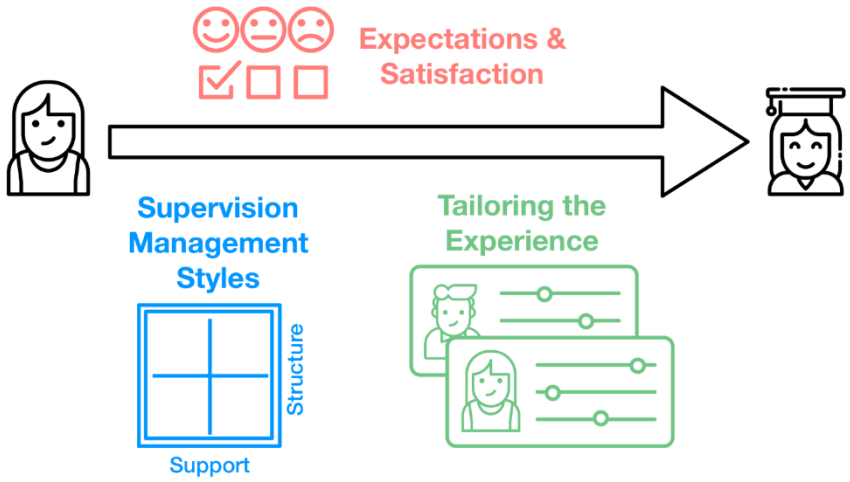

Figure 1. Illustration of the major topics discussed in this PhD supervision primer.

Supervisory Management Styles

There are different approaches that supervisors use in supervising research students and frameworks have been developed to help characterize the key attributes of how supervisors may differ in their management of students. A prevalent framework is Gatfield's (2005) model of supervisory management styles, first proposed in Gatfield and Alpert (2002) (but bears similarities to earlier frameworks, e.g., Welsh, 1979). This model focuses on two orthogonal dimensions: supervisory structure and support, each ranging from low to high. The structure factor includes characteristics such as focusing the research, progress reports, responsiveness in

returning feedback, and the instruction in technical skills (such as writing, statistics, and time management). The support factor includes characteristics such as encouragement, providing infrastructure (e.g., office space, research funds), and support with technical software. Supervisions that provide both high structure and support require the most time from the supervisor, with the opposite being the case for the corner of low structure and low support. Moreover, supervision style is dynamic and should change as the student progresses, for instance, less structure may be needed as a student gains experience and research independence.

Considering the model as a whole, it is proposed that the two orthogonal dimensions of support and structure yield four quadrants, based on previous managerial grid frameworks, as illustrated in Figure 2. A third dimension, referred to as exogenous factors, is also incorporated but considered to be distinct from supervisory relationship, particularly focused on the *candidate's* pre-existing characteristics, such as organisational and interpersonal skills, research independence, and ability to be self-directed. Additional exogenous factors include contributions from a second supervisor and departmental training workshops.

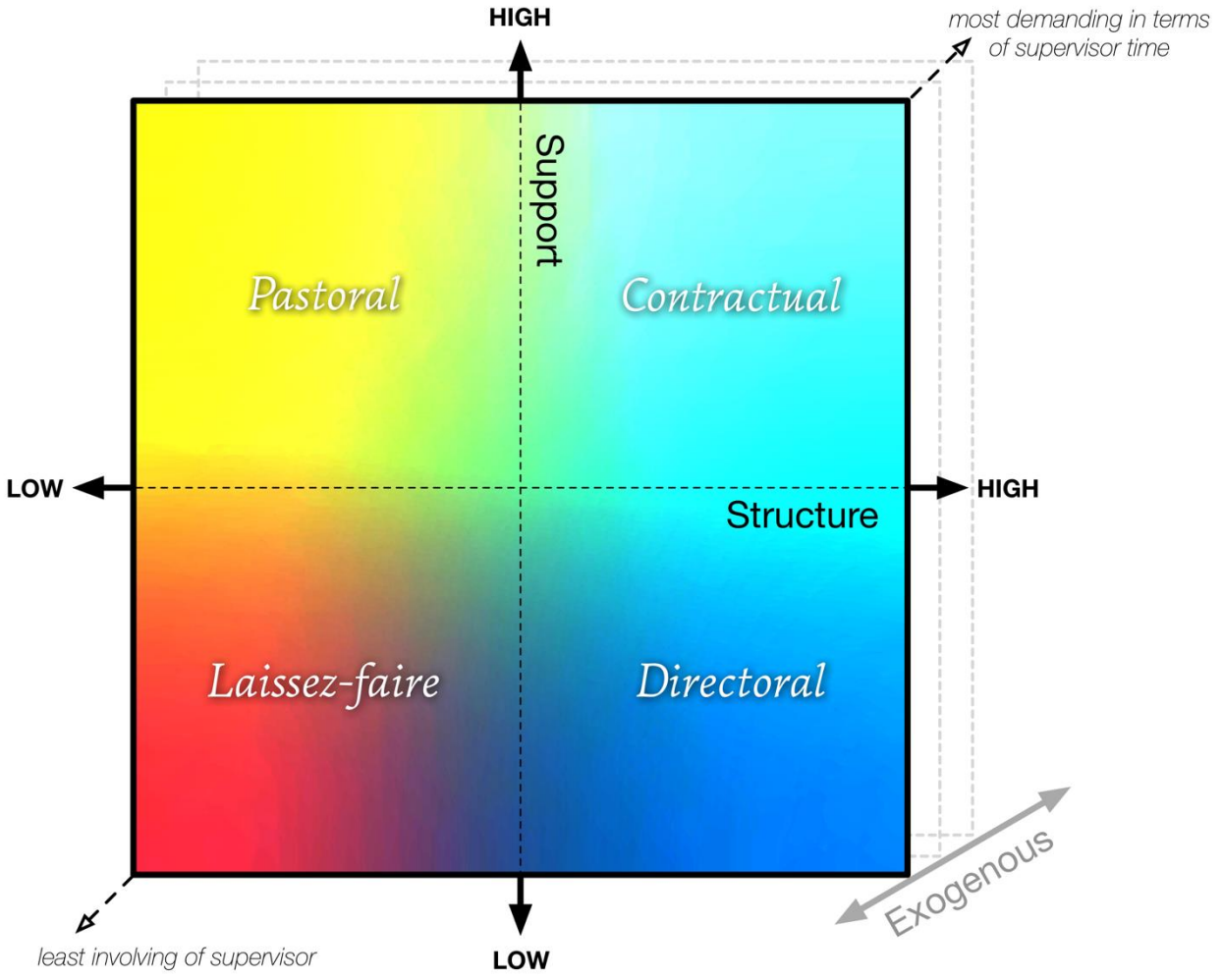

Figure 2. Illustration of Gatfield's supervisory management model. Supervisory structure and support are the primary dimensions, both ranging from low to high. The upper right corner requires the most involvement of the supervisor. Exogenous factors comprise a third dimension, illustrated in the bottom left and with outlined layers as an orthogonal feature.

Others have provided convergent views of supervision styles as well. For instance, Chopra et al. (2016b) describe six caricatures of "mentorship malpractice," which are subdivided into two categories, active and passive; examining the described characteristics of these six mentors indicates a parallel to the structure dimension from Gatfield's model. Some characteristics described in these six caricatures include inadequate supervision time (due to

busyness with other projects or world traveling), being exploitive in assigning excessive non-academic responsibilities to the student, or directing students to isolate themselves and not discuss their work with potential mentors. An opposing article by Vaughn et al. (2017) on "mentee missteps" provides further insight into exogenous factors, related to a student's potential aversion to conflict and lack of confidence. While Gatfield's model provides a useful framework for conceptualizing the supervisory relationship, it has also been criticized as being too simplistic for what is necessarily a quite complex and individualized interaction (Lee, 2010).

Expectations in Supervision and Student Satisfaction

Distinct from the management structure and support from PhD supervisors, expectations are important to the supervisory relationship. Based on interviews of supervisor-student dyads, Bui (2014) identified four themes: (1) perceptions of the role of the supervisor, along with expectations of (2) intellectual capacity, (3) emotional intelligence, and (4) logistics. Expectations of intellectual capacity included the frequency of meetings, generation of new ideas and determination of research direction, and independence of students—along with changes in these expectations as students progressed. While prior literature had not examined emotional aspects of the relationship, this has increasingly been considered as an important aspect of the PhD process (e.g., issues of burnout; Cornér et al., 2017). Expectations of emotional intelligence was related to students' empathy for the supervisor's time, enthusiasm (as intrinsic motivation), and interpersonal skills in forming relationships with others (both supervisor and peers) and was also related to cultural background. Expectations of logistics were described as students' time management and development of their own network with senior academics. Though the process for identifying these facets of expectations differed, they are convergent with those selected for

decades previously by Moses (1985) as well as by other investigations (e.g., Friedrich-Nel & MacKinnon, 2016; Hockey, 1994; Pole et al., 1997).

According to the aforementioned 2019 *Nature* survey, 75% of PhD students were either very or somewhat satisfied with their decision to pursue a PhD (Woolston, 2019b)—similar rates were reported in the 2019 AdvanceHE survey (Williams, 2019). Satisfaction during the PhD should be considered a relevant aspect of the supervisory relationship. Returning to the 2019 *Nature* survey, intellectual challenge was reported as the main aspects that respondents reported enjoying of the PhD, followed by working with interesting and bright people, the overall university environment, and creativity. 56% of respondents ranked academia as their first preference for a position beyond graduate school and a postdoc (as compared to industry, medical, government, or non-profit sectors).

Dericks et al. (2019) specifically examined PhD student satisfaction in an interdepartmental and international sample of over 400 PhD students. It was determined that the supervisor had the greatest impact on satisfaction, with lesser contributions from the department and peers. Supervisor supportiveness was particularly important, which incorporated the perception of receiving systematized support, constructively thoughtful, and understanding environment. While this conceptualization of supportiveness was intended to be broad and reflect a general sentiment, more practical terms are needed to be actionable. The 2019 AdvanceHE survey suggests several specific themes for improving the postgraduate experience (Williams, 2019, p. 11). Of those comments related to supervision, the most prominent themes were related to engagement of the supervisor, time/frequency of meetings with the supervisor, progress review and ongoing guidance, and supervisor experience. Here satisfaction with supervision was related to identifying training, providing feedback, having regular contact with

the supervisors, and having relevant skills and subject knowledge. Convergently, Fleming et al. (2013) determined that the key competencies of supervisors are effective communication, aligning expectations, assessing understanding, addressing diversity, fostering independence, and promoting professional development.

Communication is critical and I periodically have discussions about the PhD supervisory relationship and expectations as a lab meeting topic. For this discussion, I sometimes use a survey (adapted from Moses, 1985, with the addition of timely topics such as work-life boundaries, e.g., Derks et al., 2015) included as supplemental material (also see the 'Role Perception Scale' of Brown & Atkins, 1998). This includes topics related to the beginnings of a PhD, such as identification of a broad research topic, finding initial background, designing and programming of the first experiment. On-going topics are also included, such as the organization of regular meetings, providing emotional support, and ensuring continuing progress.

Others have recently developed resources to facilitate peer support of student mental health that should be considered for wider use (e.g., Homer et al., 2021; also see Homer, 2021).

Tailoring the Supervision Experience to Student Needs

Thus far I have focused on the supervisor's influence on the supervisory relationship and how the supervisor generally influences the student, but this has yet to be considerate of the students' individual experience and needs. For instance, being considerate of students' mental health and considering communication out of hours are generally good, but there are instances where experiences are more subjective and need to be tailored. While Gatfield's model considers that supervision style should change as a student progresses and variations in starting position for different students, it relegates the student's pre-existing abilities and traits to the third dimension

of exogenous factors. ‘Exogenous factors’ here include such important aspects as research skills, organisational skills, interpersonal skills, respect in relationships, and influences of additional supervisors and committees. Considering this and supervision practicalities more broadly, four instances where supervision should be tailored are: (1) skill development, (2) influences of others in the supervisory team, (3) cultural differences in how feedback is interpreted, and (4) future career plans. For each of these, there is no objective ‘always applicable’ correct approach, but rather supervision should be adjusted based on the specific situation.

As outlined at the outset of this article, academia is associated with many skills. Data analysis, problem solving, scientific writing, and public speaking are only a handful of these (Vitae, 2010; Wright & Vanderford, 2017; Weber et al., 2018). Providing skill development guidance to a PhD student considering their aptitudes and weaknesses is an important responsibility of a PhD supervisor. Moreover, research is becoming increasingly interdisciplinary and students choose research topics that do not fit as definitively within the expertise of their primary supervisor. In these cases, collective supervision—i.e., co-supervisors or supervision teams—can be a useful means of supporting the student (Nisselle & Duncan, 2008; Taylor, 2014). Having a supervision team allows for multiple research strengths to be brought together, but also requires a more thoughtful and open discussion of priorities of the PhD and supervision style (e.g., how hands-on, meeting frequency, and methods of feedback). Postdoctoral research fellows and more senior PhD students in the research group can also play a formative role in the student’s training.

Less considered are individualised aspect of PhD supervision is cultural differences in how feedback is interpreted. Different cultures express feedback with varying degrees of directness and preferences for positive vs. negative feedback (Morrison et al., 2004; Wang & Li,

2011; East et al., 2012; Tian & Lowe, 2013; Meyers, 2014; Smith, 2018). For instance, if a student is suggested to 'consider how this sentence could be more concise,' some may consider this more literally and *consider* it but decide it is fine as-is. The supervisor likely meant this as a polite way to provide directive feedback. More qualitative feedback, such as 'I have a few minor comments' can range from a handful of typos to a page of red and requiring a full rewrite. Given student's varied prior experiences and cultural differences, coupled with the PhD supervisor's own cultural background and training, it is prudent that a supervisor and trainee have open dialogue about how the supervisor can effectively provide feedback.

A supervisor should provide guidance throughout the PhD and help calibrate expectations for the viva (e.g., Mullins & Kiley, 2002; also see Golding et al., 2014; Golding, 2017). Beyond this, it is important that supervisors provide advice and support related to a post-PhD career. Not all PhD students desire an academic position and academia simply does not have enough jobs for all who would want faculty positions. Ideally, a PhD supervisor can discuss the options of both academic and non-academic positions as potential career paths and provide some guidance on further resources for understanding how these options compare (e.g., see Kelsky, 2015; Caterine, 2020; Linder et al., 2020; Madan, 2021). These resources provide perspectives and advice ranging from job applications and grant writing to examples of non-academic careers and how these jobs can benefit from PhD-related training and skills. Discussing student's aspirations in academia or beyond is crucial and can only be facilitated if supervisors are clear in defining the supervision relationship and expectations and students feel supported regardless of their desired career path.

Conclusion

New PIs role take on a myriad of new responsibilities (see Tregoning and McDermott (2020) for an overview). Despite minimal formal training in PhD supervision, this portion of the principal investigator role is formative for student careers. This brief overview outlined several key topics that all PhD supervisors should consider, including expectations, management styles, and tailoring of the supervision experience.

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