A REVIEW OF THE LITERATURE ON EFFECTIVE PhD SUPERVISION

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INTRODUCTION

In knowledge-based economies, governments see universities as engines for change and expansion of prosperity. The work of postgraduate students constitutes a vital component of a university's research effort and contributes significantly to the institution's research profile. Since the quality of supervisory practice has a demonstrable effect on postgraduate outcomes (Cullen et al., 1994) it is in the interest of university's to reliably improve the efficacy of postgraduate supervision. High quality supervision facilitates students in fulfilling their potential which, in turn, enhances the institution's research reputation. In a beneficent cycle, high calibre students are attracted by a reputation for excellent supervision and a strong research profile.

Effective supervision of research degree candidates is a complex multi-factorial process that encompasses issues at all levels from that of individual students and supervisors, to available infrastructural support, to institutional and governmental policies, structures and procedures. Numerous factors have been identified in the literature as significant predictors of candidate completion. These include attendance status (part- or full-time), availability of research funding, age, prior completion of an honours degree, discipline (sciences or humanities), gender, research topic suitability, the intellectual environment of the department, and access to appropriate equipment and computers (Rodwell and Neumann, 2007; Bourke et al., 2004; Seagram et al., 1998; Wright and Cochrane, 2000; Gasson and Reyes, 2004; Acker et al., 1994; Latona and Browne, 2001; Pearson and Brew, 2002).

METHODOLOGY

In order to maintain a tractable scope and provide a useful starting point for more ambitious investigations this literature review focuses primarily on research that evaluates and models the factors that influence the quality of relationship between the student and the supervisor. Papers that deal primarily with distance, part-time, or professional postgraduate study have been excluded. This review also assumes a rather pragmatic working definition of an effective supervisor as one who achieves high completion rates, has candidates submit within the normally expected time frame, engages in multiple supervisions, and receives excellent supervisory reports (Gatfield, 2002). Obviously there will be viable exceptions to this rule.

HISTORY

The PhD, as a research degree award, was first conferred in Germany by the Friedrich Wilhelm University, Berlin during the early nineteenth century. From the 1860s onward the United States began to import the ideas of research universities and doctoral degrees starting with Yale in 1861 (Park, 2005). During the twentieth century the research degree spread to Canada (1910), Britain (1917), and onwards to most English-speaking countries including Australia in

1948 (Park, 2005). Interestingly, the introduction of the PhD in Britain was driven less by academic considerations than by the political and economic desire to divert American and colonial students away from German universities (Simpson, 1983). In Ireland the first PhD was awarded by TCD in 1935 (Ref).

Based on the British single supervisor model, the Irish PhD has traditionally been pursued using an apprenticeship model of training. Within this framework a student registers to study on an independent piece of original research under the supervision and guidance of an experienced academic researcher who advises them on the conduct and publication of their research. Unlike the US, where most of the first year of the degree may be occupied by advanced coursework, Irish PhD students rarely take formal classes during their studies. However, many countries, most notably the U.K. and Australia, are moving towards an intermediate PhD model, where students take some coursework and training in key generic skills alongside their research, and it is proposed that Ireland move in this direction too (IUQB, 2003). Partially in response to these trends, within the natural sciences, TCD has recently introduced structured interdisciplinary four year degrees with a taught component and lab rotations in the first two years.

Historically, despite the importance and almost exalted role of graduate education, formal research on the psychological, social, and educational aspects of this form of advanced training only began during the 1970s. In 1975 Ernest Rudd published The Highest Education: A Study of Graduate Education in Britain, an investigation of student experiences of graduate education. Rudd discovered wide variation in the quality of student supervision. In particular, he noted that lazy or unmotivated supervisors had a demoralising effect on their students and recommended the creation of Graduate Schools as an institutional mechanism for raising the overall quality of postgraduate supervision.

This ad hoc model of supervision appears to be falling out of favour and early optional training modules in research supervision have progressively been replaced, particularly in the UK, continental Europe, and Australasia, by comprehensive and, in some cases, compulsory programs (Manathunga, 2005). Within Europe this trend is part of a broader EU drive to harmonise academic degree standards and quality assurance standards across Europe, as codified in the 1999 Bologna Accords (European Commission, 2008).

Interestingly, it has been argued that, rather than encourage research on pedagogical issues involved in supervising, current pressure to make universities more productive and accountable has driven research that focuses on "policy issues and questions, and on the organisation and administration of the postgraduate research degree" (Green and Lee, 1995).

FACTORS EFFECTING PhD COMPLETION

As Dinham and Scott (1999) observe; "the student-supervisor relationship has the potential to be wonderfully enriching and productive, but it can also be extremely difficult and personally devastating". Edwards (2002) four major problems in the postgraduate experience: being at cross purposes with supervisors, finding few supporting structures, isolation and confusion over resources. Powles (1989) reported that 25% of postgraduate research students surveyed were either "dissatisfied" or "very dissatisfied" with their experience. Problems with the supervisory relationship were cited by 31% (i.e. 8% of the total) of this group. Other research suggests that, within a discipline, the quality of supervision is the key factor determining the successful and timely completion of a PhD (Seagram et al., 1998; Dinham & Scott, 1998; Knowles, 1999). At a basic level Woodward (1993) has noted that more frequent supervision is strongly correlated with successful completion.

Significant differences in PhD time to completion (TTC) and successful completion arise between academic disciplines. Specifically, students in scientific areas tend to be more likely to successfully finish their PhD than those in arts and humanities disciplines (Rodwell and Neumann, 2007; Seagram et al, 1998; Wright and Cochrane, 2000). Seagram et al (1998), in a very large (n=3579) study of students at York university in Ontario, found no difference in the time to completion of male and female PhD students. She also found that males and females appear to be affected by different negative aspects of the postgraduate experience. Female postgraduates nominated interpersonal factors as most significant whilst males reported academic factors.

In the UK Wright and Cochrane (2000) examined the submission rates of 3579 postgraduate students in a single large university between 1984 and 1993 in order to identify characteristics of the student 'most likely to succeed'. They found that the only reliable predictor of successful submission was whether a student was researching a science-based or an arts and humanities-based subject. Neither gender, age nor nationality were found to have any effect on the likelihood of submitting successfully. Similar discipline-specific trends have been found in Australia, (Martin et al., 2001), the US (Bowen and Rudenstine, 1992), and Canada (Seagram et al., 1998). The faster times to completion and higher completion rates associated with the sciences appear to arise from the fact that science students appear to meet more frequently with their supervisors, make an early start on their dissertation research compared to humanities, and have generally higher levels of financial support (Seagram et al., 1998)

Scevak et al. (2007) used self-report instruments to investigate the metacognitive profile of a cohort of Australian doctoral students. Perhaps unsurprisingly, the students generally displayed a positive metacognitive profile, with above average scores on measures of coping, efficacy, volition and knowledge and below average scores on procrastinatory behaviours measures. However, when the authors performed a latent variable analysis three metacognitive groupings

emerged: a potentially non-problematic grouping, a potentially anxious and dependent grouping, and a third grouping that was associated with potentially weaker and at-risk candidates.

Parsloe (1993) found that students' moods (excitement, despair, boredom and confidence) had predictable stages as they moved through the degree.

Interestingly, in a small (n=30) study at Exeter university, UK, Abdelhafez (2007) found a significant positive correlation between student knowledge of the university's code of supervisory practice and their attitudes towards their supervisor. Supervisor attitudes were not found to be predicted by gender or year of study.

The Swedish National Agency for Higher Education (2006) published a comparative review of postgraduate student's attitudes in four geographically peripheral European countries: Sweden, Finland, and Ireland (the International Postgraduate Mirror report). The report compares student responses to a battery of questions on seven areas of postgraduate life, two of which focused on supervision: 'dialogue with supervisors' and 'supervision in action'.

In 'dialogue with supervisors' student views were elicited on perceived levels of supervisor interest in their studies, levels of constructive criticism, degree to which their supervisor engaged the student in discussions of methodological, theoretical, general subject area issues, and the student's future career plans. Overall Irish students appear to fare slightly better than the sampled European average. For example, about one third of Irish students reported that they received inadequate constructive criticism from their supervisor compared to approximately 35% for Catalonian students and just over 50% for Finnish postgraduates. Furthermore, of this sample, Irish students were the most satisfied that their supervisor displayed sufficient interest in their studies (Swedish Coordinating Centre, 2006).

Although much of the literature on graduate education and supervision has focused on the impact of student variables (e.g. age, gender, and national and linguistic backgrounds) on the PhD experience for students, Cullen et al. (1994) found that the demographics of the supervisor population (e.g. age, gender, graduate education background and teaching responsibilities) also had a significant effect on how they conduct supervision.'

MODELS OF SUPERVISION
Pearson and Kayrooz (2005) argue that the development of academic supervisors has been constrained by a "lack of robust conceptual understanding of what supervision involves". In attempting to answer this challenge and capture the multi-faceted nature of effective supervision researchers have used a number of different approaches which vary in sophistication from uni-dimensional

metaphors, to unstructured lists of desirable traits, to complex multi-dimensional empirically-driven frameworks. Grant (1999) suggests that the majority of these approaches to understanding and practicing supervision emerge from a liberal humanist view of social relations in which supervision is understood to be an essentially rational and transparent engagement between autonomous individuals. She argues that additional useful insights into the subtleties and complexities of supervision can be gained from considering supervision within a broader psychoanalytic context.

Although there is still a tendency to equate research supervision with research training and the research responsibilities of the academic role (Johnston, 1999), a particularly prevalent view of supervision is that it constitutes a sophisticated form of teaching (Ferman, 2000; Taylor, 2006). In keeping with this view, Knowles (1999) describes postgraduate supervision as "critical conversations", while Taylor (1995) proposes that supervision is 'mentorship [more than] instruction'. Whilst Green and Lee (1995) believe that 'the role of supervision remains profoundly ambiguous' they do advise replacing the notion of teaching with the broader concept of pedagogy. Connell (1985) takes a more superlative approach and describes PhD supervision as "the most advanced level of teaching…a genuinely complex teaching task". Although Green and Lee (1999) contend that this view encounters "deep-seated prejudice in the modern university which systematically privileges research over teaching". A somewhat more nuanced dualistic view is proffered by Zuber-Skerrit and Ryan (1994) who suggest that "research postgraduate training is unique among academic responsibilities in providing a direct linkage between teaching and learning activities and research".

Grant (1999), noting that supervision is a complex process that requires both situational awareness and a flexible posture, neatly captures this teetering complexity through the vivid metaphor of supervision as a process of "walking on a rackety bridge".

Cullen et al. (1994), as part of a major study carried out at the Australian National University, Canberra, produced a list of the characteristics of a 'good supervisor' (which they noted is very similar to lists of what undergraduates hold as desirable features of a good lecturer):

- approachable and friendly;
- supportive, positive attitude;
- open minded, prepared to acknowledge error;
- organised and thorough; and
- stimulating and conveys enthusiasm for research.

A more structured list of supervisory roles and attitudes is provided by Brown and Atkins (1989):

- Director (determining topic and method, providing ideas);
- Facilitator (providing access to resources or expertise, arranging field-work);
- Adviser (helping to resolve technical problems, suggesting alternatives);
- Teacher (of research techniques);
- Guide (suggesting timetable for writing up, giving feedback on progress, identifying critical path for data collection);
- Critic (of design of enquiry, of draft chapters, of interpretations or data);
- Freedom giver (authorises student to make decisions, supports student's decisions);
- Supporter (gives encouragement, shows interest, discusses student's ideas);
- Friend (extends interest and concern to non-academic aspects of student's life);

Manager (checks progress regularly, monitors study, gives systematic feedback, plans work)

Although enumerating lists of missing skills is a common approach to addressing the problem of creating employable and well-rounded PhD graduates (Taylor and Beasley, 2005; Wisker, 2001; Phillips and Pugh, 2000; Cryer, 1997) a potential pitfall with such lists, identified by Pearson (2004), is the lack of an integrating conceptual framework of what constitutes research training. According to Pearson, this means that it is difficult to identify priorities, to identify appropriate training strategies, and to determine the distribution of responsibility for different aspects of a training programme. Furthermore, it implicitly facilitates a modular, fragmented approach to designing postgraduate training programs with such desirable generic skills, such as time or project management, treated as 'add-ons'. Pearson and Krayooz (2004) argue that what is "needed is a complex outcome; a skilful performer rather than someone who can list their skills". An advance on the list approach is the framework. Several researchers have formulated empirically-driven theoretical frameworks within which to place and assess the manifold characteristics of supervisory practice.

Gurr (2001) elaborated Grant's (1999) 'rackety bridge' metaphor and devised a dynamic model for aligning supervisory style with the development of research students possessing 'competent autonomy'. Gurr's model is define by two key dimensions: a 'direct'/'indirect' and an 'active'/'passive' dimension which form a graph with four categories of behaviour:
- direct active, characterised by initiating, criticising, telling and directing the student
- indirect active, characterised by asking for opinions and suggestions, accepting and expanding students ideas, or asking for explanations and justifications of supervisee's statements
- indirect passive, characterised by listening and waiting for the student to process ideas and problem solve; and,
- passive, characterised by having no input and not responding to student's input

A central point is that the effective supervisor moves flexibly between the various modes. Most notably as the candidate progresses away from dependence and towards competent autonomy. This adaptive mode-switching can occur even within the space of a single meeting.

Gurr (2001) tested the efficacy of this Supervisor/Student Alignment Model as a supervisory tool by separately interviewing four pairs of students and supervisors in the University of Sydney. In interviews students were asked to mark on a graph where they felt their supervisor's approach fell. The supervisors were similarly asked to classify their own supervisory behaviour and the results were then compared in a joint meeting. The author found that, especially in cases where there was a marked discrepancy between the student and supervisor perceptions of supervision, the neutral graphical approach facilitated open dialogue on the state and appropriateness of the prevailing supervisory practices. The tool continues to be used to fine tune the supervisory relationships.

An alternative framework is advanced by Fraser and Mathews (1999) who performed an empirical analysis of the desirable characteristics of a supervisor from the point of view of the student. They argue that a traditional emphasis on expertise as the salient dimension of supervisorship is too limited and augment it with support and creative/critical dimensions. When Fraser and Mathews surveyed students on the desirability of an array of specific supervisor characteristics encompassed by these three dimensions they found that non-expertise-related characteristics which provide support, and which balance creativity with criticism, emerged as more important overall than expertise-related characteristics.

A perceived need to devise a "new theoretical approach drawn from a wider literature then traditional higher education pedagogy" (Pearson, 2004) has motivated several researchers to explore the potential for applying business models to the supervision process.

Vilikas (2002), for example, suggests that the role of a supervisor is strongly analogous to that of a business manager and consequently models supervision using an integrated version of Quinn's Competing Values Framework (CVF) of managerial roles. The CVF model identifies operational supervisory roles within a two-dimensional surface formed by an internal-external focus dimension and a flexibility-stability dimension. The original CVF model identified eight operational roles (innovator, broker, producer, director, coordinator, monitor, facilitator, and mentor) within four quadrants: 'expansion, adaptation'; 'maximisation of output'; 'consolidation, continuity'; and 'human commitment'. The modified version adds a ninth 'process' role of 'integrator' (Vilikas and Cartan, 2001). The integrator role has two components those of critical observer and reflective learner.

A recently updated and simplified version of the model reworks the primary dimensions as internal-external focus and people-task focus. The number of operational roles is reduced to five: innovator, broker, monitor, deliverer, and developer with the integrator as the central role (Vilikas and Cartan, 2006).

Vilkinas and Cartan (2001) argue that these roles are paradoxical in nature. In other words, supervisors need to be able to act in ways that are inherently contradictory e.g. caring for the student and dealing with their personal issues (developer role) while simultaneously demanding that the student is productive (deliverer role). A central assumption of this approach is that an accomplished supervisor/manager must be able to adaptively switch between the various roles as the situation demands. Vilikas and Cartan (200) claim, somewhat opaquely, that effective supervisors handle these paradoxes by creating "generative paradoxes as opposed to exhausting conflicts". Indeed, Gurr (2001) has observed that supervisors need to be able and willing to alter their approach to supervision appropriately as the student develops.

In order to assess the 'fit' of supervisor beliefs and practices within the ICVF framework Vilikas (2008) performed an exploratory study of the attitudes of 25 senior faculty members from seven Australian institutions. She found that the majority of supervisors were primarily task-focused coupled with some concern with the humane aspects of supervision, there was little evidence of innovation and reflection. Vilikas argued that the lack of evidence of a reflective role potentially limits the ability of supervisors to respond effectively to the dynamic demands of their position.

Another business-inspired framework is that proposed by Gatfield (2005). He extracted eighty key variables from the supervision literature to construct a four-quadrant supervisory styles model adapted from the Blake and Moulton Managerial Grid model. The eighty factors were clustered into three groups: 'structural', 'support' and 'exogenous'. The structural component is defined as those elements supplied primarily by the supervisor in negotiation with the candidate. These factors can be further grouped into 'organisational process', 'accountability and stages', and 'skills provision'. Examples include identifying roles, negotiating meetings and training seminars. The support factor constitutes those non-directive, discretionary elements supplied by the institution and supervisor and is further broken down into 'pastoral care', 'material', 'financial' and 'technical' sectors e.g. mentoring, office space, research funds, and network support. The final category is comprised of those relatively fixed factors not encompassed by the support and structure categories. These include 'candidate variables' such as research skills, and a 'various' category that includes factors such as second supervisor contribution.

By assuming that the candidate variables are relatively fixed, Gatfield identified four 'preferred' (as opposed to invariant) supervisory styles that emerged as quadrants in a support-structure graph; contractual (high support, high structure),

directorial (low support, high structure), laissez-faire (low support, low structure), and pastoral (high support, low structure).

In order to examine the reliability and applicability of the model Gatfield performed a verification study. This entailed interviewing 12 supervisors independently classified as excellent and mapping their responses onto the grid. Gatfield (2005) confirmed that the vast majority of supervisors classified as excellent mapped onto the high support, high structure contractual quadrant. However, he stressed that as all of the supervisors were rated as excellent, and not all fell into the contractual quadrant, that a range of viable effective supervisory styles exist. In an extension of this idea, Gatfield (2005) suggests that the prevailing management style for a given supervisor will also vary as a function of the stage at which their students are at within their PhDs as a result of a change in the supervisory requirements attendant upon each stage.

A framework similar to that employed by Vilikas (2002) emerged from work carried out by Murphy (2004) who attempted to characterise beliefs held by students and supervisors about supervision. Murphy (2004) conducted a small-scale (n=34) survey of supervisors and doctoral candidates in the engineering school of Griffith University, Queensland, Australia. She describes research degree supervision as a "plexus of closely related educational beliefs about research, teaching, learning and supervision" and argues that four global orientations to supervision emerge from this perspective: controlling/task-focused, controlling/person-focused, guiding/task-focused and guiding/person-focused. Paradoxically, Murphy found that whilst supervisor's beliefs regarding supervision tended to cluster within the guiding/person-focused category, student's beliefs regarding supervision were more commonly characterised as controlling/task-focused. Murphy suggests that the supervisor's role in shaping the candidates beliefs are undermined by the student's preconceptions of what supervision entails.

The use of frameworks and lists to identify supervisory roles has not gone unchallenged. Walford (1981) cautions against the use of role theory on the grounds that "the degree of simplification required to make any analysis of this sort in terms of role theory is so great that the resulting analysis omits much of what is important in understanding the development of the supervisor/student relationship and the degree of satisfaction felt by the student. In particular, the gathering together of opinions of students and supervisors who are concerned with an enormous variety of projects, from highly sophisticated theoretical problems to complex projects concerned with experimental design and development, means that to talk in terms of a single role misses the very aspects which may well give rise to dissatisfaction" (p.148).

This last point is amplified by Cullen et al. (1994) who highlight the "extreme variability and subtlety" of the relationships that emerged from their analysis. They note that "the difficulty with such lists as guides to practice is that although

they are well meaning, they are very general and indicate little sense of the judgements involved in their application." In an attempt to circumvent some of these issues Cullen et al. (1994) adopt a more holistic approach that acknowledges the "highly complex, dynamic" relationships between supervisor and supervisee. Crucially, they strive to avoid focusing on the individual relationships which obtain between students and supervisors. By locating that relationship in a broader context, the authors hope to identify universal strategies that transcend individual differences.

Cullen et al. (1994) present a high level three-stage model of supervision that attempts to encompass the key features of how experienced supervisors seek to structure the supervisory relationship as a student's PhD study progresses. The first stage is characterised by a significant input of time and effort helping the student to find or establish a question, problem or topic for their thesis. In the next stage the student is monitored but allowed to operate with greater independence. Unless there are warning signs, contact is most often left to the student to initiate. The final stage involves writing up and, like stage 1, is again characterised by an increase in the time and effort exerted by the supervisor.

Cullen et al. (1994) claim that this model is common to all disciplines and highlights certain basic elements:
- negotiating/guiding the transition from dependence to independence (i.e. the level of direction given varies bi-modally)
- adapting the supervisory approach to individual student's needs and personalities, disciplinary differences etc.
- recognising that a key to the entire process is the deft formulation of the problem/topic/question since it is that which ensures focus and engagement. The tension here arises from the delicate task of guiding students away from non-productive paths without taking over or undermining student 'ownership' of the problem.

The importance of focusing on process over roles is also advocated by Pearson and Brew (2002) who argue that the primary utility of elaborating the roles of the supervisor is limited to enabling supervisors to articulate their practice. Crucially, the authors suggest that role elaboration is not so useful for determining the content of supervisor development programmes. Several reasons are adduced to support this claim:

- the role of the supervisor too complex to be usefully captured by role categories
- research practice itself changes and supervisory arrangements are becoming more varied
- a focus on roles can lead to an unproductive strengthening of the focus on personal relationships

- a focus on roles does not facilitate allocation of the various responsibilities and practices in cases where others are involved in supervision in addition to the formal principal supervisor.

This last point is related to the process of 'enculturation' during which novices (i.e. PhD students) learn the socialised skills of laboratory work, and through which research problems are conveyed. Since a number of individuals typically contribute to this process over time, continuity arises from the process, and not from the peripatetic individual participants (Delamont et al., 1997).

A useful set of dimensions for assessing the quality of the supervisor relationship has been proposed by Kam (1997). She performed a factor analytic investigation of the level of student satisfaction with the supervisory process within a large population (n=250) of postgraduates at the Royal Melbourne Institute of Technology. Kam found that student responses were consistently clustered around three emergent factors: 'work organisation and problem solving', characterised by work tasks that denote efforts made to assure work quality in the research process, 'research preparation' representing work tasks typical of those found during the early part of the research process, and 'communication' standing for work tasks centred on communication and interaction at different levels. Based on student responses with respect to these three factors, Kam (1997) isolated four distinct groups of students that varied in their level of independence or dependence as measured by each factor. Group 1 represented students who were relatively independent along all three dimensions and constituted the largest grouping at 38% of the student body. Other groups represented students who exhibited mixed levels of (in)dependence along the latent dimensions of 'work organisation and problem solving', 'research preparation', and 'communication'. Interestingly, none of the groups were highly supervisor-dependent on all three dimensions. The level of subjective student satisfaction (as distinct from the objective quality of the research outcome as measured by completion time, pass rate, etc) was found to be strongly dependent on the extent to which the supervisor addresses needs engendered by the most salient dependent dimension. Consequently, Kam suggests, no one supervisory style can adequately meet the needs of all students.

A novel IT-based metaphor of supervision is pursued by Zhao (2001) who argues that the quality and productivity of research supervision would be enhanced if knowledge management concepts were effectively integrated into the process. He proposes a model that conceptualises the supervisory process as an input-output process mediated by a knowledge conversion stage. The input is the research candidate and environment and the outputs are a competent researcher, completion of the research degree, and research products. The intervening knowledge conversion process is modified by separate knowledge creation, transfer, and embedding processes. On the assumption that goal of research supervision is to nurture capable researchers (Down et al., 2000), Zhao

claims that effective supervisors develop students as independent researchers by interventions targeted at enhancing these sub-processes.

Following Cullen et al. (1994), Pearson and Brew (2002) suggest that a more productive approach is to focus on what supervisors are actually doing and why. This is done on the assumption that this grounds discussion in the practice of supervision and the behaviour of participants, ensuring that their learning is situated in their particular research contexts.

Although the international research literature on postgraduate supervision is replete with examples of what constitutes good supervision practice (Moses, 1985; Zuber-Skerritt, 1992; Christie and Adawi, 2006; Holbrook and Johnston, 1999; Johnson et al., 2000), there is a dearth of longitudinal research that actually assesses the impact of interventions designed to improve postgraduate supervision.

CONCLUSION

The increasing international importance of innovation and knowledge generation has driven an increase in the research literature on research supervision. However, although a rich array of supervisory models have been proposed to account for the multifarious factors that are associated with effective supervision there is still a salient need for a program of coherent empirical validation.

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