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**Title**

Does external funding push doctoral supervisors to be more directive? A large-scale Danish study

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**Does external funding push doctoral supervisors to be more directive? A large-scale Danish study**

**Introduction**

Around the world, higher education has witnessed significant core (“institutional”) funding reductions to universities since the 1990s. The changing funding policy has pushed for university departments and faculty members to find increased external project-based funding, which is evident within individual countries such as Finland (Tammi 2009), Estonia (Roudla et al. 2015), Sweden (Young 2015), Norway (Gulbrandsen and Smeby 2005), Australia (Neumann 2007), New Zealand (Sampson and Comer 2010) and USA (Mendoza 2007; Villalba and Young 2012). Whilst there is clear acknowledgement in the literature that the new funding structure of universities has fostered significant external, competitive financing (Roudla 2015; Tammi 2009), there are mixed views about how these new agendas are impacting on faculty members’ pedagogical decisions and practices (Malfroy 2011).

Within the research field of doctoral education, there is an incipient literature addressing the impact of new funding models on supervisory practice and the postgraduate student experience. So far, this literature comprises a handful of studies that address the issue more or less directly. Few of the studies point out advantages of industrial funding. They show that students (Mendoza 2007) as well as supervisors (Malfroy 2011) report positive experiences with industry-based research partnerships. Clear benefits are networks, access to resources, data and facilities, and a close, collaborative supervision process. However, most of the studies present disadvantages. Green and Usher (2003) conjecture that supervisors tend to deliver more “fast” supervision in the sense that supervisors are becoming more readily available, succinct and

speedy in their feedback, and smart in their guidance along projected timelines. In line with these findings, studies suggest that supervisors may feel an increased pressure to control and monitor the progress and direction of doctoral students' projects if the supervisors are financially accountable to external sources (Deuchar 2008; McCallin and Nayer 2012; Neumann 2007; Green and Usher 2003; Sampson and Comer 2010). Franke and Arvidsson (2011) mention another drawback. If supervisors are administering the project funding, they have double roles as both supervisors and project leaders. It may cause conflicts of interest, as the supervisors tend to prioritize aspects that move the research project forward rather than those contributing to good research education. Overall, these studies give rise to hypothesize that supervisors are more directive in their approach if they have secured project-based funding for their doctoral student's research project.

However, it is somewhat unclear how "direction" is conceptualized and measured in the research literature on doctoral supervision. Thus, we found it necessary to examine the term more closely. There is a wide literature on the varieties of supervisor/student interactions and relations (Wisker 2012). A core dilemma, often addressed within this literature is how to ensure the quality of the research product and the students' progress while facilitating students' learning and development as independent researchers (Acker et al. 1994; Cullen 1994; Holligan 2005; Cryer 2000; Mainhard et al. 2009; Manathunga and Goozée 2007; Murphy et al. 2007; Overall et al. 2011). The dilemma accentuates a principal question about how much direction is appropriate in supervision. A general answer provided in the literature is for supervisors to adopt a "negotiated" or "contractual" model of supervision that involves clarifying expectations with students in order to act responsively and flexible (Armstrong 2004; Kam 1997). Consequently, several studies have focused on developing models and tools to help supervisors adjust their

supervision to the students' level of autonomy (Fraser and Mathews 1999; Gatfield 2005; Gurr 2001; Lee 2008; Murphy et al. 2007; Mainhard et al. 2009; Pearson and Kayrooz 2004; Vilkinas 2008). While these and other studies (Manathunga 2005; Sinclair 2004) have provided convincing arguments for using a staged approach from directive towards less directive supervision as the students develop over time, it remains unclear what directive supervision actually entails and how it should be assessed. In some cases, supervisor direction is used synonymously with academic advising (e.g., to inform students of expectations and to check on their progress) (Pearson and Kayrooz 2004; Gardner 2007) whereas other authors attribute a more intervening, controlling and authoritative behaviour to the term (Sinclair 2004; Mainhard et al. 2009; Murphy 2007). The fuzzy terminology makes it difficult to operationalize directive supervision, and this might explain the distinct absence of validated questionnaire scales to measure directive supervision among the several survey instruments aimed at assessing students' perceptions of the supervisor/student relationship.

Research indicates potential factors that may explain *why* supervisors approach the relationship with students in a more or less directive way. A series of works on doctoral attrition offer profound analyses of different supervision models founded in different disciplines. They unanimously conclude that high completion rates are distinct of "hard sciences", which is attributed to, i.a., cohort and team based models of supervision and close productive relationships between students and supervisors, including frequent meetings, co-authorships, and tight monitoring of students' progress (Gardner 2007; Golde 2005; Smeby 2000; Heath 2002; Sinclair 2004; de Valero 2001; Wright and Cochrane 2000, Zhao et al. 2007). Against this strand of research, Pearson (2005), Neumann (2002) and McCallin and Nayer (2012) argue that discipline specific micro-level studies are unable to explain how emerging global trends at a

macro-level might also influence supervision practice. They call for more research on how institutional changes and governmental policies might influence supervision, including performance-based funding models. In line with these authors, Deuchar concludes: “Supervisors may be compelled to over-direct students’ development in order to meet the demands imposed by external bodies.” (2008: 490). She closes the article by stating: “New research, based on larger samples of doctoral supervisors and candidates, is needed in order to explore these areas in more depth” (2008: 498).

Our article fills the gap by developing and validating an instrument to measure directive supervision and by examining the potential link between directive supervision and external funding in a large-scale survey design that allows us to control for disciplinary differences.

### **Aim of study**

The aim of our study was 1) to develop a scale measuring doctoral students’ perception of supervisor direction, and 2) to test the hypothesis that the degree of supervisor direction is related to project financing taking into account disciplinary differences.

### **What is Directive Supervision According to the Literature?**

Direction is a recurrent theme in the literature on supervisor-student relationships although it is conceptualized in various ways. Several studies examine direction as a supervision style or role. Some of them suggest that it is a role per se (Gatfield 2005; Vilkinas 2008) while others identify direction as an element in a flexible supervision belief/orientation (Lee 2008; Murphy et al. 2009) or as a dimension that represents a continuum from very directive towards less directive supervision (Gurr 2001; Mainhard et al. 2009; Sinclair 2004). Other authors

dissociate themselves from focusing on roles, and argue that a more productive approach is to focus on supervisor tasks/activities from which the degree of direction derives (Overall et al. 2011; Pearson and Kayrooz 2004). Finally, a group of studies focuses on the correlation between disciplines and the degree of supervisor direction (Acker 1994; Morton and Thornley 2001; Pole et al. 1997; Smeby 2000).

Across the different studies, we identified a large variety in the terminology used. In one study, the directive role is explicitly labeled “Directorial” (Gatfield 2005) while in other studies, the directive approach is categorized as “Deliverer” (Vilkinas 2008), “Expert coaching” (Pearson and Kayrooz 2004), “Functional” (Lee 2008), “Leadership” (Mainhard et al. 2009), “Project director” or “Academic expert” (Murphy et al. 2007). “Hands-on supervision” is the most frequently used term for a directive supervision practice (Deuchar 2008; Gurr 2001; Sinclair 2004; Vilkinas 2008) and it has been widely adopted in the handbook literature as well (Taylor and Beasley 2005; Wisker 2012). However, “hands-on” is a metaphorical construct and thus open for interpretation. Gurr (2001) defines hands-on as “a direct active style characterized by initiating, criticizing, telling and directing” (Gurr 2001: 86). Vilkinas (2008) defines it as supervisors being “closely involved in activities such as structuring the thesis, giving directions, setting standards, and making students aware of problems and constraints.” (Vilkinas 2008: 303). Sinclair (2004) provides a rich and detailed description of “hands-on” supervision, based on a large-scale survey among more than 6,000 supervisors across 26 Australian universities combined with in-depth interviews with 83 PhD supervisors and 26 PhD candidates across 17 universities. However, Sinclair’s survey does not include items on how supervisors act or behave “hands-on” in the supervision meetings. Instead, it includes questions about the structure around supervision (e.g., meeting frequency, project funding, and number of publications). Combined

with data from qualitative interviews, Sinclair finds that research supervision “can be described as an ‘intervention continuum’, ranging from ‘hands off’ to ‘hands on’” (Sinclair 2004: 26). At the hands-on’ end of the continuum, supervisors intervene by actively assisting students to structure the research and study process. Hands-on supervisors set milestones, they advise students on how to plan and prioritize relevant tasks, and they closely follow up on students’ progress. Moreover, supervisors inform students what is expected of them, and what is required in order to meet expectations. Finally, hands-on supervisors also intervene by frequent meetings, rapid turnaround of draft texts, and integrating students into the environment. Sinclair concludes: “These supervisory practices are directive and explicitly performance-oriented in comparison with the self-reliance and competence tacitly presumed of candidates by ‘hands off’ pedagogy.” (Sinclair 2004: 28).

In line with Sinclair (2004), several authors underline structuring activities to be characteristic of directive supervision. Some of them ground it in theory (Gatfield 2005) and others in empirical data (Lee 2008; Overall et al. 2009; Vilkinas 2008), but they all provide examples of highly structuring activities such as supervisors scheduling meetings, setting realistic goals, evaluating milestones and following-up if students do not keep within the proposed timeframe. The majority of studies also portray a directive supervisor as someone who actively help students to complete academic activities by demonstrating, explaining or even assisting in writing or formulating a research topic (Gurr 2001; Morton and Thornley 2001; Overall et al. 2011; Pearson and Kayrooz 2004; Vilkinas 2008; Zhao et al. 2007). Moreover, directive supervisors act as the principal decision maker in the project by regulating, controlling and determining the direction of the project (Acker 1994; Murphy 2007; Sinclair 2004). In some cases, decision making also correlates with a dominant behavior such as being strict (Mainhard

et al. 2009), authoritative (Lee 2008), and maintaining a hierarchical teacher/student relationship (Murphy et al. 2007).

To conclude, it is a challenge to compare studies of directive supervision because of the varied terminology and approaches as well as the lack of clear definitions. Directive supervision is often implicitly operationalized and it is seldom validated in the quantitative studies. Thus, we add to the current literature by developing and validating a list of items to capture directive supervision.

## **Methods**

### **Study Context**

In Denmark, the doctoral degree requires completion of a PhD thesis, teaching duties, course work (30 ECTS - European Credit Transfer and Accumulation System), placement at a foreign research institution, and a public defence of the thesis. Independent research under supervision forms the majority of the work. The duration of a Danish PhD programme is usually three years. The general admission requirement for PhD programmes is for candidates to hold a degree equivalent to the Danish two-year Master's degree. In some areas, a four-year PhD programme is offered to students who have completed a Bachelor's degree as well as one year of study at postgraduate level. The doctoral thesis can be completed either in a form of a monograph or as a collection of articles. The student has at least one main supervisor and one co-supervisor (Danish Ministry of Higher Education and Science). A Danish PhD program can be funded in a variety of ways. The most common are PhD studentships and industrial PhD fellowships. The PhD studentships (sometimes also called PhD Scholarships) are three-year full-time positions advertised by universities, research institutions, corporate enterprises and by

public and private foundations. In addition to a workplace and free tuition, students receive a monthly grant. In return, students have teaching obligations. Industrial PhD fellowships are offered through joint collaboration between a private enterprise and a university. Fellows are employed and are paid a salary by the enterprise during their studies. The duration of these fellowships is usually three years (Danish Ministry of Higher Education and Science).

Whichever funding is chosen, departments need to document a complete financing plan as a prerequisite for enrolment of a PhD student. The monthly salary for a PhD student in Denmark (less pension, before tax) amounts to 3,400-3,800 Euros. The average time for completing a three- year program is 3.58 years (The Statistical Practice of Danish Universities).

## **Participants**

The data for this study was collected in the spring of 2013 as part of a more comprehensive survey on quality in PhD processes at a large and research intensive Danish university (Author, published report). All full-time doctoral students were invited to participate in an on-line survey. A total of 1,780 doctoral students completed the questionnaire which equals a response rate of 79 %. However, on closer inspection, 90 participants did provide valid answers to less than seventy-five percent of the questions and therefore they were omitted. The final sample thus consisted of 1,690 doctoral students. The doctoral students were from the humanities ( $N = 225$ , 13 %), social sciences ( $N = 230$ , 14 %), health sciences ( $N = 536$ , 32 %), and natural science ( $N = 699$ , 41 %). To a very high degree, the participation rate in the survey reflected the enrolment in the four discipline areas. The doctoral students' age varied between 23 and 61 ( $M = 31.8$ ,  $SD = 6.0$ ). Of the participants, 53 % were female ( $N = 889$ ) and 47 % male ( $N = 801$ ). The proportion of international doctoral students was 26 %.

## **Instrument**

The complete survey about PhD processes comprised a large pool of items about all chronological aspects of the PhD journey from induction, integration into the research environment, supervision (scope, content, and relationship) to the development of research self-efficacy, well-being, progression of the project, publication, and career plans. In construction of the complete survey instrument, we consulted existing surveys. We replicated a few items from established surveys such as PRES (Turner 2015) and PREQ (GCA 2014) regarding students' overall satisfaction, research environment, and skill development. However, we did not copy items regarding the student/supervisor relationship because we wanted to investigate this subject more thoroughly than allowed by the five or six general supervision items included in PRES and PREQ.

We included 20 items about the supervisor/student relationship, which together reflected students' experience of the interpersonal relationship; feeling of workload coming from the supervisor; and perception of supervisor direction vs. non-direction (see Table 1). In the research literature, students' perceptions of positive interpersonal relationships are among the key issues associated with student satisfaction and degree progress (Ives and Rowley 2005; Wright 2003). Supervisors are expected to recognize and respect the student (Cullen et al. 1994; Zhao et al. 2007), match expectations (Hockey 1996; Hoskins and Goldberg 2005; Kam 1997; Woolhouse 2002) and not use the student as "cheap labour" (Zhao et al. 2007). Thus, we listed seven items to capture these elements.

We also developed a list of seven items to capture direction, informed by the above-identified characteristics of directive supervision in our literature review (see Table 1). On

Heath's (2002), Li and Seale's (2007) and Pearson and Kayrooz's (2004) advice, we chose to capture a directive practice in the supervisor/student relationship by focusing on practice and behaviour in supervisor meetings rather than structures around the meetings (e.g., frequency of contact). In line with Sinclair (2004), Gurr (2001) and Mainhard et al. (2009) we perceived directive supervision as one extreme end of a continuum with non-directive supervision at the other end. To examine the items' face validity, informal group interviews were performed with doctoral students from both "hard" and "soft" disciplines.

Table 1

Pool of Items used to Assess the Supervisor/Student Relationship, Including Directive Supervision Practice

Supervisor/student relationship	Wording	Item
<b>Interpersonal</b>		
Respect and recognition	My supervisor is friendly and accommodating	SUP01
	The relationship between my supervisor and me is characterised by mutual respect	SUP15
	I can openly discuss all problems with my supervisor	SUP17
	My supervisor recognises my work	SUP16
Match of expectation	My supervisor asks me about my needs and expectations regarding supervision	SUP20
<b>Exploitation</b>		
	My supervisor expects me to work so many hours that it's difficult to have a life outside of university	SUP18
	Sometimes I have a feeling that my supervisor sees me primarily as a source of labour to advance his/her research (R)	SUP19
<b>Directive supervision</b>		
Structures the process	My supervisor sets benchmarks and tells me what I need to do	SUP11
	My supervisor follows up on whether or not I have time to do the things I need to do	SUP09
Direct active help to complete activities	My supervisor takes over writing if I come to a standstill	SUP12
Determines the direction of the project	My supervisor often sets the agenda for the supervision	SUP07
	My supervisor makes many important choices in my project	SUP08
	My supervisor has clear preferences for the direction my project needs to take	SUP10
Is authoritative	My supervisor has a clear expectation that I will follow the advice I get	SUP13

**Non-directive supervision**

My supervisor leaves the control of the project to me	SUP02
My supervisor leaves it up to me to take the initiative for supervision	SUP03
My supervisor often seems unprepared for our meetings	SUP04
My supervisor encourages me to work independently	SUP06
My supervisor rarely gives specific advice about the best thing to do	SUP14
My supervisor listens to how I want things to be	SUP05

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The following questionnaire item was used to determine whether the doctoral student was externally funded or not: “Has your main supervisor applied for external funding for a project financing your salary?”

**Statistical analyses**

To develop and test the scales exploring doctoral students’ experiences with the supervisor/student relationship, we applied both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Regarding EFA, principal component analysis (PCA) was chosen. Because the sample was very large we split the dataset as recommended by Bowen and Guo (2012). The *calibration* dataset was used to explore latent structures by means of PCA. This resulted in a hypothesised factor model which then was tested on the *validation* dataset. Cronbach’s alpha was used to test the scales’ internal reliability. Independent-samples t-test was used to analyse group mean differences regarding type of funding and experience of doctoral supervision. Statistical analyses were conducted in SPSS version 22 and its AMOS module.

For the interpretation of results, the following rules of thumbs were used to guide analyses. Concerning Pearson’s  $r$ , Cohen (1988) recommended that correlation coefficients be interpreted as weak ( $.1 < r < .3$ ), moderate ( $.3 < r < .5$ ), and strong ( $r > .5$ ). Cronbach’s alpha greater than .7 is generally considered acceptable (Abell et al. 2009). With respect to

interpretation of factor loadings, Tabachnick and Fidell (2007) as a rule of thumb suggest that loadings above .71 are excellent, .63 very good, .55 good, and .45 fair. Loadings below .32 are poor and should not be interpreted. Finally, regarding the interpretation of model fit, multiple guidelines are available. Kline (2005) suggested that RMSEA values  $< .5$  indicate close approximate fit; that values between .5 and .8 indicate reasonable error of approximation; and that RMSEA  $> .10$  suggests poor fit. Kline (2005) also suggested that CFI values around .90 or greater indicate reasonably good fit and that SRMR values less than .10 in general should be considered favourable. Finally, it is common to include the model chi-square statistic even though this is a very conservative criterion to meet when operating with large samples. Thus, according to Bowen and Guo (2012), it is still valid to claim that the model fits well if other fit indices meet their criteria.

## **Results**

### **Descriptive Statistics**

Descriptive statistics of the 20 items describing the doctoral students' experience of their supervisor were inspected (see Table 2). Extreme values regarding skewness (scores  $> 3.0$ ) and kurtosis (scores  $> 10.0$ ) were noted for item SUP1 ("My supervisor is friendly and accommodating"); thus, this item was omitted from further analysis. Also, a high proportion of missing values (9.6 %) was noted for item SUP12 ("My supervisor sometimes takes over the writing if I come to a standstill") and on closer inspection, data was systematically missing, that is, the proportion of missing values was higher among doctoral students within health and natural sciences compared to doctoral students within the humanities and social sciences. Therefore,

item SUP12 was omitted, too. We discuss the implications of omitting the two questions later in the discussion section.

Table 2

*Descriptive Statistics (Mean, Standard Deviation, Skewness, and Kurtosis) for 20 Items describing Doctoral Students' Experience with the Supervisor/Doctoral Student Relationship*

Item	Wording	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
SUP01	My supervisor is friendly and accommodating	4.79	0.61	-3.55	14.24
SUP02	My supervisor leaves the control of the project to me	4.43	0.85	-1.81	3.62
SUP03	My supervisor leaves it up to me to take the initiative for supervision	4.21	0.99	-1.29	1.18
SUP04	My supervisor often seems unprepared for our meetings	2.00	1.22	0.99	-0.18
SUP05	My supervisor listens to how I want things to be	4.48	0.82	-1.87	3.73
SUP06	My supervisor encourages me to work independently	4.53	0.80	-1.84	3.41
SUP07	My supervisor often sets the agenda for the supervision	2.45	1.21	0.43	-0.72
SUP08	My supervisor makes many important choices in my project	2.76	1.28	0.09	-1.09
SUP09	My supervisor follows up on whether or not I have time to do the things I need to do	3.20	1.34	-0.26	-1.13
SUP10	My supervisor has clear preferences for the direction my project needs to take	3.31	1.27	-0.35	-0.91
SUP11	My supervisor sets benchmarks and tells me what I need to do	2.60	1.32	0.24	-1.21
SUP12	My supervisor sometimes takes over the writing if I come to a standstill	1.87	1.24	1.16	-0.03
SUP13	My supervisor has a clear expectation that I will follow the advice I get	3.49	1.16	-0.51	-0.52
SUP14	My supervisor rarely gives specific advice about the best thing to do	2.47	1.23	0.55	-0.74
SUP15	The relationship between my supervisor and me is characterised by mutual respect	4.61	0.79	-2.46	6.39
SUP16	My supervisor recognises my work	4.53	0.87	-2.19	4.84
SUP17	I can openly discuss all problems with my supervisor	4.41	1.00	-1.90	3.06
SUP18	My supervisor expects me to work so many hours that it's difficult to have a life outside of university	1.79	1.10	1.22	0.45
SUP19	Sometimes I have a feeling that my supervisor sees me primarily as a source of labour to advance his/her research (R)	1.50	1.03	2.11	3.41
SUP20	My supervisor asks me about my needs and expectations regarding supervision	3.23	1.40	-0.25	-1.21

*Note.* All items range from 1 (Disagree) to 5 (Agree).

## **Scale Development**

Prior to factor analyses, the dataset was split into a calibration ( $N = 845$ ) and validation dataset ( $N = 845$ ), respectively.

### **Exploratory factor analysis.**

In order to explore any latent structures behind the remaining 18 items measuring doctoral students' experiences of doctoral supervision, a series of principal component analyses (PCA) were performed on the calibration dataset. For each analysis, eigenvalues, scree plot, communalities and pattern matrixes were examined in order to identify complex variables (items that cross-load on several components) and outliers among variables (items with low communalities that also fail to load substantially on any one component). For each round of analysis, a decision was made to omit an item and a new round of PCA would then be performed. In this process, four items were omitted: SUP18 ("My supervisor expects me to work so many hours that it's difficult to have a life outside of university"), SUP09 ("My supervisor follows up on whether or not I have time to do the things I need to do"), SUP04 ("My supervisor often seems unprepared for our meetings"), and SUP14 ("My supervisor rarely gives specific advice about the best thing to do").

In the end, PCA was performed on 14 items. Three components showed eigenvalues larger than 1 (Kaiser's criterion), explaining a total of 58.2 % of variance after rotation. The scree plot also showed inflexions that would support a three-component solution. Moderate correlation among factors warranted oblique rotation, and promax rotation was chosen with the intent to maximize simple structure. The resulting pattern matrix is shown in Table 3.

Table 3

*Pattern Matrix of the Loadings for 14 Items describing Doctoral Students' Experience with their Doctoral Supervision (Principal Component Analysis, Promax Rotation)*

Items	C1	C2	C3
SUP15 The relationship between my supervisor and me is characterised by mutual respect	0.84		
SUP17 I can openly discuss all problems with my supervisor	0.83		
SUP16 My supervisor recognises my work	0.83		
SUP05 My supervisor listens to how I want things to be	0.68		
SUP20 My supervisor asks me about my needs and expectations regarding supervision	0.65		
SUP19 Sometimes I have a feeling that my supervisor sees me primarily as a source of labour to advance his/her research	-0.60		
SUP10 My supervisor has clear preferences for the direction my project needs to take		0.81	
SUP08 My supervisor makes many important choices in my project		0.78	
SUP13 My supervisor has a clear expectation that I will follow the advice I get		0.75	
SUP07 My supervisor often sets the agenda for the supervision		0.63	
SUP11 My supervisor sets benchmarks and tells me what I need to do		0.58	
SUP03 My supervisor leaves it up to me to take the initiative for supervision			0.79
SUP02 My supervisor leaves the control of the project to me			0.71
SUP06 My supervisor encourages me to work independently			0.66
Rotation Sum of Squared Loading	3.63	3.01	2.22
C1	1.00		
C2	0.03	1.00	
C3	0.12	-0.36	1.00

*Note:* Loadings below .40 have been omitted for ease of interpretation. Suggested labels: C1 (interpersonal relation), C2 (directive supervision), C3 (non-directive supervision). Factor correlations are reported at the bottom of the table.

Based on the wording of items loading on the latent variables, the first component was interpreted as reflecting the interpersonal relation between doctoral student and supervisor. The second component reflected features of structure and control and thus it was labelled directive supervision. Finally, the third component encompassed items about the supervisor encouraging independence and student initiative and hence it was labelled non-directive supervision.

### **Confirmatory factor analysis.**

Based on the results from the exploratory factor analyses, a three-factor model was hypothesised (see Figure 1) and tested on the validation dataset and the 14 items using CFA with maximum likelihood estimation. Standardized regression weights were between .81 and .46. The chi-test ( $\chi^2 = 506.9$ ,  $df = 74$ ,  $p < .001$ ) indicated poor fit; however, this was expected due to the very large sample size. The fit indices (CFI = .886, RMSEA = .083, SRMR = .090) suggested a reasonable fit between the hypothesised model and the data.

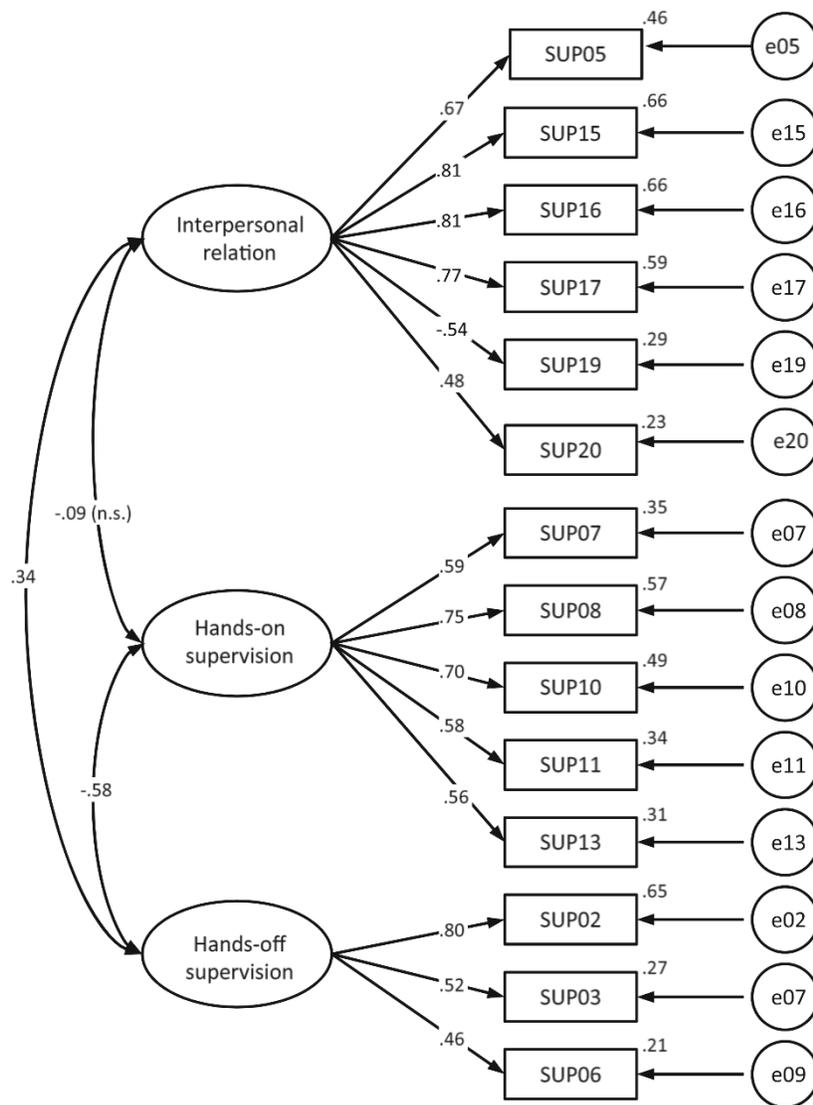


Fig. 1 The hypothesized three-factor model

**Scale construction.** Based on these results, three scales were computed using the complete dataset. Table 4 shows the scales’ descriptive statistics. Measures of internal reliability were acceptable ( $\alpha > .70$ ) for two of the scales. A low alpha statistic ( $\alpha = .594$ ) for the non-directive scale was noted. Additional analyses suggested that the alpha statistic could be slightly improved if removing item SUP06 (“My supervisor encourages me to work independently”); however, we assessed that the advantage of slightly improving the internal reliability of the non-

directive scale did not outweigh the price of omitting an item of key theoretical importance. Thus, we decided to retain SUP06. Finally, negative skewness and kurtosis were noted for the interpersonal relation and non-directive.

Table 4

*Descriptive Statistics for Scales*

Scales	Items	Mean	SD	Skewn.	Kurtosis	$\alpha$
Interpersonal relation	SUP(5, 15, 16, 17, 19R, 20)	4.30	0.73	-1.67	3.28	.808
Directive supervision	SUP(7, 8, 10, 11, 13)	2.92	0.91	0.06	-0.54	.768
Non-Directive supervision	SUP(2, 3, 6)	4.39	0.66	-1.51	3.03	.594

*Note.* All scales range from 1 (lowest score) to 5 (highest score). Item SUP19 was reversed.

Table 5 shows the correlations between scales. A moderately strong and negative correlation between directive and non-directive supervision was noted. Also, a positive but only weak to moderate association between interpersonal relation and non-directive supervision was noted. The association between directive supervision and interpersonal relationship was statistically non-significant at the .05-level.

Table 5

*Pearson Product-Moment Correlations between Scales*

Scales	1	2	3
1. Interpersonal relation	1.000		
2. Directive supervision	-.016	1.000	
3. Non-Directive supervision	.185**	-.382**	1.000

*Note.* \*\*  $p < .01$

**Funding Source and Directive Supervision**

The second major aim of our study was to investigate whether type of funding source supporting doctoral student’s project was related to type of supervision. Guided by prior research

(Guldbrandsen and Smeby 2005; Sinclair 2004), we expected both type of funding and type of supervision to vary across academic disciplines. Hence, prior to analysing any relationship between funding source and type of supervision, we explored to which extent the degree of directive supervision varied systematically across four major research domains. Analysis of variance (ANOVA) showed a main effect of disciplinary context on directive supervision,  $F(3, 1686) = 56.3, p < .001, \eta^2 = .09$ . Further post-hoc analyses using Bonferroni adjusted p values showed that directive supervision was more dominant in the health sciences ( $M = 3.03, SD = .89$ ) and natural sciences ( $M = 3.12, SD = .87$ ) than in the humanities ( $M = 2.45, SD = .79$ ) and social sciences ( $M = 2.49, SD = .88$ ). Results are shown in Table 6.

Table 6

*Context Specific Mean Scores for the Directive Supervision Scale*

	<i>N</i>	<i>M</i>	<i>SD</i>
Humanities	225	2.44	0.79
Social Sciences	230	2.49	0.88
Health Sciences	536	3.03	0.89
Natural Sciences	699	3.12	0.87
Total sample	1.690	2.92	0.91

*Note.* The directive supervision scale ranges from 1-5. Pairs of Means grouped by a vertical line are not significantly different from each other (Bonferroni adjustment,  $p < .05$ )

A frequency table showed that the proportion of doctoral students being funded by external sources varied between the humanities (20 %), social sciences (20 %), health sciences (44 %), and natural sciences (66%). Thus, in sum, preliminary analyses suggest that disciplinary context should be taken into account when analysing any relation between type of funding source and doctoral supervision.

Next we compared the group of externally funded doctoral students to the group of internally funded doctoral students regarding their scores on the directive supervision scale. The results are shown in Table 7. For the sample as a whole, an independent-samples t-test indicated that the mean score on hands-on supervision was higher for externally funded doctoral students ( $M = 3.05, SD = .84$ ) than for internally funded doctoral students ( $M = 2.72, SD = .92$ ),  $t(1504) = -7.26, p < .001, d = .37$ .

Table 7

*Comparison between Internally and Externally Funded<sup>a</sup> Doctoral Students' Experiences of Directive Supervision<sup>b</sup>*

Disciplinary context	Internal funding			External funding			Differences between groups				
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	$\Delta$ means	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Humanities	175	2.40	.80	44	2.63	.76	-.23	-1.71	217	.089	.23
Social Sciences	176	2.42	.85	44	2.62	.89	-.19	-1.32	218	.187	.18
Health Sciences <sup>c</sup>	286	2.88	.90	223	3.16	.83	-.28	-3.63	493	< .001	.33
Natural Sciences <sup>c</sup>	192	3.05	.94	380	3.08	.82	-.03	-0.37	342	.716	.04
Total sample <sup>c</sup>	829	2.72	.92	691	3.05	.84	-.33	-7.26	1504	< .001	.37

<sup>a</sup> "Has your main supervisor applied for external funding for a project financing your salary?"

<sup>b</sup> The directive supervision scale ranges from 1-5.

<sup>c</sup> Based on Levene's test for Equality of Variances, equal variances between groups was not assumed. Statistics have been adjusted accordingly.

In order to control for the effect of disciplinary context, independent-samples t-tests were conducted within each of the disciplinary domains. Within the health sciences we found a statistically significant difference between externally ( $M = 3.16, SD = .83$ ) and internally ( $M = 2.88, SD = .90$ ) funded doctoral students regarding their experiences of directive supervision,  $t(493) = -3.63, p < .001, d = .33$ . We also found differences of some magnitude within the

humanities and the social sciences; however, these differences were statistically non-significant. Within the humanities, scores on the directive supervision scale were higher for externally funded ( $M = 2.63, SD = .76$ ) than internally funded ( $M = 2.40, SD = .80$ ) doctoral students; yet the difference in group means was non-significant at the  $\alpha = .05$ -level,  $t(217) = -1.71, p = .089, d = .23$ . Within the social sciences, scores were also higher on the directive supervision scale for externally funded ( $M = 2.62, SD = .89$ ) compared to internally funded ( $M = 2.42, SD = .85$ ) doctoral students; yet the difference in group means was statistically non-significant at the  $\alpha = .05$ -level,  $t(218) = -1.32, p = .187, d = .18$ . Finally, within the natural sciences, scores on the directive supervision scale did not differ between the groups of externally ( $M = 3.08, SD = .82$ ) and internally funded doctoral students ( $M = 3.05, SD = .94$ ),  $t(342) = -.37, p = .716, d = .04$ .

## Discussion

### Measuring Directive Supervision

The first aim of our study was to develop a quantitative scale allowing us to measure and further analyse doctoral students' perceived degree of directive supervision. In this process, three latent components were identified and these formed the basis for the construction of three scales describing the supervisor/student relationship.

The first scale consisted of six items in which the doctoral students responded to issues concerning the supervisors' respect for the student, openness to discussion, recognition of the students' work, and responsiveness towards the doctoral student's needs. These items reflected the interpersonal relationship between doctoral student and supervisor. Negative skewness and a fairly high scale average indicate that a large majority of the doctoral students experience their supervisors as friendly and respectful. Although a wide literature is concerned with personal

interaction as potential problem areas in supervision relationships (Bair and Haworth 2005; Engebretson et al. 2008; Lamm 2004), our analysis suggest that neglect by supervisors or poor interpersonal skills are minority phenomena. By showing this, we do not state that interpersonal aspects of the relationship is trivial, nor that it is unaffected by external financing. That would require further correlation analysis between findings on this scale and dependent variables such as students' satisfaction with supervision or external financing. However, it is beyond the scope of this article and was not part of our hypothesis. We only observe that most students in our sample experience their supervisors as open and appreciative. This is interesting per se since the majority of studies showing students' negative experiences with supervision, are from Australia, UK or USA. It raises questions for further research about the importance of national contexts, including terms of employment and economic conditions; for example, are supervisors friendlier, more accommodating and respectful towards their students if students are employees with a high salary, which is the case in Denmark?

The second scale, on the other hand, proved to be normally distributed and to perform statistically well. It includes five items relating to how supervisors structure the process, determine the direction of the project, and act authoritatively. Altogether, this operationalization reflects the common features of directive supervision that we distilled from the review. It also reflects the meaning and usage of the term "direct" in modern English, which is to regulate, determine and control activities in a particular direction, based on an authoritative instruction (Direct, 2015 [Def. 2, 4, 5]). In this respect, directive supervision can be defined as more than giving advices; it also means expecting students to follow advice. Interestingly, though, the item about supervisors' direct help to complete academic activities was omitted. The item was phrased this way: "My supervisor takes over writing if I come to a standstill". We reason that the

item fails to address an acceptable and identifiable practice because the wording represents an extreme degree of directive supervision, close to an unscientific norm in terms of supervisors doing the work for the student. Another plausible explanation is that it relates to a specific academic activity, in this case writing, whereas the other items are de-contextualised from specific activities. The term “takes over writing” might be perceived pointless or difficult to interpret for students within the humanities and social sciences. Academic writing is well-known to be closely tied to disciplines. Most students in the health and natural sciences write article-based PhD theses, and their supervisors are often co-authors of the articles (Heath 2002), though this trend is also emerging in the “soft sciences” (Sabharwal 2013). Thus, different publication traditions might explain why a higher proportion of students from the health and natural sciences did not reply to the question compared to students from the humanities and social sciences. We recommend further sophistication of the directive supervision scale by developing questions that operationalize how supervisors provide direct active help to complete academic activities. According to the literature, an interventionist approach is characteristic of a strong focus on academic tasks, performance and completion (Lee 2008; Murphy et al. 2007; Sinclair 2004) and this feature is not captured in our current scale.

The third scale comprises three items that describe a mode of supervision in which the supervisor leaves the initiative and control of the project to the doctoral student and encourages him or her to work independently. We interpreted the scale as reflecting non-directive supervision. It should, however, be noted that the non-directive scale did not show as convincing psychometric properties as did the two former scales. For example, the internal reliability of the scale was less than recommended and closer inspection indicated that deleting item SUP06 (“My supervisor encourages me to work independently”) would strengthen the scale’s reliability. The

problem might be with the respondents' everyday conceptualisations of the word "independence". The research literature attests to the confusion over how to define the term. Independence is referred to as "emancipation" (Lee 2008), "autonomy", (Overall et al. 2011) and "growth" (Wisker 2012). Independence is sometimes linked to product (e.g., to the level of originality of research expected by a doctoral student) (Wisker 2012) and sometimes it is linked to the process (e.g., to the student's personal growth) (Overall et al. 2011). In addition, independence has been shown to vary a great deal between cultures, disciplines and individuals (Wisker 2012). Thus, while independence is a key concept in the professional practice of researchers including doctoral students, the word "independence" might be problematic in the formulation of questionnaire items. This taken into account, we are reluctant to use the scale for more substantial analyses, and especially hypothesis testing, before it has been further developed. An area for further development of the non-directive scale could be to elaborate on the item about independence; for example by developing and testing a range of items that in greater detail operationalise the concept.

### **The influence of Funding Source on Supervisor Direction**

The second aim was to test our hypothesis about the influence of external funding on doctoral supervision; that is, to test whether supervisor direction is more likely in doctoral research projects in which the doctoral student's salary is secured by external funding applied for by the supervisor. The results from our study are ambiguous. For the total sample of doctoral students, we found that in comparison with internally funded doctoral students, doctoral students with projects that were financed by external funding applied for by their supervisor largely experienced their supervisors as directive. However, on closer inspection, such difference was

only statistically significant among doctoral students in the health sciences. On the other hand, no such difference was found among doctoral students in the natural sciences.

For doctoral students within the humanities and the social sciences, respectively, results were more complex. For example, within the humanities, the difference between externally and internally funded students regarding directive supervision ( $\Delta_{\text{humanities}} = -.23$ ) was close to the difference found within the health sciences ( $\Delta_{\text{health}} = -.28$ ). However, the difference within the humanities was *statistically* non-significant and, thus, the sample difference cannot be inferred. Nonetheless, one should be very aware that the sample size for the health sciences was double the sample size for the humanities and further research should examine the possible relation between type of funding and type of supervision with a larger sample of doctoral students from the humanities. This also applies to the results for the social sciences.

Overall, results from the Danish sample suggest that a link between funding source and degree of directive supervision might be *moderated* by disciplinary context for reasons we can only speculate on. For example, one might speculate whether context specific factors such as research tradition, epistemological beliefs, norms and values, and conceptions of the aims of doctoral education attenuate or amplify the influence of funding regimes. The natural sciences and health sciences both have strong traditions for research collaboration, frequent meetings, article production, co-authorships, and accordingly a more directive supervision practice (Heath 2002; Sinclair 2004). External financing is prevalent in both disciplines and some would argue that it reflects the research and publication traditions within these domains. Sampson and Comer (2010) suggest that the necessity for external funding favours some models of supervision while challenging others. Team-based and directive supervision models are distinctive of the hard sciences, and they are known for their effective research production based on a critical mass in

large research groups. Such outputs meet the requirements for attracting funding, and thus the team-based models enjoy marked advantages in such funding contexts.

However, this does not explain why the correlation between external funding and supervisor direction is only significant in the health sciences and not in the natural sciences. A possible explanation is that the two domains differ in terms of conceptions of research, despite their many similarities. For instance, Stubb, Pyhältö, and Lonka (2014) report that medical students perceive research as a “job to do”, as a job with specific duties to accomplish. In the natural sciences and social sciences, it is more common to consider research as a personal journey. Researchers in the medical domain often work with well-defined problems, which may reflect a conception of research as a process of “finding the facts” and achieving certain outcomes or products. In addition, it is typical for students to pursue a PhD in medicine in order to secure a permanent position at the university hospital (Stubb et al. 2014). It is possible that external financing has a self-perpetuating effect on such strong product and achievement related conceptions within this discipline. Publication is an indicator of performance and an important criterion in obtaining funding, and funding is a way of proving one’s excellence. Such an approach might compel medical supervisors to achieve good results in an arena of intense competition and thus to “over-direct” students’ projects. That said we must be careful not to make extensive, oversimplifying conclusions based solely on disciplinary differences (Kamler 2008). The potentially moderating role of disciplinary context calls for further research.

Finally, it is reasonable to imagine that external funding is only one of many factors at macro-level that affects research and subsequently doctoral supervision practice (Halse and Mowbray 2011; McCallin and Nayer 2012). The recent report by the European University Association (Estermann and Claeys-Kulik 2015) gives basis for hypothesizing that the

performance-based funding models of universities in Europe push supervisors to focus on students' completion and research output. Performance-based funding implies an increased focus on output indicators to measure researchers' productivity through bibliometric criteria, the extent of external funding obtained, the number of contracts with business and industry, etc. (Estermann and Claeys-Kulik 2015). In order to achieve a high score on these indicators, researchers benefit by having a steady flow of doctoral students who deliver timely high quality products.

Neumann's (2007) national study on doctoral education in Australia support this hypothesis. She concludes that all six universities in her multiple case study are moving towards a closer and tighter monitoring of doctoral students' progress because of increased performance-allocated budgets. Especially, supervisors tend to encourage less risky and ambitious projects. They 'downsize' projects so they are likely to be completed within the expected timeframe.

Altogether, it may push supervisors to accelerate a "doctoral student machinery". More research is needed to address this issue.

### **Limitations**

A number of limitations should be considered when interpreting the findings from the current study. Firstly, the study has examined doctoral supervision in a given Danish context characterised by very attractive conditions of work and pay for doctoral students in terms of high salaries, a daily workplace environment, and free tuition. Therefore, our study should be replicated in other national context. For example, it would be interesting to replicate the study at universities in which students are not recognized as professional employees with the same rights and financial security as in Denmark during their study time. This also applies to the further validation of the scales applied in this study. Secondly, since this study was part of a larger

survey on doctoral students' experiences of the PhD process, our study examined doctoral supervision from the viewpoint of the doctoral student. It would be interesting to develop survey items that would allow addressing the experience of the doctoral supervisor as well. Thirdly, while our study provides substantial analysis of correlations between directive supervision and external funding, the survey design only allows us to conjecture about the reasons for the seeming correlation. Qualitative interview studies with supervisors would be the next obvious step in order to understand both the factors at micro- and macro level that influence the degree of direction. Finally, our survey did not include data about different types of external funding. One can conjecture that industry grants may influence supervision style differently from government funding. For example, Harman (2002) finds that Australian science and technology academics are more concerned about how industry funding threatens their research autonomy compared with government funding. In line with these findings, Malfroy (2011) shows how supervisors experience growing conflicts of interests because they feel a pressure from industry partners who want influence over the scope of the project. It places high demands on the supervisors' integrity and negotiation skills, and they believe there is a potential threat that students do not feel ownership of their projects. On the other hand, Harman (2002) finds that industry funded students are more satisfied with their doctoral studies compared with government-funded students. Overall, it calls for future research that allows for analysis of different types of funding.

### **Conclusion**

In this study, we add to the current literature with a validated scale for directive doctoral supervision. The scale reflects how supervisors structure the process, determine the direction of the project, and act authoritatively. The scale items can be integrated into questionnaires and

hence enable researchers to analyse the possible impact of directive supervision. Analyses of associations between supervisor direction and students' well-being, time to degree, satisfaction, self-efficacy and independence would all be of great interest. We want to emphasize that we do not frame directive supervision as inexpedient per se. A certain degree of structure and clear decision making by the supervisor may reduce students' feeling of insecurity, loneliness or feelings of being worn out. On the other hand, one could fear that too much direction will crowd-out an important aspect of doctoral supervision, that is, doctoral students acquiring the skills needed to become independent researchers. Several publications have put forward this assumption (Gurr 2001; Deuchar 2008). Gurr's model is essentially based on the idea that directive supervision ("hands-on") and independence are inversely proportional. Deuchar (2008) states that 'over-direction' of students' projects is at the expense of promoting students' autonomy and ownership. However, these studies are theoretical in nature or based on small cases, and thus need more follow-up to establish a true relation about the balancing act between direction, autonomy, and new political agendas.

In this study, we specifically analysed possible correlations between direction and external funding while controlling for disciplinary differences. We conclude that doctoral students perceive their supervisors to be more directive in case of external funding, although this association is statistically significant only in the health sciences. These findings partially support the theoretical and case-based assumption in the current literature that new funding models push supervisors to increase their focus on students' completion and productivity. It results call for more research in order to understand *why* supervisors might act more directive in case of external funding.

## References

Author, published report

- Abell, N., Springer, D. W., & Kamata, A. (2009). *Developing and validating rapid assessment instruments*. New York: Oxford University Press.
- Acker, S., Hill, T., & Black, E. (1994). Thesis supervision in the social sciences: managed or negotiated? *Higher Education*, 28, 483-498.
- Armstrong, S. J. (2004). The impact of supervisors' cognitive styles on the quality of research supervision in management education. *British Journal of Educational Psychology*, 74, 599-616.
- Bair, C., & Haworth, J. (2005). Doctoral Student Attrition and Persistence: A Meta-Synthesis of Research. In J. Smart (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 19, pp. 481-534): Springer Netherlands.
- Bowen, N., & Guo, S. (2012). *Structural equation modeling*. New York: Oxford University Press.
- Cleys-Kulik, A.-L., & Estermann, T. (2015). DEFINE Thematic Report: Performance-based funding of universities in Europe. Brussel: European University Association. Retrieved from [www.eua.be](http://www.eua.be)
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cryer, P. (1996). *The Research Student's Guide to Success*. Maidenhead: Open University Press
- Cullen, D., Pearson, M., Saha, L., & Spear, R. (1994). *Establishing Effective PhD Supervision*. Canberra: Australian Government Publishing Service.
- Danish Ministry of Higher Education and Science (2015, December, 10). Retrieved from [http://ufm.dk/en?set\\_language=en&cl=en](http://ufm.dk/en?set_language=en&cl=en)
- de Valero, F. Y. (2001). Departmental factors affecting time-to-degree and completion rates of Doctoral students at One Land-Grant Research Institution. *The Journal of Higher Education*, 72(3), 341-367.
- Deuchar, R. (2008). Facilitator, director or critical friend? Contradiction and congruence in doctoral supervision styles. *Teaching in Higher Education*, 13(4), 489-500.
- Direct, 2015. In *Merriam-Webster.com*. Retrieved December 10, 2015, from <http://www.merriam-webster.com/dictionary/direct>.
- Engebretson, K., Smith, K., McLaughlin, D., Seibold, C., Terrett, G., & Ryan, E. (2008). The changing reality of research education in Australia and implications for supervision: a review of the literature. *Teaching in Higher Education*, 13(1), 1-15.
- Franke, A., & Arcidsson, B. (2010). Research supervisors' different ways of experiencing supervision of doctoral students. *Studies in Higher Education*, 36(1), 7-19.
- Fraser, R., & Matthews, A. (1999). An evaluation of the desirable characteristics of a supervisor. *Australian Universities Review*, 42(1), 5-7.

- Gardner, S. K. (2007). "I heard it through the grapevine": Doctoral student socialization in chemistry and history. *Higher Education*, 54, 723-740.
- Gatfield, T. (2005). An Investigation into PhD Supervisory Management Styles: Development of a dynamic conceptual model and its managerial implications. *Journal of Higher Education Policy and Management*, 27(3), 311-325.
- GCA – Graduate Careers Australia (2014) Postgraduate Research Experience 2014. A report on the postgraduate research experience perceptions of recent higher degree research graduates. Melbourne: Edvina Lindsay. Retrieved from [http://www.graduatecareers.com.au/wp-content/uploads/2015/09/Postgraduate\\_Research\\_Experience\\_2014.pdf](http://www.graduatecareers.com.au/wp-content/uploads/2015/09/Postgraduate_Research_Experience_2014.pdf)
- Golde, C. (2005). The Role of the Department and Discipline in Doctoral Student Attrition: Lessons from Four Departments. *The Journal of Higher Education*, 76(6), 669-700.
- Green, P., & Usher, R. (2003) Fast Supervision: Changing supervisory practice in changing times. *Studies in Continuing Education*, 25(1), 37-50.
- Gulbrandsen, M., & Smeby, J.-C. (2005). Industry funding and university professors' research performance. *Research Policy*, 34(6), 932-950.
- Gurr, G. M. (2001). Negotiating the "Rackety Bridge" – a Dynamic Model for Aligning Supervisory Style with Research Student Development. *Higher Education Research & Development*, 20(1), 81-92.
- Harman, G. (2002). Producing PhD Graduates in Australia for the Knowledge Economy. *Higher Education Research & Development*, 21(2), 179-190.
- Harman, G. (2001). University-Industry Research Partnerships in Australia: Extent, benefits and risks. *Higher Education Research & Development*, 20(3), 245-264.
- Halse, C., & Mowbray, S. (2011). The impact of the doctorate. *Studies in Higher Education*, 36(5), 513-525
- Heath, T. (2002). A Quantitative Analysis of PhD Students' Views of Supervision. *Higher Education Research and Development*, 21(1), 41-53.
- Hockey, J. (1996). Motives and Meaning amongst PhD Supervisors in the Social Sciences. *British Journal of Sociology of Education*, 17(4), 489-506.
- Holligan, C. (2005). Fact and fiction: a case history of doctoral supervision. *Educational Research*, 47(3), 267-278.
- Hoskins, C. M., & Goldberg, A. D. (2005). Doctoral Student Persistence in Counselor Education Programs: Student–Program Match. *Counselor Education and Supervision*, 44(3), 175-188.
- Ives, G., & Rowley, G. (2005). Supervisor selection or allocation and continuity of supervision: PhD students' progress and outcomes. *Studies in Higher Education*, 30(5), 535-555.
- Kam, B. H. (1997). Style and Quality in Research Supervision: The Supervisor Dependency Factor. *Higher Education*, 34(1), 81-103.

- Kamler, B. (2008). Rethinking doctoral publication practices: Writing from and beyond the thesis. *Studies in Higher Education* 33(3), 283–94
- Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York: The Guildford Press.
- Lamm, R. (2004). *Nurture or challenge in research higher degree supervision*. Paper presented at the AARE Conference, Melbourne, Australia.
- Lee, A. (2008). How are doctoral students supervised? Concepts of doctoral research supervision. *Studies in Higher Education*, 33(3), 267-281.
- Li, S., & Seale, C. (2007). Managing criticism in Ph.D. supervision: a qualitative case study. *Studies in Higher Education*, 32(4), 511-526.
- Mainhard, T., van der Rijst, R., van Tartwijk, J., & Wubbels, T. (2009). A model for the supervisor–doctoral student relationship. *Higher Education*, 58(3), 359-373.
- Malfroy, J. (2011) The impact of university-industry research on doctoral programs and practices. *Studies in Higher Education*, 36(5), 571-584.
- Manathunga, C. (2005). Early warning signs in postgraduate research education: a different approach to ensuring timely completion. *Teaching in Higher Education*, 10(2), 219-233.
- Manathunga, C., & Goozée, J. (2007). Challenging the dual assumption of the ‘always/already’ autonomous student and effective supervisor. *Teaching in Higher Education*, 12(3), 309-322.
- McCallin, A., & Nayar, S. (2012). Postgraduate research supervision: a critical review of current practice. *Teaching in Higher Education*, 17(1), 63-74.
- Mendoza, P. (2007). Academic Capitalism and Doctoral Student Socialization: A Case Study. *Journal of Higher Education*, 78(1), 71-96.
- Morton, M., & Thornley, G. (2001). Experiences of Doctoral Students in Mathematics in New Zealand. *Assessment & Evaluation in Higher Education*, 26(2), 113-126.
- Murphy, N., Bain, J., & Conrad, L. (2007). Orientations to research higher degree supervision. *Higher Education*, 53(2), 209-234.
- Neumann, R. (2007). Policy and practice in doctoral education. *Studies in Higher Education*, 32(4), 459-473.
- Overall, N. C., Deane, K. L., & Peterson, E. R. (2011). Promoting doctoral students' research self-efficacy: combining academic guidance with autonomy support. *Higher Education Research & Development*, 30(6), 791-805.
- Pearson, M., & Kayrooz, C. (2004). Enabling critical reflection on research supervisory practice. *International Journal for Academic Development*, 9(1), 99-116.
- Pole, C., Sprokkereef, A., Burgess, R., & Lakin, E. (1997). Supervision of doctoral students in the natural sciences: expectations and experiences. *Assessment and Evaluation in Higher Education*, 22(1), 49-63.

- Raudla, R., Karo, E., Valdmaa, K., & Kattel, R. (2015). Implications of project-based funding of research on budgeting and financial management in public universities. *Higher Education, 70*(6), 957–971.
- Sabharwal, M. (2013). Comparing Research Productivity Across Disciplines and Career Stages. *Journal of Comparative Policy Analysis: Research and Practice, 15*(2), 141-163.
- Sampson, K. A., & Comer, K. (2010). When the governmental tail wags the disciplinary dog: some consequences of national funding policy on doctoral research in New Zealand. *Higher Education Research & Development, 29*(3), 275-289.
- Sinclair, M. (2004). *The Pedagogy of 'Good' PhD Supervision: A National Cross-Disciplinary Investigation of PhD Supervision*. Australia: Central Queensland University, Faculty of Education and Creative Arts.
- Smeby, J.-C. (2000). Disciplinary Differences in Norwegian Graduate Education. *Studies in Higher Education, 25*(1), 53-67.
- Stubb, J., Pyhältö, K., & Lonka, K. (2014) Conceptions of research: the doctoral student experience in three domains. *Studies in Higher Education, 39*(2), 251-264,
- Tabachnick, B., & Fidell, L. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson Education.
- Tammi, T. (2009). The competitive funding of university research: the case of Finnish science universities. *Higher Education, 57*(5), 657-679.
- Taylor, S., & Beasley, N. (2005). *A handbook for doctoral supervisors*. London: Routledge.
- The Statistical Practice of Danish Universities [Universiteternes Statistiske beredskab] (2015. December, 10). Retrieved from <http://www.dkuni.dk/Statistik/Universiteternes-statistiske-beredskab>.
- Turner, G. (2015) PRES 2015. The research student journey. Higher Education Academy. Retrieved from [https://www.heacademy.ac.uk/sites/default/files/pres\\_2015.pdf](https://www.heacademy.ac.uk/sites/default/files/pres_2015.pdf)
- Villalba, J. A. & Young, J. S. (2012). Externally Funded Research in Counsellor Education: An Overview of the Process. *Counsellor Education and Supervision, 51*(2), 141-154.
- Vilkinas, T. (2008). An Exploratory Study of the Supervision of Ph.D./Research Students' Theses. *Innovative Higher Education 32*, 297–311.
- Wisker, G. (2012). *The Good Supervisor. Supervising Postgraduate and Undergraduate Research for Doctoral Theses and Dissertations*. (2nd ed.). Hampshire: Palgrave Macmillan.
- Woolhouse, J. (2002). Supervising dissertation projects: Expectations of supervisors and students. *Innovations in Education and Teaching International, 39*(2), 137 - 144.
- Wright, T. (2003). Postgraduate research students: People in context? *British Journal of Guidance & Counselling, 31*(2), 209-227.
- Wright, T., & Cochrane, R. (2000). Factors Influencing Successful Submission of PhD Theses. *Studies in Higher Education, 25*(2), 181-195.

- Young, M. (2015). Competitive funding, citation regimes, and the diminishment of breakthrough research. *Higher Education*, 69(3), 421-434.
- Zhao, C.-M., Golde, C. M., & McCormick, A. C. (2007). More than a signature: how advisor choice and advisor behaviour affect doctoral student satisfaction. *Journal of Further and Higher Education*, 31(3), 263-281.