

Mentoring the Next Generation of Translational Researchers: Comparing Scientific and Clinical Mentoring

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Mentoring is a key element of structured clinician scientist programs, yet little is known about how mentoring differs between scientific and clinical contexts or which mentoring roles shape protégés' evaluations of mentor effectiveness. Drawing on Kram's Mentor Role Theory, this study examines mentoring relationships among early career clinician scientists at a large German university hospital using quantitative survey data. We analyse characteristics of mentoring relationships, career-related and psychosocial mentor roles, and their association with protégés' evaluations of mentoring effectiveness. Scientific mentors provided significantly more challenge than clinical mentors. Aggregated career-related roles were positively associated with evaluations of *scientific* mentor effectiveness, whereas psychosocial roles were linked to more positive evaluations of *clinical* mentor effectiveness. These findings highlight the distinct functions of scientific and clinical mentoring in supporting clinician scientists' dual career development, with different mentoring roles required across contexts and career demands.

Keywords: Early career clinician scientists, mentoring relationships, mentor roles, mentor effectiveness

1 Career Attrition and Mentoring Among Early Career Clinician Scientists

Medical professionals pursuing academic research ("*clinician scientists*"¹) occupy a unique position between research and patient care, translating scientific findings into clinical applications and bringing patient-centered perspectives into research. This intermediary role makes clinician scientists a key group for translational medicine (Deutsche Forschungsgemeinschaft [DFG], 2024; Hendriks et al., 2019; Vignola-Gagne, 2014). However, their number has been declining for decades, threatening the translation of discoveries "*from bench to bedside*" (Furuya et al., 2017; Wyngaarden, 1981). One contributing factor is the high attrition rate among early career clinician scientists

¹Clinician Scientists are also referred to as "physician scientists" or "translational scientists" (e.g., Hendriks et al., 2019).

who begin pursuing a research career during residency training (*Facharztweiterbildung*)² at the postdoctoral stage but abandon this path before or shortly after its completion. This period is particularly critical due to substantial time constraints, conflicting professional demands, ambiguous career structures, and comparatively lower financial rewards than those available in purely clinical careers (DFG, 2024; National Institute of Health [NIH], 2014; Williams et al., 2022).

Mentoring is widely recognised as essential for early career clinician scientists in successfully navigating the dual demands³ of clinical practice and scientific research (DFG, 2024; Salata et al., 2018; Williams et al., 2022). Although both scientific and clinical training typically take place within university hospitals, the two professional developments occur in two distinct institutional contexts: scientific training within academic research environments and clinical development within healthcare structures (Hendriks et al., 2019). This duality reflects the structural position of university medicine at the intersection of the academic and healthcare systems, which operate according to different institutional logics and career structures (Großkraumbach, 2025). Structured clinician scientist programs therefore incorporate mentoring components tailored to these challenges, typically following a tandem mentoring model that combines clinical and scientific mentors and is regarded as a key success factor for integrated clinical and academic career development (DFG, 2025).

To understand mentoring practices in this context, the present study views mentoring as a relationship between mentor and protégé, in which the mentor fulfils several distinct functions for the protégé that can be characterised as either career-related or psychosocial (Kram, 1985). Effective mentoring is characterised by the integration of these multiple roles, suggesting the mentoring quality depends on the enactment of a wide variety of roles within the relationship (Kram, 1985; Schneider, 2009).

Empirical research in academic medicine indicates that mentoring is often primarily career-focused, whereas psychosocial functions are less consistently emphasised, particularly among clinician scientists (Crites et al., 2023; Straus et al., 2009). Nevertheless, both mentoring domains have been associated with positive outcomes such as satisfaction, productivity, and self-efficacy (Alhamidi, 2022; Dilmore et al., 2010; Foster & Hill, 2019; Jeffe et al., 2017). However, research remains fragmented, as scientific and clinical mentoring are typically examined as separate domains. One strand

²Residency training is the supervised clinical training physicians complete after their medical studies to gain specialised, hands-on experience in a chosen field before independent practice (Bayerische Landesärztekammer, 2025).

³University medicine is characterised by a triadic mission of clinical care, research, and teaching (e.g., Großkraumbach, 2025), with teaching particularly reflected in academic qualification pathways such as the habilitation, which grants the formal authorisation to teach (Lehrbefugnis). While teaching constitutes an important dimension of academic work, it is not the focus of the present study.

of research examines *scientific* mentoring in academic medicine (Fishman, 2021; Geraci & Thigpen, 2017; Hill et al., 2022), including mentoring specifically for clinician scientists (Elhalaby et al., 2026; Yoon et al., 2018). A separate strand focuses on *clinical* mentoring that supports professional development as medical doctors (Joe et al., 2023; van Schalkwyk et al., 2017).

Accordingly, little is known about how mentoring is enacted in structured clinician scientist programs and which factors contribute to its effectiveness in supporting early career clinician scientists, despite their central role in translational medicine (Ianni et al., 2025). Evidence remains particularly limited in Germany, where systematic research on mentoring within university medicine is still scarce (DFG, 2024; Großkraumbach, 2025).

In this study, we jointly examine scientific and clinical mentoring of clinician scientists during this critical early-career phase, drawing on survey data from participants in structured clinician scientist programs at a large German university hospital. Indicators derived from the literature are related to mentoring effectiveness. As mentoring effectiveness cannot be measured directly, we rely on clinician scientists' evaluations of their mentoring relationships as a proxy.

Our guiding research questions are:

- RQ1) What are the characteristics of scientific and clinical mentoring relationships, and do they correspond to factors known to be associated with effective mentoring?
- RQ2) Given that scientific and clinical mentoring take place under different professional conditions, do both mentor types fulfil all core career and psychosocial roles, or do they exhibit distinct mentoring profiles?
- RQ3) How do protégés evaluate their scientific and clinical mentors' support for their career development as an indicator of mentoring effectiveness from the protégé perspective, and do they differ?
- RQ4) Which mentoring characteristics and roles are associated with protégés' evaluation of their scientific and clinical mentors' effectiveness and therefore can be assumed to contribute to effective mentoring within the dual mentoring system?

2 Effective Mentoring for Early Career Clinician Scientists

2.1 Closeness and Contact

In order for an effective mentoring relationship to develop, an appropriate degree of closeness, contact and meaningful interaction is indispensable. Importantly, the closeness of a mentoring relationship appears to depend less on shared background characteristics and more on the frequency and depth of interactions. Faculty members

have emphasised that an effective mentor does not necessarily need to be an expert, but rather someone who “*speaks their language*”, is accessible, and has sufficient time to support their development (Steele et al., 2013). Regular, meaningful mentor-protégé contact and ongoing communication about progress are strongly associated with protégés’ satisfaction and career development. Greater frequency and higher quality of interaction predict higher satisfaction and more positive developmental outcomes (DeCastro et al., 2014; Hill et al., 2022). In residency training, there seems to be a substantial variation in the frequency of mentor-protégé meetings across mentoring programs (Joe et al., 2023). Most commonly, meetings took place every three to six months, but some also reported weekly meetings, meetings every one to two months, every six months, or variable intervals. The heterogeneity in contact frequency reflects a persistent challenge in both academic medicine and residency training: the limited time mentors can dedicate to protégés, which may hinder the development of sustained and functional relationships (Joe et al., 2023; Keller et al., 2014; Sambunjak et al., 2010; Sambunjak et al., 2006).

2.2 Hierarchy and Dependency

As a mentor is by definition a senior, more advanced professional (Ragins & McFarlin, 1990) differences in age, experience, and hierarchical position shape mentoring dynamics. Seniority can strengthen mentors’ role-model function, and their formal authority can enable them to actively advocate for protégés, facilitating access to institutional resources (Elhalaby et al., 2026). In addition, senior supervisors often have access to professional networks within and beyond their organisation, including connections to other professors and senior physicians, which can be important for visibility, collaboration, and career development (Elhalaby & Epstein, 2024; Elhalaby et al., 2026; Hill et al., 2022). However, these inherently hierarchical mentoring relationships create power asymmetries that can shape communication and expectations (Hill et al., 2022) and may impede open communication about career uncertainties, work-life conflicts, or performance concerns (Geraci & Thigpen, 2017). In addition, protégés may feel uncomfortable requesting a new mentor or dissolving an unproductive mentoring relationship (Joe et al., 2023).

2.3 Mentor Roles

An understanding of what effective mentoring can look like can be guided by Kram’s (1985) Mentor Role Theory, which outlines a range of distinct mentor roles that can be characterised as either career-related or psychosocial:

- (1) The *career functions* comprise mentor activities that facilitate protégés’ professional advancement. These include providing access to networks, offering challenging assignments that stimulate growth, coaching on career-relevant skills,

offering strategic advice, and protecting protégés from negative organisational influences. These roles create opportunities and resources that directly support career progression.

- (2) The *psychosocial functions* include serving as a role model, offering acceptance, building confidence, and providing personal and professional counselling. Through this function, mentors help protégés develop a secure professional identity.

The theory suggests that mentoring relationships promoting retention and success ideally contain both career-related and psychosocial roles. The underlying assumption is that mentoring quality increases with the number and breadth of fulfilled mentor roles (Kram, 1985; Schneider, 2009).

Research in academic medicine indicates that mentoring most commonly centres on career guidance, while additional roles include serving as advisor, counsellor, or sponsor; however, mentors often adopt only one of these roles (Crites et al., 2023). Among early career clinician scientists in particular, mentors are primarily perceived as career supporters who provide feedback on grant proposals, assist with manuscript and presentation preparation, and facilitate networking opportunities (Straus et al., 2009). Nevertheless, junior faculty frequently report a need for support related to well-being alongside career and research guidance (Steele et al., 2013). While mentors may provide such support, they do not always view it as a central component of their mentoring responsibilities (Elhalaby et al., 2026).

Overall, there appears to be strong alignment between the roles mentors consider important and those protégés rate highly, suggesting a generally good fit between mentoring practices and protégés' perceptions (Elhalaby et al., 2026). Notably, Elhalaby et al. (2026) also found markedly lower ratings for the parent and social roles, which were not part of the original mentor role framework but were later introduced as context-specific extensions in the Mentor Role Instrument (Ragins & McFarlin, 1990; Schneider, 2009). This pattern was reflected not only in protégés' assessments of their mentoring relationships but also in mentors' own accounts of their mentoring practices. The authors conclude that these findings may indicate limits to the universality of the assumption that all mentoring roles must be present at all times. In the context of mentoring adult, highly trained postdoctoral clinician scientists working in a competitive and highly specialised university hospital environment, mentoring may instead be primarily oriented toward career development, research-related functions, and fostering independence as both researchers and physicians.

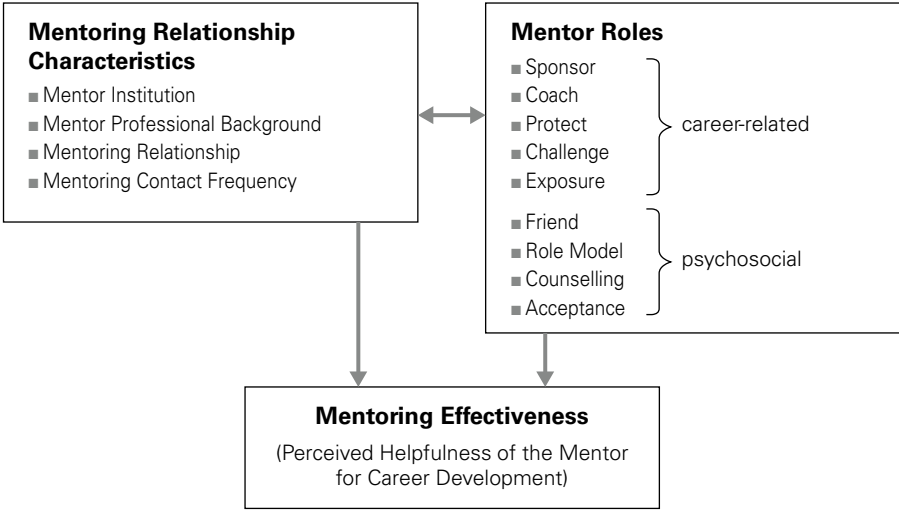
More broadly, empirical evidence suggests that higher-quality mentoring, reflected in the provision of both career-related and psychosocial mentoring roles, is positively related to satisfaction with mentoring (Alhamidi, 2022; Dilmore et al., 2010; Foster & Hill, 2019), research self-efficacy and research productivity, such as a greater number of publications (Jefte et al., 2017).

2.4 Synthesis and Conceptual Model

Overall, the literature indicates that mentoring in academic medicine is shaped by structural constraints, hierarchical dynamics, and the multiple roles mentors assume. Building on this body of work, Figure 1 presents the conceptual model guiding our study.

The left side of the model captures key characteristics of the mentoring relationships that relate to closeness, contact quality and dependency. These include whether mentor and protégé share the same background or institution, the nature of the mentoring relationship (independent or hierarchically dependent), and the frequency of contact. The right side of the model represents the career-related and psychosocial mentoring functions, according to Mentor Role Theory, excluding the *“Parent”* and *“Social”* roles as they have been shown to be of low relevance in this study population (Elhalaby et al., 2026). Both mentoring relationship characteristics and mentor roles are conceptualised as predictors of perceived mentoring effectiveness, defined as the mentor’s helpfulness for career development. We assume that the performance of all mentoring functions from both domains may be related to the characteristics of the mentoring relationship, as the arrow between the two boxes indicates. By jointly examining scientific and clinical mentoring within this framework, our study addresses the gap in understanding how mentoring across both domains supports the integrated development of early career clinician scientists.

Figure 1: Conceptual Model Linking Mentoring Relationship Characteristics, Mentor Roles, and Mentoring Effectiveness



3 Data and Methods

3.1 Setting and Survey Design

This study draws on survey data from all early career clinician scientists enrolled in a clinician scientist program at a large university hospital in Germany. All participants had completed their doctoral degrees at the start of the programme and were, for the most part, still in residency training or had only recently completed it. In accordance with the recommendations of the German Research Foundation (DFG, 2015), each fellow had two mentors, one clinical mentor and one scientific mentor, reflecting the dual clinical and research responsibilities inherent in clinician scientist career paths. The two mentors were recruited by the fellows themselves before the programme started, since the application requires that two suitable persons agree to take over this responsibility. This procedure ensures a high degree of personal choice and fit, since most mentoring relationships had already been established informally before program participation (for example by participating in joint research projects) and often even suggested or encouraged the fellow’s application.

As part of a continuous quality assurance scheme, every fellow is surveyed several times over the course of their three-year fellowship to assess working conditions, satisfaction with program components, mentoring experiences and future career plans. While some questions appear in more than one survey to cover possible changes over time, most are only assessed in one survey in order to reduce respondent burden.

This is also the case for most of the questions concerned in this study, which were included in the survey approximately one year into the program.

All procedures related to data collection, analysis, and storage complied with European and German data protection requirements. Ethical approval was obtained from the relevant institutional ethics committee and data protection office. Participants received detailed information about the study prior to participation and provided informed consent through written signatures. In addition, participants in the survey provided consent via an online confirmation checkbox before accessing the questionnaire.

3.2 Sample/ Participants

Data were collected between fall 2020 and spring 2025 via online surveys. Respondents were 57 % male and 94 % German nationals, and the study was conducted with Tivian Communicate X. Participation rates were high, although they varied across surveys. The final sample comprised 58 individuals, corresponding to a response rate of 81 % of the 72 fellows who were invited to the survey during the study period as part of the evaluation routine. One person declined to participate in the evaluation entirely; 13 additional participants were excluded from the present analyses due to program noncompletion, temporary interruptions (e.g., parental leave) or missing responses to key variables.

3.3 Measures

Regarding closeness, protégés reported their mentors' institutional affiliation (same as or different from the protégé), professional background relative to the protégé (same or different), and frequency of contact (ranging from approximately weekly to less frequent or irregular contact). For multivariate analyses, this variable was dichotomised into "*approximately weekly*" vs "*less than weekly*", since contact frequency was overall very high and the other categories contained few cases, as this question was not included in the very first instalments of the survey, leading to a higher share of missing values. Respondents also indicated whether their relationship with each mentor was dependent/hierarchical (i.e., involving supervisory authority) or independent.

Mentor roles were assessed for the clinical and scientific mentors using the Mentor Role Instrument (Ragins & McFarlin, 1990) as adapted, validated, and translated into German by Schneider (2009) and demonstrated to be applicable in academic medicine by Dilmore et al. (2010) (Appendix Table A1).

Based on prior evidence in academic medicine indicating consistently lower relevance of the "*Parent*" and "*Social*" roles in clinician scientist contexts (Elhalaby et al., 2026),

and to maintain conceptual consistency across our analyses, we focused on the following career-related and psychosocial roles:

- (1) Sponsor, Coach, Protect, Challenge, and Exposure (career-related)
- (2) Friend, Role Modelling, Counselling, and Acceptance (psychosocial)

Each role was assessed by four items describing central aspects of that role, which were rated on a 7-point Likert-type scale ranging from 1 (low endorsement) to 7 (high endorsement). For each mentor and each role, the mean of all four item ratings was computed to indicate the degree to which the mentor fulfilled the respective role. Internal consistency checks revealed a very high level for all mentor role subscales (Cronbach's Alpha in all cases > 0.9). In addition to these individual mentoring roles, aggregated career and psychosocial role scores were computed as the mean of the items within each domain (Cronbach's Alpha between 0.88 and 0.94).

As a proxy for mentoring effectiveness, protégés' overall evaluation of the career development support provided by their scientific and clinical mentors was used, based on a single-item measure on a 5-point Likert scale (1 = to a very small extent, 5 = to a very large extent), asking how helpful mentoring support was for their career development within the clinician scientist program. This evaluation was measured at three time points. An overall score was calculated as the mean across available observations. If only one observation was available, that score was used. The distribution of evaluations leans towards positive ratings for the clinical mentors (skew = -0.550) and even more for the scientific mentors (skew = -1.044). Since data transformations did not reduce skew, the 5-point scale was dichotomised for use in a logistic regression, with ratings of 4–5 coded as 1 (positive evaluation) and ratings of 1–3 coded as 0 (negative/less favourable evaluation).

3.4 Data Analysis

Descriptive statistics (frequencies, percentages, means, standard deviations, and ranges) were calculated to summarise mentoring relationship characteristics (RQ1) and protégés' ratings of individual and aggregated mentoring roles for scientific and clinical mentors (RQ2). For mentoring effectiveness, mean values were reported separately for clinical and scientific mentors (RQ3).

To examine differences between scientific and clinical mentoring, bivariate analyses were conducted: Chi-square tests were used to compare characteristics of the mentoring relationship across the two mentoring contexts (RQ1). Differences in individual and aggregated mentoring roles between scientific and clinical mentors were analysed using Wilcoxon matched-pairs signed-rank tests based on paired ratings from each

protégé (RQ2). The same procedure was used for the analyses of differences in ratings of mentor effectiveness (RQ3).

Associations between mentoring roles and protégés' ratings of mentor effectiveness (RQ4) were empirically tested in several steps. First, differences in protégés' ratings of aggregated career-related and psychosocial roles across mentoring relationship characteristics were examined using Kruskal-Wallis rank tests. Second, two logistic regression analyses were conducted separately for scientific and clinical mentors, with mentor effectiveness ratings as the outcome variable and mentoring relationship characteristics and mentoring roles as predictors. In the first step, models included either individual roles (Model 1a) or aggregated career and psychosocial roles (Model 1b). In the second step, mentoring relationship characteristics were added to these baselines, resulting in Model 2a (including individual roles and relationship characteristics) and Model 2b (including aggregated roles and relationship characteristics).

4 Results

4.1 Characteristics of Mentoring Relationships (RQ1)

Both scientific and clinical mentors were, in the overwhelming majority of cases, affiliated with the same university as their protégés (96.36 % of scientific mentors; 96.30 % of clinical mentors, cf. Table 1). Regarding professional background, a similar background between mentor and protégé was most common in both groups. However, this pattern was less pronounced among scientific mentors: 65.45 % shared the same background as their protégés, compared with 81.48 % among clinical mentors, representing a trend toward statistical significance ($p = .058$). With respect to dependency within the mentoring relationship, scientific and clinical mentoring relationships were very similar: 74.07 % of scientific mentors and 73.58 % of clinical mentors reported that their mentor held hierarchical and supervisory authority. In contrast, contact frequency was significantly higher for scientific mentors: weekly contact was most common (57.58 %), followed by monthly contact (33.33 %). Among clinical mentors, the corresponding proportions were 31.25 % and 28.13 %, respectively. Overall, most protégés reported at least monthly contact. The distribution of contact frequency differed significantly between scientific and clinical mentoring relationships ($p = .043$).

Table 1: Descriptive and Bivariate Results, Comparison of Characteristics Between Scientific and Clinical Mentors

	Scientific Mentor		Clinical Mentor		Comparison		
	N	Percent	N	Percent	χ^2	p-value	Cramér's V
Mentor Institution ($N_{ges} = 55/54$)							
Same affiliation	53	96.36	52	96.30	$\chi^2(1)=0.00$	.985	.00
Different affiliation	2	3.64	2	3.70			
Mentor Background ($N_{ges} = 55/54$)							
Same as protégés	36	65.45	44	81.48	$\chi^2(1)=3.58$	.058	.18
Different from protégés	19	34.55	10	18.52			
Mentoring Relationship ($N_{ges} = 54/53$)							
Dependent	40	74.07	39	73.58	$\chi^2(1)=0.00$	.954	.01
Independent	14	25.93	14	26.42			
Mentoring Contact Frequency ($N_{ges} = 33/32$)							
About once a week	19	57.58	10	31.25	$\chi^2(5)=11.48$	.043*	.42
About once a month	11	33.33	9	28.13			
About once a quarter	1	3.03	7	21.88			
About once every six months	2	6.06	2	6.25			
About once a year	—	—	3	9.38			
less often/irregularly	—	—	1	3.13			

Note: Significance levels are indicated as follows: * $p < .05$, ** $p < .01$, *** $p < .001$.

4.2 Mentor Roles (RQ2)

Protégés ratings of their scientific mentors' roles covered the full range of the scale with a mean rating around 4 and 5 (cf. Table 2, Figure 2) and the distributions were skewed towards higher ratings. Among the career-related roles, *Challenge* received the highest mean rating, followed by *Sponsor* and *Coach*, *Protect* and *Exposure*. Among the psychosocial roles, *Acceptance* received the highest rating on average, and also *Friend* was rated relatively highly. Other psychosocial functions, including *Role Model* and *Counseling*, were moderately endorsed.

Ratings for clinical mentors followed a similar pattern, with a wide range of scores across all roles, a mean rating around 4 and 5 and distributions for career functions generally skewed toward higher ratings. Here, *Sponsor* and *Coach* received the highest mean ratings among the career-related functions.

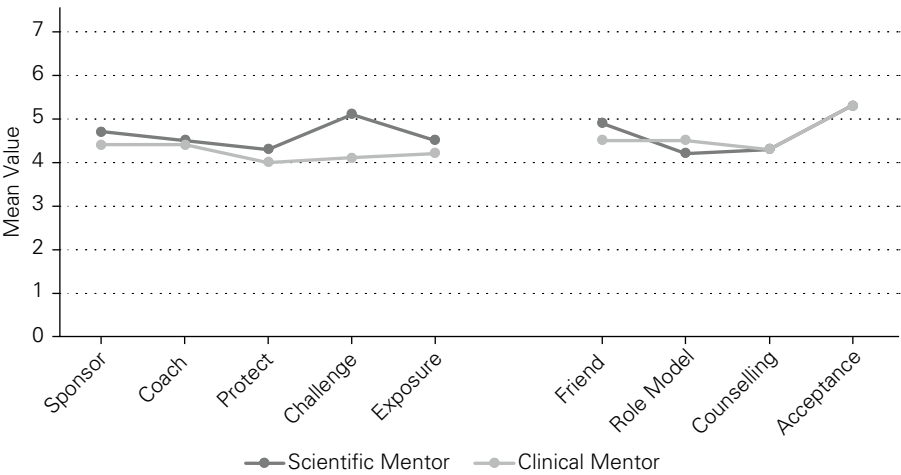
Wilcoxon matched-pairs signed-rank tests indicated that most mentoring roles were performed to a very similar degree by scientific and clinical mentors (cf. Table 2). Within the career functions, a significant difference emerged only for the *Challenge* role, with scientific mentors providing higher levels of challenge than clinical mentors ($p < .001$; unrounded $p = .0004$). Accordingly, the aggregated score for career-related roles did not differ significantly between mentor types. Within the psychosocial functions, there was no significant difference.

Table 2: Descriptive and Bivariate Results: Comparison of Protégés’ Ratings of Individual and Aggregated Mentor Roles

	Scientific Mentor					Clinical Mentor					Comparison	
	N	M	SD	Min	Max	N	M	SD	Min	Max	p-value	r
Career Roles												
Sponsor	55	4.7	1.6	1	7	49	4.4	1.9	1	7	.261	.17
Coach	55	4.5	1.5	1	7	49	4.4	1.7	1	7	.663	.07
Protect	55	4.3	1.6	1	7	50	4.0	1.7	1	7	.212	.18
Challenge	55	5.1	1.7	1	7	50	4.1	1.8	1	7	< .001**	.50
Exposure	55	4.5	1.6	1	7	50	4.2	1.8	1	7	.298	.15
Aggregated Career Roles	55	4.6	1.4	1	7	50	4.2	1.6	1	7	.096	.24
Psychosocial Roles												
Friend	55	4.9	1.7	1	7	50	4.5	1.6	1	7	.066	.27
Role Model	55	4.2	1.6	1	7	50	4.5	1.6	1	7	.775	-.04
Counselling	55	4.3	1.6	1	7	50	4.3	1.6	1	7	.495	.10
Acceptance	55	5.3	1.4	1	7	50	5.3	1.2	2.75	7	.604	.08
Aggregated Psychosocial Roles	55	4.7	1.4	1.1	7	50	4.7	1.3	1.75	7	.309	.15

Note: For Wilcoxon matched-pairs signed-rank tests, N = 46/47 paired observations.
Significance levels are indicated as follows (Bonferroni-corrected): * p < .0045, ** p < 0.0009, *** p < .00009.

Figure 2: Mean Values for Mentor Roles by Mentor Type

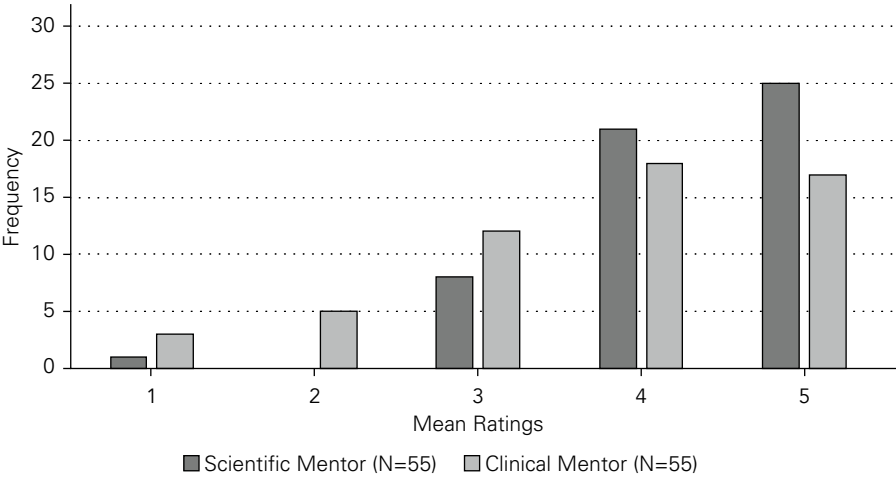


4.3 Mentor Effectiveness (RQ3)

Scientific and clinical mentor effectiveness ratings ranged from 1 to 5. The distribution was skewed towards the higher end of the scale, with most ratings concentrated at 4 and 5 (Figure 3). The share of top ratings (4 or 5) was higher for scientific than for

clinical mentors, while lower ratings (1 or 2) were rare for both mentor types but slightly more frequent for clinical mentors. This difference was statistically significant (Wilcoxon matched-pairs signed-rank, $p < .001$, $r = .59$, $N = 54$ paired observations).

Figure 3: Distribution of Ratings of Mentor Effectiveness for Scientific and Clinical Mentors



Note: “How helpful was the support provided by your scientific and clinical mentors for your career development within the clinician scientist program?” Responses were rated on a 5-point Likert scale (1 = to a very small extent, 5 = to a very large extent).

4.4 Factors that Influence Protégés’ Ratings on Their Mentors’ Effectiveness (RQ4)

To examine the link between mentoring roles and protégés’ evaluation of their scientific and clinical mentors, a series of logistic regressions was conducted.

As a preliminary step, we examined differences in aggregated mentoring role ratings across mentoring relationship characteristics using the Kruskal-Wallis test by ranks. Mentor Institution was not included due to limited variance. The comparison showed no significant differences in mentor role ratings between mentor relationships with different or similar background, hierarchical or independent type or according to higher or lower contact frequency (cf. Table 3).

Table 3: Bivariate Results: Comparison of Mentoring Relationship Characteristics and Aggregated Mentor Roles

	Scientific Mentor							Clinical Mentor						
	Career Roles				Psychosocial Roles			Career Roles				Psychosocial Roles		
	M	p-value	η^2_h	M	p-value	η^2_h	N	M	p-value	η^2_h	M	p-value	η^2_h	N
Mentor Background														
same as protégés	4.7	.284	.021	4.7	.894	.000	36	4.2	.840	.001	4.6	.405	.014	41
different from protégés	4.3			4.7			19	4.2			5.0			9
Mentoring Relationship														
dependent	4.7	.305	.020	4.7	.867	.001	40	4.1	.795	.001	4.5	.174	.038	36
independent	4.2			4.5			14	4.4			5.1			13
Contact Frequency														
weekly	4.6	.942	.000	4.7	.870	.001	19	4.9	.120	.086	5.2	.345	.032	9
less than weekly	4.5			4.8			14	3.8			4.5			20

Note: Career roles and psychosocial roles are depicted as aggregated values. Group differences were analysed using the Kruskal-Wallis test by ranks.

In order to estimate the association between mentor roles and mentors’ effectiveness, a first model included only individual career and psychosocial mentor roles (cf. Table 4, Model 1a). For scientific mentors, the overall model was significant ($p = .019$, McFadden $R^2 = .30$). Among the career-related roles only *Challenge* showed a significantly positive association with the outcome ($p = .032$), suggesting higher odds for a positive evaluation of mentor effectiveness when scientific mentors scored higher on this role. For clinical mentors, the overall model was also significant ($p = .021$, McFadden $R^2 = .30$). The psychosocial role *Role Model* showed a significantly positive association with the outcome ($p = .027$), indicating that clinical mentors who had higher ratings for the *Role Model* role had higher odds of receiving a positive evaluation.

Model 1b complemented the first model by using aggregate mentor roles (cf. Table 4). For scientific mentors, the overall model was significant ($p = .004$, McFadden $R^2 = .17$). Protégés’ evaluations of mentor effectiveness were positively associated with the aggregated career-related roles, whereas no association was observed with aggregated psychosocial roles. For clinical mentors, the overall model was also significant ($p = .010$, McFadden $R^2 = .14$). Within this model, higher odds of positive evaluations were associated with stronger performance on psychosocial functions, while career-related roles showed no significant association with the outcome.

Table 4: Logistic Regression Analysis, Individual (1a) and Aggregated (1b) Mentor Roles on Mentor Effectiveness (Model 1)

Effectiveness of ...	... Scientific Mentor				... Clinical Mentor			
	OR	SE	95% CI	p-value	OR	SE	95% CI	p-value
Model 1a: Individual Roles								
Career Roles								
Sponsor	1.45	0.64	[0.61, 3.44]	.401	1.11	0.53	[0.43, 2.84]	.827
Coach	0.85	0.37	[0.36, 1.97]	.703	1.33	0.75	[0.44, 4.01]	.613
Protect	0.92	0.49	[0.33, 2.60]	.873	0.82	0.42	[0.30, 2.25]	.694
Challenge	1.79	0.49	[1.05, 3.06]	.032*	1.38	0.42	[0.75, 2.51]	.298
Exposure	1.06	0.65	[0.32, 3.49]	.923	0.28	0.20	[0.07, 1.11]	.070
Psychosocial Roles								
Friend	0.59	0.25	[0.25, 1.36]	.214	0.41	0.23	[0.14, 1.22]	.110
Role Model	0.73	0.38	[0.27, 2.01]	.540	3.04	1.53	[1.13, 8.15]	.027*
Counselling	1.83	1.02	[0.62, 5.44]	.275	3.13	2.07	[0.86, 11.43]	.084
Acceptance	1.70	0.79	[0.68, 4.22]	.255	1.95	0.87	[0.81, 4.69]	.139
Constant	0.02	0.03	[0.00, 0.53]	.021	0.00	0.01	[0.00, 0.24]	.011
N	53				47			
P > chi ²	.019				.021			
McFadden R ²	.30				.30			
Model 1b: Aggregated Roles								
Career Roles	2.62	1.08	[1.17, 5.90]	.020*	0.84	0.28	[0.43, 1.63]	.603
Psychosocial Roles	0.83	0.28	[0.42, 1.62]	.578	2.49	1.09	[1.05, 5.87]	.037*
Constant	0.08	0.11	[0.01, 1.01]	.051	0.03	0.04	[0.00, 0.47]	.012
N	53				48			
P > chi ²	.004				.010			
McFadden R ²	.17				.14			

Note: Significance levels are indicated as follows: * p < .05, ** p < .01, *** p < .001.

Finally, characteristics of mentoring relationships were included in the model (cf. Table 5, Model 2a and 2b). Mentoring Contact Frequency was excluded from the analyses due to substantial missing data, as this variable was introduced only during a later phase of the study. Mentor Institution was also excluded from the analysis because of insufficient variability, as all but two mentors were affiliated with the same institution as their protégés.

Including mentoring relationship characteristics did not substantially alter the findings for the individual mentor roles (Table 5, Model 2a). For scientific mentors, the overall model remained statistically significant ($p = .016$, McFadden $R^2 = .36$). Consistent with the previous model, the career-related role *Challenge* was the only significant predictor of mentor effectiveness ($p = .022$), indicating that protégés whose scientific mentors more strongly emphasised challenging behaviours had higher odds of evaluating their mentors positively. For clinical mentors, the overall model was not statistically significant ($p = .071$, McFadden $R^2 = .29$). However, the psychosocial role *Role Model* was positively associated with mentor effectiveness ($p = .042$), suggesting that clinical mentors who more strongly fulfilled the role model function were more likely to receive positive evaluations. *Mentor Background* and *Mentor Relationship* were not significantly linked to the outcome.

Model 2b examined aggregated career and psychosocial mentor roles (Table 5). For scientific mentors, the overall model was statistically significant ($p = .010$, McFadden $R^2 = .21$). As in the previous analyses, aggregated career-related mentoring behaviours were positively associated with mentor effectiveness ($p = .027$), whereas aggregated psychosocial roles were not significantly associated with mentor effectiveness. Neither *Mentor Background* nor *Mentoring Relationship* was significantly associated with mentor effectiveness.

For clinical mentors, adding mentoring relationship characteristics likewise did not change the overall pattern of results. The model was statistically significant ($p = .025$, McFadden $R^2 = .17$). Aggregated psychosocial mentoring behaviours were positively associated with mentor effectiveness ($p = .020$), indicating that protégés whose clinical mentors provided greater psychosocial support had higher odds of evaluating their mentors positively. In contrast, aggregated career-related mentoring behaviours were not significantly associated with mentor effectiveness. As in the model for scientific mentors, neither *Mentor Background* nor *Mentoring Relationship* reached statistical significance.

Table 5: Logistic Regression Analysis, Individual (2a) and Aggregated (2b) Mentor Roles and Characteristics on Mentor Effectiveness (Model 2)

Effectiveness of ...	... Scientific Mentor				...Clinical Mentor			
	OR	SE	95% CI	p-value	OR	SE	95% CI	p-value
Model 2a: Individual Roles								
Career Roles								
Sponsor	1.82	0.92	[0.68, 4.90]	.234	1.08	0.52	[0.42, 2.76]	.872
Coach	0.65	0.32	[0.25, 1.70]	.383	1.27	0.73	[0.41, 3.92]	.677
Protect	0.81	0.50	[0.24, 2.74]	.737	0.80	0.43	[0.28, 2.29]	.677
Challenge	1.92	0.55	[1.10, 3.36]	.022*	1.37	0.43	[0.74, 2.52]	.316
Exposure	1.19	0.85	[0.30, 4.80]	.803	0.31	0.23	[0.07, 1.32]	.112
Psychosocial Roles								
Friend	0.48	0.24	[0.18, 1.28]	.144	0.45	0.27	[0.14, 1.45]	.180
Role Model	0.58	0.35	[0.18, 1.90]	.366	2.86	1.48	[1.04, 7.88]	.042*
Counselling	2.67	1.74	[0.74, 9.57]	.132	3.08	2.05	[0.84, 11.36]	.090
Acceptance	2.08	1.17	[0.69, 6.26]	.195	1.86	0.85	[0.75, 4.56]	.178
Mentor Background	9.36	13.3	[0.57,152.43]	.116	0.60	0.75	[0.05, 6.83]	.682
Mentoring Relationship	0.30	0.32	[0.04, 2.35]	.252	1.22	1.23	[0.17,8.84]	.847
Constant	0.00	0.01	[0.00, 0.53]	.026	0.00	0.01	[0.00, 0.33]	.016
N	52				46			
P > chi ²	.016				.071			
McFadden R ²	.36				.29			
Model 2b: Aggregated Roles								
Career Roles	2.59	1.11	[1.12, 6.02]	.027*	0.76	0.26	[0.39, 1.50]	.429
Psychosocial Roles	0.84	0.30	[0.41, 1.70]	.620	2.98	1.40	[1.19, 7.46]	.020*
Mentor Background	2.04	1.72	[0.39, 10.61]	.398	0.36	0.35	[0.05, 2.47]	.300
Mentoring Relationship	0.27	0.22	[0.06, 1.36]	.113	0.61	0.50	[0.12, 3.06]	.545
Constant	0.10	0.13	[0.01, 1.34]	.081	0.03	0.04	[0.00, 0.43]	.010*
N	52				47			
P > chi ²	.010				.025			
McFadden R ²	.21				.17			

Note: Career roles and psychosocial roles are depicted as aggregated values.
Significance levels are indicated as follows: * p < .05, ** p < .01, *** p < .001.

5 Discussion and Conclusion

This study examined scientific and clinical mentoring among participants in structured clinician scientist programs at a large German university hospital, focusing on mentoring relationship characteristics, mentoring roles, and their association with protégés' evaluations of mentor effectiveness.

We first sought to characterise the mentoring relationships of clinician scientists with respect to features commonly associated with effective, high-quality mentoring, namely closeness and contact frequency (DeCastro et al., 2014; Hill et al., 2022; Steele et al., 2013), hierarchy and dependence (Elhalaby et al., 2026; Geraci & Thigpen, 2017; Hill et al., 2022) and the fulfilment of a wide range of career-related and psychosocial mentoring roles (Kram, 1985; Schneider, 2009). Most clinician scientists in this study reported generally favourable mentoring conditions and a high degree of closeness, such as a similar professional background, affiliation with the same institution, and regular contact, often on a weekly or monthly basis. However, the predominance of hierarchical and dependent mentoring relationships may also entail potential disadvantages (Geraci & Thigpen, 2017; Hill et al., 2022; Joe et al., 2023).

When comparing clinical and scientific mentoring, the characteristics of mentors were largely similar with respect to institutional affiliation and hierarchical dependency. Professional background, however, was more often similar for clinical mentors. This may reflect a tendency for protégés to select mentors from the speciality they aspire to enter themselves, as speciality alignment is often prioritised in mentorship pairings and allows mentors to provide guidance on speciality-specific career development (Bondok et al., 2025). In contrast, research settings often involve collaboration across different disciplines (Homer-Vanniasinkam & Tsui, 2012). Although contact with scientific mentors tends to be more frequent, and clinical mentoring relationships showed greater variation in contact frequency, clinical mentoring was still characterised by regular interaction for most protégés. The higher frequency of contact with scientific mentors likely reflects the collaborative nature of research, where mentors and protégés often work closely on joint projects (Elhalaby et al., 2026). In contrast, mentors in clinical training contexts may more often assume advisory, role-modelling, and supportive roles within the clinical environment, guiding trainees' professional development and identity formation (Rosenblum et al., 2016). In addition, frequent day-to-day interaction may be limited to periods when protégés are assigned to the same clinical unit, as residency training requires physicians to complete training periods in different clinical settings and subspecialties (Bayerische Landesärztekammer, 2025).

With respect to the mentor roles, protégés' rating of mentors' roles covered the full spectrum of the scale. For most roles, however, the distribution was skewed towards

higher ratings, indicating that most protégés received most forms of mentoring support to a moderate to high degree. While scientific and clinical mentoring show largely similar patterns in the mentoring roles fulfilled by mentors, one significant difference emerged. Scientific mentors were reported to provide higher levels of *Challenge*, probably reflecting their role in fostering (research) skills and promoting scientific independence.

Overall, protégés rated both scientific and clinical mentors very positively, indicating that most participants perceived their mentors as highly supportive of their professional development. These favourable evaluations may, at least in part, be explained by the structure of the program: fellows selected their own mentors and had typically already established collaborative relationships with them in clinical and/or research settings. Such a formation of mentor-protégé-pairs by mutual self-selection has been shown to be beneficial (Ragins & Cotton, 1999), although of course not feasible in many contexts.

Dependent mentoring relationships are very common, as might be expected in hierarchical environments such as academic research and clinical practice. Mentors were often principal investigators or senior scientists directly involved in research projects in the case of scientific mentors, or clinical superiors such as attending physicians (*Oberärzte*) or heads of department (*Chefärzte*) in the clinical context. The support ratings, however, were not different between those in dependent and independent mentoring relationships. It seems that the practical advantages, including direct supervision, access to institutional resources, expert career-related guidance or tailor-made professional networks (Elhalaby et al., 2026; Epstein & Elhalaby, 2023), outweigh potential risks associated with hierarchical dependency.

At the level of individual mentoring roles, two significant associations with mentor effectiveness emerged. *Challenge* was positively associated with evaluations of scientific mentors' effectiveness, whereas *Role Model* was positively associated with evaluations of clinical mentors' effectiveness. The remaining individual mentoring roles were not significantly associated with mentor effectiveness. One possible explanation for the significant association between *Challenge* and the perceived effectiveness of scientific mentors is that the competitive and demanding nature of research careers (Elhalaby & Epstein, 2024; Waaijer et al., 2018) increases protégés' need for career-related guidance and support. In this context, mentors who challenge protégés to pursue ambitious goals, take on demanding tasks, and develop greater scientific independence may be perceived as particularly effective.

In contrast, the positive association between *Role Model* and the perceived effectiveness of clinical mentors likely reflects the distinctive characteristics of clinical education.

Clinical work involves not only acquiring medical knowledge and technical skills but also developing a professional identity (Cruess et al., 2019). Mentors who exemplify professional values, ethical conduct, and effective patient care may therefore play a particularly important role in protégés' perceptions of mentoring effectiveness, as they provide concrete examples of the professional behaviours expected in clinical practice.

In addition, analyses of aggregated mentor roles revealed interesting patterns: Career-related support was more strongly linked to evaluations of scientific mentors' effectiveness, while psychosocial support showed a stronger association with positive evaluations of clinical mentors' effectiveness. Interestingly, these findings are consistent with the results at the level of individual mentoring roles. *Challenge*, a career-related mentoring role, was associated with scientific mentor effectiveness, whereas *Role Model*, a psychosocial mentoring role, was associated with clinical mentor effectiveness, suggesting that the significant associations observed for individual mentoring roles reflect the broader patterns found at the functional level. One possible explanation is that clinical practice often confronts early-career physicians with demanding situations that can be personally and emotionally challenging, as hospital residents report high job demands and notable levels of occupational distress and depressive symptoms (Bernburg et al., 2016). In contrast, the competitive and demanding nature of research careers (Elhalaby & Epstein, 2024; Waaijer et al., 2018) may increase protégés' need for career-related guidance and support.

A further interpretation relates to the mentoring tandems commonly implemented in clinician scientist programs. Scientific mentoring and clinical mentoring may both provide career-related as well as psychosocial support; however, the present findings suggest that the perceived relevance of these functions varies depending on the mentoring context. Scientific mentoring may be particularly associated with navigating competitive research careers, whereas clinical mentoring may be more closely linked to psychosocial support in the demanding clinical environment. This does not necessarily imply that scientific and clinical mentors assume complementary mentoring roles. Rather, the findings suggest that protégés evaluate mentor effectiveness based on those mentoring functions that are most relevant within the respective professional context.

From a programmatic perspective, these findings indicate that tandem mentoring structures may help ensure that clinician scientists have access to both career-related and psychosocial support across their mentoring network, allowing different mentoring functions to become relevant depending on the context. Accordingly, mentoring programs should not necessarily assign distinct roles to scientific and clinical mentors but rather encourage both mentors to respond to the context-specific needs of their protégés. In addition, program designs may benefit from explicitly fostering role flex-

ibility and shared responsibility for both career-related and psychosocial support, rather than relying on implicit or fixed role expectations. Furthermore, establishing regular coordination or reflection points between mentors could help align support with evolving protégé needs and reduce the risk of fragmented mentoring experiences. Finally, making the context-dependent nature of mentoring effectiveness explicit during mentor training and program onboarding may help set expectations on all sides.

6 Limitations and Further Research

6.1 Sample-Related Limitations

The clinician scientists in our study were drawn exclusively from a single university hospital in Germany, limiting the generalizability of the results to other institutional, disciplinary and national contexts (Zhao, 2021). As described in Chapter 3.1 (Setting and Survey Design), this specific university hospital has begun to implement mentoring principles and quality standards for all early career clinician scientists, leading to a standardisation in mentoring practices among all participants. Since most German university hospitals follow a similar model, some degree of standardisation and convergence of practices is to be expected. Future research should include participants from multiple institutions to provide a broader understanding of mentoring practices in this field.

In addition, the overall sample size was relatively small, limiting possibilities for analyses and reducing statistical power as well as the precision of the estimated effects. Clinician scientists represent a relatively small and specialised group within the medical workforce (Hendriks et al., 2019) and for Germany, it has been recommended that about five to eight per cent of physicians completing their residency training at university hospitals should be qualified as clinician scientists (Wissenschaftsrat, 2016). Consequently, multicenter studies will be essential to obtain larger samples and enable more robust analyses of mentoring practices in this field.

The dataset did not include several variables that would have allowed a more comprehensive analysis, as the survey was part of a broader evaluation project and could not be tailored exclusively to the research questions of this study. Future research could therefore benefit from including additional variables such as gender composition of mentor-protégé pairs, complete data for contact frequency, and formation and duration of mentoring relationships in order to provide a more detailed understanding of mentoring relationships and their effectiveness.

6.2 Measurement and Conceptual Constraints

All measures are based on self-reports. Specifically, the Mentor Role Instrument captures protégés' perceptions of mentoring roles rather than mentors' actual mentor-

ing behaviour (Ragins & McFarlin, 1990; Schneider, 2009), which may not actually reflect what mentors actually do in supporting their protégés. Also, mentor evaluations of career support do not directly capture the distal outcomes that the support is directed at, such as the commitment to a long-term clinician scientist career or career success indicators for research and clinical careers.

Moreover, evaluations of mentor support were generally very favourable, necessitating a dichotomised outcome variable with limited variability. This restriction may have reduced the potential to detect more nuanced associations between mentoring roles and mentor effectiveness.

6.3 Design and Scope Limitations

The cross-sectional data used in this study do not allow causal interpretations of the observed associations between perceived mentoring roles and mentoring effectiveness. Longitudinal data would be needed to examine development processes over time and to better understand causal pathways and behavioural outcomes related to mentoring. Such data would have to cover a longer timespan and include a myriad of variables influencing the desired outcome measures.

Furthermore, the study focused exclusively on a single, central mentoring format: the dyadic relationship between senior mentors and individual protégés. While this approach reflects traditional mentoring structures, it does not capture other mentoring formats that are increasingly discussed for supporting early career clinician scientists, such as mentoring networks or peer mentoring (Campo et al., 2024; Fishman, 2021; Ramani et al., 2024).

6.4 Contextual Limitations

The focus on dyadic mentoring relationships also constitutes a contextual limitation. Although the study considered two mentoring relationships for each fellow, one with a scientific and one with a clinical mentor, these relationships were examined separately. The survey instrument did not capture whether or how the two mentors interacted, coordinated their guidance, or jointly supported their protégés. As a result, potential dynamics between clinical and scientific mentoring relationships could not be assessed. Future research should therefore move beyond traditional dyadic mentoring models and systematically examine the effectiveness of alternative and complementary mentoring approaches. Such work may contribute to the development of more flexible, inclusive, and sustainable mentoring frameworks for clinician scientists.

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Manuscript received: 16.03.2026
Manuscript accepted: 10.08.2026

Appendix

Table A1. Mentor Role Instrument (excluding “Social” and “Parent” roles)
(Ragins & McFarlin, 1990; Schneider, 2009)

Please indicate the extent to which you agree or disagree with the following statements. My scientific/clinical mentor ... (1 = <i>strongly disagree</i> , 7 = <i>strongly agree</i>)
[Career Roles]
(SPONSOR)
... helps me attain desirable positions.
... uses his/her influence to support my advancement in the organization.
... uses his/her influence in the organization for my benefit.
... uses her/his influence to advance my career.*
(COACH)
... helps me learn about other parts of the organization
... gives me advice on how to attain recognition in the organization.
... suggests specific strategies for achieving career aspirations.
... helps me with career planning.*
(PROTECT)
... protects me from those who may be out to get me.
... “runs interference” for me in the organization.
... shields me from damaging contact with important people in the organization.
... stands in front of me when I am criticised improperly.*
(CHALLENGE)
... gives me tasks that require me to learn new skills.
... provided me with challenging assignments.
... assigns me tasks that push me into developing new skills.
... gives me tasks through which I can further develop my skills.*
(EXPOSURE)
... helps me be more visible in the organization.
... creates opportunities for me to impress important people in the organization.
... brings my accomplishments to the attention of important people in the organization.
... facilitates contact with people who can positively influence my career.*

Continued on Next Page

Table A1, Continued

[Psychosocial Roles]

(FRIENDSHIP)

- ... is someone I can confide in.
- ... provides support and encouragement.
- ... is someone I can trust.
- ... takes a sincere interest in my person.*

(ROLE MODEL)

- ... serves as a role-model for me.
- ... is someone I identify with.
- ... represents who I want to be.
- ... is respected and admired by me.*

(COUNSELING)

- ... serves as a sounding board for me to develop and understand myself.
- ... guides my professional development.
- ... guides my personal development.
- ... gives me advice for my personal and professional development.*

(ACCEPTANCE)

- ... accepts me as a competent professional.
- ... sees me as being competent.
- ... thinks highly and of me.
- ... shows respect for me as person.*

Note: The marked items (*) did not exist in the original scale from Ragins and McFarlin (1990) and were added by Schneider (2009) in the validation and translation process of the English scale. The items were presented in German in the online survey and reported in English only for the purpose of this article.

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