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Shared understanding and task-interdependence in nursing interns' collaborative relations: A social network study of vocational health care internships in the Netherlands

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ABSTRACT

Shared understanding among collaborators is a key element of delivering successful interprofessional care and a main challenge for professional education concerns nurturing such understanding among students. We assessed how nursing students perceived different levels of shared understanding in their collaborations with others in clinical internships. We analyse the collaborative networks of interns to examine whether individual factors (attitudes, perceptions of collaborative cultures, and motivation) or relational factors among collaborators (task-interdependence, cooperation frequency, and interprofessional and hierarchical roles) affect shared understanding among 150 Dutch nursing interns and their collaborators ($n = 865$). Theoretically, we stress the importance of focusing on collaborative relations in interprofessional care settings. Multilevel models distinguish two levels in explaining the variation in shared understanding, nesting collaborative relationships within individuals. Results indicate merely 37.4% of found variation of shared understanding could be attributed to individual-level factors (variation between interns), while 62.6% of variation is found within interns, showing that shared understanding differs substantially between the collaborations one intern engages in. Multilevel models reveal that task-interdependence strongly predicts shared understanding in inter- and intraprofessional collaborations. We conclude that focusing on collaborative relations is essential to foster shared understanding in vocational internship programmes, and that health care organisations should pay explicit attention to task-interdependence in interns' collaborations.

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Introduction

To deliver effective health outcomes, health care workers increasingly engage in interprofessional collaboration that crosses professional and organisational boundaries (World Health Organization, 2010). The increase in prevalence and intensity of collaborations between different professions has launched *interprofessionalism* as one of the key competencies of the modern health care professional (Interprofessional Education Collaborative, 2016). The growing importance of interprofessionalism is reflected in its increased inclusion in educational programmes for health care workers (Grace, 2021), with many programmes including practical internships in their curricula (Roczniewska et al., 2020). By exposing students to the day-to-day functioning of health care professionals, internships are a nurturing ground for several collaborative competencies that are difficult to emulate in other traditional school-like settings (Sides & Mrvica, 2016).

Shared understanding among collaborators plays a particularly critical role in the process of professionalisation of health care workers (Zerden et al., 2021). In an interprofessional collaborative relationship this means that two collaborators are consciously aware of each other's professional backgrounds and the practices and goals they bring into the collaboration (Olson & Brosnan, 2017; Walsh et al., 1999). The opportunity to develop shared understanding with collaborators with different expertise in internship programmes directly feeds into the intern's competency regarding the roles and responsibilities of health care professionals (Lewitt et al., 2018). Despite these advantages, relatively little is known about how such interns develop shared understandings with collaborators and how shared understanding varies among different collaborations (Franklin et al., 2015; Pugsley et al., 2021).

We studied shared understanding in health care interns' collaborative relationships, examining how shared understanding is shaped by characteristics of collaborating individuals. The main mechanism we expected to explain shared understanding in collaborative relations is task-interdependence. We define task interdependence as the extent to which an individual needs the effort, competence and skills of one or more other individuals to be able to complete their tasks. The more interns perceive a collaborative relation to be task-interdependent, the higher their shared understanding with that collaborator will be. We assessed the collaborative relationships of a sample of first-year nursing students ($n = 150$) participating in a 20-week internship programme in the Northern Provinces of The Netherlands in 2018. Using social network survey data, we

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investigated how shared understanding in health care interns' collaborative relations is affected by characteristics of the collaborative relation and characteristics of the health care intern.

We first describe our theoretical approach to collaborative relations, and theorise how shared understanding in collaborations connects to individual and relational characteristics. We developed hypotheses on the relation between shared understanding and characteristics of the collaborative relations and characteristics of the intern. Following the methods section, we present the results of our model predicting shared understanding between interns and their collaborative partners. The paper concludes with a discussion.

Theory and hypotheses

To assess how shared understanding differs across various collaborative relations, we explicitly distinguish individuals and the collaborations in which they engage. Our argument is that one intern may experience different levels of shared understanding across different collaborative relations.

We employed a network-theoretical lens that allowed us to analyse individuals and collaborations as separate, though interconnected, entities (Borgatti & Halgin, 2011). In network-analytical terms, we looked at interns' *ego-networks*, consisting of the intern (*ego*), the collaborators (*alters*), and the nature of those collaborative relations. Figure 1 depicts the ego-networks of two interns. Collaborators are represented as different shapes, indicating their role in an organisation, and the shape's shade represents professional background. The collaborative ties are the lines between the focal intern and the collaborators. Visually represented, we aim to explain the presence of high shared understanding ties (black). To illustrate, in ego-network 1, interprofessional collaborations (shaped differently) are characterised by a lower level of shared understanding. The intern in ego-network 2 reports higher levels of shared understanding across their collaborators. Our network-analytical lens allows us to distinguish whether such variation in shared understanding can be explained at the level of the relation (as ego-network 1 seems to suggest) or at the level of the individual intern (for instance, is it individual motivation that explains the difference between ego-network 1 and 2?).

Taking the *collaborative relation* as the unit of analysis allows for a fine-grained assessment of how individuals from different backgrounds and roles create and maintain mutual shared understanding. In this study, we identified how task-interdependence between nursing interns and their collaborators affects shared understanding, while controlling for frequency of contact. In addition, we examined how the embeddedness of different interns in social roles and professional backgrounds affects their shared understanding. We investigated whether relationships that cross professional or hierarchical boundaries differ in their shared understanding. Simultaneously, our network model accounts for individual-level factors that may affect one person's overall level of shared understanding in internship situations. Figure 2 represents our overarching theoretical framework explaining shared understanding in a collaborative relation, and Table 1 contains the hypotheses we tested.

Regarding interprofessional relations, individuals prefer to connect to others they perceive as more similar to themselves. This "homophily effect" (McPherson et al., 2001) occurs across several types of social and symbolic boundaries in the workplace (Lamont & Molnár, 2002; Shoham et al., 2016). People find it easier to understand and put into context the behaviour of others whom they perceive as similar to themselves (Caza et al., 2018). Shared knowledge backgrounds also explain why shared understanding in intraprofessional collaborations might be higher than in interprofessional collaborations (Hogg, 2000). As professional educational programmes socialise students into the roles, functions, and performances of a profession (Grace, 2021), certain carriers of social meaning, such as the use of jargon laden language or professional problem-framings, are shared by professionals in the same disciplines (Langley et al., 2019). Therefore, we expected the degree of shared understanding between interns and coworkers to increase in intraprofessional collaborations (H1).

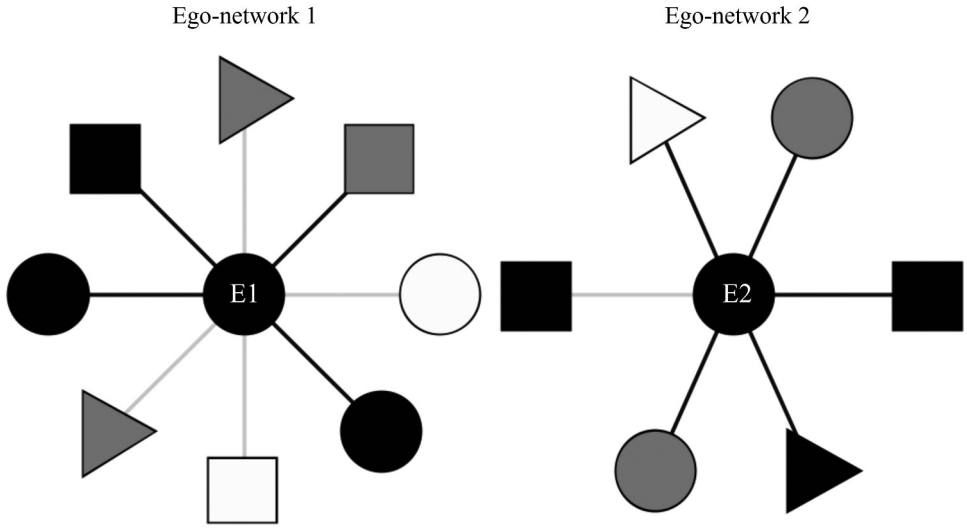


Figure 1. Illustrations of Two Intern Ego-Networks. Note. This figure shows two intern ego-networks, with Ego 1 (E1) and Ego 2 (E2) in the middle of their respective collaborative networks. Alter shapes denote their role in the organisation, alter shades denote professional background. Ties are shaded by degree of shared understanding (black = high shared understanding, gray = lower shared understanding).

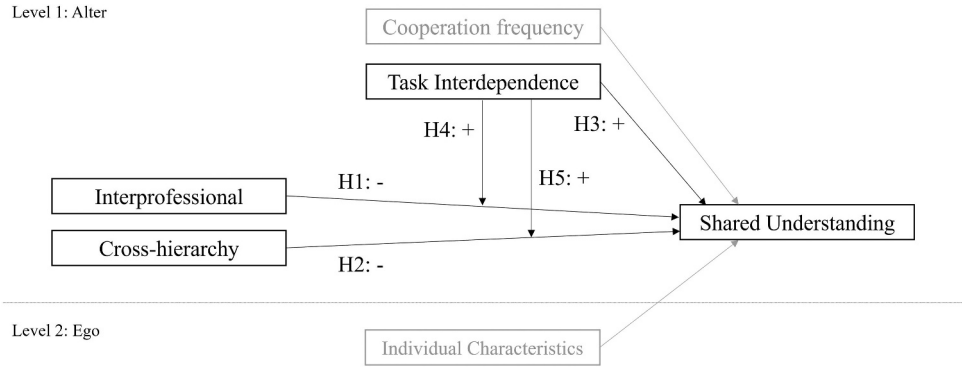


Figure 2. Theoretical Model of Shared Understanding. Control variables are presented in gray.

Table 1. Hypotheses Tested in This Study.

H1:	The more a relation between two individuals qualifies as interprofessional cooperation, the lower the level of shared understanding.
H2:	The more a relation between two individuals qualifies as crossing hierarchical boundaries, the lower the level of shared understanding.
H3:	Task-interdependence will positively affect shared understanding in interns' collaborative relations.
H4:	The effect of task-interdependence on shared understanding will be stronger in interprofessional collaborative relations than in intraprofessional relations.
H5:	The effect of task-interdependence on shared understanding will be stronger in collaborative relations across hierarchical boundaries than in collaborative relations between interns.

Besides the effect of interprofessional collaborative relations on shared understanding, cross-hierarchies in collaborations also play a crucial role. Interns and professionals frequently have difficulty developing consensus on appropriate roles and functions in organisations (Ross & Naidoo, 2018; Sheehan et al., 2005). In markedly hierarchical relations, where one individual has power over another, this formal differentiation hampers the development of shared understanding and empathising (Fox & Comeau-Vallée, 2020). Additionally, interns often strive for the approval of supervisors and professionals in the organisation (Pugsley et al., 2021), sometimes experiencing their work as not seen by their supervisors (Naidoo et al., 2017). On the contrary, interns embedded in horizontal relationships will find it easier to understand their peers than interns embedded in hierarchical relationships with professionals (H2).

Task-interdependence has a strong history in organisational sciences as an explanatory concept for the strength and success of collaborations, with many studies showing complex relations between perceived group structures, tasks, goals, and rewards (Runhaar et al., 2014; Wageman, 1995). Task-interdependence is a functional characteristic of a collaborative relationship, with clear implications for the value of such collaborations: if one person's outcome depends on another person's cooperation, the first person has an incentive to cooperate with the other (Raub, 2021). Given this interest, individuals are more inclined to gain accurate knowledge about that person's behaviour (Shimizu et al., 2022). In other words, the functional interdependence of collaborations is *cognitively mediated* (Lindenberg, 2015): when their tasks are interdependent, we expect individuals to invest in understanding those people with whom they perceive an interdependence. As a result, interns would be more motivated to develop shared understanding particularly in collaborative relations they perceive to be task-interdependent (H3).

Importantly, task-interdependence does not only mean you depend on another person's actions, but also that their tasks are dependent on your behaviour. As such, task-interdependence can have a strong motivational effect on health care workers (Teekens et al., 2021) who recognise that only through joint effort can optimal patient care be achieved (Reeves et al., 2016). Additionally, task-interdependence needs to be cognitively experienced by the collaborators (Johnson et al., 2003). Although many opportunities for joint benefits in collaborations between health care workers may appear, collaborators might only engage in interprofessional relationships when they perceive their tasks as interdependent (Frenk et al., 2010).

Although we expect shared understanding to be lower in interprofessional collaborations, we hypothesise task-interdependence might play a moderating role in situations that cross professional boundaries (H4). Given that interprofessional collaboration promises to offer several collaborative benefits, an increase in task-interdependence will make the relationship more useful in the experience of the collaborating parties. Following the argument that functional interdependence is cognitively mediated (Lindenberg, 2015), the realisation that the collaborators' tasks are intertwined will increase their motivation to understand how the other works (Baik et al., 2018; Pomare et al., 2019). Therefore, we expect interns will be motivated even more to develop shared understanding in collaborations with professionals from other professional backgrounds with whom they have task-interdependent relations (Schot et al., 2019).

Similar to the interaction effect proposed in Hypothesis 4, we expect task-interdependence to moderate the relationship between shared understanding and crossing hierarchical boundaries in collaborations (H5). Authority structures present in work teams often work best when the hierarchical superior's behaviour is perceived as useful and meaningful by

the subordinate (Lindenberg & Foss, 2011). When the behaviour of the intern and supervisor/professional is task-interdependent, we expect that interns will be more likely to see the added value of the other, while simultaneously being cognitively motivated by the situation to contribute to the common good.

Method

Empirical setting

Data were collected in the health care sector in the Northern provinces of the Netherlands, in collaboration with the inter-organisational agency NetwerkZON, which functions as a central actor in the organisation and allocation of health care internships among several institutions in the region. In that role, NetwerkZON has changed the content of internships for students following an education at *Middelbaar beroepsonderwijs*-schools (educational programmes for upper-level secondary vocational education, consisting of 1- to 4-year programmes offered to students after completion of their high school curricula (see Renold et al., 2018, p. 32)). Several of these organisations now offer internships in so-called "learning networks." These learning networks explicitly aim to be interprofessional and interorganisational by containing members from different professional backgrounds and organisations. The goal of such learning networks is to explicitly foster learning among all participating members, based on a design theory developed by Zuidersma (2012). Given the learning networks' combination of interprofessional collaboration and explicit focus on learning, the setting offers a fitting opportunity to assess shared understanding among interns and their collaborators.

The present article deals with one particular type of learning network, in which first-year nursing students participate in a 20-week internship to acquire clinical and practical insights into their future occupation. These students follow their internship programmes in different organisations (e.g., hospitals, nursing homes, mental health care organisations), while collaborating on joint assignments and presentations in school, aiming to increase interprofessional collaborative capacities at an early stage.

Data collection

The study included all nursing students who participated in a learning network internship organised by NetwerkZON in the academic year of 2018–2019 ($n = 150$). This study was approved by the departmental Ethics Committee at University of Groningen (ECS-190410). Data were collected in collaboration with NetwerkZON and participating schools and health care organisations. Participants were first informed of our research purposes through an information letter distributed by a coordinator of the learning network. The information letter included the purposes of the study, the research procedure, and an indication of when a member of the research team would join the interns' learning network meeting to distribute the survey. The information material stressed that participation was optional, and that interns would not be disadvantaged if they refused to participate.

Participants completed a tablet-based network questionnaire in Dutch. The questionnaire was programmed in Qualtrics (Provo, UT, 2005). To ensure the highest possible response and completion rate, the questionnaire was installed on tablets. The researchers attended learning network meetings at health care organisations around Groningen, between April and June in 2019, where each participating intern was handed a tablet to answer the questionnaire. Respondents could raise questions during the data collection when necessary. The average completion time was just over 18 minutes. All names were anonymised after carefully checking for duplicate alter names for interns.

Measurement and control variables

The questionnaire was developed by the research team for the empirical setting of "learning networks" in the Netherlands, in collaboration with the director of NetwerkZON and in consultation with two internship supervisors in health care organisations. We first ran a pilot-study on two sub-learning networks, after which we calibrated the survey to ensure the data would be comparable across interns from different professional backgrounds. To temper the length of the questionnaire, most variables were measured with one-item five-point Likert-type scales. Only intrinsic motivation was measured using a validated scale from Ryan and Connell (1989).

Our network survey followed the convention of ego-network data gathering, by using a name-generator first and questions on the relations afterward. The name-generating questions asked interns to nominate up to eight network members with whom they have discussed matters relating to work in their internship organisation. Students were not required to fill in a name, although they were nudged to enter at least one name if they attempted to skip the question. The upper limit of eight alters was chosen to avoid overburdening the respondent, while giving ample room to mention relevant collaborative partners (following Merluzzi & Burt, 2013). Sample statements from the survey are featured in Table 2.

Our main argument is that shared understanding differs across the set of an individual's collaborative relationships, and that a focus on individuals alone does not suffice. Therefore, we included three key individual characteristics in our models: motivation, attitude, and perception of a collaborative culture in the organisation. We included *motivation*, because student outcomes such as grades, participation, and attendance often strongly depend on student's individual motivation (Ganotice et al., 2021), *interprofessional attitudes* to ensure our models control for a generalised willingness to collaborate with workers from different professions (Pugsley et al., 2021; Sumiyoshi et al., 2020), and *perceived collaborative culture* to control for the potential alternative explanation that students follow the perceived norms in their internships (Carney et al., 2019). Frequency of collaboration was included to check whether we are simply measuring exposure effects alone. The last control variable in our model was a structural variable counting the size of an intern's collaborative network. We included

Table 2. Operationalisations, Measurements, and Descriptive Results of Concepts.

Level	Concept	Item	Question	Min.	Max.	Mean	Standard Deviation
Level-1 (Alter)	Shared understanding	5-point Likert-type scale	When we are discussing matters related to work, [*alter's name*] and I find it easy to understand one another	1	5	4.04	0.76
	Interprofessional Relation	Dichtomous	To which of the following professions does [*alter's name]* belong? (0 = nursing, 1 = other)	0	1	0.40	-
	Cross-hierarchical Relation	Categorical	Which role does [*alter's name*] have in your internship?: Student	0	1	0.10	-
			Which role does [*alter's name*] have in your internship?: Supervisor in organisation	0	1	0.24	-
			Which role does [*alter's name*] have in your internship?: Supervisor in school	0	1	0.04	-
			Which role does [*alter's name*] have in your internship?: Colleague	0	1	0.62	-
	Task interdependence	Two item 5-point Likert-type scales	How important is [*alter's name*] for you to finish your work?	1	5	2.74	0.89
			How important are you for [*alter's name*] to finish their work?				
	Cooperation frequency	5-point Likert-type scale	How often do you collaborate with [*alter's name*] in a regular week?	1	5	2.60	0.94
Level-2 (Ego)	Interprofessional Attitude	5-point Likert-type scale	I believe that by collaborating with colleagues from different professions I will provide better care to my patients	1	5	4.18	0.63
	Belief in collaborative culture	5-point Likert-type scale	In my internship organisation, colleagues from different professions collaborate closely to provide better care to the patients	1	5	4.15	0.90
	Motivation	Sixteen item 5-point Likert scale	Scale from Ryan and Connell (1989) (α=.82)	1.69	5.00	3.49	0.46
Level-2 (Ego)	Network Size	Count	Count of the amount of alters mentioned	2	8	7.30	1.33

network size to estimate the levels of shared understanding when interns have more or fewer collaborative partners.

Data analysis: multilevel modelling

Due to violations of the independence assumption, regular regression analyses were not appropriate for hierarchical data structures. Rather, following Snijders et al. (1995) and van Duijn (2013), we conceived our data points as a multilevel structure, with relations to alters (level-1) nested in egos (level-2). This is possible because the ego-networks themselves are independent from one another.

Figure 3 shows a visual representation of a traditional ego-network depiction next to the nested multilevel data structure. On the left, the ego-network from Figure 1 is depicted again. On the right-hand side, the same ego-network data is represented in multilevel structure. This multilevel model allows for the variance of the dependent variable to be divided over the two levels, explaining some of the variance of shared understanding as a characteristic of the relationship, and the remaining variance as a characteristic of ego. We estimated our

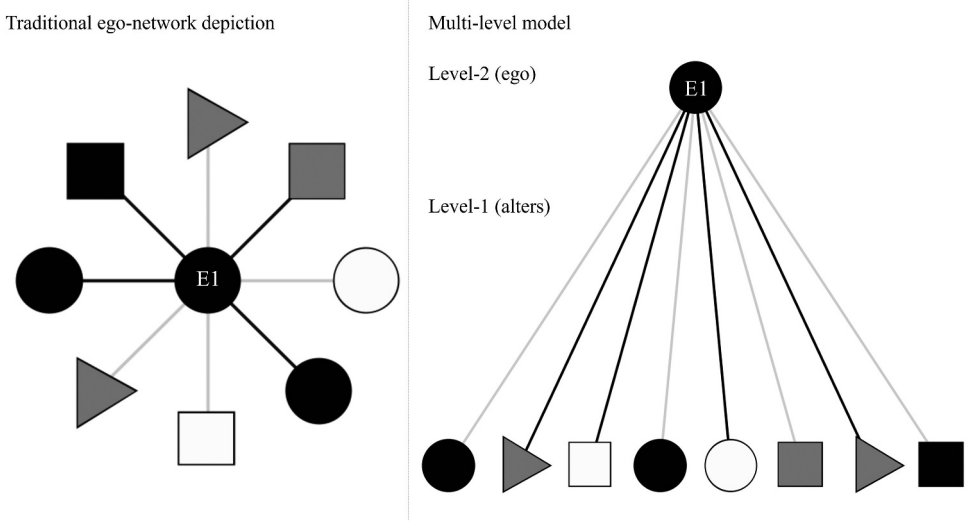


Figure 3. Representation of one ego-network as traditional ego-network and multilevel model.

models using the lmer-package in R, and used a stepwise approach to elicit the best fitting model. As some models contain interaction terms, the continuous variables were mean-centered.

Results

From the 150 interns who participated in the learning networks, 135 completed the questionnaires (90.0% completion rate). Our final data consist of 135 egos, who on average reported 6.86 alters, adding up to a dataset of 865 alters. Table 2 presents the descriptive statistics regarding the variables measured at the ego-level.

Table 3 contains information on the reported alters. Out of 865 reported alters, 49 relations were shared among egos, indicating some ego-networks are connected through collaboration with a shared alter. Therefore, our data violated the assumption of independence slightly. However, as alternative cross-classified models that acknowledge the interdependence fail to converge, we continued with models without cross-lagged effects.

Table 4 contains the results of the analyses. To assess whether a multilevel structure is appropriate for the nature of the sampled data, we first estimated an empty model. This model distinguishes between the variance of shared understanding found at the ego-level (0.218) and the alter-level (0.365). These values allowed us to calculate the Intraclass Coefficient (0.374), a measurement of the proportion of the variance that is found at the ego-level. This score indicates that 37.4% of the variance of shared understanding could be attributed to individual-level factors, while 62.6% of variation was found within interns, showing that shared understanding differs substantially between collaborations one intern engages in. Our empty model thus indicates that distinguishing relational from individual factors in explaining shared understanding is essential, as both levels affect the final scores that interns report.

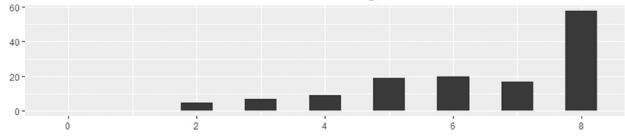
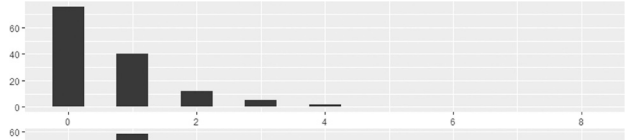
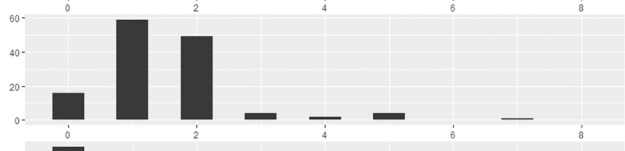
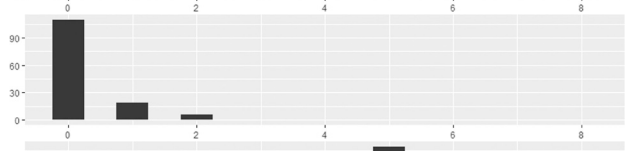
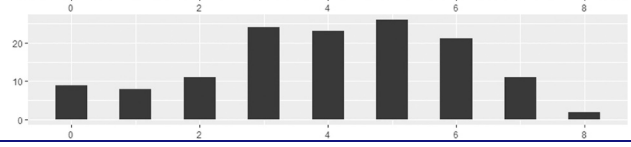
Model 1: Relational characteristics as fixed effects

In Model 1, we added all relational characteristics as direct fixed effects. We assessed the general effects of hierarchy, interprofessionalism, cooperation frequency and task-interdependence on shared understanding. The proportion of remaining variance at the ego-level decreased from .365 to .314. Model 1 is an improvement on the empty model ($\chi^2 = 121.52$, $df = 6$, $p < .001$). Although we found no difference in the degree of shared understanding between collaborations with interns, organisational supervisors, and colleagues, the model shows a negative, significant effect of supervisors in school on shared understanding. Moreover, cooperation frequency and task-interdependence have positive significant effects.

Model 2: Interactions on the relational level

Model 2 introduces several interaction terms of the relational (level-1) variables. The model fit is not a significant improvement ($\chi^2 = 12.51$, $df = 9$, $p = .186$). Most of the model effects remain the same. The only notable difference is that the effect of collaborations with organisational supervisors has become significant. The only significant interaction effect pertains to task-interdependence in collaborative relations with colleagues, with its positive sign indicating that task-

Table 3. Descriptive counts of alters in ego-networks.

Alters	Distribution of Number of Reported Alters	Min	Max	Mean	SD
Total Count		2	8	6.41	1.78
Roles					
Interns		0	4	0.64	0.90
Supervisors in Organisation		0	7	1.51	1.11
Supervisor in School		0	2	0.23	0.52
Colleagues		0	8	4.02	1.98

The figures indicate the distribution of the amount of alters each ego identified, first in total, and below categorised by role.

Table 4. Estimated coefficients for the 2-level random intercept models for alters (level-1) and egos (level-2).

	Model 0		Model 1		Model 2		Model 3		Model 4	
Fixed Part	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	0.02	0.05	0.02	0.04	0.00	0.41 ***	0.01	0.04	0.01	0.05
Alters (Level-1)										
Intern: reference category				ref		ref		ref		ref
Supervisor in Org.			0.07	0.09	0.23	0.11 *	0.23	0.11 *	0.19	0.11
Supervisor in School			−0.60	0.13 ***	−0.53	0.16 ***	−0.54	0.16 ***	−0.60	0.15 ***
Colleague			0.05	0.07	0.20	0.10	0.20	0.10	0.17	0.10
Interprofessional			−0.04	0.05	−0.04	0.05	−0.04	0.05	−0.02	0.04
Cooperation Frequency			0.09	0.02 ***	0.10	0.03 ***	0.10	0.03 ***	0.10	0.02 ***
Task interdependence			0.19	0.03 ***	0.20	0.03 ***	0.19	0.03 ***	0.20	0.04 ***
Interactions (Level-1)										
Org. Supervisor * TI					0.16	0.11	0.16	0.11	0.15	0.11
School Supervisor * TI					0.28	0.17	0.30	0.17	0.33	0.17
Colleague * TI					0.22	0.10 *	0.21	0.10 *	0.18	0.10
Interprofessional * TI					−0.01	0.05	−0.01	0.05	−0.02	0.05
Org. Supervisor * CF					−0.11	0.08	−0.10	0.07	−0.10	0.07
School Supervisor * CF					−0.25	0.14	−0.27	0.14 *	−0.29	0.13 *
Colleague * CF					−0.03	0.06	−0.03	0.06	−0.04	0.06
Interprofessional * CF					−0.04	0.05	−0.04	0.05	−0.07	0.05
TI * CF					0.03	0.03	0.03	0.03	0.01	0.03
Egos (Level-2)										
Interprofessional attitude							0.17	0.07 *	0.16	0.07 *
Collaborative culture							0.10	0.05 *	0.07	0.05
Motivation							0.13	0.09	−0.07	0.09
Network (Level-2)										
Network size							−0.06	0.03 *	−0.06	0.03 *
Random part										
Alter (Level-1 residual variance)	.365	.604	.314	.560	.312	.559	.312	.559	.283	.532
Ego (Level-2 residual variance)	.218	.467	.216	.464	.218	.467	.187	.433	.197	.444
Ego TI Variance									.058	.241
Deviance	1790.70		1669.18		1656.67		1636.61		1608.44	

Shown values are the unstandardised B coefficients, predicting the response variable Shared Understanding. Significant coefficients are marked by: *p < .05, **p < .01, ***p < .001.

interdependence has a more positive effect in collaborations with colleagues than in collaborative relations with interns.

Model 3: Intern characteristics as fixed effects

Model 3 introduces characteristics of the student and network size as fixed effects. We included interprofessional attitudes, perceptions of the collaborative culture in the organisation, motivation, and network size as level-2 variables. This model is an improvement compared to previous models, as the deviance decreases to 1,636.61 ($\chi^2 = 12.78$, $df = 5$, $p = .026$). The effects of previous variables remain similar. Only the interaction effect of cooperation frequency for collaborations with school supervisors changes, as the negative effect in this model turns significant ($b = -0.27$, $p = .046$). Given that the negative coefficient of this interaction is larger than the positive coefficient of the direct effect of task-interdependence, this model predicts that cooperation frequency with school supervisors has a net negative effect on the shared understanding with supervisors.

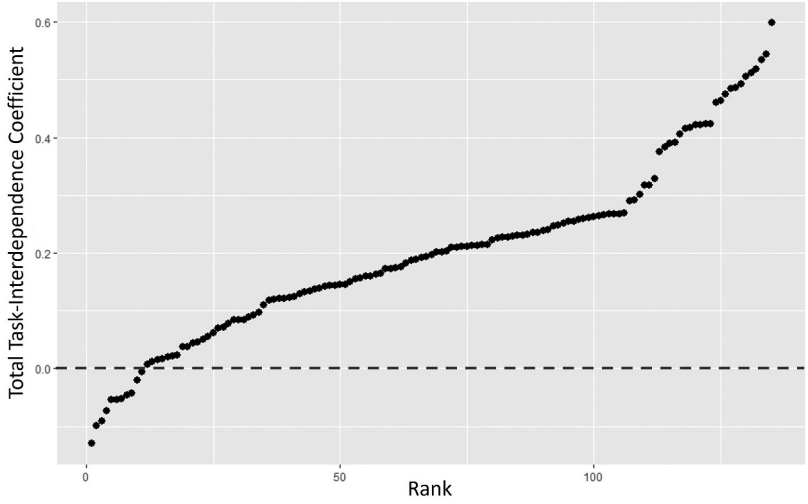


Figure 4. Ordered Plot of Total Task Interdependence Coefficients. This ordered plot shows the total effect (fixed plus random) effect of task interdependence on shared understanding per intern, from the strongest total negative effect to the strongest total positive effect. The dashed line indicates a null effect.

Of the intern's individual characteristics, interprofessional attitude and perceptions of the collaborative organisational culture are significant predictors of shared understanding, both with a positive effect. Individual motivation does not significantly affect the predicted shared understanding in collaborations. The negative and significant effect of network size indicates that with an increase in intern's network size, the predicted level of shared understanding decreases.

Model 4: Random slope for task-interdependence

In our final model, we included a random slope for task-interdependence. This means that we analysed how the strength of the effect of task-interdependence differed between interns. Adding this random slope makes for a significantly better model fit, with a deviance of 1608.44 ($\chi^2 = 28.71$, $df = 1$, $p < .001$). The random slope allows each intern to have their own effect size of task-interdependence on shared understanding. In Figure 4, we plot each intern's effect size (fixed and random taken together) of task-interdependence on shared understanding, ordered by the strength and direction of the effect. For the majority of interns, task-interdependence positively affects understanding: most of the cases are above the null-coefficient line. Nevertheless, there is a small sub-group of interns for whom task-interdependence has no, or even a negative, effect on shared understanding.

With this random slope, we find the most accurate model fit. Most effects found in previous models remain, with the main effects of task-interdependence and cooperation frequency being positive and significant predictors of shared understanding. The majority of interaction effects hypothesised in H4 and H5 were not found: only cooperation frequency in collaborations with school supervisors interact negatively. The net predicted effect of task-interdependence in collaborations with school supervisors is no longer positive, as seen by adding the coefficients of the direct effect ($b = 0.20$) and interaction effect ($b = -0.29$) together. This indicates that the effect of cooperation frequency on shared understanding differs for supervisors in schools: meeting with interns more regularly does not increase shared understanding for teachers as it does for collaborators in the internship organisation. On the individual level, the only remaining significant predictor of shared understanding is an intern's interprofessional attitude, with both motivation and organisational culture returning non-significant results. The final effect we found is a network effect, with interns naming more collaborators reporting lower levels of average shared understanding.

Discussion

This study reveals the importance of collaborative relations in preparing students for the interprofessional practices of health care work. Interprofessional collaboration has often been studied as an individual trait (e.g., Dellafiore et al., 2019; Reeves et al., 2016; Stadick, 2020; Ulrich et al., 2019), and sometimes as a characteristic of a team (Spitzer-Shohat et al., 2018), but empirical researchers seldom examine the collaborative relation *between* health care workers (see Pomare et al., 2019; Shoham et al., 2016; Simpson et al., 2020 for exceptions). However, theoretical work often distinguishes individuals from their collaborations (Abu-Rish et al., 2012; D'Amour et al., 2005; Walsh et al., 1999), indicating the need for empirical assessments of the relational nature of interprofessional collaboration.

Nursing interns reported variation in the shared understanding across their collaborators that cannot be explained by individual characteristics of the interns alone. The forecasted differences in shared understanding between interprofessional versus intraprofessional collaborations (H1) were not found. These results are relevant in light of increasing attempts by health care organisations to increase the incidence of interprofessional education in work settings (Grace, 2021). The insignificance of the effect hints that interns do not necessarily find it easier to understand others they perceive as having a similar professional background (cf. Tai et al., 2017). However, Tynjälä et al. (2021) pointed out that such collaboration requires sufficient supervision from professionals within organisations, and further research is necessary to understand under which organisational conditions collaborative student-learning thrives.

Regarding the different roles (H2), the only significant finding is that shared understanding was lower when collaborating with a supervisor compared to collaborating with another intern. The distance between teachers and internship organisations often reflects that interns experience their internship as disconnected from their educational curricula (Deketelaere et al., 2006; Naidoo et al., 2017). The negative interaction effect of cooperation frequency and school supervisor relations suggests a solution would require more than increasing contact between interns and supervisors. Increasing the perceived interdependencies between teachers and interns may help to improve the connection between vocational education and workplace professionalisation.

In all models, task-interdependence (H3) had a positive and significant effect on shared understanding in interns' collaborations, even when including cooperation frequency as a control variable. The hypothesised interaction effects of collaborations crossing professional (H4) or hierarchical (H5) boundaries were not found. Nevertheless, the consistently positive direct effect of task interdependence in collaborative relations indicates that internship supervisors and programme designers could focus on making this feature of collaborations salient for the interns in order to nurture shared understanding. Professional learning occurs in situations that closely resemble real work settings, in which students realise how their behaviour affects organisational processes (Ceelen et al., 2021; Ng et al., 2012; Shimizu et al., 2022). Our study shows a potential path toward developing such a sense of impact on the organisation, as interns' understanding of others is boosted in situations where they perceive their collaborative relations as task-interdependent (corroborating qualitative insights from Visser et al., 2019). This finding invites educational practitioners to actively emphasise to interns how their work affects the work of others. To do so, Sy (2017) showed evidence that workplace team meetings may affect student awareness. The Centre for Interprofessional Education (2022) offers materials that aid

in building assignments for student-professional collaboration. We echo the point of Barr et al. (2005) that interprofessional education has to be interactive.

Our models include several individual characteristics, namely motivation, interprofessional attitude, and perception of the organisational culture. The positive and significant effects of interprofessional attitudes on shared understanding are in line with previous empirical research (e.g., Pugsley et al., 2021; Sumiyoshi et al., 2020). Surprisingly, we did not find significant effects of intern motivation and perceptions of organisational culture on shared understanding in interns' relations. We believe our shift in focus, moving from the individual to their collaborations, may explain these results. Given the well-documented positive effects of motivation on several behavioural outcomes in health care (Ganotice et al., 2021; Ng et al., 2012), and the often-found effects of organisational culture on interns' behaviour (Carney et al., 2019; Lewitt et al., 2018), we interpret our results as an indication that shared understanding varies among collaborators *despite* these general individual-level effects. This variation implies a potential avenue toward increasing shared understanding for both motivated and less-motivated interns, as increasing the perceived task-interdependence seems to strengthen the shared understanding among collaborators for almost all interns, regardless of their individual motivation or perceived organisational culture.

Future researchers might strengthen the relational line of reasoning by improving upon some of this study's limitations. First, this study uses information that originated from the nursing interns only, while not measuring the perceptions of their collaborators. Including the perception of both parties might elucidate the interns' progress more accurately than their own perceptions of that progress (Pollard et al., 2005). Second, our study is cross-sectional, limiting our capacity to make causal claims about the relation between task-interdependence, shared understanding, and individual characteristics. Nonetheless, the aim of the study was not to establish causal links between the theoretical concepts, but to demonstrate the crucial role of a relational lens with regard to shared understanding in students' internship collaborations. Finally, the conclusions may be specific to the Dutch context, and research in other countries might help identify any cultural specificities.

Conclusion

We set out to uncover how shared understanding in health care interns' collaborative relations is affected by characteristics of the collaborative relation and characteristics of the health care intern. We analysed the collaborative networks of interns to examine whether individual factors (attitudes, perceptions of collaborative cultures, and motivation) or relational factors between collaborators (task-interdependence, cooperation frequency, and interprofessional and hierarchical roles) affected shared understanding among 150 Dutch nursing interns and their collaborators ($n = 865$). Our results indicate that task-interdependence, above and beyond cooperation frequency and individual characteristics, may enhance shared understanding in interns' collaborative relations, regardless of whether these collaborations cross hierarchical or professional boundaries. This study shows the potential of theoretically and empirically assessing interprofessional learning on a relational level. As nursing interns report the highest levels of shared understanding in relations characterised by high levels of task-interdependence, this study indicates internship design might benefit from a focus on improving the salience of the tasks that interns perform together with professionals from both their own, and other, professional backgrounds.

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