Disclosed Curriculum: Transfer-Climate Mediates Discipline-Differences in Learner Outcomes

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Abstract

Empirical findings generally indicate positive effects of early interprofessional education on student outcomes. The current study seeks to add to this evidence base by examining training transfer as an explanatory-mechanism for IPE's comparative-effectiveness across programs. Specifically, we examine learner curricular experiences (transfer climate) post-IPE delivery in predicting two learner outcomes: 1) team attitudes, and 2) professional identity. A prospective observational design with N=306 first-year students across five disciplines were assessed before an IPE training and 18-months later. A transfer climate-mediation model was used to test program differences in team attitudes and professional identity post-IPE training. Results supported full-mediation, such that program differences in team attitudes and professional identity were contingent on students' post-training reports of IP experiences (transfer climate). In turn, transfer climate's effects on team attitudes and professional identity were partially mediated by two IP variables: 1) normative beliefs (professional valuation), and 2) affective reactions (collaboration comfort). The findings contribute to the identification of ‘curricula design factors’ as potential confounds of program-differences in learner outcomes following early IPE. We discuss the limited value of program differences in learner outcomes, particularly for studies of early IPE effectiveness.

Keywords: Interdisciplinary Medical Education, Qualities/Skills/Values/Attitudes, Professional Development

Introduction

As complementary skills depend on professional training, likewise, the effectiveness of interprofessional education (IPE) depends on placement of common competencies. The IPE Collaborative, for example, locates IP values as the primary competency for practitioners. Toward this goal, pre-licensure (early) IPE targets the onset of socialization processes and signals IP-valuation to new learners. Expressed IP values (attitudes) are foundational to
trainees’ professional identity for normative practice.⁴

To date, IPE researchers have chiefly examined one direction of this link, that is, IPE effectiveness for distal outcomes.⁵ Far less attention has been paid to how normative differences (heterarchical) across curricula may explain differences in IPE’s short-term effectiveness. As the latest Best Evidence Medical Education (BEME) review of IPE concludes, ‘IPE can continue to be impeded by a number of contextual factors such as space and timetabling of other profession-specific learning activities’.⁶ IPE researchers typically regard ‘profession-specific learning’ activities as static-antecedents to delivery (context-as-presage). Findings of program differences in IPE outcomes, however, are confounded by the continuous learning activities of early curricula (context-as-process). For example, consider the duality of competition in both, 1) learner needs, and 2) curricula demands. Furthermore, educational researchers such as Cahn et al.⁷ recognize the reciprocality of context-processes for IPE effectiveness evaluations, reasoning ‘Because classroom and clinical settings overlap so extensively in health professions education it is also reasonable to ask whether student learning outcomes related to IPE change based on the culture of the environment in which they are precepted’. Ultimately, IPE’s incomplete evaluation can be expected to limit its reproducibility and sustainability.⁸

In this study, we address this gap by repurposing transfer’s outcome-status (temporal distillation) as a process-mechanism for program differences in early-IPE outcomes.⁹ Specifically, we examine transfer climate (TransClim), defined by Rouiller and Goldstein⁹ as ‘the practices and procedures used in an organization that signal to people that transferring KSAs from training is important to develop a shared pattern of meaning’ as an explanatory variable for program-differences in IPE outcomes. Specifically, two IPE outcomes, 1) team attitudes (TeamAtts), and 2) professional identity (ProID) are briefly reviewed as background to our proposed model of TransClim as a mediator (explanatory mechanism) of program-differences reported in studies of IPE.

**Attitudes from Early IPE**

Researchers have distinguished between the goals of IPE in early training from those occurring in later training (post-licensure settings).¹⁰ Early IPE prioritizes common competencies, with goals to raise awareness, redress misconceptions, and foster favorable early experiences for future IP collaborations. For example, Carpenter examined the impact of a one-day workshop designed to improve attitudes between medical - nursing students.¹¹ Results indicated that outgroup-attitudes improved by more than one-standard deviation from pre-post assessment (\(d=1.27\)). From these findings, three substantive conclusions were drawn: 1) professional stereotypes are observable early in training, and 2) these attitudes are fairly malleable, and finally 3) failure to redress early-attitudinal biases may exacerbate ineffective collaborations later in practice.

Historically, the empirical evidence of early-IPE effectiveness for attitude-change has been presented as positive, but ‘mixed’.¹² Systematic reviews, however, have been limited to qualitative-descriptivist reports of directional findings (e.g., “positive”, “mixed”, “no change”). A more recent meta-analysis (MA) of team-training effectiveness permits stronger, quantitative conclusions.¹³ Specifically, MA estimates from a total of \(k=38\) studies comprising \(N=3,204\) learners support training's effectiveness for changing attitudes (\(d=.71\)). The MA also supported early training, with comparative-effectiveness (overlapping 95% confidence intervals) across student samples (\(d=.62\)) and clinician samples (\(d=.81\)).

**Professional Identity in Early IPE**
Although there is little controversy about the value of building TeamAtts, some researchers maintain that premature efforts may undermine early ProID formation. The argument's central tenet is seeded in social identity theory's 'distinctiveness threat' where it is argued that individuals are more likely to adhere to ingroup norms (i.e., profession-based), countervailing the goals of early IPE. A corollary of this argument is, that exposing students to IPE prematurely may elicit anxiety, role insecurity, and negative reactions generally to subsequent IP collaborations.

Because ProID is not a formal outcome of IPE, few studies have explicitly focused on its development. Supplementary Appendix 1 organizes existing IPE research on ProID in a 2 x 2 table - 'Training Stage (pre / post)' x 'Data Approach (qualitative / quantitative)'. Summarizing the studies pertinent to the current investigation (pre / quantitative quadrant), Hind et al. found a positive relationship between ProID and outgroup-valuations ($d=0.24$). Furthermore, findings failed to support the hypothesized negative relation (tradeoff) between ProID and IP attitudes, instead, a significant positive relation was observed ($d=0.37$). Similarly, Adams et al. also found a positive effect of students’ teamwork-understanding on ProID ($d=0.43$). To the authors’ knowledge, however, there are currently no longitudinal IPE studies of ProID, which prohibits any claims regarding IPE effects on learners’ ProID development.

In summary, most arguments against early IPE are predicated on premature ProID, however, few IPE studies have included both ProID and TeamAtts variables in assessments. Still fewer studies theorize specific mechanisms for TeamAtts and ProID development. Consequently, the frequently reported program-differences on IPE outcomes are necessarily of limited validity and insight. The current study seeks to fill this gap by contributing to the argument for early IPE delivery. Specifically, using social identity theory, we identify transfer climate as a common antecedent of TeamAtts and ProID. Below, we briefly elaborate on the explanatory potential of training transfer as determined by curricular experience.

The Disclosed Curriculum - IP Transfer Climate

Cribb and Bignold described the hidden curriculum as the 'processes, pressures, and constraints which fall outside of, or are embedded within, the formal curriculum and which are often unarticulated or unexplored.' Interestingly, early IPE shares the feature of being embedded in formal curriculum. A recent systematic-review of IPE concluded that ‘existing curriculum’ remains one of the largest hindrances to IP training. We further relate the unexplored “processes, pressures, and constraints” of formal curricula (albeit, thus far, disclosable by student reports) in IPE to a specific criterion of IPE effectiveness, training transfer.

In IPE literature, training transfer is defined by D’Eon as "the ability to extend what has been learned in one context to new contexts." Importantly, in addition to generalization gradients, transfer can also be ordered on a temporal continuum, ranging from proximal, maintenance, distal, and sustainment. This stands in stark contrast to Kirkpatrick’s conceptualization. Training transfer’s context-temporal distinction was recognized in a MA of training outcomes' interrelation –

‘Kirkpatrick actually used the term “behavior” to refer to any behavioral changes that occur as a result of training. However, he did not make a clear distinction between behavior demonstrated in the training context and behavior demonstrated on the job.’

Unfortunately, transfer’s imprecise beginnings has largely endured as-in, for example, the equivocality in the BEME Collaboration’s coding rubric, where behavioral change is defined as ‘documents the transfer of learning to the
workplace or willingness of learners to apply new knowledge and skills'. The conflation implicates environmental factors (workplace / transfer climate) and trainee characteristics (motivation / willingness) as common causes to IPE effectiveness. Consequently, failure to specify person-environment factors constitutes a confound in comparative-models of IPE effectiveness.

Two factors impacting transfer parallel those found in IPE's 3P model, specifically, 1) environmental factors (i.e., context), and 2) trainee characteristics (i.e., learners). First, among environmental factors, TransClim has received MA support as the largest determinant of training transfer ($d=.47$). TransClim includes organization supports, for example, opportunities to use, defined by Ford et al. as ‘the extent to which a trainee is provided with or actively obtains work experiences relevant to the tasks for which he or she was trained.’ Second, among learner characteristic, Noe et al. define motivation to transfer as ‘trainee’s desire to use the knowledge and skills on the job.’ Motivation to transfer has received MA support as the largest learner determinant of training transfer ($d=75$).

Next, we elaborate TransClim and motivation to transfer's role in our conceptual model.

**Conceptual Model and Hypotheses**

Ronfeldt and Grossman argue that early curricular experiences impact later role transitions and identity integration over training, which has empirical support. From the above-reviewed research, Figure 1 illustrates our proposed conceptual model with factors hypothesized to mediate program-differences on TeamAtts and ProID. Specifically, as shown, Program (formal curricula) will systematically expose students to TransClims, post-IPE delivery. Consistent with social identity theory, TransClim is expected to similarly impact motivation to transfer (TeamAtts) and ProID. Thus, we hypothesize that the effect of Program on TeamAtts and ProID will operate indirectly only, as afforded by TransClim following the IPE training.

*Hypothesis 1 (H1)*: TransClim will fully mediate program’s effect on TeamAtts.

*Hypothesis 2 (H2)*: TransClim will fully mediate program’s effect on ProID.

In addition to the practical role that TransClim may have on TeamAtts and ProID, we explore two theoretical mechanisms by which TransClim is argued to impact TeamAtts and ProID. First, drawing on Fishbein and Ajzen’s theory of attitude-formation and Tajfel and Turner’s social identity theory, we hypothesize that:

*Hypothesis 3 (H3)*: TransClim will positively impact IP-Normative beliefs, and

*Hypothesis 4 (H4)*: TransClim will positively impact IP-AffectReact.

Second, theorizing by Ibarra on trialing ‘possible selves’ in early ProID development suggests that, the value-signaling beliefs of professions should impact learners’ ProID development (normative beliefs). Also, longitudinal evidence on ProID development suggests that students’ comfort with teamwork behaviors (affective reactions) impact early ProID development. Both normative beliefs and affective reactions are components of attitude formation. Building on social-psychology theory with models of early-identity negotiations normative beliefs and affective reactions are expected to impact both TeamAtts and learners’ early ProID.

*Hypothesis 5 (H5)*: IP-NormBeliefs will positively predict TeamAtts and ProID, and

*Hypothesis 6 (H6)*: IP-AffectiveReactions will positively predict TeamAtts and ProID.
Method

Our realistic evaluation design is consistent with Thistlethwaite et al. account, whereby we aim to ‘identify underlying causal mechanisms and how they work under varying conditions rather than assuming simple cause and effect solutions’.35

Sample

Students matriculating into an academic medical center in the Southeast United States were recruited to participate in the study. Students represented disciplines of medicine (N=115), nursing (N=95), physical therapy (N=50), physician assistance (N=44), and medical technologist (N=11). A total of N=315 students attended the IPE session and completed a follow-up survey. Nine participants identified as careless responders were removed from the dataset, resulting in N=306. Missing value analysis identified 11 participants with single-values missing across four variables. The missing completely at random (MCAR) test was non-significant $X^2(96)=114.33$ (p >.05), and multiple imputation was implemented for recovering missing values. Summary sample characteristics are displayed in Table 1 below.
Procedure

Six weeks after matriculation, students participated in an IPE training. Instructional delivery comprised a 1-hour didactic followed by three, small-group clinical vignettes designed with high-cognitive fidelity. Trained facilitators moderated the clinical vignettes.

Two weeks before the IPE session, an online survey was administered to assess learner demographics and professional program. A purposive follow-up assessment was conducted 18-months later, during learners’ fourth semester. The follow-up survey assessed TransClim, ProID, and team attitude variables. Because the IPE sessions, where collections occurred, were embedded in students’ curriculum, completion rates were fairly high at 81%.

Measures

All measures were selected from previously validated instruments and were selected based on sufficient psychometric reporting (Supplementary Appendix 2). Responses were recorded on a Likert-type response format, while our locally developed TransClim measure utilized mixed-response formats. All scores were computed by summing item responses for a total score inputted into structural equation model estimates.

Team Attitudes

Five items were adopted from Heinemann et al.’s Attitudes toward Health Care Teams Scale (ATHCTS) to assess students’ evaluative judgments of IP teams.\(^{36}\)

IP-AffectReact (IP-AffectReact)
Six items were adopted from King et al.’s IP Socialization and Valuing Scale (IPSVS) to assess affective reactions to engaging in IP interactions.\(^\text{37}\)

**IP-NormBeliefs (IP-NormBeliefs)**

Four items were adopted from McFadyen et al.’s Interdisciplinary Education Perception Scale to assess profession-based normative beliefs regarding for IP teamwork.\(^\text{38}\)

**Professional Identity (ProID)**

Four items were adapted from Jetten et al. to assess students’ professional identity (ProID).\(^\text{39}\)

**Transfer Climate (TransClim)**

Transfer experience was assessed with a locally developed 10-item instrument. Item stems explicitly cued students to report transfer experiences occurring after the IPE training.

### Results

#### Data Treatment

Descriptive statistics, internal reliability estimates, and correlations for all variables are provided in Table 2. All measures exhibited good psychometric properties based on internal reliability estimates (Cronbach’s α ranged from .75 - .85). Inspection of the correlation matrix indicated a small, but positive significant correlation between TeamAtts and ProID, providing preliminary empirical support for the mutual-compatibility of TeamAtts and ProID in early IPE.

#### Table 2

| Variable | Mean (SD) | Range | Program | TransClim | IPAfffect | IPNorms | TeamAtts | ProID |
|----------|----------|-------|---------|-----------|-----------|---------|----------|-------|
| Program  | 34% MD   | [0-1] | n/a     |           |           |         |          |       |
| TransClim| 26.53 (6.05) | [9-40] | -0.61** | .78       |           |         |          |       |
| IPAfffect| 29.59 (3.75) | [6-26] | -14*    | .28**     | .85       |         |          |       |
| IPNorms  | 19.52 (2.74) | [4-24] | -29**   | .30**     | .46**     | .81     |          |       |
| TeamAtts | 24.15 (3.37) | [15-30] | -12*    | .19**     | .25**     | .28**   | .75      |       |
| ProID    | 20.15 (3.42) | [4-24] | -17**   | .17**     | .14*      | .26**   | .12*     | .85   |

*Note. Alpha reliability estimates on main-diagonal. TransClim = Transfer Climate, IPAfffect = Affective Reactions, Norms = Normative Beliefs, ProID = Professional Identity. N=306. *p<.05, **p<.01.*

### Measurement-Model Confirmation

Confirmatory factor analysis (CFA) was conducted in order to evaluate the relative-fit of our proposed 5-factor solution for structural-hypothesis testing. Results supporting our hypothesized 5-factor structure are reported in
Structural-Model Hypothesis Testing

Path estimates corresponding to all six of our hypotheses are depicted in Figure 2 below. The first two hypotheses tested TransClim as a full-mediator of Program effects on IP-TeamAtts ($H_1$) and ProID ($H_2$). Full-mediation hypotheses were examined separately.

First, a significant direct-effect was observed for Program on TeamAtts ($\beta = -0.15, p < 0.05$) and ProID ($\beta = -0.13, p < 0.05$). Second, TransClim was added and Program showed significant indirect effects on TransClim in predicting TeamAtts ($\beta = -0.62, p < 0.05$) and ProID ($\beta = -0.54, p < 0.05$). Third, as expected, TransClim positively predicted both TeamAtts ($\beta = 0.18, p < 0.05$) and ProID ($\beta = 0.20, p < 0.05$). These findings provide sufficient evidence for TransClim’s partial-mediation of Program-differences on early-IPE outcomes. Fourth, full-mediation models were tested by setting the direct-effect of Program on TeamAtts and ProID to zero and comparing model-fit indices. Results displayed in Table 3 indicate non-significant improved fit from including Program’s direct-effect on TeamAtts ($H_1$) and ProID ($H_2$) when TransClim is included in the model. These findings support our first two, full-mediation hypotheses ($H_1$, $H_2$).
Further inspection of the paths between TransClim and, IP-NormBeliefs and IP-AffectReact indicated support for Hypothesis 3 and 4, respectively. In accordance with theorizing on socialization processes in early training, additional post-IPE experiences via TransClim reinforced students’ perceptions of professional valuation ($\beta=.43$, $p<.05$) and behavioral comfort ($\beta=.37$, $p<.05$) with IP collaborative behaviors.

Inspection of the paths between IP-NormBeliefs and, ProID and TeamAtts indicated support for Hypothesis 5. In accordance with social psychology models, IP-NormBeliefs positively impacted ProID ($\beta=.26$, $p<.05$) and TeamAtts ($\beta=.11$, $p<.05$). Last, inspection of the paths between IP-AffectReact, and TeamAtts and ProID and indicated partial-support for Hypothesis 6. Specifically, IP-AffectReact positively impacted TeamAtts ($\beta=.11$, $p<.05$), but was non-significant for ProID ($\beta=.12$, $p=.21$).

In summary, five of our six hypotheses received support, whereas one hypothesis received only partial-support. Additional exploratory analyses are reported in Supplementary Appendix 4. Specifically we report: 1) Alternative partial-mediation models for comparison, 2) A further follow-up of medical students’ last semester after clinical experience, 3) A joint-variance synthesis from MA estimates of IPE criteria to assess potential reciprocality of outcomes, and 4) A more direct-test of the distinctiveness threat hypothesis from early IPE, which is found to be unsupported. In the Discussion section,

### Discussion

The current study builds on prior theorizing and empirical investigations in the IPE literature to offer a latent-variable model of pre-licensure TeamAtts and ProID. Our focal variable in the current model is IP Experiences, specifically, those occurring outside formal IPE delivery. We briefly summarize our empirical findings below.

Support for our first two hypotheses (H1, H2) informs the IPE literature as to the source of program-differences observed for select IPE outcomes. Specifically, the value of program as an explanatory variable for IPE outcomes seems delimited to the training transfer-experiences offered. This should limit the scope of potentially arbitrary inferences made from observed program-differences on IPE outcomes. Instead, we concur with Freeth et al., who argue that opportunities for reflection and practice are vital for the transfer of concepts learned in early IPE.

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**Table 3**

*Nested-Model Comparisons for Experience as Full- and Partial-Mediator of Program Effects by ‘Attitudes’ and ‘Professional Identity’ Criterion*

| Model                    | S-B $X^2$ | df | CFI | RMSEA [90% CI] | Change Indices |
|--------------------------|-----------|----|-----|----------------|----------------|
| Full-Mediati(TeamAtts)   | 127.45    | 32 | .91 | .09 [.08 -.12] | $\Delta S-B X^2$ | $\Delta df$ | $\Delta CFI$ |
| Part-Mediati(TeamAtts)   | 126.30    | 31 | .91 | .10 [.08 -.12] | $\Delta S-B X^2$ | 1 | .00 |
| Full-Mediati(ProID)      | 115.26    | 56 | .93 | .08 [.06 -.09] | $\Delta S-B X^2$ | 1 | .00 |
| Part-Mediati(ProID)      | 115.84    | 55 | .92 | .08 [.06 -.10] | $\Delta S-B X^2$ | 1 | -.01 |

*Note. N=306. S-B = Satorra-Bentler scaled chi-square. Df = degrees of freedom. CFI = comparative fit index. RMSEA = root mean square error of approximation.*
Further support for full-mediation effects of Experience on, both IP Attitudes (H2b) and ProID (H2a) was found. However, the effect of Affective Reactions on ProID was non-significant (H4b), which may reflect the slower identity negotiation through continued interaction. This concurs with qualitative evidence indicating that professional identity cannot be taught, but only experientially established in practice. In contrast, the effect of IP Affect on IP Attitudes was significant, providing support for H3b. Furthermore, the findings for Normative Beliefs (H3a & H4a), however, should be encouraging and apropos to a 'just-in-time' trend in the IPE domain. Similar, Thistlethwaite and Ewart have argued for diversity-valuing content in early curricula. It bears repeating, however, that our evaluation design was targeted to galvanize (observe at disequilibrium) the curricular-borne program effects on IPE outcomes. For example, Reeves et al. observe the importance of early-IPE's authenticity as-perceived by students. In briefest, equivalence in training onset (matriculation) does not imply comparable maturation in professional identity or attitude formation.

Our findings are complemented by arguments for research of facilitator training and student transfer. More directly, Clouder et al. examined the role that IPE student-facilitators has on widening perceptual scopes of professional identity. Extrapolating, recent longitudinal findings support the effects of learner’s identification with instructors, in situ, on trainees’ motivation to transfer. In the next section, we briefly elaborate on the theoretical and practical implications of our findings.

Theoretical and Practical Implications

As a preface to implications, we summarize a few reasons for the narrow-outcome foci in extant IPE research. First, as Reeves et al. explicitly acknowledge in the latest systematic review of the evidence, IPE criteria are ‘differing, but non-hierarchical.' In essence, in this study, we utilized the vertical-hierarchy of training to explain heterarchical-differences on IPE learner outcomes. Second, according to the ubiquitous 3P model of IPE (presage-process-product), context- and learner- presage factors are orthogonal. Related, each presage factors is reciprocally related to IPE outcomes. Third, the recently published MA of team training in healthcare provided the first empirical support for the empirical relations between IPE criteria, support an indirect-effects model of IPE and results, partly via cascading-determinants (e.g., trainee reactions à student learning à practitioner transfer).

Drawing on tenets of socially influenced attitude formation and identity development processes, we proposed that inclusion of team experiences after IPE delivery can help clarify mixed-findings of IPE’s effects on student attitudes and related, positive relations between IP Attitudes and ProID. While arguments against pre-licensure delivery of IPE have waned with growing institutionalization of such programs, rationale for early delivery has centered on defensiveness for mitigating patient hazard. With the abiding burden of IPE’s distal-effectiveness, instead, local stakeholders are well-served by an affirmative argument for removing doubts regarding negative implications of IP attitudes for ProID development. For example, the positive relation in these data may be understood in the framework of a Common Ingroup Identity Model (CIIM), which is distinguished from social identity theories that argue for decategorization between groups; In contrast, the CIIM argues for recategorization of groups under an overarching, superordinate frame.

Limitations
There are many limitations to the current study that warrant caution for interpretation and generalization. First, while our design was longitudinal, all but one of our study variables was collected at the same assessment occasion. Therefore, there are likely a number of equivalent models that may fit the data equally well. It should also be emphasized that we did not assess attitude change and, therefore, cannot determine from the current data whether the positive relations between our experience factor and attitude antecedents are determinants or correlates. In addition, without a control group, causality cannot be inferred.

Conclusion

The accelerated growth in empirical studies of IPE, not only incommensurate to our meaningful understanding of the phenomenon, but is also an incredible indicator of the strength of evidence Proximal learner outcomes of IPE (reactions, attitudes, and knowledge / skill acquisition) have received empirical support, but specific mechanisms have largely been overlooked. Understanding how IPE influences desired student competencies is important both for the selection into, and customization of, IPE delivery. In addition, the evidence base for IPE on more distal outcomes can be strengthened by identifying potential confounds to IPE effectiveness. In addition, our results highlight an important boundary condition to the interpretation of program differences on IPE criteria, specifically, IPE does not occur in a vacuum and, other curricular experiences necessarily interact with any potential effects of IPE delivery. Consequently, substantive or explanatory inferences of program-differences on early IPE criteria warrant caution. In principle, our findings concur with Brooks and Thistlethwaite’s conclusion that, formal learning is the optimal setting for interprofessional learning. Finally, this study provides additional support for the positive relation between ProID and attitudes toward IP teamwork. It is important to understand how normative perceptions of contemporary cohorts influence both factors upon matriculation for optimizing sustainment of necessary early IPE delivery. In closing, there may be space for program differences on short-term outcomes, but is there place in IPE’s long-term sustainability?

Declaration of Interest

All authors of the current manuscript formally declare no conflicts of interest.

Take Home Messages

- Program-differences on IPE outcomes are confounded by student antecedents and discipline-curricula processes.
- IP experiences following training support IPE transfer.
- IPE criteria are interrelated and mutually-reinforcing.

Notes On Contributors

Matthew J. Kerry holds a PhD in Quantitative Psychology. His main interests are health-sciences education assessment, interprofessional education, and item response theory (IRT) applied to patient-reported outcomes (PROs) and health-services research. The first-author contributed IPE measurement selection, questionnaire
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The first-author contributed IPE measurement selection, questionnaire programming, data curation, and technical analyses.

The second-author contributed IPE literature review synthesis, IPE facilitator training and delivery support, and expository write-up and copy-editing.

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Bibliography/References

1. O'Keefe M, Henderson A, Chick R. Defining a set of common interprofessional learning competencies for health profession students. Medical Teacher. 2017;39(5):463-8.

   https://doi.org/10.1080/0142159X.2017.1300246

2. Collaborative IE. Team-based competencies: Building a shared foundation for education and clinical practice. Washington, DC: Interprofessional Education Collaborative. 2011.

3. Rogers GD, Thistlethwaite JE, Anderson ES, Abrandt Dahlgren M, Grymonpre RE, Moran M, et al. International consensus statement on the assessment of interprofessional learning outcomes. Medical teacher. 2017;39(4):347-59.

   https://doi.org/10.1080/0142159X.2017.1270441

4. Hamilton J. Two birds with one stone: Addressing interprofessional education aims and objectives in health profession curricula through interdisciplinary cultural competency training. Medical teacher. 2011;33(4):e199-e203.

   https://doi.org/10.3109/0142159X.2011.557414

5. Collaborative IE. Team-based competencies: Building a shared foundation for education and clinical practice. Washington, DC: Interprofessional Education Collaborative. 2011.

6. Cox M, Cuff P, Brandt B, Reeves S, Zierler B. Measuring the impact of interprofessional education on collaborative practice and patient outcomes. Taylor & Francis; 2016.

7. Cahn PS, Bzowyckyj A, Collins L, Dow A, Goodell K, Johnson AF, et al. A design thinking approach to evaluating interprofessional education. Journal of interprofessional care. 2016;30(3):378-80.

   https://doi.org/10.3109/13561820.2015.1122582

8. Anderson E, Smith R, Hammick M. Evaluating an interprofessional education curriculum: a theory-informed
approach. Medical teacher. 2016;38(4):385-94.

9. Rouiller JZ, Goldstein IL. The relationship between organizational transfer climate and positive transfer of training. Human resource development quarterly. 1993;4(4):377-90.

https://doi.org/10.1002/hrdq.3920040408

10. Reeves S, Goldman J, Gilbert J, Tepper J, Silver I, Suter E, et al. A scoping review to improve conceptual clarity of interprofessional interventions. Journal of Interprofessional Care. 2011;25(3):167-74.

https://doi.org/10.3109/13561820.2010.529960

11. Carpenter J. Interprofessional education for medical and nursing students: evaluation of a programme. Medical education. 1995;29(4):265-72.

https://doi.org/10.1111/j.1365-2923.1995.tb02847.x

12. Reeves S, Fletcher S, Barr H, Birch I, Boet S, Davies N, et al. A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. Medical Teacher. 2016;38(7):656-68.

https://doi.org/10.3109/0142159X.2016.1173663

13. Hughes AM, Gregory ME, Joseph DL, Sonesh SC, Marlow SL, Lacerenza CN, et al. Saving lives: A meta-analysis of team training in healthcare. 2016.

14. Funnell P. Exploring the value of interprofessional shared learning. Interprofessional Relations in Health Care Edward Arnold, London. 1995.

15. Brewer MB. The social self: On being the same and different at the same time. Personality and social psychology bulletin. 1991;17(5):475-82.

https://doi.org/10.1177/01461672911175001

16. Spears R, Doosje B, Ellemers N. Self-stereotyping in the face of threats to group status and distinctiveness: The role of group identification. Personality and social psychology bulletin. 1997;23(5):538-53.

https://doi.org/10.1177/0146167297235009

17. Hind M, Norman I, Cooper S, Gill E, Hilton R, Judd P, et al. Interprofessional perceptions of health care students. Journal of interprofessional care. 2003;17(1):21-34.

https://doi.org/10.1080/1356182021000044120

18. Adams K, Hean S, Sturgis P, Clark JM. Investigating the factors influencing professional identity of first-year health and social care students. Learning in Health and Social Care. 2006;5(2):55-68.

https://doi.org/10.1111/j.1473-6861.2006.00119.x

19. Cribb A, Bignold S. Towards the reflexive medical school: the hidden curriculum and medical education research. Studies in Higher Education. 1999;24(2):195-209.
20. Sunguya BF, Hinthong W, Jimba M, Yasuoka J. Interprofessional education for whom?—challenges and lessons learned from its implementation in developed countries and their application to developing countries: a systematic review. PLoS One. 2014;9(5):e96724.

https://doi.org/10.1371/journal.pone.0096724

21. D'Eon M. A blueprint for interprofessional learning. Medical Teacher. 2004;26(7):604-9.

https://doi.org/10.1080/01421590400004924

22. Kirkpatrick DL. Evaluation of training. 1967.

23. Alliger GM, Tannenbaum SI, Bennett W, Traver H, Shotland A. A meta-analysis of the relations among training criteria. Personnel psychology. 1997;50(2):341-58.

https://doi.org/10.1111/j.1744-6570.1997.tb00911.x

24. Blume BD, Ford JK, Baldwin TT, Huang JL. Transfer of training: A meta-analytic review. Journal of management. 2010;36(4):1065-105.

https://doi.org/10.1177/0149206309352880

25. Ford JK, Qui-ones MA, Sego DI, Sorra JS. Factors affecting the opportunity to perform trained tasks on the job. Personnel psychology. 1992;45(3):511-27.

https://doi.org/10.1111/j.1744-6570.1992.tb00858.x

26. Noe RA. Trainees' attributes and attitudes: Neglected influences on training effectiveness. Academy of management review. 1986;11(4):736-49.

https://doi.org/10.5465/AMR.1986.4283922

27. Ronfeldt M, Grossman P. Becoming a professional: Experimenting with possible selves in professional preparation. Teacher Education Quarterly. 2008;35(3):41-60.

28. Morison S, Jenkins J. Sustained effects of interprofessional shared learning on student attitudes to communication and team working depend on shared learning opportunities on clinical placement as well as in the classroom. Medical Teacher. 2007;29(5):450-6.

https://doi.org/10.1080/01421590701477381

29. Hamilton J. Two birds with one stone: Addressing interprofessional education aims and objectives in health profession curricula through interdisciplinary cultural competency training. Medical teacher. 2011;33(4):e199-e203.

https://doi.org/10.3109/0142159X.2011.557414

30. Fishbein M, Ajzen I. Belief, attitude, intention, and behavior: An introduction to theory and research. 1977.
31. Tajfel H, Turner JC. The social identity theory of inter group behavior in S Worcel & WG Austin (Eds) Psychology of intergroup relations. Chicago: Nelson. 1986.

32. Ibarra H. Provisional selves: Experimenting with image and identity in professional adaptation. Administrative science quarterly. 1999;44(4):764-91.

https://doi.org/10.2307/2667055

33. Pratt MG, Rockmann KW, Kaufmann JB. Constructing professional identity: The role of work and identity learning cycles in the customization of identity among medical residents. Academy of management journal. 2006;49(2):235-62.

https://doi.org/10.5465/AMJ.2006.20786060

34. Cote JE, Levine CG. Identity, formation, agency, and culture: A social psychological synthesis: Psychology Press; 2014.

35. Thistlethwaite J, Kumar K, Moran M, Saunders R, Carr S. An exploratory review of pre-qualification interprofessional education evaluations. Journal of interprofessional care. 2015;29(4):292-7.

https://doi.org/10.3109/13561820.2014.985292

36. Heinemann GD, Schmitt MH, Farrell MP, Brallier SA. Development of an attitudes toward health care teams scale. Evaluation & the Health Professions. 1999;22(1):123-42.

https://doi.org/10.1177/01632789922034202

37. King G, Shaw L, Orchard CA, Miller S. The interprofessional socialization and valuing scale: A tool for evaluating the shift toward collaborative care approaches in health care settings. Work. 2010;35(1):77-85.

38. McFadyen A, Maclaren W, Webster V. The Interdisciplinary Education Perception Scale (IEPS): an alternative remodeled sub-scale structure and its reliability. Journal of interprofessional care. 2007;21(4):433-43.

https://doi.org/10.1080/13561820701352531

39. Jetten J, Spears R, Manstead AS. Distinctiveness threat and prototypicality: Combined effects on intergroup discrimination and collective self-esteem. European Journal of Social Psychology. 1997;27(6):635-57.

https://doi.org/10.1002/(SICI)1099-0992(199711/12)27:6<635::AID-EJSP835>3.0.CO;2-#

40. Clark PG. Values in health care professional socialization: Implications for geriatric education in interdisciplinary teamwork. The Gerontologist. 1997;37(4):441-51.

https://doi.org/10.1093/geront/37.4.441

41. Baldwin TT, Ford JK. Transfer of training: A review and directions for future research. Personnel psychology. 1988;41(1):63-105.

https://doi.org/10.1111/j.1744-6570.1988.tb00632.x
42. Cook DA, West CP. Perspective: reconsidering the focus on "outcomes research" in medical education: a cautionary note. Academic Medicine. 2013;88(2):162-7.

https://doi.org/10.1097/ACM.0b013e31827c3d78

43. Freeth DS, Hammick M, Reeves S, Koppel I, Barr H. Effective interprofessional education: development, delivery, and evaluation: John Wiley & Sons; 2008.

44. Goldie J. The formation of professional identity in medical students: considerations for educators. Medical teacher. 2012;34(9):e641-e8.

https://doi.org/10.3109/0142159X.2012.687476

45. Sargeant J, Hill T, Breau L. Development and testing of a scale to assess interprofessional education (IPE) facilitation skills. Journal of Continuing Education in the Health Professions. 2010;30(2):126-31.

https://doi.org/10.1002/chp.20069

46. Thistlethwaite J, Ewart B. Valuing diversity: helping medical students explore their attitudes and beliefs. Medical Teacher. 2003;25(3):277-81.

https://doi.org/10.1080/0142159031000100346

47. Anderson E, Thorpe L. Early interprofessional interactions: Does student age matter? Journal of Interprofessional Care. 2008;22(3):263-82.

https://doi.org/10.1080/13561820802054689

48. Chue S. Discourse analysis for understanding nature of facilitation and teaching approaches in interprofessional education. 2017.

49. Clouder DL, Davies B, Sams M, McFarland L. "Understanding where you're coming from": Discovering an [inter] professional identity through becoming a peer facilitator. Journal of interprofessional care. 2012;26(6):459-64.

https://doi.org/10.3109/13561820.2012.706335

50. Bjerregaard K, Haslam SA, Morton T. How identification facilitates effective learning: the evaluation of generic versus localized professionalization training. International Journal of Training and Development. 2016;20(1):17-37

https://doi.org/10.1111/ijtd.12067

51. Gaertner SL, Dovidio JF. Reducing intergroup bias: The common ingroup identity model: Psychology Press; 2014.

52. Brooks V, Thistlethwaite J. Working and learning across professional boundaries. British Journal of Educational Studies. 2012;60(4):403-20.

https://doi.org/10.1080/00071005.2012.729665
Appendices

Appendix 1:

**Training Stage**

| Data Approach | Pre-Licensure | Post-Licensure |
|---------------|---------------|----------------|
| Qualitative   | Clouder et al. (2012) | King & Ross (2003) |
|               | DeMatteo & Reeves (2013) | Arndt et al. (2009) |
| Quantitative  | Adams et al. (2006) | Richter et al. (2006) |
|               | Hind et al. (2003) | Mitchell, Parker, & Giles (2011) |

*Arndt, J., King, S., Suter, E., Mazonde, J., Taylor, L., & Arthur, N. (2009). Socialization in health education: Encouraging an integrated interprofessional socialization process. *Journal of Allied Health*, 38(1), 18-23.

*Baker, L., Egan-Lee, E., Martimianakis, M. A., & Reeves, S. (2011). Relationships of power: Implications for interprofessional education. *Journal of Interprofessional Care*, 25, 98–104.

https://doi.org/10.3109/13561820.2010.505350

*Caricati, L., Guberti, M., Borgognoni, P., Prandi, C., Spaggiari, I., Emanuela, V., Marina, L. (2015). The role of professional and team commitment in nurse–physician collaboration: A dual identity model perspective. *Journal of Interprofessional Care*, 29(5), 464-468.

https://doi.org/10.3109/13561820.2015.1016603

*Clarke, M., Hyde, A., & Drennan, J. (2013). Professional identity in higher education. In: Kehm, B. and Teichler, U (eds). The Academic Profession in Europe: New Tasks and New Challenges. Dordrecht Heidelberg London New York: Springer pp.7-22.

https://doi.org/10.1007/978-94-007-4614-5_2
Appendix 2:

Item-Measure Selection and Data Recoding

Item-Measure Selection

Items were selected for construct-saturation for purpose of satisfying internal reliability standards, as well as essential-unidimensional assumptions for subsequent latent-variable structural hypothesis testing.

TeamAtts (TeamAtts). An example item is, "The give and take among team members in an interprofessional team helps them to make better patient care decisions".

IP-AffectReact (IP-AffectReact.) An example item is, "I am comfortable engaging in shared decision making with others on an interprofessional team".
**IP-NormBeliefs (IP-NormBeliefs).**

An example item is, "Individuals in my profession have good relations with people in other professions".

**Professional Identity (ProID).** An example item is, "I identify strongly with other [customized to profession] students".

**Transfer Climate (TransClim).** An example item is, "Thinking about your experience since October of your first year, please indicate: How much IP interaction have you observed?"

**Data Recoding**

Our purposive sampling, which predated medical students' entry into clinical rounds, was premised on curricular differences in TransClim. Toward model parsimony and more useful interpretation, we examined the viability of recoding our 5-category Program variable into a binary-contrast of 'medical vs. non-medical'. Planned contrasts indicated non-significant pairwise differences between all non-medical programs, furthermore, medicine indicated significantly lower TransClim than the average of all other programs ($t = -11.02, p < .01$).

Based on these findings, we proceeded with binary-recoding of our nominal Program variable. The complete findings of our orthogonal contrast codes our displayed in Table S-4 below.

**Appendix 3:**

**Measurement-Model Confirmation for Subsequent Hypothesis Testing**

We compared our proposed 5-factor measurement model solution to a plausible 3-factor alternative. Initial results for the 5-factor solution indicated strong item-factor loadings patterns. Global indices further indicated good model fit, Comparative Fit Index (CFI) = .91, Root-Mean-Square Error of Approximation (RMSEA) = .05, RMSEA 90% confidence interval (CI) = [.04 - .06]). Results were compared to the alternative 3-factor solution, which indicated significantly worse fit, $\Delta$S$\chi^2$ (7) = 295.57, $p < .001$; CFI = .72, RMSEA = .09, 90% CI = [.09-.10]. The 5-factor model was retained for subsequent hypothesis testing.

**Appendix 4:**

**Four Exploratory Analyses**

1. Alternative models for comparison (partial-mediation model)

Despite obtaining good global-fit indices and general support for our hypotheses, based on path estimates in our proposed model, two nested-model comparisons proceeded in order to evaluate plausible alternatives for our
observations. First, an alternative model that permitted a direct-path from Experience to IP Attitudes was tested, and results indicated slight decrement in model-fit indices ($\Delta$S-B X2(1) = .16, $\Delta$CFI = -.001, $\Delta$RMSEA = -.01). The path estimate was also non-significant ($\beta = .05, p > .05$). Second, concordantly, a model that permitted a direct-path from Experience to ProID was estimated, and results indicated a non-significant improvement in model-fit indices ($\Delta$S-B X2(1) = .23, $p > .05$, $\Delta$CFI = .00, $\Delta$RMSEA = .00). The path estimate was also non-significant ($\beta = .11, p > .05$). Results of these alternative model comparisons are displayed in Figure S-A 3 below.

![Figure S-A3](image)

*Figure S-A3. Exploratory alternative partial-mediation model with structural coefficient estimates. Standardized estimates in parentheses. *p < .05.*

2. A further follow-up of medical students' last semester after clinical experience

In effort to strengthen our mediation-inferences, a random subsample of medical students (25%, $N=30$) were sent a follow-up survey in their final semester. The shortened survey reassessed TransClim, TeamAtts, and ProID. As expected, TransExp increased substantively after entering clinical rotations ($MT_1 = 21.85$, $MT_2 = 30.4$). ProID, however, remained stable ($MT_1 = 19.69$, $MT_2 = 19.03$), but also showed a significant increase in variability ($F = 4.62, p = .03$). Finally, TeamAtts indicated a significant increase ($MT_1 = 23.62$, $MT_2 = 25.28$). Taken together, it may be inferred that, an increase in exposure to IP TransClim coincides (co-varies) with increased variability in ProID and greater TeamAtts. These mediator-outcome covariance analyses strengthens our inference for the purported impact of TransExp for IPE outcomes.

3. A joint-variance synthesis of IPE criteria to assess outcomes' potential reciprocity

Our third exploratory analysis is not drawn from locally collected data, but relates to our principled rational for examining ‘Transfer-Experience’ as an explanatory-mediator for program differences on early IPE outcomes. Specifically, we argued against unidirectional interpretations of IPE criterion but, rather, for a reciprocal / interdependence interpretation. To provide preliminary empirical evidence for this argument, we conducted a joint-
variance synthesis of IPE criterion using meta-correlations reported in Hughes et al.’s MA of team training effectiveness (2016). Specifically, we estimated the proportional variance explained in Results (organizational and patient outcomes) by Reaction, Learning, & Transfer. Results indicated that approximately 15% of the variance in ‘Results’ is accounted for by shared- components between Reactions, Learning, and Transfer criteria. Substantive interpretations of this variance-decomposition approach are discouraged without formal theoretical articulation, but we supply the evidence to illustrate our argument; Measuring distal (up-level) IPE outcomes necessarily has implications for group-estimates of proximal (down-level) training effectiveness indicators.

4. Distinctiveness Threat from Early IPE (premature ProID) causes more negative reactions

In attempt to more rigorously evaluate claims for negative reactions as a function of premature ProID, we sought student samples for comparing reaction-estimates. After consulting a recent review of early IPE for extracting data (Thistlethwaite et al. 2014), we meta-analyzed $k = 4 \ (n = 333)$ studies with student reactions as-criterion ($d = .61$, $z = 11.34$, $p < .01$) and compared it to clinician reactions ($d = .48$) extracted from Hughes et al. 2016. In result, overlapping-95% confidence intervals indicated support for the comparability of IPE reactions across stages of professionalization (student vs. practitioner samples). Taken together, the empirical evidence sufficiently refutes claims of more adverse reactions to IPE in earlier stages of training.

**Declaration of Interest**

The author has declared that there are no conflicts of interest.