FernUniversität in Hagen

Diversity Adapted CSCL in Higher Distance Education (DivAdapt)

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DivAdapt's main objectives

Use-inspired basic research (Stokes,1997)

- describing, predicting and explaining diversity effects in CSCL, in order to

- develop evidence-based interventions to optimize CSCL in higher distance education

DivAdapt's focus
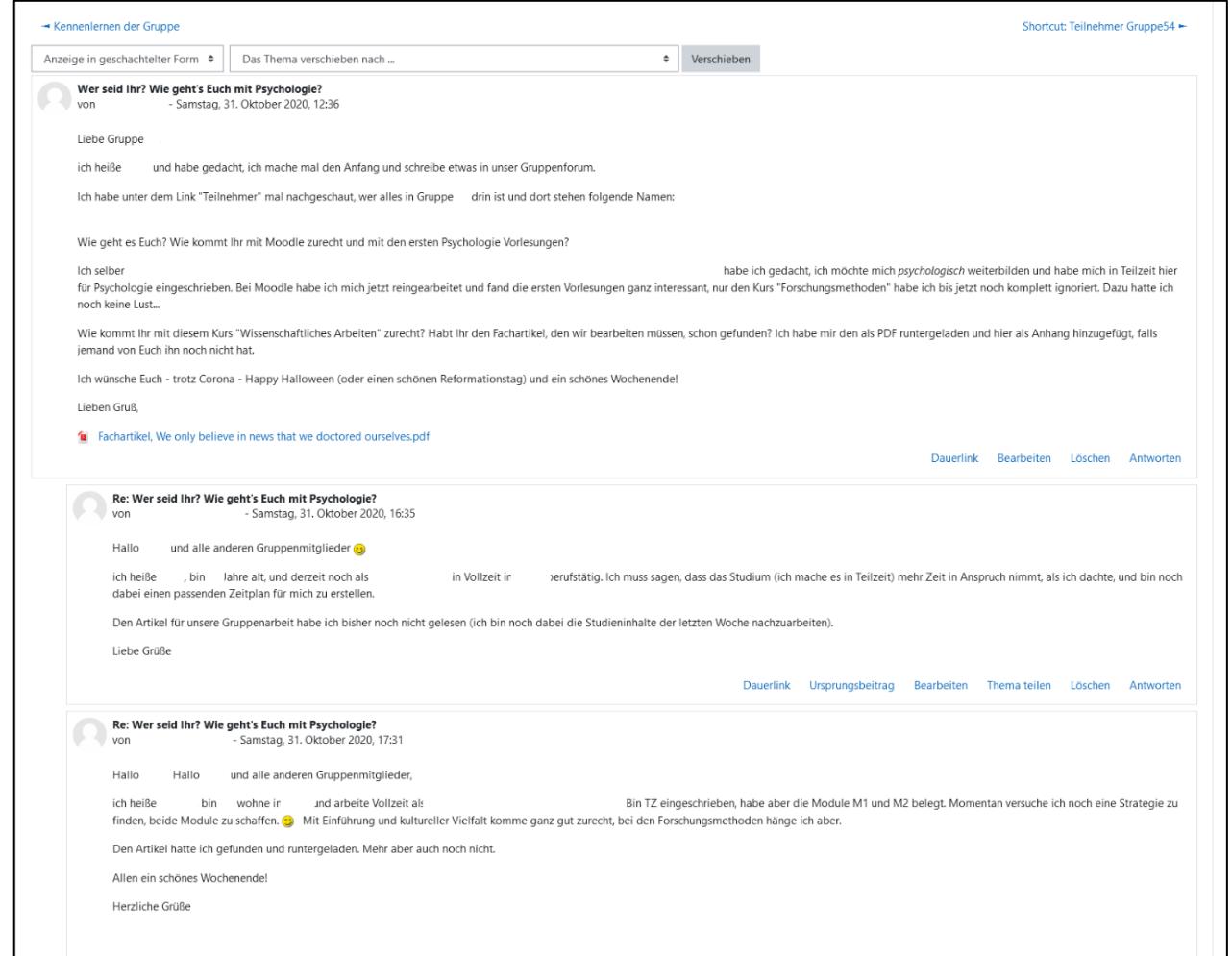
- Sociodemographic diversity effects, due to…

  - previous research findings indicating relationships between sociodemographic variables, drop-out, commitment, and motivations (e.g., Ihme et al., 2016; Ihme & Stürmer, 2019; Stoessel et al., 2015)

  - educational justice concerns

DivAdapt's methodology

- Multi-method approach combining

  - Quantitative field studies

  - Field experiments

  - Intervention studies

  - Qualitative follow-ups

DivAdapt's data sources

- Students' self-reports

- Individual moodle data

- Social network data (on the basis of moodle)

- Objective group performance data (e.g., tutor ratings)

Interactions in moodle forums

Sample of empirical studies

- Understanding <u>multi-</u>attributional diversity effects in CSCL

- Exploring the relationships between distinct diversity dimensions, group processes and learning outcomes

- Investigating the role of subjective diversity perceptions (e.g., group diversity, diversity climate)

Setting, task and goals

Setting
Introductory course in bachelor of psychology

CSCL task
Writing a joint summary of a research article using moodle collaboration software (e.g., wiki/forums)

Learning goals
Increasing students' capabilities to organize and execute joint online activities to attain desired learning outcomes

CSCL task assigned via moodle

Procedures: General framework

Registered students → Baseline survey + pre-quiz (T1) → Groups of 8 → Pre-collaboration survey (T2) → **Work phase** [Week 1 | Week 2 | Week 3 | Evaluation (T3) | Week 4 | Week 5 | Week 6] → Survey + post-quiz (T4)

Main measures

- Sociodemographic variables

- Diversity indexes based on sociodemographic + task-related information

- Established psychological measures

- Self-reported time estimates on group processes

- Social network analyses measures

How is multi-attributional diversity related to CSCL?
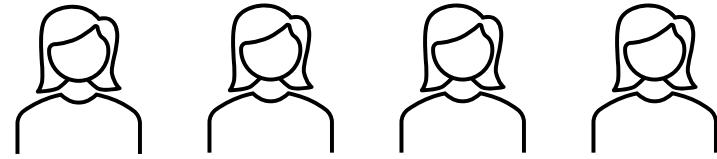
Multi-attributional diversity

- **Socio-demographic diversity features**
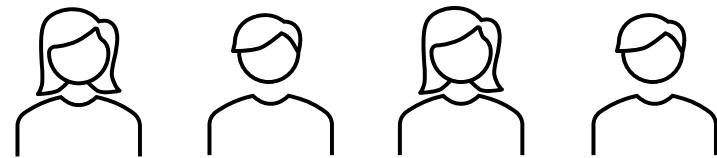
  - Age (<30 / 30+)

  - Gender (m / f)

  - Native language (German/non-German)

  - Perceived socio-economic status (higher/lower)

- **Task-related diversity features**

  - Secondary student (y/n)

  - Previous online learning environment experience (y/n)

  - Previous scientific reading experience (y/n)

  - Repeating this current CSCL course (y/n)

No diversity
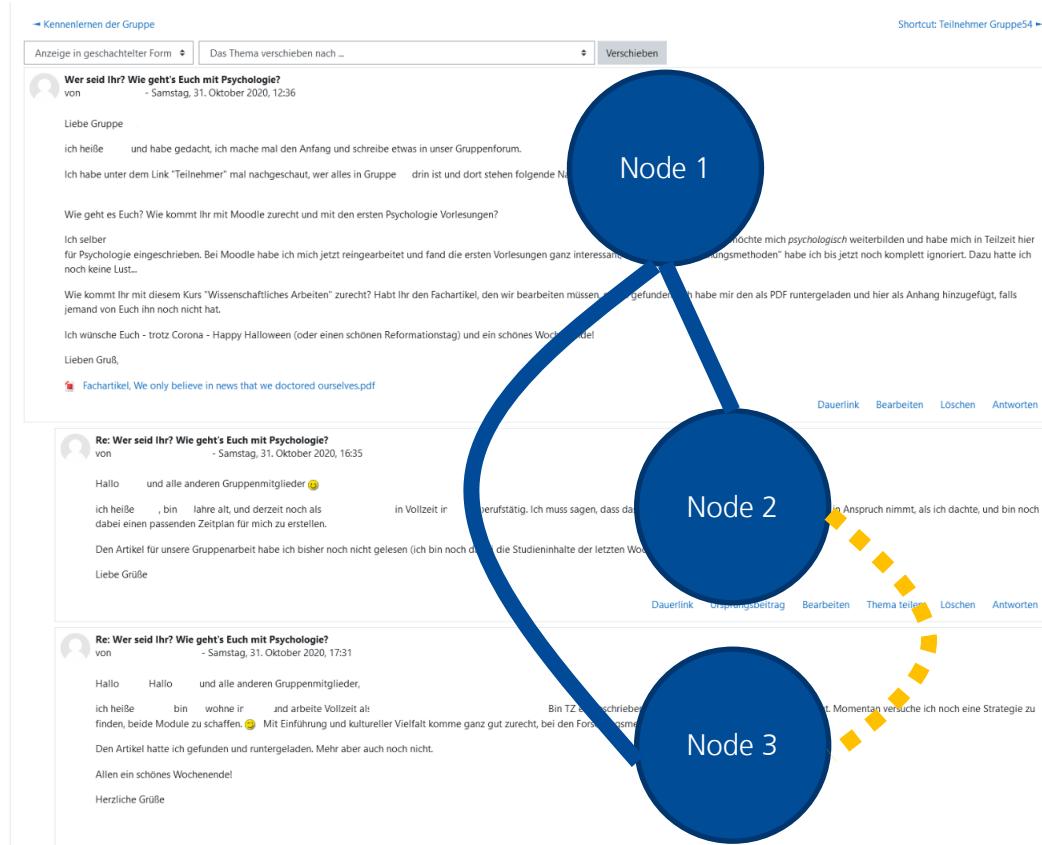
Single-attributional diversity
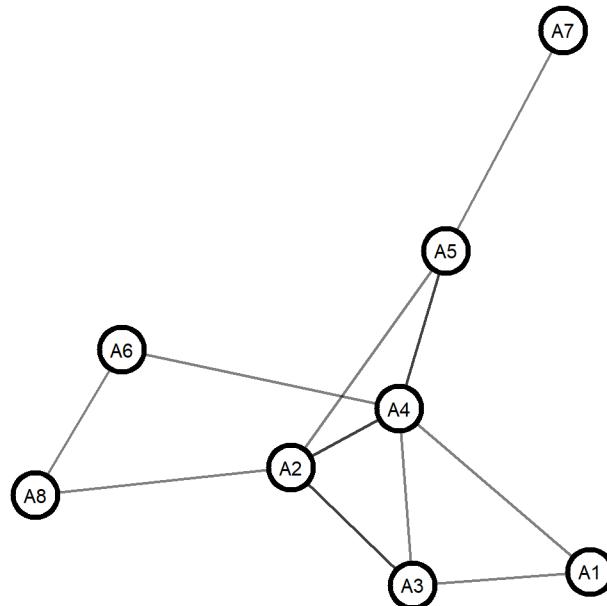
Multi-attributional diversity

Structural integration in moodle forums
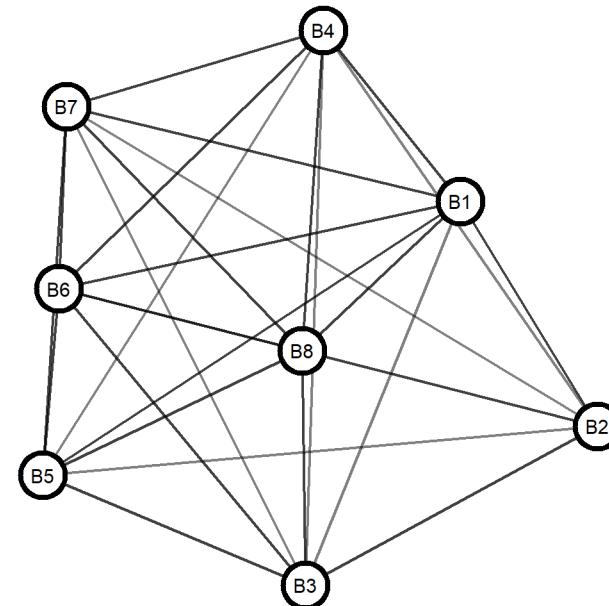
Structural integration in moodle forums

A

B
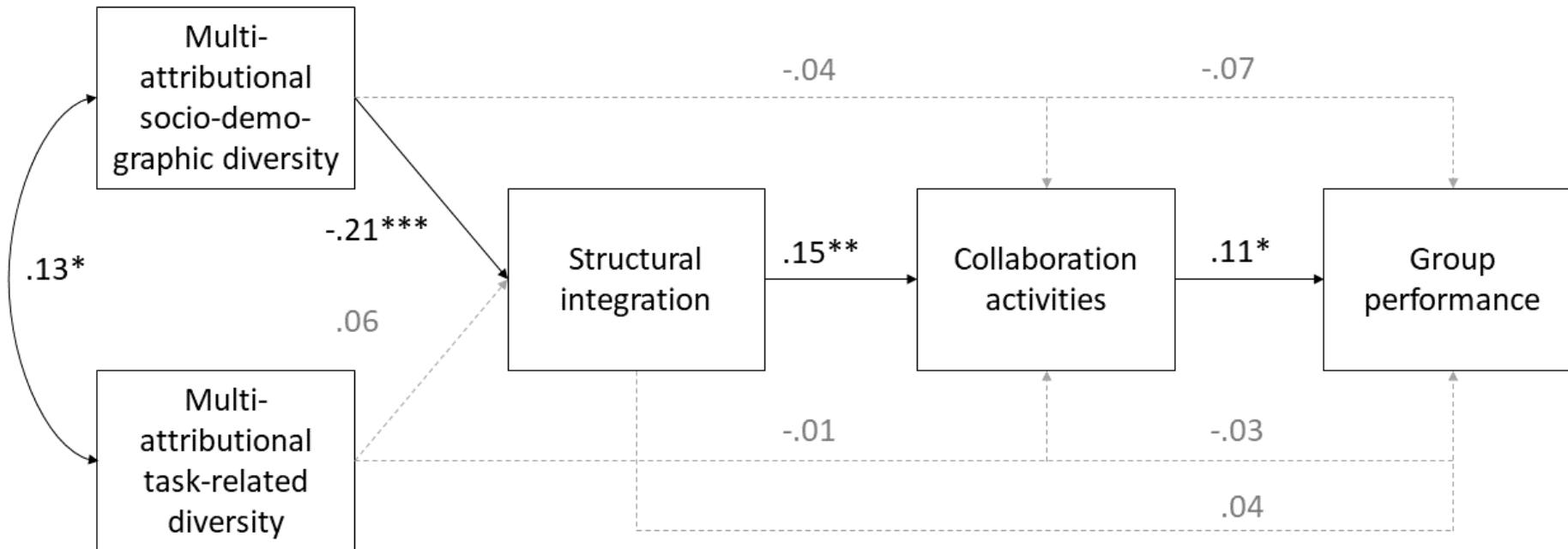
Low structural integration
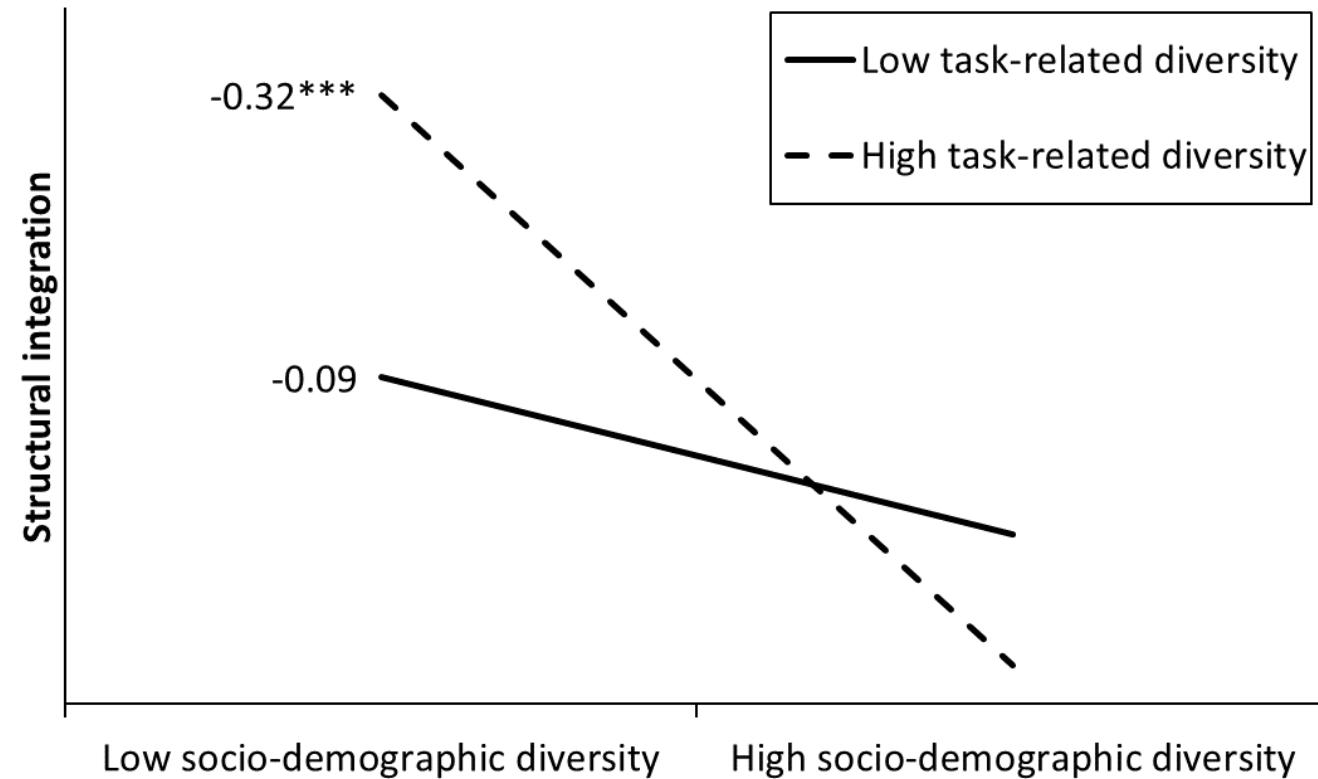
High structural integration
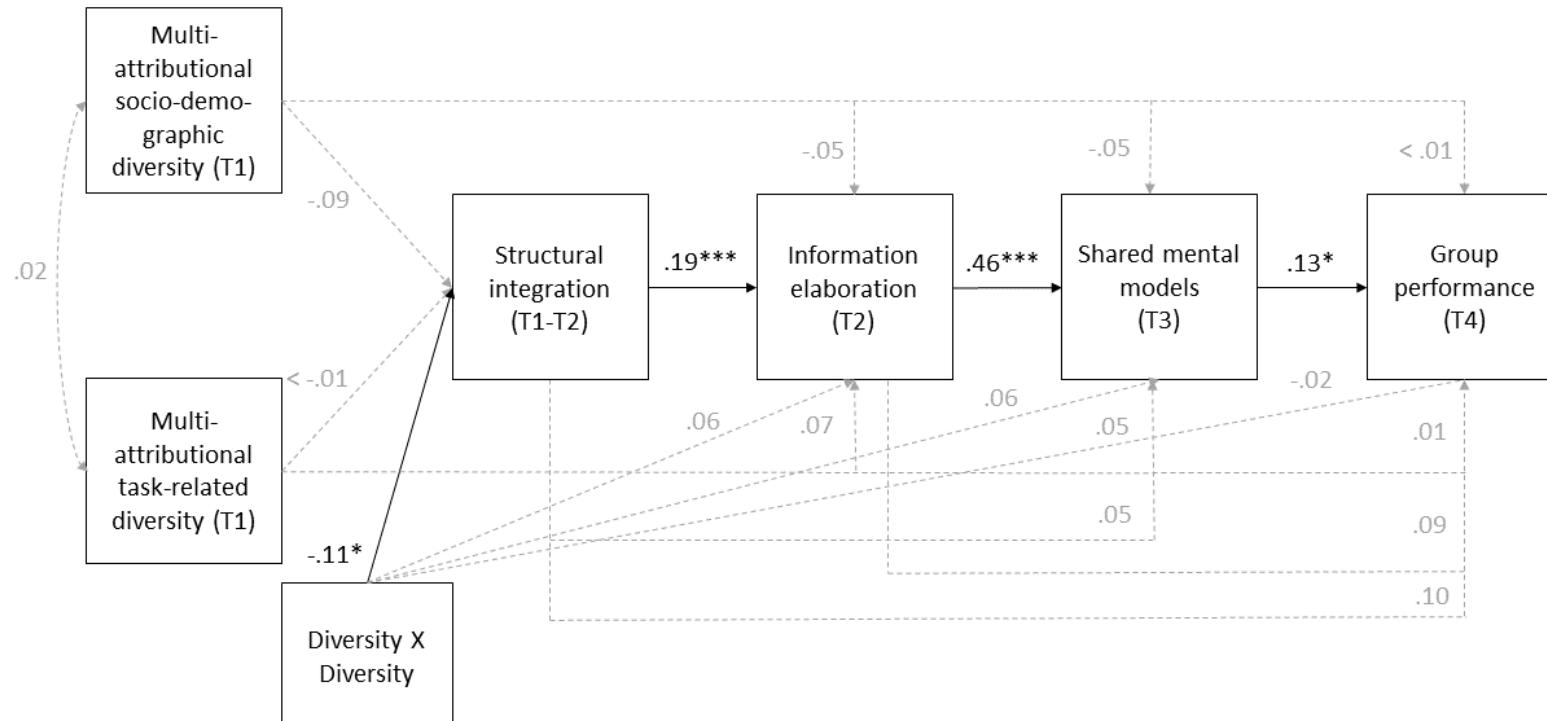
Previous results: negative direct & interactive effect of socio-demographic diversity on structural integration (WS 19/20) (Voltmer et al., under review)
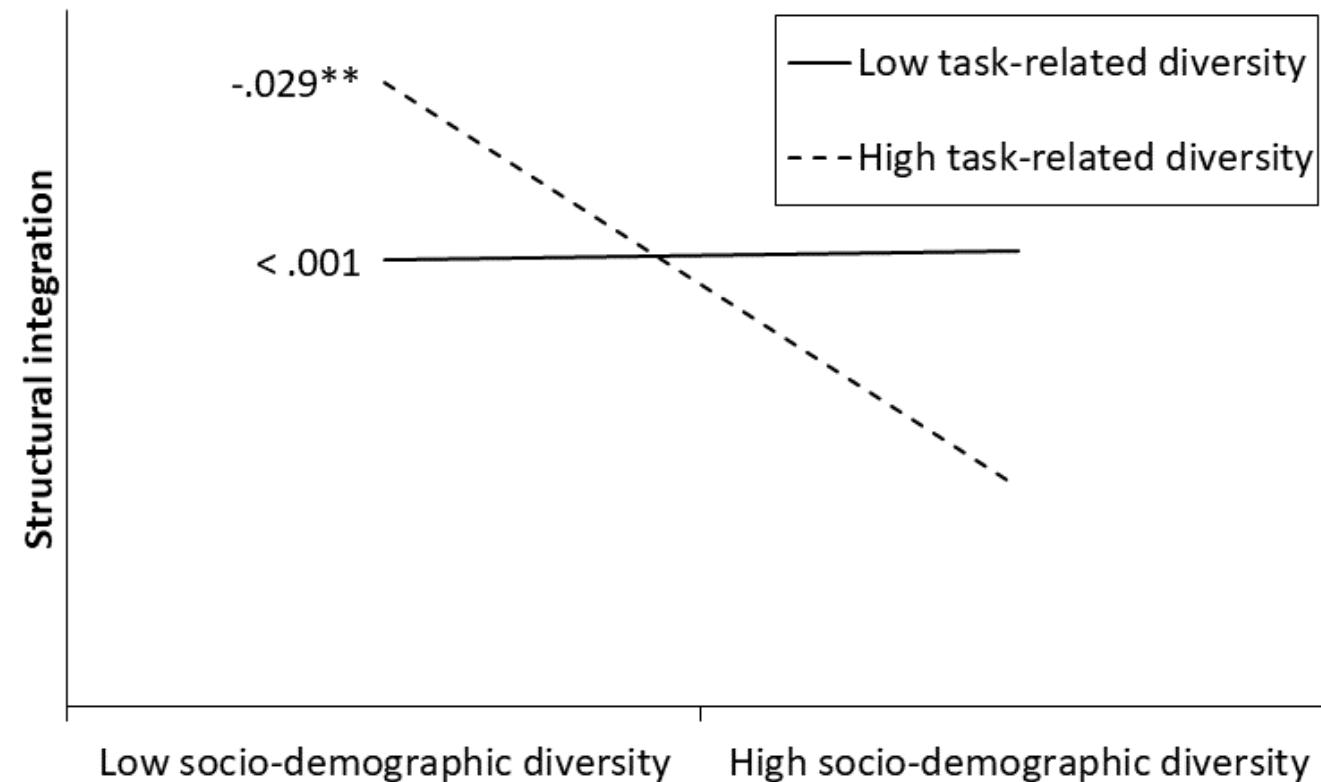
Previous results (WS 19/20): interactive diversity X diversity effect

Replication and extension (WS 20/21): replication and exploration of potential mediators of the structural integration-group performance link (Voltmer et al., under review)

               *p <.05, ***p <.001

Replication and extension (WS 20/21): replication of interactive effect of diversity

**p* <.01

Replication and extension (WS 20/21): exploration of potential mediators of the structural integration-group performance link

Direct and indirect effects of structural integration on group performance via information elaboration or shared mental models.

Effect	b	z	p
Model 1			
Structural integration → Group performances	2.39	2.33	.020
Model 2a: Mediator information elaboration (T2)			
Structural integration → Information elaboration	0.75	3.59	< .001
Information elaboration → Group performance	0.70	2.67	.008
Indirect effect	0.53	2.14	.032
Model 2b: Mediator shared mental models (T3)			
Structural integration → Shared mental models	0.68	2.52	.012
Shared mental models → Group performance	0.64	3.12	.002
Indirect effect	0.43	1.96	.050

Summary

- Replication of interaction of socio-demographic and task-related diversity on structural integration

  - Combination of high socio-demographic and task-related diversity seems to be a risk constellation for CSCL group integration

- Effect of structural integration on group performance is at least partially mediated via

  - Groups' information elaboration and shared mental models

In-depth analyses:

Gender diversity
Language diversity

How does gender diversity affect CSCL groups?
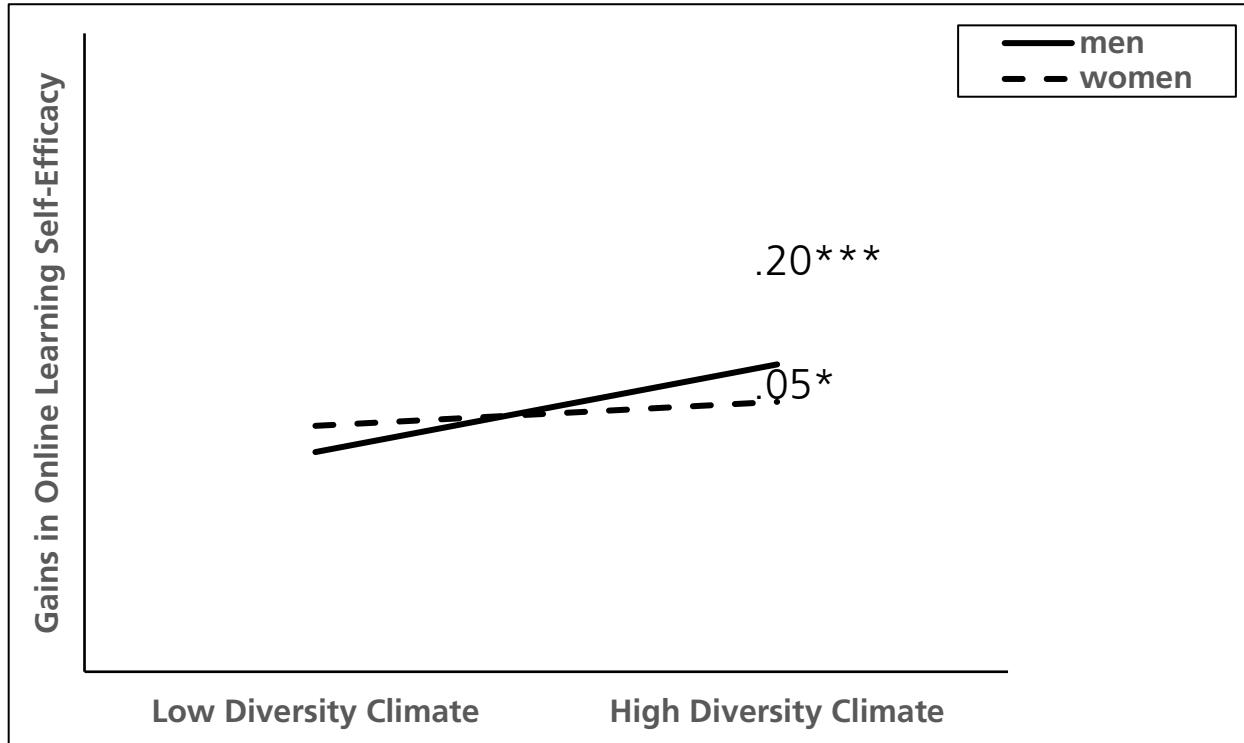
Gender, perceived diversity climate and individual learning gains

- Diversity Climate: the degree of perceptions of an organization's diversity-related policies, practices and procedures and social integration of underrepresented members (Boehm et al., 2014; McKay et al., 2008)

- Diversity climate is positively related to individual performance (McKay et al., 2011; Rhoades & Eisenberger, 2002)

  - Effects are stronger for minority group members (Avery et al., 2018; Simon et al., 2008)

  - Effects are stronger for attitudinal oucomes vs. objective behavioral outcome (Holmes et al., 2021)

- Therefore, we considered two individual learning outcomes

  - pre-post-course gains in online-learning self-efficacy

  - pre-post-course gains in objective knowledge perfomance

Gender, perceived diversity climate and individual learning gains

➢ RQ 1: Do CSCL students in mixed-gender groups who perceive a positive diversity climate after a period of joint collaboration show better individual learning outcomes at the end of the CSCL course ?

➢ RQ 2: Are these relationships stronger among male CSCL students whose gender group was traditionally in the minority in the study programme?

➢ RQ 3: We explored the causal direction in the relationships between diversity perceptions and individual learning outcomes by way of cross-lagged panel analyses.

Moderating effect of gender on gains in online-learning self-efficacy (WS 19/20) (Raimann et al., manuscript ready for submission)

Overall $R^2 = .24$, $F(7, 1062) = 46.91$, $p < .001$

Diversity climate: $\beta = .196$, $t(1062) = 4.63$, $p < .001$
Gender: $\beta = .539$, $t(1062) = 2.75$, $p < .01$
Interaction: $\beta = -.143$, $t(1062) = -2.89$, $p < .01$
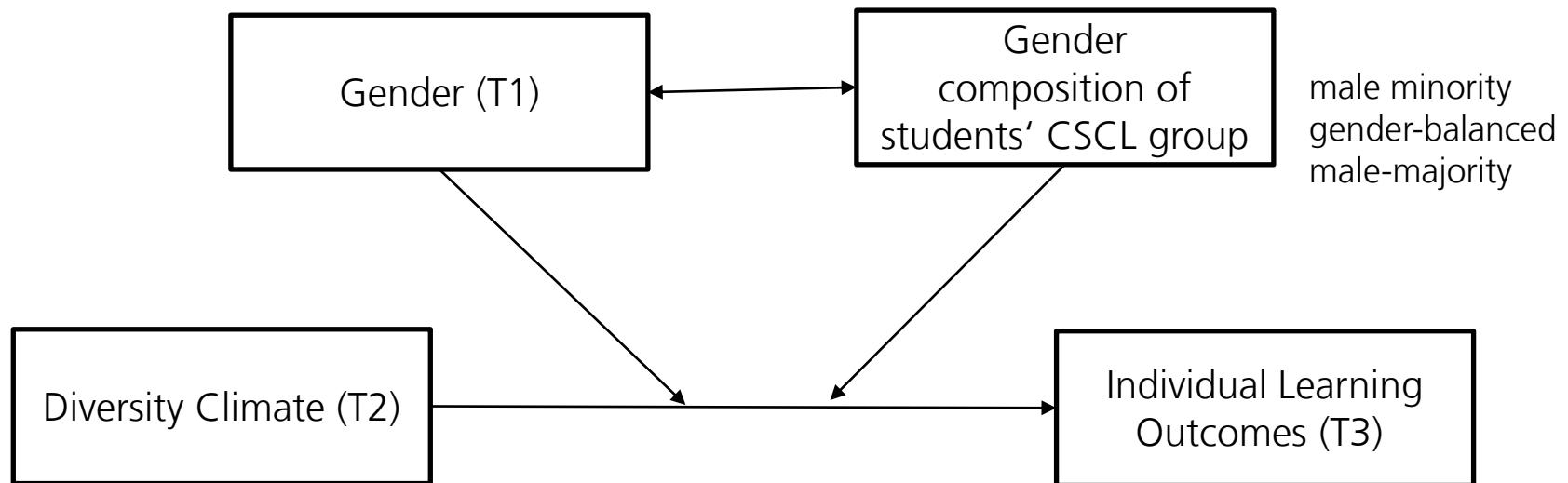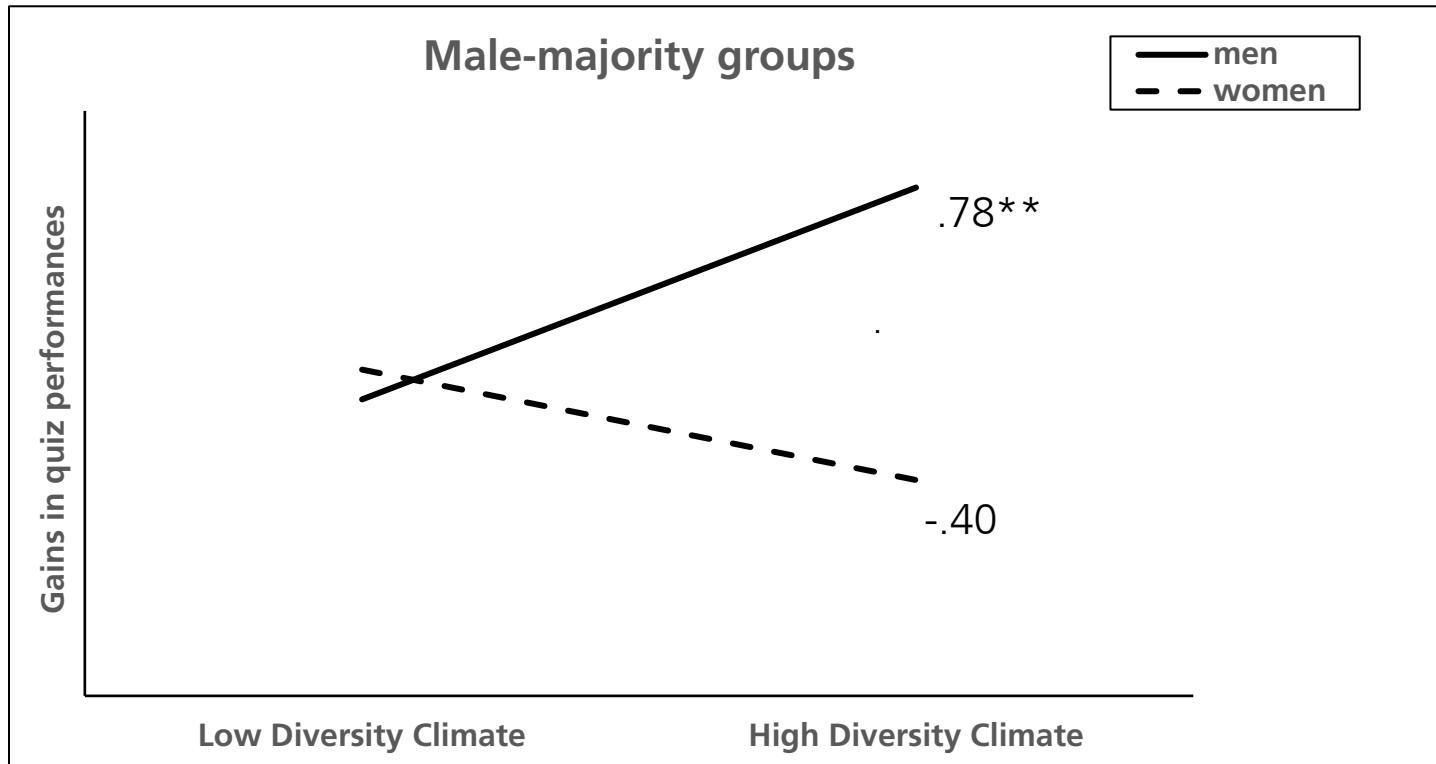
➢ **Men benefit more from a better diversity climate than women**

$*p < .05, ***p < .001$

Additonal analyses: Interaction diversity climate x gender x group composition

Gender (T1)

Gender composition of students' CSCL group

male minority
gender-balanced
male-majority

Diversity Climate (T2)

Individual Learning Outcomes (T3)

Additional exploratory results: Interaction diversity climate x gender x group composition

Male-majority groups

— men
- - women

Gains in quiz performances

.78**

.

-.40

Low Diversity Climate   High Diversity Climate
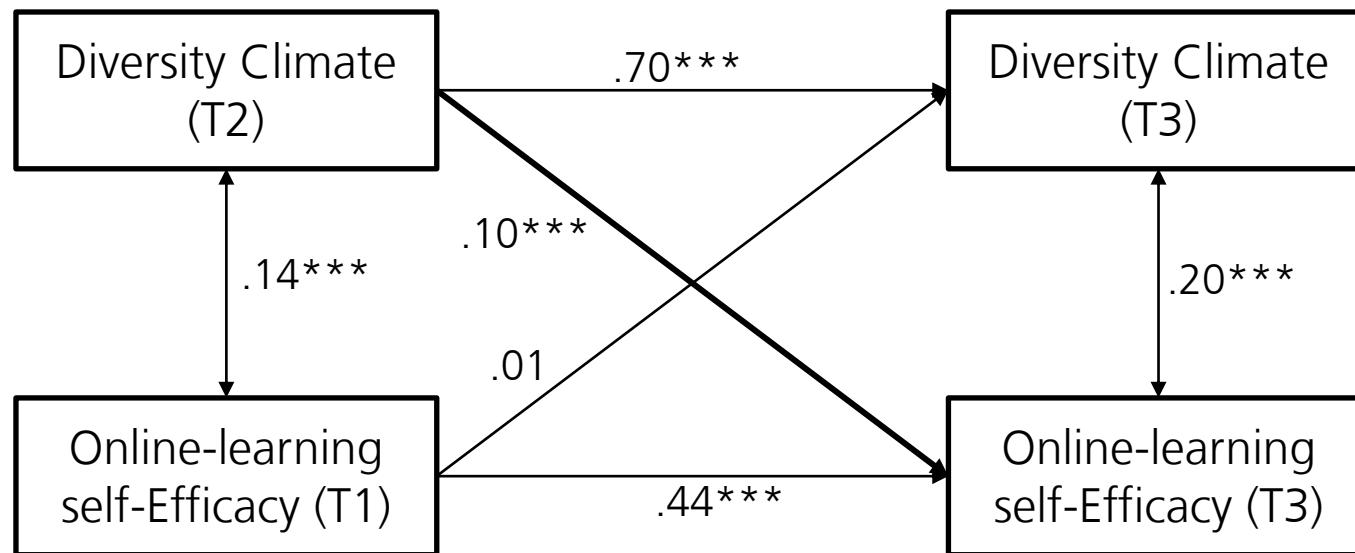
3-way interaction for men-majority groups:
$F(2,1064) = 5.82$, $p < .01$

Other group compositions: all ps ≥ .178

➢ **In men-majority groups: Men benefit more from a better diversity climate than women (gains in quiz performance)**

**$p < .01$
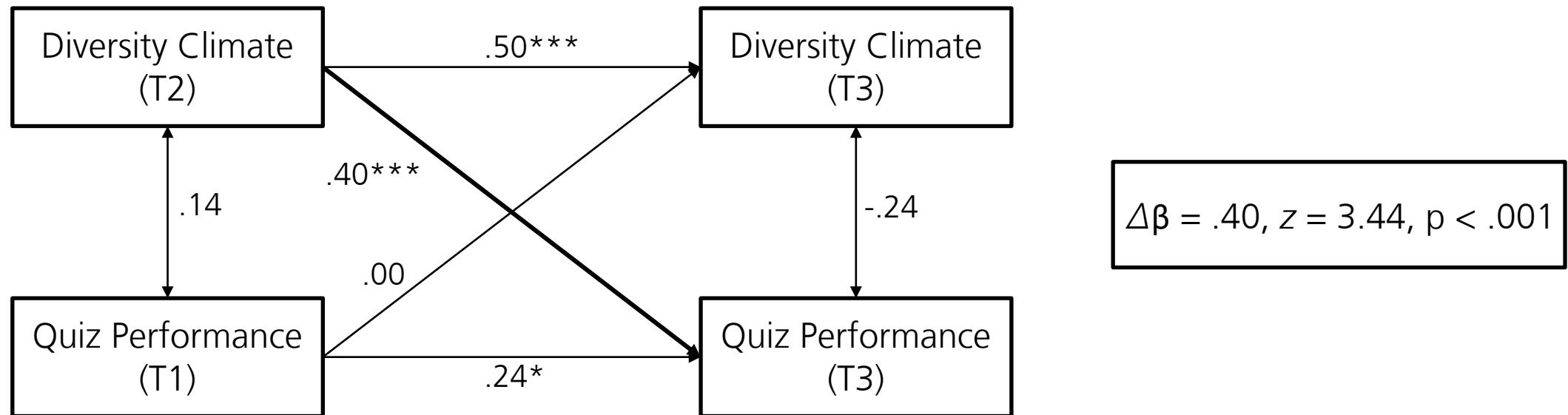
Testing for "feedback effects"

> **Tentative evidence for an unidirectional causal effect of perceived diversity climate on online learning self-efficacy for all groups (marginally significant)**

***$p < .001$

Testing for "feedback effects"

> **unidirectional causal effect of perceived diversity climate on quiz performance for men-majority groups**

*p <.05,***p <.001

Summary

- The perceptions of diversity climate within the CSCL group increased gains in online learning self-efficacy

- This link was moderated by students' gender

  - students benefitted more when perceived diversity climate was high than when it was low

  - This effect is stronger for male students than for female students

  - Independent of students' relative gender minority/majority status in the CSCL-group

Summary
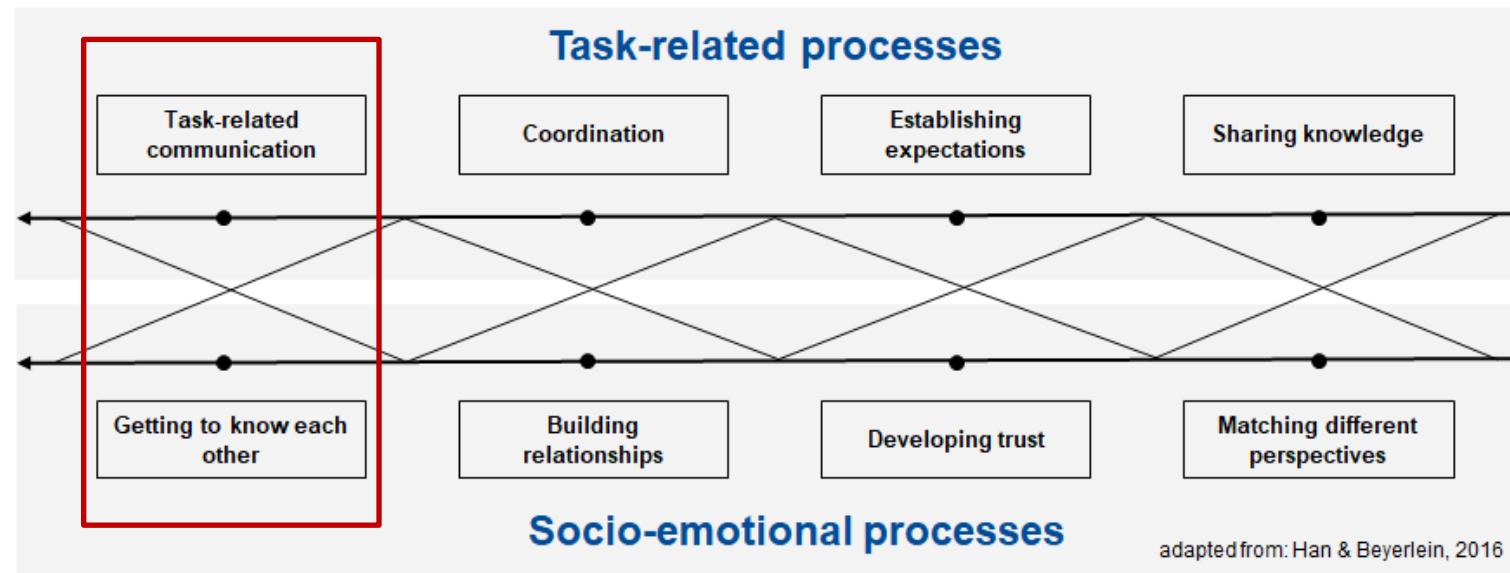
- The effect of diversity climate on quiz performance increases was moderated by students' gender and group composition within their CSCL groups

    - Male students in men-majority groups benefitted more when perceived diversity climate was high than when it was low

    - Female students' perceived diversity climate was relatively irrelevant

➤ Diversity climate is an important determinant in gender-mixed CSCL groups

➤ In study programmes with a traditional majority of female students, male students are the primary beneficiaries

How does first-language diversity affect CSCL groups?

Theoretical background: negative effects of language diversity on CSCL outcomes

- Diversity in "mother tongue" is a negative predictor for innovation in online groups (Usher & Barak, 2020)

- Lower learning outcomes among culturally heterogeneous CSCL groups (e.g., Popov et al., 2013; Stepanyan et al., 2014)

Theortical background: potential moderating conditions

Task-related processes

| Task-related communication | Coordination | Establishing expectations | Sharing knowledge |

| Getting to know each other | Building relationships | Developing trust | Matching different perspectives |

Socio-emotional processes

adapted from: Han & Beyerlein, 2016
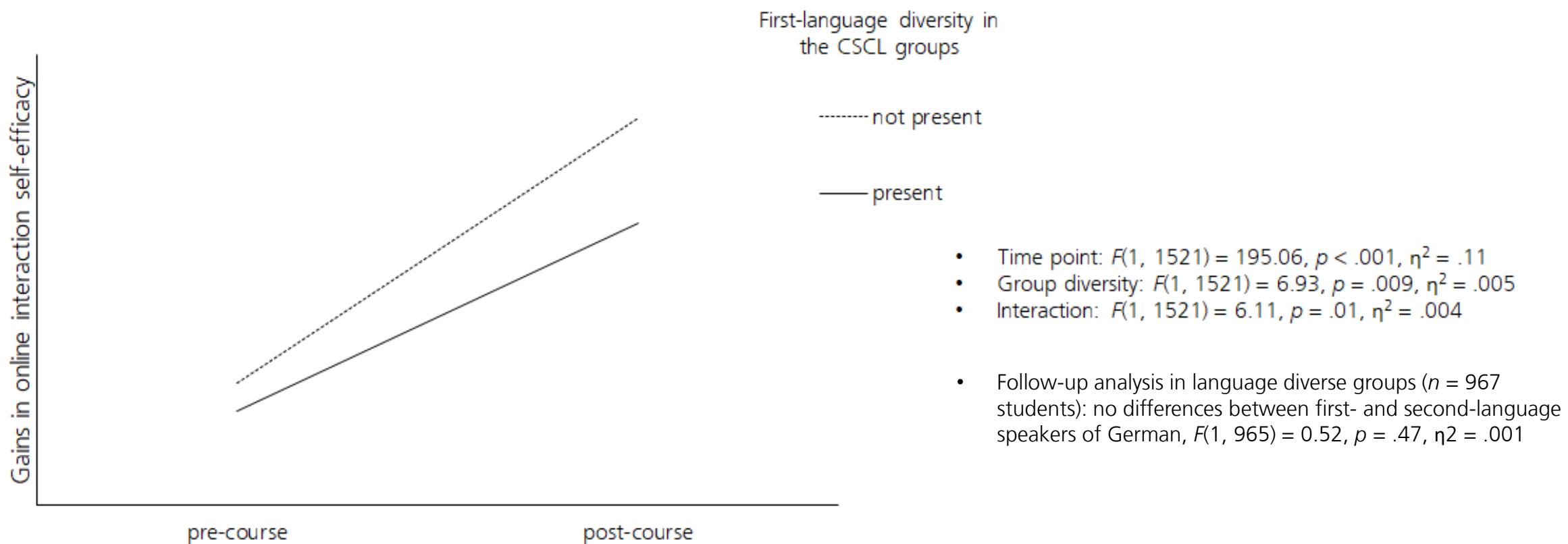
➢ Spending more time on these activities should mitigate the effects of language and/or cultural diversity within groups (Han & Beyerlein, 2016; meta-analysis of 60 studies)

Research questions & conceptual moderation model (Reich-Stiebert et al., under review)

1. Do students in CSCL groups with high first-language diversity show lower gains in online interaction self-efficacy than students in groups with low first-language diversity?

2. Does the amount of time spent on task-related communication and/or getting to know each other in the beginning of the collaboration mitigate these diversity effects?
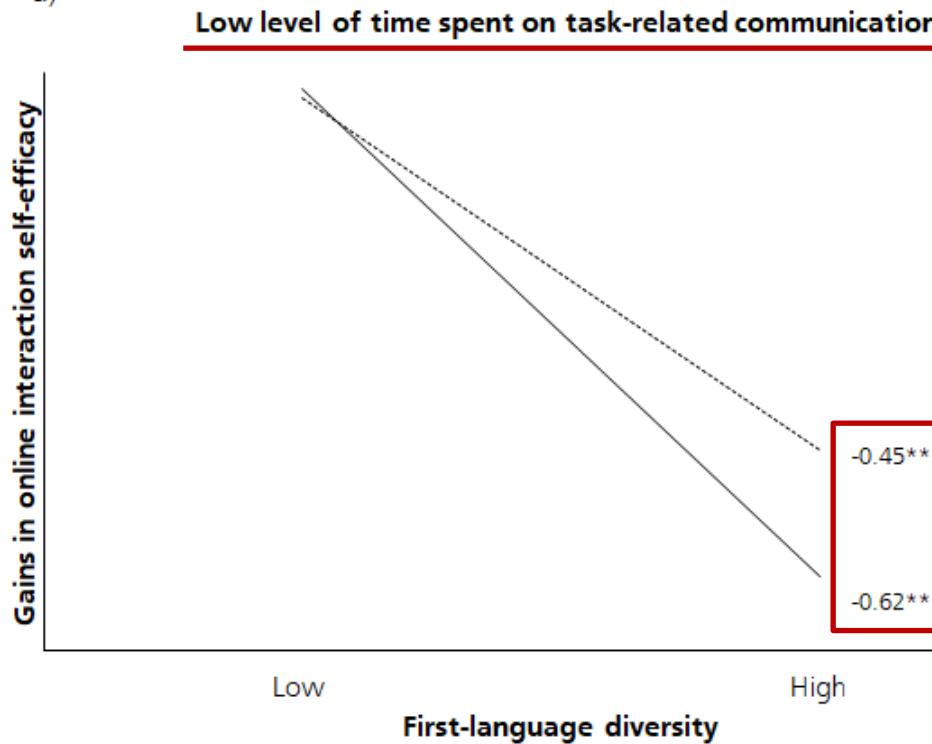
Results: direct effects of CSCL groups' first-language diversity on self-efficacy gains
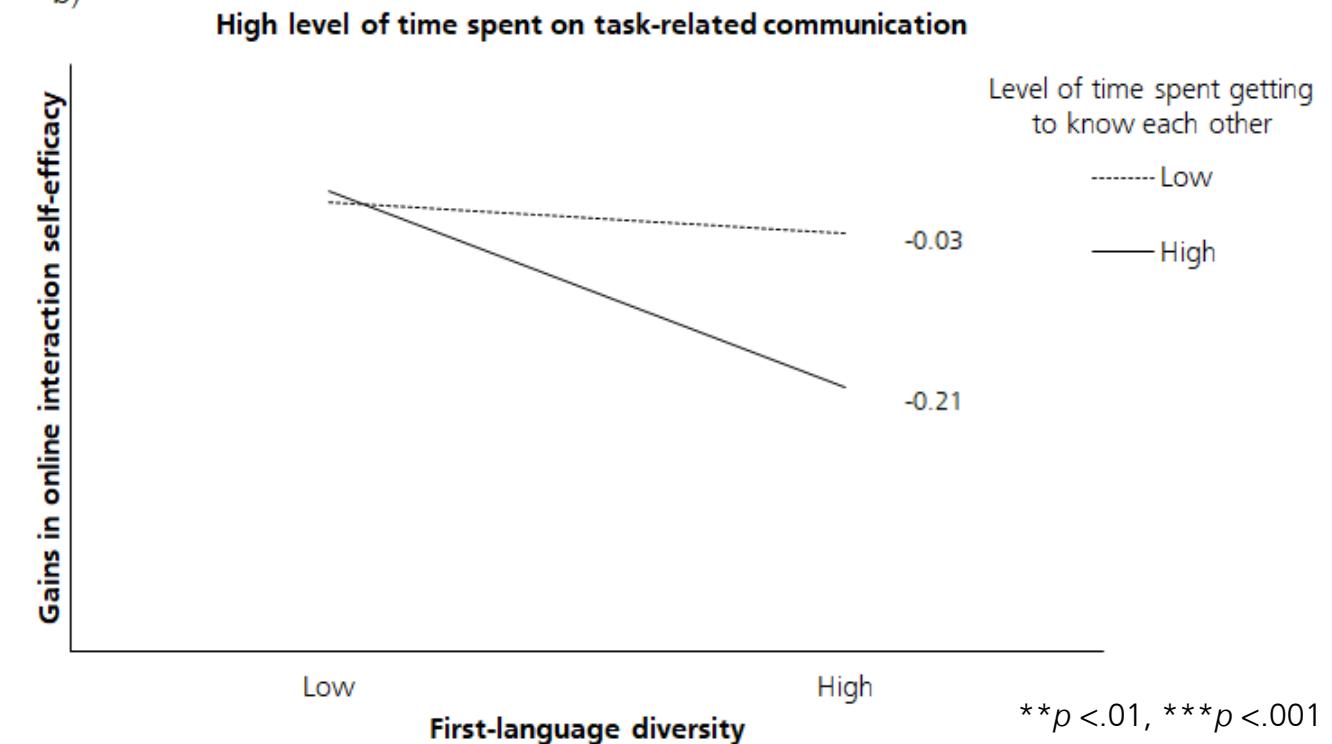
First-language diversity in
the CSCL groups

- - - - - - - not present

———— present

- Time point: $F(1, 1521) = 195.06$, $p < .001$, $\eta^2 = .11$
- Group diversity: $F(1, 1521) = 6.93$, $p = .009$, $\eta^2 = .005$
- Interaction: $F(1, 1521) = 6.11$, $p = .01$, $\eta^2 = .004$

- Follow-up analysis in language diverse groups ($n = 967$ students): no differences between first- and second-language speakers of German, $F(1, 965) = 0.52$, $p = .47$, $\eta2 = .001$

➢ **First-language diversity in CSCL groups reduced gains in online interaction self-efficacy independent of students' language status**

Results: time spent on group activities as moderating processes

a) Low level of time spent on task-related communication — Gains in online interaction self-efficacy vs. First-language diversity (Low to High); values -0.45** and -0.62***

b) High level of time spent on task-related communication — Gains in online interaction self-efficacy vs. First-language diversity (Low to High); Level of time spent getting to know each other: Low (dashed) -0.03, High (solid) -0.21

**p <.01, ***p <.001
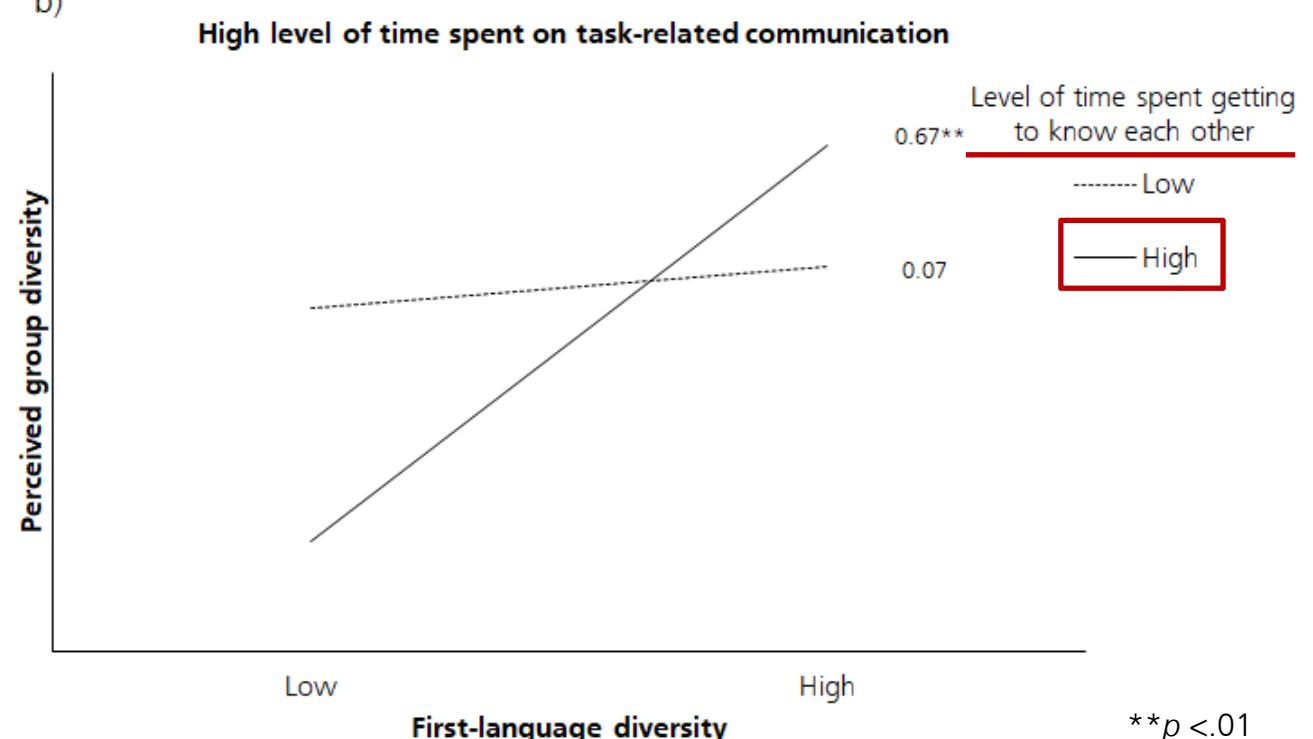
➤ **Low levels of task-rel. communication strengthened the negative effect of first-language diversity on students' self-efficacy gains**

Results: follow-up analyses on the role of time spent getting to know each other

a) Low level of time spent on task-related communication

b) High level of time spent on task-related communication

Level of time spent getting to know each other

0.69** / 0.09 / 0.67** / 0.07

**p < .01

➢ **In first-language diverse groups, time spent getting to know each other increased diversity perceptions among group members**

Summary & discussion
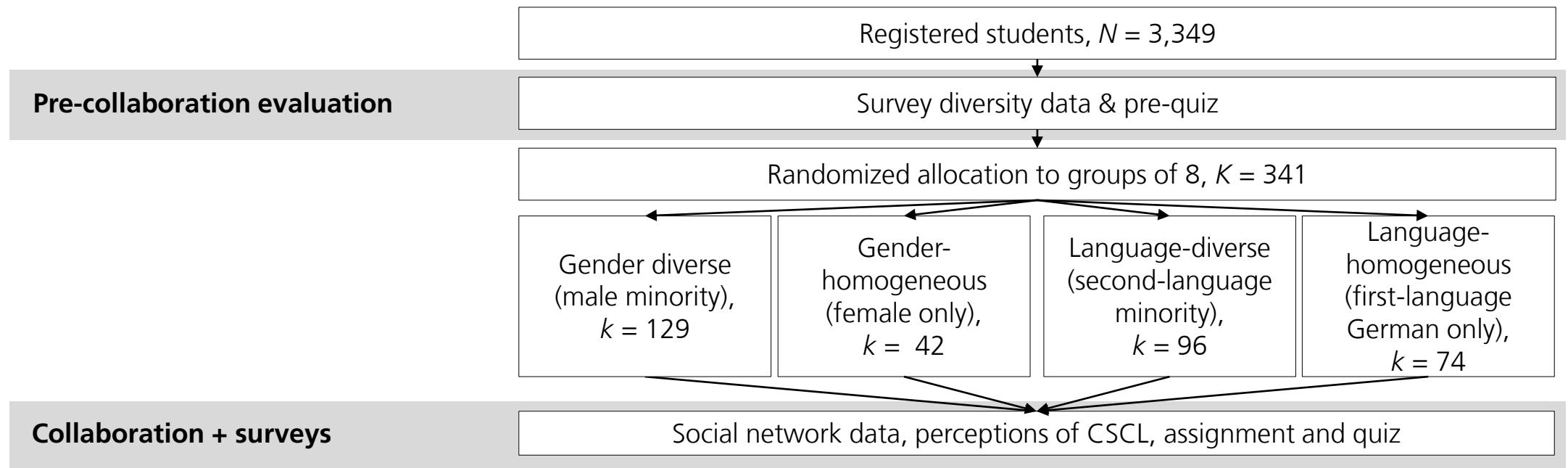
- First-language diversity in CSCL groups reduced gains in online interaction self-efficacy
  - ➤ Low interaction self-efficacy may lead to avoidance of future collaboration with other students

- The link was moderated by the amount of time spent on task-related communication
  - ➤ Risk constellation: first-language diversity & low engagement in task-related communication

- More time spent getting to know each other did not mitigate the first-language diversity effect
  - ➤ Paradoxically, it rather increased diversity perceptions among group members
  - ➤ Unstructured social communication seems to increase the salience of group boundaries and categorical differentiations (cf. SIDE model; Lea & Spears, 1991; Spears, 2017)

Experimental manipulation: Composition of group diversity

Background

- Particular group compositions have been found to be beneficial for group work

  - e.g., higher proportion of women in groups (Curşeu et al. 2015, Woolley et al. 2010, Zhan et al. 2015)

- But: Group composition effects may differ for different diversity features (Wegge et al., 2008)

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Participants and procedures (WS 20/21)

	Registered students, $N = 3{,}349$
Pre-collaboration evaluation	Survey diversity data & pre-quiz
	Randomized allocation to groups of 8, $K = 341$

Gender diverse (male minority), $k = 129$	Gender-homogeneous (female only), $k = 42$	Language-diverse (second-language minority), $k = 96$	Language-homogeneous (first-language German only), $k = 74$

Collaboration + surveys	Social network data, perceptions of CSCL, assignment and quiz

Effects of diversity composition (Overall – gender, language)

	Diverse $k = 225$	Homog. $k = 116$	Δ	X task-related diversity
After first collaboration phase				
Structural integration	.51 (.14)	.53 (.14)	-	-
Perceived diversity	3.1 (0.4)	3.1 (0.4)	-	-
Diversity climate	3.7 (0.4)	3.7 (0.4)	-	-
Group performance	32.0 (2.7)	32.0 (2.7)	-	-

Effects of <u>gender</u> diversity composition

	Gender-diverse $k = 129$	Gender-homog. $k = 42$	Δ	X task-related diversity
After first collaboration phase				
Structural integration	.51 (.14)	.56 (.15)	H > D†	-
Perceived diversity	3.1 (0.5)	2.9 (0.4)	D > H**	-
Diversity climate	3.9 (0.4)	4.0 (0.4)	-	-
Group performance	32.0 (2.7)	33.0 (2.2)	-	-

Further effects of gender diversity composition (examples)

	Gender-diverse $k = 129$	Gender-homog. $k = 42$	Δ	X task-related diversity
After first collaboration phase				
Shared mental model of task	3.6 (0.5)	3.8 (0.5)	H > D*	-
Online-communication self-efficacy	3.9 (0.4)	4.1 (0.3)	H > D*	-
Quality of peers' writing quality	4.0 (0.4)	4.2 (0.3)	H > D***	-
Perceived participation of peers	3.5 (0.5)	3.9 (0.5)	H > D***	-
Identification with group	3.0 (0.6)	3.2 (0.4)	H > D*	-

Provisional practical implications regarding grouping interventions

- "Operational" challenges in multi-attributional settings

- Homogeneity effects on structural integration (and also diversity perceptions)

  - only in female-only groups

  - literature shows that male only groups show often poorest outcomes

- Supporting positive diversity climate

# Experimental intervention: Structured communication
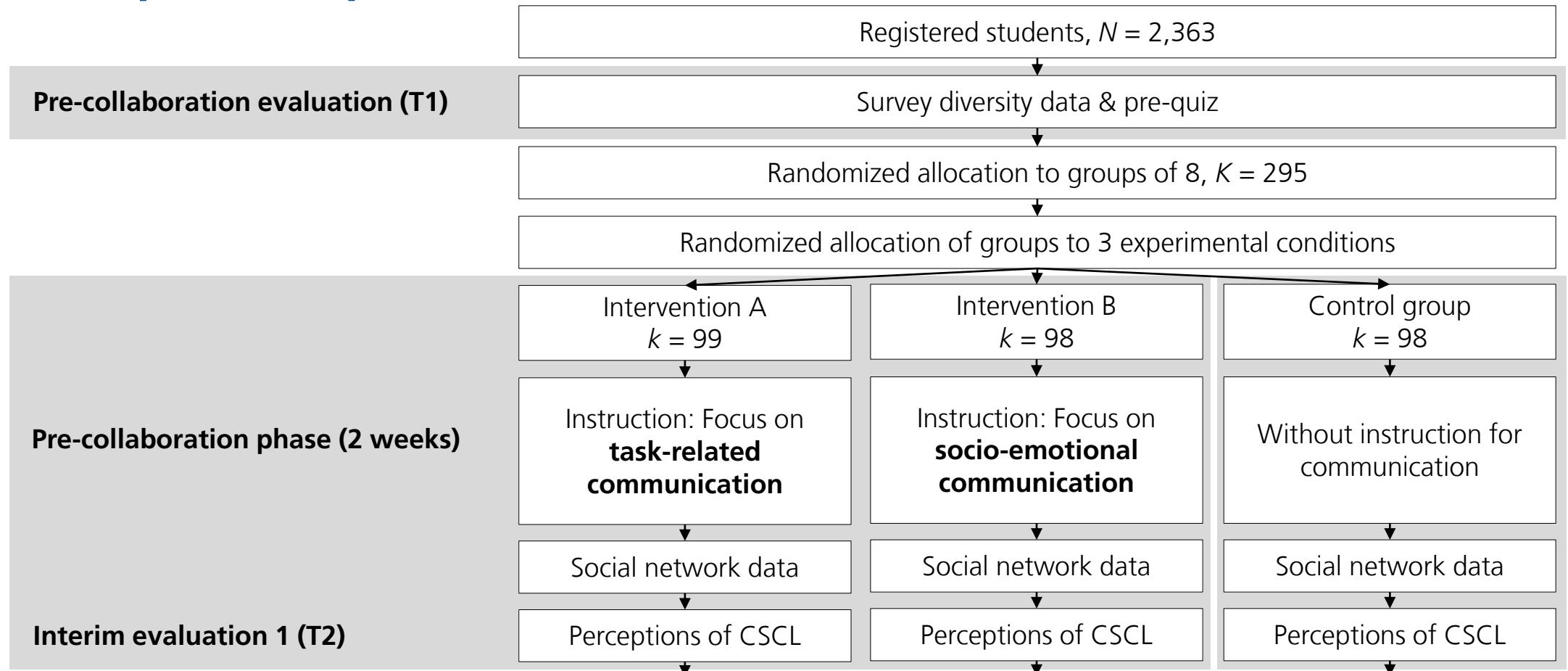
Background

- Structured communication at an early stage of collaboration

- Focus on task-related vs. socio-emotional group activities according to Han & Beyerlein (2016)

- Task-related activities have been found beneficial for group work (e.g., Erkens et al., 2005, Massey et al., 2003, Shah, 1997)

Manipulation of structured communication

Intervention A: Task-related communication	Intervention B: Socio-emotional communication	Control condition Without instruction
Take the opportunity until the working phase to discuss the time ahead of you.

In our experience, it has proven effective if you exchange ideas about the task early and regularly, divide up the tasks and clarify responsibilities, agree on your respective goals for the course, and share your knowledge and experience with each other. | Take the opportunity until the working phase to discuss the time ahead of you.

In our experience, it has proven successful if you discuss commonalities early and regularly, establish and maintain contact with all group members, create a trusting relationship with each other and reconcile different perspectives and views. | Take the opportunity until the working phase to discuss the time ahead of you. |

Participants and procedures (winter term 21/22)

	Registered students, $N = 2{,}363$		
Pre-collaboration evaluation (T1)	Survey diversity data & pre-quiz		
	Randomized allocation to groups of 8, $K = 295$		
	Randomized allocation of groups to 3 experimental conditions		
	Intervention A $k = 99$	Intervention B $k = 98$	Control group $k = 98$
Pre-collaboration phase (2 weeks)	Instruction: Focus on **task-related communication**	Instruction: Focus on **socio-emotional communication**	Without instruction for communication
	Social network data	Social network data	Social network data
Interim evaluation 1 (T2)	Perceptions of CSCL	Perceptions of CSCL	Perceptions of CSCL

Preliminary results

	Intervention Task-related (A)	Intervention Socio-emotional (B)	Control (C)	Δ
k	99	98	98	
MC Task (T2)	18.0 (11.0)	15.0 (7.5)	16.0 (9.0)	A > B*
MC Social (T3)	2.6 (0.7)	2.7 (0.7)	2.5 (0.7)	B > A,C[†]
Perceived group heterogeneity (T3)	2.9 (0.4)	3.0 (0.4)	3.0 (0.4)	B > A*
Structural integration T1-T3	.32 (.13)	.27 (.13)	.29 (.12)	A > C[†] A > B**

Practical implications

CSCL groups may benefit from active diversity management in the early phases of the collaboration

- **Fostering structural integration through** scaffolding communication, specifically supporting task-related (versus socio-emotional communication)

Further directions

- Further understanding of diversity effects in CSCL

  - e.g., effects of stereotype threat in CSCL

- Development of CSCL interventions to reduce multi-attributional diversity effects

  - e.g., adaptive interventions based and depending on collaboration activities (scaffolding, diversity climate, comon ingroup)

- Grant application (with Laura Froehlich) to systematically compare intervention effects

Appendix