Supplementary materials: Simulation training and professional self-confidence: a large-scale study of third year nursing students

This document provides supplementary tests referenced in the main paper. Data is the same as in the main paper; see the methods section for description.

S.1 Randomization check

As the study employed cluster randomization, randomization could be imperfect. An asymmetry between clusters in the order of teaching activities (due to an uneven number of classes in each group) is a known challenge, which is easily controlled out, but additional problems might be present. To test this, we recorded prior experience of the participants of the study, in a series of questions fielded in the pre-treatment survey (T1). These questions, seen in table S.1, asked participants about their experience working in health care and their experience with simulation. This table shows control and treatment means, difference in means (treatment – control) and p-value from logit models (group predicting value). For the ordinal participation variable, an ordered logit model is used.

S.1. Randomization check

	Control	Treatment	Diff	p-value, logit
Health care experience				
Social health worker[a]	0.08	0.07	-0.01	0.65
Social health assistant[b]	0.11	0.09	-0.03	0.40
Other health care education	0.14	0.09	-0.05	0.17
Unskilled in health care sector	0.47	0.51	0.04	0.45
Voluntary health care work (e.g. red cross)	0.06	0.07	0.01	0.65
Military	0.05	0.04	0	0.85
Simulation experience				
Participated before	0.39	0.48	0.09	0.03
Observed during clinical training	0.78	0.8	0.02	0.10
Seen videos supplied by school	0.33	0.28	-0.06	0.66
Seen videos on YouTube	0.14	0.17	0.03	0.29
Read books or articles	0.13	0.21	0.09	0.47
Other	0.03	0.04	0.00	0.05
No prior experience	0.00	0.00	0.00	0.89
If participated, how many times				0.23[c]

1-3	0.5	0.36	-0.14	0.30
4-5	0.26	0.38	0.12	0.00
>5	0.24	0.26	0.02	0.22
What kind of simulation				
Clinical competency skill training	0.79	0.82	0.03	0.48
Scenarios with mannequins or actors	0.66	0.72	0.07	0.19
Other	0.02	0.06	0.04	0.90
Participated in simulation during education	0.62	0.69	0.07	0.54
Participated in simulation during clinical training	0.98	0.97	-0.01	0.20

Notes: All variables are dichotomous, except for participation, which is a single ordinal variable. a; Social- og sundhedshjælper in Danish, b; Social- og sundhedsassistent in Danish, c; p-value from ordered logit regression

The two groups have approximately the same levels of health care experience. No differences reach statistical significance at 0.1-level. When looking at simulation experience, the treatment group has a bit more experience with simulation training than the control, which also achieves statistical significance in a logistic regression and is substantially significant at 9 percentage points for prior participation. Due to this difference, prior experience with simulation (yes/no) is included as a control in the self-confidence regressions. Additionally, when looking at the number of times participants have participated in simulation, this same asymmetry is seen (though statistically insignificant in an ordered logit model).

Overall, this is interpreted as a successful randomization, but the differences in prior experience are noted, and are controlled for in the main analysis.

S.2 Attrition

To test whether attrition is systematic, the levels of professional self-confidence in the pretest (t1) and after treatment (t2) are predicted by whether the participants answered at t2 and t3 (after the subsequent semester). The resulting attrition dummies are inserted into the full models from the main analysis and can be seen in table S.2 below.

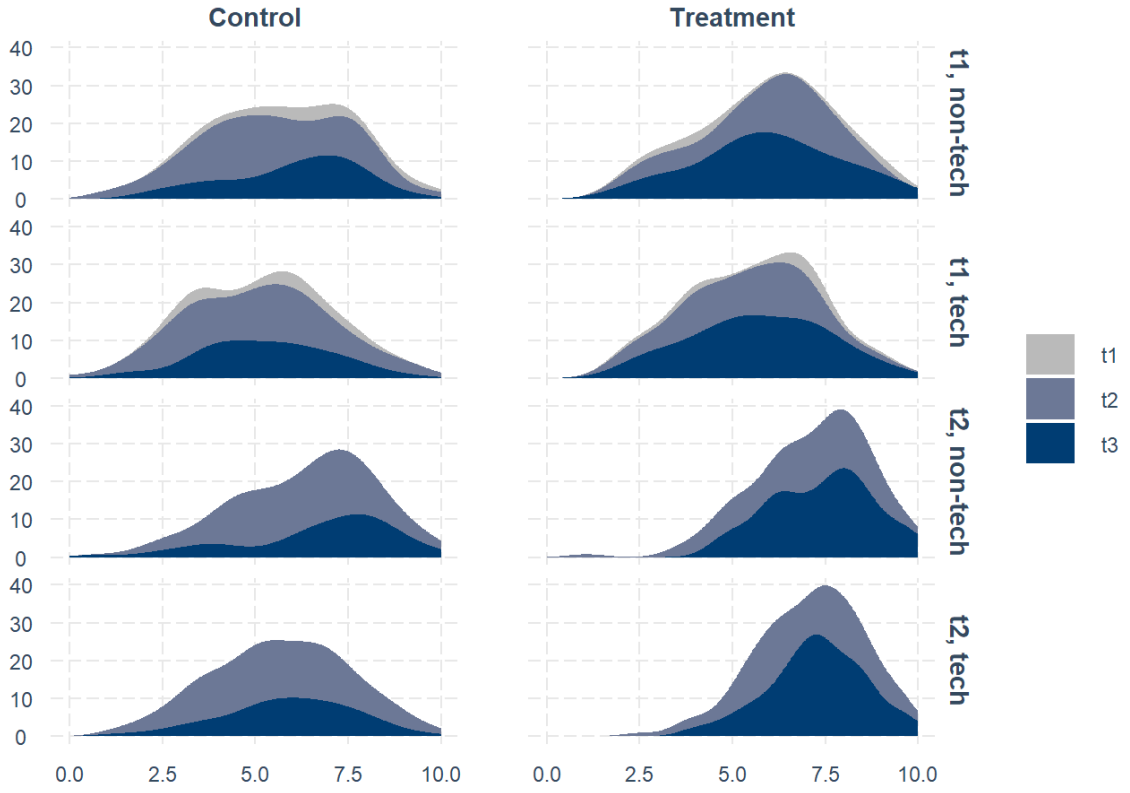
S.2 Attrition tests

	T1, Tech	T1, Non-tech	T1, Tech	T1, Non-tech	T2, Tech	T2, Non-tech
Intercept	4.67 ***	5.27 ***	4.32 ***	4.91 ***	2.43 ***	2.44 ***
	(0.56)	(0.57)	(0.48)	(0.49)	(0.38)	(0.43)
T2	-0.42	-0.43				
	(0.36)	(0.37)				
T3			0.15	0.13	0.17	0.36 *
			(0.22)	(0.22)	(0.15)	(0.16)
Treatment	0.27	0.08	0.24	0.05	1.10 ***	0.48 **
	(0.21)	(0.22)	(0.22)	(0.22)	(0.15)	(0.17)

Prior grades	-0.06	-0.08	-0.06	-0.09	-0.02	0.04
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Prior simulation experience	1.09 **	1.23 **	1.07 **	1.22 **	0.33	0.49
	(0.41)	(0.42)	(0.41)	(0.42)	(0.29)	(0.32)
Pre-Prac	0.79 ***	0.74 ***	0.75 ***	0.70 **	0.17	0.34 *
	(0.21)	(0.22)	(0.21)	(0.22)	(0.15)	(0.17)
Active					-0.18	-0.27
					(0.16)	(0.17)
Pretest (specific)					0.60 ***	0.55 ***
					(0.04)	(0.04)
N	306	306	306	306	278	278
R2	0.08	0.08	0.08	0.07	0.58	0.46

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

The results indicate that attrition is not systematic with regards to the self-confidence measures, except for the t2 non-technical skills self-confidence. Though this is interesting, it does not affect conclusions in the main paper, since self-confidence in non-technical skills was found to be insignificant for the t3-sample.



Another way of looking at the differences in self-confidence for the subgroup that remains in the sample across survey rounds, is by looking at the density plots above, where the values across the two self-confidence measures are displayed for the t1 and t2 data for the treatment

and control group. This shows similar distributions across those that answer in each of the three survey rounds, indicating that attrition should not bias results.

S.3 Questions from batteries

Below are the questions from the two batteries measuring self-confidence in technical and non-technical skills. Questions were originally in Danish; both the original wording and a translation is provided.

Table S.3: Question wording

Danish	Translation
Non-technical skills	
1. Kommunikation med teammedlemer	Communicating with team members
2. Kommunikation med patient	Communicating with the patient
3. Anvendelse af ISBAR	Using ISBAR- in English SBAR (communication tool: Situation-Background-Assessment-Recommendation)
4. Procedurer for teamsamarbejde (opgavefordeling og beslutninger)	Procedures for team collaboration (task assignment and decision making)
5. Prioritering af opgaver/beslutninger i akutte situationer	Prioritizing tasks/decisions in acute situations
6. At fortolke og forholde sig til vitale parametre i akutte situationer	Interpreting vital signs in acute situations
7. Brug af ABCDE algoritmen ved akutte syge patienter	Using the ABCDE algorithm in treating acutely sick patients
Technical skills	
1. Måling af vitale værdier jf. ABCDE vurdering	Assessment of vital signs using the ABCDE algorithm
2. Urinkateter-anlæggelse	Urinary catheterization
3. Lejring af patient, Trendelenburg	The Trendelenburg position
4. Blodtransfusion	Blood transfusion
5. PVK-anlæggelse, observation og pleje	Peripheral intravenous cannulation, observation and care
6. Luftvejs-håndtering	Airway management
7. Iltbehandling	Oxygen therapy
8. Sonde-anlæggelse, observation og pleje	Duodenal tube placement, observation and care
9. Medicin-administration	Medication Administration

10. Intravenøs administration	Intravenous medication administration
11. Væsketerapi	Intravenous fluid therapy

S.3 Clinical intensity

To investigate the relation between simulation training and clinical training, we registered whether participants had training in a high intensity (hospital) or low intensity (municipal) setting. To test whether our assumption on the intensity of clinical training is correct, we test the correlation between clinical training and student perception of being challenged or stressed in clinical training (both scaled 1-5, where 5 is high challenge/stress). The treatment dummy is also included as an interacting variable, to see whether the connection between "objective" and "perceived" intensity is affected by participating in the treatment.

Table S.3: Perceived and coded intensity

	Challenged		Stressed	
Intercept	3.53 ***	3.58 ***	3.62 ***	3.25 ***
	(0.20)	(0.32)	(0.19)	(0.31)
Clinical intensity (high)	0.82 ***	0.93 *	0.50 *	1.13 **
	(0.23)	(0.38)	(0.22)	(0.37)
Treatment		-0.08		0.60
		(0.41)		(0.39)
Intensity*treatment		-0.16		-0.98 *
		(0.48)		(0.46)
N	122	122	122	122
R2	0.10	0.11	0.04	0.08

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

Students feel more challenged in what we coded as high intensity clinical training, confirming our expectations of the levels of intensity in different settings. This is not substantially affected by being in the treatment group. Feeling of stress shows the same pattern, but interestingly the treatment group moderates the connection between our coded intensity and perceived intensity. This interaction term indicates that having participated in the full-scale simulation lessens how stressful students find high intensity clinical training, this can be seen as a soft indication of the treatment lessening negative effects of high intensity real-world nursing.

These findings indicate that our assumptions on the clinical intensity of different settings are correct.

S.4 Blocked regressions

This section shows all results from table 2 from the main paper including confounders one by one. Variables are included according to their placement in time; final models are identical to

the results shown in main paper. These regressions do not alter conclusions from the main paper but will be briefly commented on here.

Table S.4.1 presents blocked versions of the two first models from table 2 in the main paper. The main interesting point here is the statistically significant difference in self-confidence in technical skills between the groups in the pretest when controls are not included. This difference is interesting, though most of this difference seems to be due to differences in the order of teaching activities in the two groups, which is controlled out in the complete model. When including all the relevant controls, there is practically no difference in confidence in non-technical skills, but a small (statistically insignificant, p = 0.22) difference in self-confidence in technical skills persists. This difference could be indicative of some differences in groups that are not controlled out, or a separate effect of group assignment (e.g. Hawthorne effects), though such an effect cannot be sufficiently investigated.

Table S.4.1: Pretest (t1) blocked regressions

	Technical skills			
Intercept	5.13 ***	5.44 ***	4.49 ***	4.33 ***
	(0.15)	(0.34)	(0.49)	(0.48)
Treatment	0.45 *	0.48 *	0.41	0.26
	(0.21)	(0.21)	(0.21)	(0.21)
Prior grades		-0.04	-0.05	-0.06
		(0.04)	(0.04)	(0.04)
Prior simulation experience			1.13 **	1.10 **
			(0.42)	(0.41)
Pre-training				0.77 ***
				(0.21)
N	311	306	306	306
R2	0.01	0.02	0.04	0.08
	Non-technical skills			
Intercept	5.66 ***	6.13 ***	5.07 ***	4.92 ***
	(0.16)	(0.35)	(0.50)	(0.49)
Treatment	0.27	0.29	0.21	0.07
	(0.22)	(0.22)	(0.22)	(0.22)
Prior grades		-0.07	-0.08	-0.09
		(0.05)	(0.05)	(0.04)
Prior simulation experience			1.27 **	1.24 **
			(0.43)	(0.42)
Pre-training				0.71 **
				(0.22)
N	311	306	306	306
R2	0.01	0.01	0.04	0.07

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

The next table, S.4.2, shows blocked versions of all of the two next models from table 2 in the main paper, investigating t2 self-confidence. These results show nothing new, consistently showing positive effects of simulation training on both self-confidence measures across modellings.

Table S.4.2: After initial treatment (t2) blocked regressions

	Technical skills					
Intercept	5.69 ***	5.95 ***	5.03 ***	4.84 ***	2.41 ***	2.44 ***
	(0.14)	(0.33)	(0.47)	(0.46)	(0.38)	(0.38)
Treatment	1.42 ***	1.43 ***	1.35 ***	1.21 ***	1.10 ***	1.13 ***
	(0.20)	(0.20)	(0.20)	(0.20)	(0.15)	(0.15)
Prior grades		-0.04	-0.04	-0.05	-0.02	-0.02
		(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Prior simulation experience			1.08 **	1.07 **	0.35	0.35
			(0.39)	(0.39)	(0.29)	(0.29)
Pre-training				0.68 ***	0.17	0.19
				(0.20)	(0.15)	(0.15)
Pretest (specific)					0.60 ***	0.60 ***
					(0.04)	(0.04)
Active						-0.17
						(0.16)
N	284	279	278	278	278	278
R2	0.16	0.16	0.18	0.22	0.57	0.57
	Non-technical skills					
Intercept	6.36 ***	6.27 ***	5.29 ***	5.07 ***	2.43 ***	2.46 ***
	(0.15)	(0.34)	(0.49)	(0.48)	(0.44)	(0.44)
Treatment	0.80 ***	0.80 ***	0.70 ***	0.54 *	0.49 **	0.53 **
	(0.20)	(0.21)	(0.21)	(0.21)	(0.17)	(0.17)
Prior grades		0.01	0.01	0.00	0.04	0.04
		(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Prior simulation experience			1.15 **	1.13 **	0.52	0.53
			(0.41)	(0.40)	(0.33)	(0.33)
Pre-training				0.80 ***	0.34 *	0.37 *
				(0.20)	(0.17)	(0.17)
Pretest (specific)					0.55 ***	0.56 ***
					(0.04)	(0.04)
Active						-0.24
						(0.17)
N	284	279	278	278	278	278
R2	0.05	0.05	0.08	0.13	0.44	0.45

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

The final blocked regressions show the blocked versions of the final four models of table 2 in the main paper. These also show the same picture consistently, leading to no new conclusions.

Table S.4.3: Final survey (t3) blocked regressions

	Technical skills						
Intercept	7.22 ***	6.87 ***	5.31 ***	5.38 ***	4.37 ***	4.36 ***	5.28 ***
	(0.20)	(0.42)	(0.75)	(0.76)	(0.73)	(0.74)	(0.83)
Treatment	0.81 **	0.76 **	0.63 *	0.68 *	0.60 *	0.59 *	1.33 **
	(0.26)	(0.27)	(0.29)	(0.30)	(0.27)	(0.28)	(0.48)
Prior grades		0.05	0.06	0.06	0.10	0.10	0.05
		(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)
Prior simulation experience			1.58 *	1.58 *	0.51	0.52	-0.80
			(0.68)	(0.68)	(0.66)	(0.67)	(0.68)
Pre-training				-0.20	-0.40	-0.40	-0.52 *
				(0.27)	(0.25)	(0.26)	(0.26)
Pretest					0.34 ***	0.34 ***	0.32 ***
					(0.07)	(0.07)	(0.07)
Active						0.03	-0.06
						(0.27)	(0.26)
High clinical intensity							1.30 **
							(0.45)
Treatment*Clinical intensity							-0.93
							(0.55)
N	143	140	127	127	127	127	110
R2	0.07	0.07	0.11	0.12	0.26	0.26	0.27
	Non-technical skills						
Intercept	7.84 ***	7.48 ***	5.97 ***	5.93 ***	4.53 ***	4.45 ***	6.23 ***
	(0.20)	(0.41)	(0.72)	(0.73)	(0.72)	(0.74)	(0.71)
Treatment	0.35	0.33	0.20	0.17	0.26	0.24	-0.16
	(0.25)	(0.26)	(0.28)	(0.29)	(0.26)	(0.26)	(0.41)
Prior grades		0.05	0.05	0.05	0.08	0.08	0.04
		(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)
Prior simulation experience			1.55 *	1.55 *	0.82	0.85	-0.09
			(0.65)	(0.65)	(0.61)	(0.62)	(0.57)
Pre-training				0.10	-0.12	-0.15	-0.26
				(0.26)	(0.24)	(0.25)	(0.22)
Pretest					0.32 ***	0.32 ***	0.30 ***
					(0.06)	(0.06)	(0.06)
Active						0.15	-0.04
						(0.26)	(0.22)

High clinical intensity							-0.03 (0.38)
Treatment*Clinical intensity							0.33 (0.47)
N	143	140	127	127	127	127	110
R2	0.01	0.02	0.07	0.07	0.23	0.23	0.23

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

S.5 Prior training and experience interactions

As noted in the main text, asymmetries in previous training and experience could be theorized to moderate the effect of the treatment. However, as seen below this does not seem to be the case, as the interaction term is quite small and far from statistically significant.

Table S.5.1: Interactions with pre-training

	T2, Tech	T2, Non-tech	T3, Tech	T3, Non-tech
Intercept	2.43 *** (0.38)	2.46 *** (0.44)	4.32 *** (0.74)	4.44 *** (0.74)
Treatment	1.25 *** (0.20)	0.48 * (0.23)	0.97 * (0.38)	0.11 (0.37)
Prior grades	-0.02 (0.03)	0.04 (0.03)	0.09 (0.06)	0.08 (0.05)
Prior sim experience	0.32 (0.29)	0.54 (0.33)	0.43 (0.67)	0.87 (0.62)
Pre-training	0.34 (0.22)	0.31 (0.25)	0.09 (0.43)	-0.33 (0.42)
Treat*pre-training	**-0.27 (0.30)**	**0.12 (0.33)**	**-0.76 (0.53)**	**0.28 (0.51)**
Pretest (specific)	0.60 *** (0.04)	0.56 *** (0.04)	0.34 *** (0.07)	0.32 *** (0.06)
Active	-0.18 (0.16)	-0.24 (0.17)	0.00 (0.27)	0.16 (0.26)
N	278	278	127	127
R2	0.57	0.45	0.27	0.23

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*

The same is the case for the interaction with prior simulation experience, as seen below. Together, these indicate that prior knowledge (at least at the levels of this sample) does not affect the effects of the treatment upon professional self-confidence.

Table S.5.2: Interactions with prior experience

	T2, Tech	T2, Non-tech	T3, Tech	T3, Non-tech
Intercept	2.46 ***	2.44 ***	4.35 ***	4.65 ***
	(0.39)	(0.46)	(0.80)	(0.79)
Treatment	1.00	0.62	0.61	-0.81
	(0.69)	(0.77)	(1.53)	(1.46)
Prior grades	-0.02	0.04	0.10	0.08
	(0.03)	(0.03)	(0.06)	(0.05)
Prior sim experience	0.32	0.55	0.52	0.62
	(0.33)	(0.37)	(0.75)	(0.69)
Treat*prior experience	**0.13**	**-0.09**	**-0.01**	**1.08**
	(0.70)	**(0.78)**	**(1.54)**	**(1.47)**
Pre-training	0.19	0.37 *	-0.40	-0.13
	(0.15)	(0.17)	(0.26)	(0.25)
Pretest (specific)	0.60 ***	0.56 ***	0.34 ***	0.32 ***
	(0.04)	(0.04)	(0.07)	(0.06)
Active	-0.17	-0.24	0.03	0.15
	(0.16)	(0.17)	(0.27)	(0.26)
N	278	278	127	127
R2	0.57	0.45	0.26	0.23

*Notes: OLS regressions *** p < 0.001; ** p < 0.01; * p < 0.05. Standard error in parentheses.*