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The Utility of Peer-to-Peer Practice for Teaching Speech-Language Pathology Students Transnasal Endoscopy

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Abstract

Introduction: Transnasal flexible endoscopy (TNFE) is necessary for multiple assessments in speech-language pathology (SLP), but it is generally considered an advanced practice technique to be learned during clinical practice. As such, there is no standardized way that it is taught in training programs, leading to a substantial knowledge gap for new graduates. Though peer-to-peer practice has been discussed as an important step in training, it is not clear whether it confers additional benefits above and beyond simulation. This study sought to answer that question in the areas of student confidence, endoscopy speed, and motivation to pursue further TNFE experiences. Methods: Thirty-six SLP graduate students completed TNFE training and one of two practice conditions: simulation only or simulation with additional peer-to-peer practice. Outcome measures included confidence and comfort surveys, intrinsic motivation to complete an additional TNFE experience, and speed of TNFE. Results: No significant differences were found between the two groups for any measure, and consistently low effect sizes indicated there was little difference between groups. Conclusions: These results indicate that teaching TNFE through simulation may provide similar outcomes to peer-to-peer practice during the initial training that an SLP graduate program can provide. This adds to the literature indicating that TNFE simulation is a worthwhile addition to SLP programs.

Keywords

Endoscopy, dysphagia, FEES, peers, simulation, speech-language pathology, transnasal

Speech-language pathologists (SLPs) complete transnasal flexible endoscopy[1] (TNFE) for swallowing and voice assessments, like fiberoptic endoscopic evaluations of swallowing (FEES) and laryngeal videostroboscopy. TNFE allows the SLP to directly evaluate the structure and movement of the larynx, pharynx, and surrounding physiology. For example, TNFE for FEES provides useful visualization of details like secretion management, mucosal anatomy, and vocal fold closure that are not discernable from any other swallowing evaluation (Nacci et al., 2008; Warnecke et al., 2021). TNFE is therefore an invaluable skill for SLPs working with voice and swallowing.

Despite its importance for high-quality patient care, SLPs are inconsistently trained to complete TNFE. As a whole, they do not feel well-prepared by their graduate programs or confident in their ability to complete the technique (Caesar & Kitila, 2020). In fact, of the myriad areas of swallowing evaluation and treatment, SLPs are often the least confident in TNFE for FEES. Caseser and Kitla (2020) surveyed 374 SLPs who provide dysphagia services in the United States about their confidence in 11 areas of dysphagia management. They asked participants about how prepared they had felt immediately after their master's programs and how confident they were now that they have practiced in the field. Participants rated conducting and interpreting FEES assessments as areas in which they felt the least prepared after their graduate programs. Those who had graduated from programs with more FEES training tended to feel more prepared. When asked about their current confidence, respondents reported they were now confident in their abilities in all 11 areas of dysphagia management except conducting and interpreting FEES assessments and addressing pediatric dysphagia. The authors postulated that respondents may not have been confident in FEES because they did not regularly conduct FEES or had not sought out the necessary specialized training in the procedure.

Insufficient TNFE Training Opportunities

This reduced confidence with TNFE may be at least partially ascribed to a lack of training and mentorship opportunities. As Robinson (2021) discusses, most SLPs learn TNFE after graduation while working clinically. Though each clinician's experience differs, Robinson (2021) describes three typical levels of training: didactic teaching, hands-on practice with familiar volunteers and possibly simulation, and "workplace-based" learning in which the novice endoscopist practices in their workplace with patients, under the supervision of a mentor. It is this transition to workplace learning where much of the trainee attrition occurs (Slade, 2009). Many lack a workplace mentor. Others do not feel sufficiently confident in their skills to progress to this step (Slade, 2009).

If relatively few SLPs are competent and confident conducting FEES, then few SLPs are available to mentor others in their learning. Though requirements differ by certification or licensing body (e.g., Speech Pathology Australia, 2007; American Speech-Language-Hearing Association

[1] [1] Transnasal flexible endoscopy (TNFE) has been described using varied terms and abbreviations, including transnasal endoscopy (TNE), transnasal flexible laryngoscopy (TFL), and flexible fiberoptic laryngoscopy (FFL). The terms TNE and TNFE appear to the authors to best align with how speech-language pathologists use this procedure. TNFE has been chosen here to minimize confusion between this procedure and transnasal esophagoscopy, which is also often abbreviated TNE.

[ASHA], n.d., state licensure boards), FEES training typically includes practice passing the endoscope on numerous healthy volunteers and then on patients with suspected dysphagia. All of this practice is conducted under the mentorship of another clinician already competent in FEES, yet mentorship after initial training is difficult to find due to the shortage of SLPs knowledgeable in this area (Robinson & Dennick, 2015; Robinson, 2021). While training opportunities for SLPs in TNFE may have been insufficient at baseline, the reduced ability to practice TNFE clinically during the COVID-19 pandemic (Kearney et al., 2021; Patterson et al., 2020; Robinson, 2021) and an overall shortage of professional training opportunities for SLPs (Hill et al., 2021) have worsened the problem. Increasing training and mentorship opportunities for SLPs in TNFE is important to ensure high-quality patient care.

Simulation to Teach TNFE

While there is no standardized way that transnasal endoscopy is taught internationally, competency is typically not expected of entry-level SLPs (ASHA, 2020; Robinson, 2021; Speech Pathology Australia, 2007; Wallace et al., 2020). Therefore, when universities do address this training, it comes in varied forms. As Robinson (2021) notes, there is not an agreed-upon framework for teaching FEES. Some university programs teach FEES interpretation through demonstration and videos but do not appear to complete hands-on practice (Brady et al., 2018). Others practice passing and maneuvering endoscopes through non-lifelike objects, such as pool toys or glove boxes (Berkowitz, 2017; Benadom & Potter, 2011). Still others have described using task trainers, cadavers, and medical manikins to simulate passing an endoscope transnasally (Benadom & Potter, 2011; Stead et al., 2020; Wolford, & Wolford, 2020). Some have practiced in-vivo on peers or on volunteers (Benadom & Potter, 2011; Berkowitz, 2017; Wolford & Wolford, 2020; Yoshida et al., 2020). Students appear to find all of these techniques useful, and they generally improve on self-efficacy, confidence, speed, and skills measures following the trainings. Indeed, any simulation appears to be better than no simulation at all (Johnston et al., 2015).

One potential benefit of simulation in the university setting is the opportunity to practice endoscopy repeatedly and in a low-stakes way throughout the semester, quarter, or program. While practice with volunteers often involves a one or two-day bootcamp-type experience due to the need to clean endoscopes and source volunteers (Benadom & Potter, 2011; Johnston et al., 2015; Wolford & Wolford, 2020). Stead and colleagues (2020) and Berkowitz (2017) described opportunities for students to practice on simulators throughout a more extended training period. Because they do not require endoscope reprocessing between passes or direct supervision to ensure volunteers are not harmed, students can learn more gradually or at their own pace. In this way, simulation can allow for distributed learning, a practice that has been repeatedly shown to improve information and skills retention over massed practice (Kerfoot et al., 2007a, 2007b; Moulton et al., 2006; Raman et al., 2010).

Prior work has found no substantial difference between simulation and in-vivo practice for the outcomes of student confidence, procedure speed, or patient comfort during their first pass on a simulated patient (Wolford & Wolford, 2020). This raises the question: Can simulation for transnasal endoscopy be a replacement for a portion of hands-on training? It is unclear whether this simulated practice can be used as a substitute for a portion of the student's practice on a peer or volunteer. Is it "real practice" or an additional step to take before the "real practice" begins?

Stead et al. (2020) notes difficulties with faculty and student buy-in for TNFE simulation. Understanding the answer to this question may help with such buy-in. It may also help to reduce the burden on mentors to supervise a particular number of practice endoscope passes if a portion of them could be appropriately completed using simulation.

Peer-to-Peer Practice

Despite its potential benefits, faculty and students often feel simulation for transnasal endoscopy is not a stand-in for practice on a volunteer or peer. For example, the student participants in Stead et al. (2020) described that although practicing on medical manikins helped with their confidence and skills, they wanted the opportunity to pass the scope on each other. This is not an unreasonable expectation; peer-to-peer practice is common in many other medical and healthcare professions. Peer-to-peer practice is common for manual tasks, such as drawing blood (Terzi et al., 2019), transferring one another from bed to wheelchair (Baird et al., 2015), and administering local anesthesia (Rosenberg et al., 2009).

In dentistry, where this sort of peer-to-peer practice is common in administering local anesthesia, it has been linked to increased confidence in the manual technique (Kary et al., 2018; Sjöström & Brunden, 2021) and reduced stress and anxiety during the procedure (Wong et al., 2019) in comparison to practicing with a model. However, the ethical concern has been raised that peer-to-peer practice of invasive procedures, particularly during required coursework, may coerce students into receiving an invasive procedure about which they are not comfortable (Holden, 2018; Rosenberg et al., 2009).

Yet without this peer-to-peer practice, students feel more concerned about the transition directly from manikin to first patient (Wong et al., 2020). They are unsure how well their skills will translate to a real person and prefer the additional step of practicing on a peer with whom they feel safe (Hossaini, 2011; Wong et al., 2020). The transition from simulation to practice on a patient can indeed be daunting. Berkowitz (2017) indicated that after practicing TNFE with a simulation, SLP students' most pressing concern was whether they would hurt a patient. While studies of TNFE training have mentioned allowing students the opportunity for peer-to-peer practice (e.g., Berkowitz, 2017; Robinson & Dennick, 2015), none have directly studied whether it is an important component to training.

TNFE Training Goals for SLP Programs

As noted above, transnasal endoscopy is generally considered an advanced skill that is pursued after graduation, often over the course of 6 to 12 months of mentored practice (Robinson, 2021). It is unlikely that a university would be able to offer this level of intensive hands-on practice. Competence, then, is not an appropriate target for an initial training at this setting. Indeed, models of competence in TNFE have only recently been described (Melchiors, et al., 2018; Robinson, 2021), and their applicability to SLP students is unclear.

If expecting competence is not appropriate, the goal of the training must shift. Instead of aiming to teach students to be competent endoscopists, the goal might be instead to encourage students to complete further training in TNFE. While this may seem simple, SLPs do not seem pressured to

gain this knowledge (Birchall, et al., 2021), and it may be difficult for them to pursue because of insufficient training and mentorship opportunities (Robinson, 2021; Wolford & Wolford, 2020). Additionally, students and seasoned clinicians alike may be uncomfortable or nervous about the procedure (Berkowitz, 2017; Caesar & Kitila, 2020; Slade, 2009; Stead et al., 2020). These hurdles may contribute to a reluctance to pursue further training in TNFE.

To encourage students to seek further training, it may be more appropriate to strive to improve confidence in TNFE, rather than competence. Prior research has indicated that confidence partially mitigates educational choices. People tend to choose tasks and learning opportunities in which they feel more confident and avoid those where they feel insecure (Carlebach & Yeung, 2020; Murayama et al., 2016). In medical education, Eva and Regehr (2005) describe that "self-efficacy will also lead to an increased likelihood of success. Self-efficacy beliefs are […] part of a self-fulfilling prophecy that affects performance" (p. S48). Self-efficacy may be crucial in driving students to seek more training and mentorship in TNFE after graduation despite the hurdles they may face. Confidence may therefore be a more important outcome of preliminary TNFE education.

Purpose

This study aimed to address whether simulation might be an appropriate substitute for a portion of transnasal flexible endoscope passes. It compared simulation-only practice to simulation that was followed by peer-to-peer practice across three variables: student confidence, speed of endoscopy, and choice to undertake an optional practice opportunity with an unfamiliar simulated patient. The research questions were the following:

1. Does confidence vary because of peer practice?
2. Does confidence or peer practice predict if student will choose to complete an additional optional TNFE experience?
3. Does peer practice lead to faster endoscope pass time for students who choose to complete an additional, optional TNFE experience?

Methods

This study used a quasi-randomized control trial design to assess whether students who had the extra experience of completing transnasal endoscopy on a peer after simulation were more confident in their endoscopy skills, faster, or more likely to choose to complete an additional, optional endoscopy experience with a simulated patient. This study was completed prior to the COVID-19 pandemic. Ethical approval for this study was granted by the Midwestern University – Glendale Institutional Review Board. All participants provided written consent.

Participants. Thirty-six speech-language pathology graduate students were recruited for this study. They had all completed a graduate-level dysphagia course and voice disorders course, in which they learned about the anatomy visualized, the path that the endoscope takes, and the clinical indications for FEES or videostroboscopy. They had also analyzed video taken via TNFE. No participants reported prior experience observing TNFE or completing the procedure outside of this coursework. Participants completed the Purdue Pegboard Test (Tiffin & Asher, 1948) to assess for manual dexterity and were divided into groups of even manual dexterity using summed scores,

$t(32.253) = .040$, $p = .842$ using a Welch's unequal variances *t*-test. The Welch's *t*-test was chosen due to the uneven group sizes.

Sixteen participants were initially assigned to the peer practice group (Ypeer), and twenty participants were assigned to the no peer practice group (Npeer). The logistics of thoroughly disinfecting the endoscope between volunteers capped the number of potential participants in the Ypeer group, leading to unequal numbers between groups. However, during the peer practice phase of the training, two participants chose not to complete endoscopy on a peer and were transferred to the Npeer group, leading to fourteen Ypeer and twenty-two Npeer participants.

Study Design. This study spanned three consecutive days. Each day included a different phase of the study: teaching, practice, and test.

Teaching. Participants engaged in a two-hour classroom lecture in which they learned about nasal pharyngeal anatomy and appropriate handling of the endoscope. They watched multiple videos of TNFE and a live demonstration. Each student had the opportunity to handle the endoscope and insert it into a flexible drinking straw, as described in prior studies (Benadom & Potter; 2011; Wolford & Wolford, 2021).

Practice. On the second day, participants each had twenty minutes to complete guided passes of the endoscope on a simulator with instructor guidance. They received feedback on endoscope handling and body positioning, as well as insertion and manipulation. These passes were conducted on simulators that have previously demonstrated equivalent learning outcomes (Wolford & Wolford, 2021).

Following completion of the simulation, the peer practice group had the additional opportunity to complete an endoscope pass on a peer volunteer. Each student completed a successful pass of the endoscope, from nare to visualization of the vocal folds, with instructor guidance and supervision. A successful pass was defined as the student independently guiding the endoscope from nare to visualization of the vocal folds without removal of the endoscope or requiring instructor intervention. Two of the initial sixteen Ypeer students chose not to complete this step and were transferred to the Npeer group, as indicated above.

Test. On the third day, students were given the option of completing an additional endoscopy experience on a healthy unfamiliar adult volunteer acting as a simulated patient. To control for potential confounding motivations, such as competing time commitments, all participants were asked to complete the preparatory steps for the endoscopy with the simulated patient – explaining the assessment to the simulated patient, handling the endoscope, and positioning themselves for endoscopy. However, participants were informed that they could choose to pass the endoscope or end the procedure once they had placed the tip of the endoscope at the entrance to the nare.

Student participants and simulated patients were both reminded that they could choose to terminate the endoscopy at any point without negative consequences. A trained speech-language pathologist was also present to call a halt to any procedure that appeared it might harm a simulated patient. Other precautions in place included a time limit of three minutes for the procedure and a maximum

of three attempts to pass the endoscope. No participant reached either limit, and no procedures were halted by the student or the instructor.

Simulators. For the simulation portion of the study, two simulators were chosen which have previously been shown to lead to similar learning outcomes for TNFE (Wolford & Wolford, 2021): the METIman ® Adult Patient Simulator (CAE Healthcare, Inc., Sarasota, FL) and the low-cost handmade simulator described in Johnston et al., (2015).

Endoscopy Equipment. All endoscopy was completed using the Olympus ENF-VH flexible video rhinolaryngoscope (Olympus Corporation of the Americas, Center Valley, PA). Compatible videoimaging equipment (CLV-S190 light source and OEV-262H monitor, Olympus Corporation of the Americas) allowed for visualization of the nasal and pharyngeal cavities. Videos were digitized with the nStream video recording system (Image Stream Medical, Littleton, MA).

Outcome Measures. Three variables were measured: student confidence in their ability to complete TNFE, intrinsic motivation to pursue an additional TNFE opportunity, and endoscopy speed if they completed said TNFE experience.

Student Confidence. The student confidence survey originally described in Benadom and Potter (2011) was used as adapted in Wolford and Wolford (2021), in which the full measure is published. The survey was administered three times: between the teaching and practice phases, again after the practice phase, and after the test phase. Questions in the confidence survey addressed students' self-perceived ability to complete technical steps of the TNFE pass, visualize a variety of anatomical landmarks, and maintain patient comfort. One question assessed overall confidence in their TNFE ability. Participants marked their agreement with each of the ten items on a five-point Likert-type scale.

Intrinsic Motivation to Pursue TNFE. Intrinsic motivation to pursue an additional TNFE experience was measured as a binary behavioral measure. Participants who chose to advance the endoscope on the simulated patient during the test phase were counted as having completed the additional TNFE opportunity.

Speed of Endoscopy. The speed of the procedure was measured using the video from the endoscope videorecording system. Full procedure time, from first entry into the nare until successful visualization of the vocal folds, was recorded using the software ELAN, version 5.2 (Max Plank Institute for Psycholinguistics, Nijmegen, NL) for all participants that completed the optional TNFE experience.

Statistical Analyses. All statistical analyses were conducted using the statistical software R version 4.1.1 (R Core Team, 2021). Analyses for each research question are as follows.

RQ1: Does confidence vary because of peer practice? A two-way repeated measures ANOVA was used to compare average confidence scores between the two groups over the three time periods. All participants' combined confidence scores were also compared over time using a one-way repeated measures ANOVA to determine if there were differences by time but not by group. Statistically significant results were followed by post-hoc analyses. F-statistics, p-values, and

effect sizes were reported for all ANOVAs. Eta squared (η2) is the generalized effect size from the repeated measures ANOVA models. The effect size quantifies the amount of variability due to the within-subjects factor.

A multiple linear regression model was also used to predict students' final confidence score. The independent variables were peer practice, after-practice confidence score, and choice to complete the additional endoscopy experience. Peer practice and choice to complete TNFE were coded as dummy variables. Model results reported were estimates and standard errors of regression coefficients, results for the tests of significance for the regression coefficients, and overall model results including the R^2 value and results of the F-test. All model assumptions were met for linear regression.

RQ2: Does confidence or peer practice predict student choice to complete the procedure on a simulated patient? A logistic regression model was used to predict the choice to complete the TNFE opportunity. The choice to complete the additional endoscopy experience was the dependent variable; peer practice and after-practice confidence scores were the predictors. Only after practice scores were chosen because those scores most closely estimate student confidence at the time they were making their choice. Model results reported were the odds ratio values, effect sizes, and p-values from the Wald tests for the tests of significance for the regression coefficients. All model assumptions were met for logistic regression.

RQ3: Do groups differ on timing measures based on peer practice? For the students who chose to complete the procedure, Welch's *t*-test was conducted to determine if there were differences between the students with or without peer practice. Total procedure time was compared between groups.

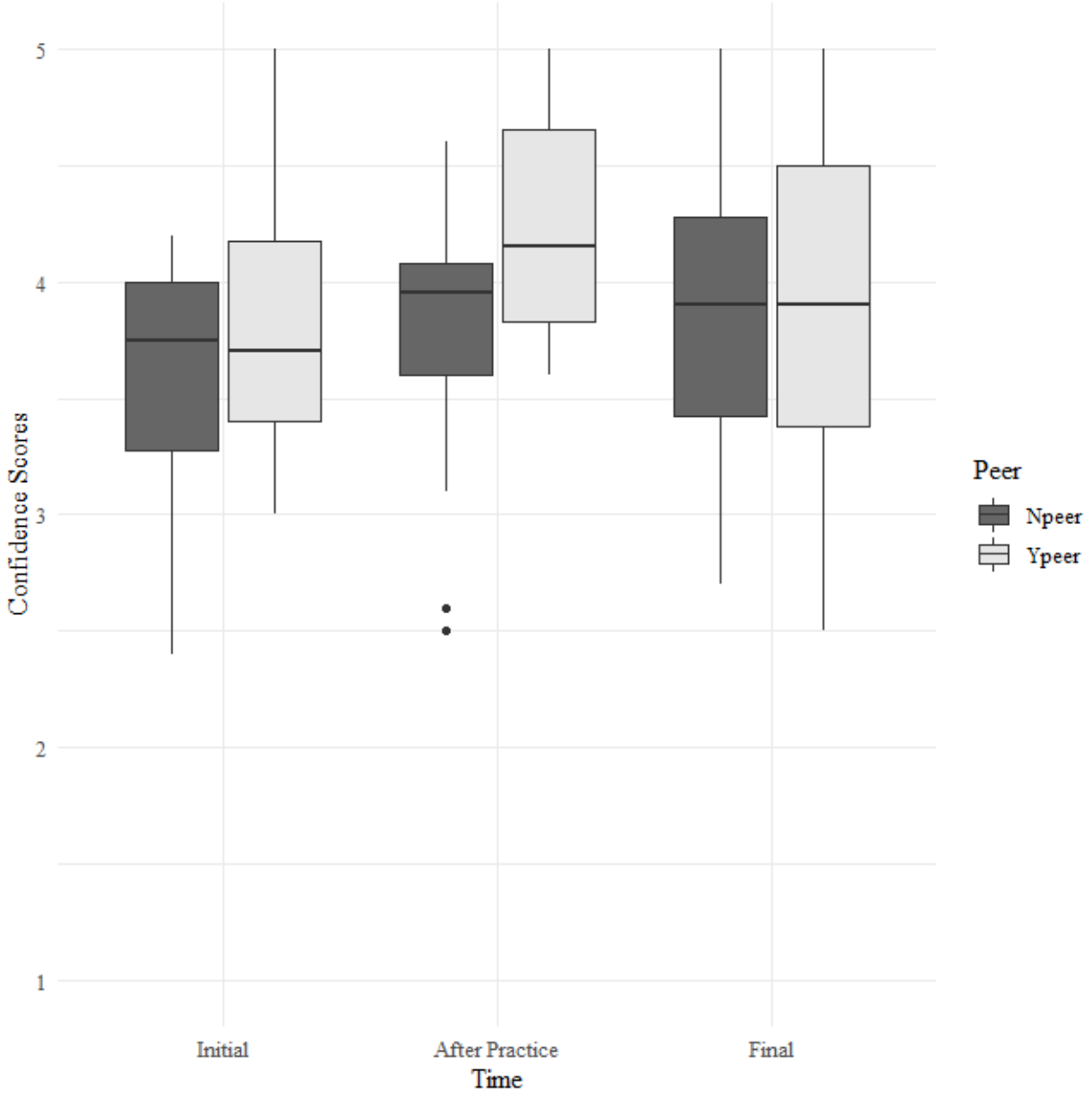
Results

RQ1: Confidence. Average confidence across time is plotted in Figure 1 to show the trends in the data.

There was not a statistically significant two-way interaction between practice group and confidence across time for average confidence scores, $F(1.47, 50.13) = 1.167$, $p = 0.306$, $\eta 2 = 0.016$. There was not a statistically significant difference between the peer and no peer groups, $F(1, 34) = 2.522$, $p = 0.121$, $\eta 2 = 0.038$. Change over time was marginally significant, $F(1.47, 50.13) = 3.467$, $p = 0.052$, $\eta 2 = 0.046$. The low effect size of the time group interaction ($\eta 2 = .016$) indicated that there was not much practical difference on change in confidence between peer practice groups. A post-hoc power analysis was conducted for the two-way repeated measures ANOVA for the within factor effect over time. With a sample size of $n = 36$ for two groups, 3 measurements, alpha = 0.05, and effect size $f = 0.2196$ (based on partial $\eta 2 = 0.046$), there was 81.39% power to detect a statistically significant difference in average confidence scores over time.

Figure 1

Students' Average Confidence Across Sessions



Results of the one-way repeated measures ANOVA indicated that the confidence scores were not statistically significantly different at the different time points, $F(1.5, 52.5) = 3.177$, $p = 0.063$, $\eta 2 = 0.04$. The low effect size ($\eta 2 = 0.04$) again indicated that there was not much practical difference based on time of survey administration.

To further explore the impact on final confidence, a multiple linear regression model was specified predicting students' final confidence score with the independent variables of peer practice (Practice Group), the after-practice confidence score (After Practice Score), and the students'

choice to complete the additional TNFE experience or not (Motivation). The adjusted R-squared value for the model was 1.89%. There was very little variation in final confidence scores that can be explained by the factors in the model. The F-test for the overall model was not statistically significant, $F(3,32) = 1.225$, $p = 0.3167$, nor were any factors within the model, $p > .05$. See Table 1 below.

Table 1

F-test for the Overall Model

	Estimate (B)	Standard error	*t* value	*p*-value
(Intercept)	2.78	0.78	3.55	0.001
Practice Group (Ypeer)	-0.06	0.23	-0.26	0.799
After Practice Score	0.26	0.20	1.26	0.216
Motivation (Yes)	0.28	0.22	1.30	0.204

Taken together, the low effect sizes from the ANOVA models and the low R^2 from the multiple regression indicates that the variables of time and group did not impact final confidence.

RQ2: Intrinsic Motivation. A table showing which participants chose to complete the optional TNFE experience is shown in Table 2 below, with the number of participants in each group.

Table 2

Students' Completion of Optional TNFE

	Abstained *n* (%)	Conducted *n* (%)
Peer Practice (*N* = 14)	8 (57.14%)	6 (42.86%)
No Peer Practice (*N* = 22)	14 (63.63%)	8 (36.63%)

A logistic regression model was specified to predict whether students chose to complete the optional TNFE experience with the independent variables of peer practice (Practice Group) and also accounting for the after-practice confidence score (After Practice Score). Table 3 below shows the odds ratio for the variables within the model that include the upper and lower CI with *p*-values. No factors were significant, and the addition of peer practice yields essentially even odds (1.14 times greater for the Ypeer group) of completing the procedure compared to the Npeer group, holding after-practice confidence score constant.

RQ3: Speed. Total procedure time was not significantly different between groups, $t(11.94) = 1.97$, $p = .073$, indicating that the two groups performed similarly in the actual use of the endoscope.

Table 3

Odds Ratio for the Model Predicting TNFE Completion

	Odds Ratio	Lower Bound of 95% CI	Upper Bound of 95% CI	*p*-value
(Intercept)	0.15	0.00	22.84	0.476
Practice Group (Ypeer)	1.14	0.25	5.03	0.862
After Practice Score	1.41	0.39	5.74	0.612

Discussion

This study sought to determine whether an additional step of peer practice following simulation for TNFE conferred any substantial benefits to student confidence, intrinsic motivation to pursue further TNFE experiences, or speed of endoscopy. The results indicate that this does not appear to be the case. There were no significant differences between the group that had the additional practice on a peer in comparison with the one that only practiced with simulation. The low effect sizes observed in the results support this conclusion.

These findings indicate that the additional step of peer-to-peer practice for TNFE is unlikely to confer substantial benefits in the graduate school setting. The graduate program is a unique circumstance in which to learn the basics of TNFE because the students do not have a ready clinical environment in which to hone their new skills to competence. Unlike SLPs in clinical practice, they are not planning to bring their new skill directly to their practice-based mentor and immediately practice on a clinical population. Their clinical populations and mentors change rapidly until they graduate.

Therefore, it is not feasible to expect the student to transition immediately from the initial TNFE training into practice. Students will have to seek out further training, mentorship, and practice following graduation from their programs. Since competence in the procedure is not the goal of this training, it is more important to foster confidence and intrinsic motivation to practice TNFE. The additional step of peer-to-peer practice appears unlikely to confer additional benefits to confidence or intrinsic motivation to practice TNFE.

These findings are useful for programming in the graduate environment. Transnasal endoscopy equipment is expensive, and reprocessing of endoscopes can be labor intensive, costly, and time intensive. Additionally, the ethical concerns of potential coercion in a setting that requires peer-to-peer practice for a course ought not be overlooked. The results of this study indicate that these potential pitfalls of TNFE may be appropriately avoided in the graduate program by focusing on simulation, as students are unlikely to be deprived of key educational benefits. Since beneficial, hands-on TNFE training in the graduate setting may be more feasible than previously believed, it may be worthwhile for SLP programs to invest in infrastructure for TNFE simulation.

Limitations and Future Directions

While medical education and speech-language pathology education have used simulation for decades, there is very little known about the extent to which simulation can replace in-vivo clinical practice. Simulation research in the field of speech-language pathology emerged gradually (Strang & Meyers, 1987; Wolford et al., 2021), and now there is compelling evidence about the degree to which simulation can replace hands-on practice in the field for SLP students (Hill et al., 2020). Through directly evaluating the effect of peer practice, this study adds to that body of literature, but far more needs to be done. One limitation of this study was its limited scope; students only had the opportunity to practice on a single peer. It is perhaps possible that practicing on multiple peers would have increased confidence. Further studies might assess how much simulation can effectively replace in-vivo practice, as that threshold is not yet known.

Another limitation of this study was that it did not account for the peers who were recipients of the TNFE. It is possible that having experienced being scoped confers benefits, such as an embodied understanding of what might make the client more comfortable. Future research could assess students' expressed experiences with being scoped. A third limitation of this study is its small sample size. Although comparable to other research in this area, a future study with a larger sample size would lead to better generalizability for the SLP student population at large though the small effect sizes would imply that there would be little difference between groups. Also, future studies could assess faculty and students' perceptions of the simulation and peer-to-peer endoscopy experience. It is presently unclear whether one leads to greater buy-in or perceived benefit than another. Further research might also assess the impact of even more simulation passes or replicate the study with an additional peer-to-peer only group that did not practice with simulation. Future studies might also assess the impact of students' intrinsic interest and inherent motivation to complete endoscopy or control for it as a potential confounding factor. In this study, it is unclear how students' baseline interest in endoscopy may have affected the results.

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