Helsinki Studies in Education, number 144

Sirke Seppänen

‘What would happen if I said “Yes”?’

Measuring the immediate and long-term impact of improvisation training on student teachers’ subjective, neuroendocrine and psychophysiological responses

To be presented for public discussion with the permission of the Faculty of Educational Sciences of the University of Helsinki, in Auditorium 302, Athena Building, Siltavuorenperger 3 A, on the 11th of November 2022, at 13 o’clock.

Helsinki 2022

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Unigrafia, Helsinki

ISSN 1798-8322 (print)
ISSN 2489-2297 (online)

ISBN 978-951-51-8511-2 (paperback)
ISBN 978-951-51-8512-9 (PDF)

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Abstract

Improvisation is commonly understood as a performance or creating something without preparation. As an art form, improvised theatrical plays are created spontaneously on stage without a script. As an applied form of theatre, improvisation has been utilised in fields requiring collaboration and a tolerance for uncertainty, such as in the business and education sectors. This dissertation contributes to the literature in educational research by investigating applied improvisation as a tool to promote student teachers' interpersonal competence. Applied improvisation enables individuals to explore and practise teaching-related encounters in a fictional and psychologically safe context. Psychological safety is particularly important when practising challenging interactions. Despite the fictionality of the context, bodily experiences during improvisations may promote experiential learning.

The research summarised in this dissertation was guided by two primary research questions. First, I asked whether improvisation training influenced student teachers' interpersonal competence and social stress. Student teachers (n = 19) participated in a 7-week (17.5-h) improvisation intervention, comprising the fundamentals of theatre improvisation and status expression (verbal and nonverbal behaviours indicating the social dominance of a person). The impact of the intervention was measured using subjective self-reports (interpersonal confidence, i.e., belief regarding one's capability related to effective social interactions, self-esteem and experienced stress) and a large array of physiological measurements (heart rate, heart rate variability, skin conductance, facial muscle activity, frontal electroencephalogram (EEG) alpha asymmetry and stress hormone cortisol). Self-reports, physiological measurements and Trier Social Stress Tests (TSST; including public speaking) were performed before and after the improvisation intervention. An improvisation course was arranged for the control group (n = 20) following the intervention study. One year later, the long-term effects of improvisation training on self-reported interpersonal confidence were measured in a follow-up study.

Second, I asked how real versus fictional social rejections impact experienced stress and psychophysiological responses. Student teachers (n = 39) participated in an experiment including both real (interview) and fictional (improvisation

exercises) dyadic interactions. In the real condition, student teachers were unaware that the interviewer was an actor trained to include subtle social rejections during the interview by using three types of social rejections: devaluing, interrupting and nonverbal rejections. In the fictional condition, student teachers were informed in advance which social rejection type would be used during a later improvisation exercise. Experienced stress and psychophysiological reactivity during social rejections were measured under both experimental conditions.

Following an improvisation intervention, interpersonal confidence and its components of performance confidence and a tolerance for failure increased relative to controls, whilst one year later the improved performance confidence persisted. Furthermore, a heterogeneous treatment effect was found. Those with the lowest pretest interpersonal confidence score benefited most from the improvisation intervention. No between-group differences in self-esteem were observed. Psychological and physiological indications of relief from performance-related stress were also observed following improvisation training. In addition, interpersonal confidence moderated self-reported and cardiovascular stress responses. Thus, interpersonal confidence may be worth controlling for in future research which examines the effects of interventions aimed at relieving social stress. The results also support the notion that repetition may also diminish performance-related stress, since the control group exhibited decreases in cardiovascular stress during some of the test conditions.

The primary finding regarding the second research question emerged through the absence of any systematic attenuation of the psychophysiological reactivity to fictional versus real-world social rejections. In other words, although student teachers knew that improvised social rejections were fictional, their psychophysiological responses during improvisation remained relatively similar and associated with those of real-world rejections. It appears as though personal relevance and engagement during improvisation explain the relatively similar bodily responses. This result suggests that interpersonal encounters can be realistically modelled through applied improvisation.

In this dissertation research, I also produced a validated self-report measure, the Interpersonal Confidence Questionnaire (ICQ), to evaluate the impact of social interaction training relying on applied improvisation. Using an additional dataset ($n = 208$), I validated the questionnaire and examined the impact of improvisation training on a larger sample. A confirmatory factor analysis identified six factors—performance confidence, flexibility, listening skills, a tolerance for failure, collaboration motivation and presence—that contribute to interpersonal confidence. Thus, the ICQ appeared valid and reliable as a self-report measure of interpersonal confidence.

In summary, the findings from this research indicate that a relatively brief improvisation intervention promotes interpersonal confidence, specifically amongst those with low interpersonal confidence. Furthermore, improvisation

training serves as an intervention against performance anxiety and generates long-term improvements to performance confidence. This dissertation provides a theoretical framework and empirical support for the application of improvisation as a tool to develop interpersonal competence skills, particularly within professions requiring face-to-face interactions. Regardless of the fictionality of the improvisational context, genuine emotions and experiences may emerge, serving as experiential learning experiences. The significance of these findings may extend to theatre-based practices and drama education in general, which rely on holistic action and personal engagement in fictional contexts. The findings agree with previous research, suggesting that including the improvisation method in teacher education curricula can enhance student teachers' interpersonal competence as well as their skills related to sensitive and responsive teaching. Finally, this dissertation contributes to social neuroscience by recommending an ecologically valid experimental design wherein naturally unfolding social interactions can be achieved using improvisation techniques.

Keywords: experiential learning, fictionality, improvisation, interpersonal confidence, intervention, psychophysiology, social interaction, social rejection, social stress, teacher education, theatre-based practices

Helsingin yliopisto, Kasvatustieteellinen tiedekunta
Kasvatustieteellisiä tutkimuksia, numero 144

Sirke Seppänen

'Mitä tapahtuisi, jos sanoisinkin "joo"?'
Improvisaatioharjoittelun välittömät ja pitkäaikaiset vaikutukset opettajaopiskelijoiden subjektiivisilla, hormonaalisilla ja psykofysiologisilla vasteilla mitattuna

Tiivistelmä

Improvisaatiolla tarkoitetaan yleisesti esiintymistä tai toimintaa, jota ei suunnitella etukäteen. Teatterissa improvisoidut näytelmät syntyvät näyttämöllä spontaanisti ilman käsikirjoitusta. Soveltava teatteri hyödyntää improvisaatiota aloilla, joissa tarvitaan yhteistyötä ja epävarmuuden sietokykyä, kuten liike-elämässä ja koulutuksessa. Tämä väitöstyö tarkastelee teatterilähtöistä improvisaatiomenetelmää opettajakoulutuksen kontekstissa. Käyttämällä improvisaatiota soveltavan teatterin muotona on mahdollista tutkia ja harjoitella vuorovaikutukseen liittyviä kohtaamisia kuvitteellisessa ja psykologisesti turvallisessa ympäristössä. Psykologinen turvallisuus on erityisen tärkeää, kun harjoitellaan haastavissa vuorovaikutustilanteissa toimimista. Ympäristön fiktiivisyydestä, eli kuvitteellisuudesta, huolimatta improvisaatioharjoittelu tarjoaa kehollisia kokemuksia, jotka voivat edistää kokemuksellista oppimista.

Väitöstutkimuksen ensimmäisenä tavoitteena oli selvittää improvisaatioharjoittelun vaikutuksia opettajaopiskelijoiden vuorovaikutusosaamiseen ja sosiaaliseen stressiin. Opettajaopiskelijoille (N = 19) järjestettiin 7 viikon (17,5 h) interventio, jossa harjoiteltiin improvisaation perusteita ja statusilmaisua, eli sanallista ja sanatonta ilmaisua liittyen valta-asemaan vuorovaikutuksessa. Intervention vaikutuksia kartoitettiin itsearviointien (vuorovaikutusvarmuus, itsetunto ja koettu stressi) kautta ja kehollisia vaikutuksia mittaamalla opettajaopiskelijoiden kehollisia vasteita (syke, sykevälivaihtelu, ihon sähkönjohtavuus, kasvolihasten aktivaatio, aivosähkökäyrä ja stressihormoni kortisoli). Fysiologiset mittaukset, Trierin sosiaalisen stressin testit (mm. julkinen puhe) sekä itsearvioinnit suoritettiin ennen improvisaatiointerventiota ja sen jälkeen. Kontrolliryhmälle (N = 20) järjestettiin improvisaatiokurssi loppumittausten jälkeen. Vuorovaikutusvarmuutta mitattiin viivästetyllä kyselyllä vielä vuoden kuluttua interventiosta.

Väitöstutkimuksen toinen tavoite oli syventää ymmärrystä siitä, miten tietoisuus tilanteen fiktiivisyydestä vaikuttaa kokemukseen vertaamalla aidon ja fiktiivisen vuorovaikutustilanteen kehollisia vasteita. Opettajaopiskelijat (N = 39) osallistuivat kokeeseen, joka sisälsi sekä aidon (haastattelu) että fiktiivisen (improvisaatioharjoittelu) vuorovaikutustilanteen. Aidossa tilanteessa

opettajaopiskelijat eivät tienneet, että haastattelijan tehtävänä oli epäsuorasti torjua opiskelijoiden vastauksia vähättelemällä, keskeyttämällä ja sanattomalla torjunnalla. Fiktiivisessä tilanteessa opettajaopiskelijoille kerrottiin etukäteen mitä em. torjuntatapaa improvisaatioharjoituksessa käytetään. Molemmissa koetilanteissa mitattiin koettua stressiä ja kehollisia vasteita epäsuorien sosiaalisten torjuntojen aikana.

Improvisaatioharjoittelu lisäsi osallistujien vuorovaikutusvarmuutta sekä sen osatekijöitä esiintymisvarmuutta ja epäonnistumisen sietokykyä, kun tuloksia verrattiin kontrolliryhmään. Vuoden kuluttua interventiosta esiintymisvarmuus säilyi korkeammalla tasolla kontrolliryhmään verrattuna. Tulosten mukaan improvisaatioharjoittelusta oli hyötyä erityisesti epävarmimmille opettajaopiskelijoille, joilla vuorovaikutus- ja esiintymisvarmuus kasvoi eniten. Itsetunnossa ei havaittu eroa interventio- ja kontrolliryhmien välillä. Sykevälivaihtelu ja kasvolihasten aktivaatio osoittivat, että improvisaatiokurssilaiset olivat rentoutuneempia esiintymisvuoroa odottaessa kuin kontrolliryhmä. Sykevälivaihtelun ja koetun stressin mukaan epävarmimpien kurssilaisten stressitaso laski enemmän kuin varmempien. Tulokset tukevat myös käsitystä, että toistoharjoittelu voi lieventää esiintymiseen liittyvää stressiä, koska myös kontrolliryhmässä stressivasteet laskivat osassa esiintymistilanteita.

Väitöstutkimuksen keskeinen löydös vertailtaessa aitoja ja fiktiivisiä vuorovaikutustilanteita oli se, että improvisoitujen ja aitojen sosiaalisten torjuntojen keholliset vasteet eivät systemaattisesti eronneet toisistaan. Toisin sanoen, vaikka opettajaopiskelijat tiesivät, että improvisoidut sosiaaliset torjunnat olivat fiktiivisiä, keholliset vasteet olivat samankaltaisia kuin vastaavassa aidossa tilanteessa. Tulokset viittaavat siihen, että sosiaalisia vuorovaikutustilanteita voidaan mallintaa realistisesti teatterilähtöisen improvisaation keinoin.

Väitöstyö tuotti myös validoidun vuorovaikutusvarmuuden itsearviointimittarin improvisaatiopohjaisten vuorovaikutuskoulutusten vaikutusten arviointiin. Itsearviointimittarin validoinnissa käytettiin konfirmatorista faktorianalyysia ja laajempaa kyselyaineistoa (N = 208). Faktorianalyysi osoitti, että vuorovaikutusvarmuuteen sisältyy kuusi osa-aluetta: esiintymisvarmuus, joustavuus, kuunteleminen, epäonnistumisen sietokyky, yhteistyömotivaatio ja läsnäolo. Tulosten mukaan mittari on myös luotettava vuorovaikutusvarmuuden itsearvioinnin väline.

Tutkimustulosten mukaan jo suhteellisen lyhyt improvisaatioharjoittelu voi lisätä erityisesti epävarmojen henkilöiden vuorovaikutusvarmuutta sekä lieventää esiintymisjännitystä. Esiintymisvarmuuden osalta positiiviset vaikutukset olivat pitkäaikaisia. Väitöstyö tuottaa myös uutta, empiiristä tietoa improvisaatioharjoittelun kehollisista vaikutuksista. Tulosten merkitystä voidaan ulottaa myös muille soveltavan teatterin alueille, joissa teatterilähtöisillä menetelmillä pyritään tuottamaan elämyksellisiä oppimiskokemuksia ja kokemuksellista oppimista. Väitöstutkimus luo teoreettista pohjaa sovelletun

improvisaation käyttämiselle laajemminkin työelämän ja arkipäivän vuorovaikutustilanteiden mallintamiseen. Löydökset vahvistavat aikaisempia kansainvälisiä tutkimustuloksia, joiden mukaan improvisaatio opettajankoulutuksen osana lisäisi opettajan vuorovaikutuskompetenssia sekä opetuksen sensitiivisyyttä ja vuorovaikutteisuutta. Poikkitieteellinen väitöstyö osoitti myös käytännön suuntaviivoja improvisaation ja neurotieteen yhdistämiselle vuorovaikutuksen kokeellisessa tutkimuksessa.

Avainsanat: fiktiivisyys, improvisaatio, interventio, kokemuksellinen oppiminen, opettajakoulutus, psykofysiologia, sosiaalinen stressi, sosiaalinen torjunta, teatterilähtöiset menetelmät, vuorovaikutus, vuorovaikutusvarmuus

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Acknowledgements

No one can write a doctoral dissertation alone, despite only one name appearing on the cover page. I am grateful to all of my supervisors for their rigourous and vigourous support in guiding me through this academic endeavour. Tapio, you were the first to believe in my idea of bridging drama and psychophysiological methods, and you trusted and encouraged me all the way towards pursuing my goals. You also patiently and repeatedly guided me towards focusing on teacher education when I was all over the place with my research and writing. Kaisa, your exceptional ethics and attention to the rights of study participants remain pillars of an invaluable and inspiring model for conducting ethically sound research. Moreover, your requests for clarity in expressing my ideas and results helped me to write better and to keep the viewpoint of the reader in mind. Iiro, your expertise was invaluable, as well as your bold and insightful suggestions and solutions regarding the research design and analysis.

Thank you, Tommi Makkonen. This dissertation would not have been possible without your guidance and support in data acquisition, analysis and writing. You were always there when I needed your advice and your positive attitude lifted my spirit during those times when I felt overwhelmed. You are a genius, a wizard and a superhero. Thank you to my outstanding co-authors, for your valuable input and insight. Mikko Anttonen, you joined the team out of a pure interest in the topic and brought along your expertise and enthusiasm. Olli Saari, you helped me to take my first steps into the world of statistics, and I so admire your support and patience. Johanna Novák, I had the immense pleasure to get to know you and your open mind. You allowed me to use the questionnaire you developed and the data you collected. I hope we will continue working and improvising together in one form or another.

Thank you, Laura Haveri, Tanja Linnavalli, Olli Saari and Kalle Toikka, for piloting the experimental design with patience and perseverance. I am also indebted to Tuija Härkönen, Seppo Kalliomäki, Mika Perälä and Anu Pyykkö for acting as stone-faced judges during the Trier Social Stress Tests. Special thanks go to Mika for acting also as an interviewer and planning the interview together—I can always trust your creativity, collaboration and superior improvisation skills. I am also grateful to Jari Ranimo, who first introduced to me the Johnstone’s improvisation method, and Pauli Mahlamäki, whose theater courses brought Mika, Jari and I together. Pauli, a tiny seed of that creative madness you taught must have germinated within me, and eventually sprouted into this dissertation.

I am immensely grateful to all of the members of Sattumateatteri and Impresso, individuals with whom I was able to gradually develop my improvisational skills. I remember how laughter, joy, excitement and flow filled our weekly 3-hour improvisational sessions, during which each one of us took risks, supported one another and miracles happened. I genuinely became addicted to our improvised adventures, and I miss you all.

My sincerest thanks also go to all my dance students and colleagues, who patiently accepted and endured my experimentations through the introduction of drama methods, role playing and improvisation to our dance lessons and performances. I would not have grown to become a drama teacher without your understanding of and engagement with even the wildest ideas I proposed.

I am enormously grateful for the student teachers who participated in this study. It was an immense pleasure to work with you, and I hope the improvisation courses helped each of you reach your goals in life. Your voices echo throughout this dissertation, beginning with the title.

Thank you, Stefanie Giebert and Andrei Rodionov for your insightful feedback on the manuscripts and the summary of this dissertation, and special thanks to Vanessa Fuller for English-language proofreading of my writing. I also extend my gratitude to the preliminary examiners, Jari Hietanen and Mathieu Hainselin, for their outstanding feedback, which helped to clarify and balance the contents of this dissertation.

Thank you, Mari Tervaniemi, for allowing me to use the mobile EEG devices from the Cicero Learning Network in this research. I am grateful to the KEHU programme, which develops teacher's holistic communications skills through professional interactions, for including my research in the programme and funding the cortisol analysis of this dissertation. In addition, I am grateful to the Doctoral School in Humanities and Social Sciences at the University of Helsinki for funding travel grants to conferences and covering the article processing fees related to the publications summarised in this dissertation. I also extend much gratitude to the Finnish Work Environment Fund for a scholarship that supported the finalisation of this dissertation.

Finally, I extend my thanks to my family members for their unconditional support and understanding throughout this process. Seppo, you are an essential part of whatever I do. I knew I can count on your support at every step of this lengthy dissertation process. Jesse, you helped me with physics assignments and now your own doctoral dissertation research has begun. I hope you enjoy the journey and maintain your passion for science—you already have it all. Mira, thank you for helping me with my English-language skills; I wish I spoke it as beautifully as you do. Tinja, thank you for sharing your theatre studies with me—I write about the world of theatre, but you live and enjoy it to the fullest. Finally, Mum and Dad, I learned from you the most important lessons in life: kindness and courage. Whilst my father passed away a while ago, I can see his proud smile for

me as I eventually climbed the academic stairs to this point. This dissertation is dedicated to his memory, to his love and to his support.

Vantaa 13.5.2022
Sirke Seppänen

List of original publications

I. Seppänen, S., Tiippana, K., Jääskeläinen, I., Saari, O., & Toivanen, T. (2019). Theater Improvisation Promoting Interpersonal Confidence of Student Teachers: A Controlled Intervention Study. *The European Journal of Social & Behavioural Sciences*, 24(1), 2770–2788. https://doi.org/10.15405/ejsbs.244

II. Seppänen, S., Toivanen, T., Makkonen, T., Jääskeläinen, I. P., Anttonen, M., & Tiippana, K. (2020). Effects of Improvisation Training on Student Teachers' Behavioral, Neuroendocrine, and Psychophysiological Responses during the Trier Social Stress Test. *Adaptive Human Behavior and Physiology*, 6(3), 356–380. https://doi.org/10.1007/s40750-020-00145-1

III. Seppänen, S., Toivanen, T., Makkonen, T., Jääskeläinen, I. P., & Tiippana, K. (2021). The Paradox of Fiction Revisited—Improvised Fictional and Real-Life Social Rejections Evoke Associated and Relatively Similar Psychophysiological Responses. *Brain Sciences*, 11(11), 1463. https://doi.org/10.3390/brainsci11111463

IV. Seppänen, S., Novák, J., Toivanen, T., & Tiippana, K. (2021). Validated Interpersonal Confidence Questionnaire to Measure the Impact of Improvisation Training. *European Proceedings of International Conference on Education and Educational Psychology EpICEEPSY*, 1–27. https://doi.org/10.15405/epiceepsy.21101.1

In the text, the publications are referred to using their Roman numerals (I–IV).

Abbreviations

ANOVA	Analysis of variance
ANS	Autonomic nervous system
CFA	Confirmatory factor analysis
CFI	Comparative fit index
ECG	Electrocardiography
EDA	Electrodermal activity
EEG	Electroencephalography / -gram
EMG	Electromyography / -gram
ERP	Event-related potential
ERQ	Emotion Regulation Questionnaire
FDR	False discovery rate
FIR	Finite impulse response
fMRI	Functional magnetic resonance image / -ing
GDPR	General Data Protection Regulation
HF	High frequency
HPA axis	Hypothalamus–pituitary–adrenal axis
HR	Heart rate
HRV	Heart rate variability
IC	Interpersonal confidence
ICQ	Interpersonal Confidence Questionnaire
JN procedure	Johnson–Neyman procedure
LF	Low frequency
pNN50	Proportion of successive heartbeat intervals exceeding 50 ms
RM-ANOVA	Repeated measures analysis of variance
RMSEA	Root mean square error of approximation
RMSSD	Root mean square of successive heartbeat differences
RR interval	Time between two successive R waves of the QRS complex on the electrocardiogram
RSE	Roserberg's Self-Esteem Scale
SCR	Skin conductance response
SRNR	Standardised root mean square residual
STDHR	Standard deviation of the heart rate
TLI	Tucker Lewis index
TSST	Trier Social Stress Test

Prologue

2007
We spent the evening at the house of a member of our amateur theatre group. At some point, one of us was asked to show how to improvise in the Johnstone style, with which he had recently become familiar. He was a bit reluctant at first. He said that it is not just about techniques; you cannot understand it by doing some isolated games. It is much more than that, he said, it is about becoming a better person for one another. Yet, we began by doing one of the basic improvisation exercises, writing letters word-by-word. I was thrilled and wanted to learn more. Could it really be that easy and fun to become a better person?

2013
I had finished teaching an improvisation workshop and I was packing up my teaching materials. One of the participants came to thank me for the course and discuss some details. She studied psychology at the university, and found improvisation, especially status expression, inspiring. Then, she asked about the theory behind improvisation. I could not answer. Isn't improvisation quite self-explanatory? A complete package of both theory and practice? Or had I not dug deeply enough? Did I pass on just some loose claims and beliefs about interpersonal behaviour? I became irritated and began to search for more information in order to justify improvisation.

2014
A Google search on 'status expression' led me to read about how somebody had studied brain activity while a person's status was challenged. Findings were unsurprising, with the results indicating negative emotions. But, I was amazed by the fact that it was possible to measure brain activity during a very similar episode we addressed during improvisation classes. Perhaps I might find a solid theoretical basis for improvisation within neuroscience?

2015
Someone was presenting her doctoral dissertation at the annual education fair. The researcher claimed that teachers view empathy as the most valuable tool in their work. Suddenly, I realised that I must write a dissertation as well, about learning social interaction skills and what happens in the brain while improvising. Thus far, improvisation had given me so much: qualification as a drama teacher, a bunch of new friends and a whole new perspective for life. I wanted to give something back in return.

These moments stand out among the most vivid memories I have experienced along my improvisational journey to this dissertation. I would call them flashbulb memories, since for each I remember the time of day, the light in the room, my location at the time and even the goosebumps that erupted on my skin in the moments. As a drama teacher, I also understand these memories as essential plot turns, points of no return, whereby I became aware of new possibilities and challenges in my personal storyline.

Today, more often than not, I still use a drama exercise known as *marking the moment*[1], referring to the moment of flashbulb memory formation, as the last activity for any improvisation course I teach. I ask participants to look at the classroom and recall a moment during the course when they experienced something relevant to them. This can be anything: succeeding or failing in a task, remembering something or someone linked to a topic or an insight related to the learning aims or themselves. Then, I ask participants to go to the precise spot in the room where they were during that moment and to share the moment with the group if they wish to. Typically, everyone is willing to share, since we have worked hard to create a psychologically safe environment within the group, whereby sharing a piece of personal information of their own choosing is no longer an issue. I am always amazed by their elaborate descriptions about what they experienced and its importance to them. These shared moments from the last ten years or so and the recurring themes within them have greatly inspired the experimental design of this dissertation.

Apart from simply a journey to the world of improvisation, this dissertation also represents a part of a lengthy academic voyage. My academic career began by exploring intercultural encounters. With a background in studies of comparative religion and international politics, I focused on the conflict between the Western and Islamic worlds. Since then, my focus shifted to study interpersonal encounters, first when gathering experiences as a dance teacher and performing artist and later when completing my qualification as a drama teacher. Today, I am fascinated by the possibility of peeking into the brain and the body of an individual during social interactions. This long and winding road might appear random and inconsistent. However, the journey from international conflicts to the brain activity of a single person has been driven by my persistent passion for and desire to understand human social interactions. Fundamentally, cultures have always and will continue to interact via individuals.

Thus, how can we avoid or minimise conflicts and improve interpersonal communications? What kinds of signals—verbal or nonverbal, conscious or

[1] Neelands and Goode, 2015, p. 127.

unconscious—do we send and receive? My dance career taught me to use my body as a tool to connect with the world. For dance teachers, it is natural to look at the body from head to toe, to touch the body and communicate nonverbally using the body. Today, having moved from dance to research, I still use the body as a source of information when I attach electrodes to the skin of study participants to measure their physiological responses. Through this embodied perspective, my mission through this dissertation is to enhance constructive social interaction by understanding the bodily responses to interpersonal behaviour.

My methodological strategy for fulfilling this mission relies on the use of psychophysiological methods to investigate the impact of theatre-based improvisation on interpersonal behaviour. This interdisciplinary approach contributes a novel, biological layer to the accumulation of knowledge on improvisation, and theatre-based practices in general. In terms of learning, the bodily focus links to experiential learning. To learn experientially means not only engaging in doing something, but also reflecting on the experience of doing to increase one's knowledge of a topic. The *marking the moment* exercise described above provides one example of experiential learning, aligned with socioconstructivist learning theory, where knowledge and understanding are constructed through interactions with others. These methodological and theoretical approaches have framed the form and focus of this dissertation.

This dissertation focuses on teachers' interpersonal communication. Teaching happens through interaction—either face-to-face or remotely via digital equipment. Including improvisation in teacher education curricula might provide a tool via which to enhance student teachers' abilities to create a positive learning environment and enhance their flexibility in ever-changing classroom situations as well as their sensitivity and reciprocity in communicating with students, their parents and colleagues. Ultimately, I hope that future student teachers will graduate with a handful of vivid, lasting and empowering flashbulb memories for their own journeys.

1 Introduction

I am; therefore, I improvise.

This paraphrase of Descartes' statement, 'I think; therefore, I am', is the motto of my friend and colleague, Mika Perälä,[2] a skilled improviser in music, theatre and life. For me, as an educator by profession, this motto translates to, '*I teach; therefore, I improvise*.'

Improvisation[3] is commonly understood as performing or making something without preparation on the spot and on the spur of a moment. Frequently, improvisation is linked to comedic theatre and witty actors entertaining an audience (Szuster, 2018). But, how does this apply to the profession of an educator? Are teachers not trained to plan their lessons and to establish learning objectives, relevant content and appropriate teaching methods into a coherent whole? More often than not, however, even the best-structured lessons do not proceed as planned. A classroom discussion may take an unpredictable turn, computers may crash and emotional turbulence may disturb a class (Maheux & Lajoie, 2011; Sawyer, 2004). Whilst planning lessons is a crucial part of a teacher's professional skills, sensitivity and responsiveness play equally important roles (Jennings & Greenberg, 2009), allowing a teacher to abandon a plan and intuitively shift the direction of a lesson according to situational challenges. Keith Sawyer (2011), an educational theorist, argues that exceptional teaching requires both structured elements and improvisational brilliance. By accepting the idea that teaching is improvisational, we can use a theatre improvisation method as a tool to develop teachers' flexibility—that is, the ability to adjust behaviour and thinking according to situational demands—in ever-changing classroom situations as well as to promote teachers' sensitivity and reciprocity in communicating with students (Lehtonen et al., 2016). After all, teaching takes place within social interactions—either face-to-face or virtually, as we have learned during the lockdown periods during the last two years of the Covid-19 global pandemic.

This dissertation focuses on the potential of developing student teachers' social interaction competence through improvisation training. Developing teachers' interpersonal competence is important since teacher–student interactions associate with students' academic and social skills development and motivation (Hamre et

[2] Mika Perälä also contributed to this dissertation by co-creating some of the experimental tasks and acting as a collaborator during the experiments in studies II and III.

[3] 'Improv' and 'impro' are also frequently used abbreviations within the theatre community (for a summary of abbreviations, see Szuster, 2018).

al., 2013; Jennings & Greenberg, 2009; Mashburn et al., 2008; Muhonen et al., 2016). Numerous studies recommend improvisation in order to promote teachers' interaction skills (Becker, 2012; Graue et al., 2015; Lehtonen et al., 2016; Lobman, 2006; Sawyer, 2004, 2006; Toivanen et al., 2011) as well as creativity and interactivity in teaching (Corbella, 2020; Lobman, 2005, 2014; Rossing & Hoffmann-Longtin, 2016; Sawyer, 2012).

In this chapter, section 1.1 introduces the concept of improvisation and places the fundamentals of improvisation into an historical context. Next, I develop a theoretical framework to structure the various forms, goals and contexts of improvisation and its applications. Finally, I present the applied improvisation intervention employed in this study, created to serve teacher education. In section 1.2, I introduce *the paradox of fiction,* a seminal concept in this dissertation, as a lens through which to understand the possible mechanism enabling applied improvisation to generate experiential learning. In section 1.3, I present the methodological approach used in this dissertation research, which comprises both psychological and physiological measurements. This introductory chapter concludes with section 1.4 in which I present the research questions guiding this dissertation project.

1.1 Improvisation

> 'The action or fact of doing anything spontaneously, without preparation, or on the spur of the moment; the action of responding to circumstances or making do with what is available; an instance of this. Also: the result of this; something produced or created in this manner. The action or fact of composing or performing music, poetry, drama, etc., spontaneously, or without preparation; this method of performance' ('Improvisation, n.', Oxford English Dictionary).

> 'Teamwork and cohesion at its best' (Student teacher, learning diary, 2017).

The Latin root of the word improvisation, '*improviso',* translates as 'unforeseen; not studied or prepared beforehand.' The first citation above from the *Oxford English Dictionary* defines improvisation as covering various contexts from the performing arts to 'anything', and characterises improvisation as a spontaneous action, result or method. The second citation, a brief statement by a participant of this study, highlights the shared action and togetherness inherent within improvisation. The first definition holds a one-person perspective, and the second represents a multiperson perspective. While it is certainly possible for one person

to improvise a poem, melody or dinner using just their imagination or leftovers from the fridge, improvisation is understood in this dissertation as *co-created*, where persons interact spontaneously with each other and with the environment.

Figure 1 illustrates the context of improvisation applied in this study, which draws from DeMarco's philosophical conceptualisation of improvisation (2012). According to DeMarco, improvisation represents a continuum, where the artistic end refers to improvisation as an art form, including theatre, music, dance, circus, literature and the visual arts. At the other end of the continuum, improvisation represents something fundamental to our existence in the world, since we respond immediately and adapt constantly to complex environments (DeMarco, 2012; Maheux & Lajoie, 2011). In other words, everyday life necessitates that we improvise when we meet people, answer a phone call, play football or teach a class. From various forms of art, this dissertation focuses on *theatre improvisation* and its applications, whereby the raw material for improvisation constitutes everyday dialogues, commonplace gestures, postures and facial expressions. Furthermore, theatre improvisation is examined at the intersection between performance and applied theatre.

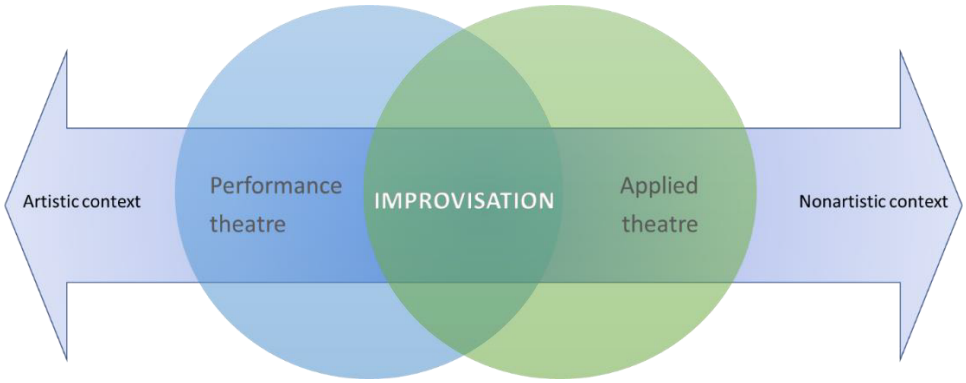

Figure 1. Improvisation in the study context

Improvisation in the context of *performance theatre* comprises both improvised plays on stage ('pure' improvisation, a performance created on-the-spot without a script or preparation) and a training method to develop actors' resources, such as liberating an actor's body and imagination. Apart from training the actor for improvised plays, improvisation facilitates developing a character role for traditional, scripted plays, such as experimenting with a character's reactions in off-scripted scenarios (Frost & Yarrow, 2015, pp. 62–63). Additionally, improvisation can aid scriptwriting and generate material for a novel theatre play. Situations, characters and their relationships might be improvised, along with emerging, more suitable elements chosen for the final play (Frost & Yarrow,

2015). For example, the *devising* method relies on improvisation to collaboratively create a performance without a pre-existing script (Heddon & Milling, 2015, p. 3).

Applied theatre, on the other hand, uses theatrical principles and practices, such as improvisation, in nontheatrical settings to achieve outcomes beyond the artistic experience itself. These outcomes represent, amongst others, the promotion of empowerment, capacity-building or social transformation (Baldwin, 2009; Taylor, 2003). For example, Özmen (2010) used actor training methods to foster student teachers' professional teacher identities and nonverbal immediacy (Andersen et al., 1979; Mehrabian, 1968), including behaviours that improve psychological closeness across communicators. Since the primary objective of applied theatre is to address personal or social change instead of producing a performance, the absence of an audience is characteristic of various forms of applied theatre.[4] Whether with an audience or not, applied theatre includes improvisation as an important method across various games and exercises (Dudeck & McClure, 2018). In this dissertation, improvisation as an actor training method was applied in the context of teacher education to promote student teachers' interpersonal competence. As such, interpersonal competence refers to motivation, knowledge and skills associated with social interaction, in line with Spitzberg's competence theory (1981).

1.1.1 Historical context

In this section, I place the fundamentals of improvisation within an historical context. Rather than providing a comprehensive history of improvisation, I present those epochs and pioneers which help us to understand the scope of improvisation as related to this dissertation research project—that is, applied improvisation in the context of student teachers' interpersonal competence.

Improvisation in theatre is ancient. If we were to briefly step back in time to late sixteenth century Europe, we would find travelling actors' troupes performing impromptu plays outdoors, often commenting on moral, social and political phenomena (Darius, 1996; DeMarco, 2012, p. 82). Instead of strict manuscripts, these troupes used loose plot elements and archetypical characters, allowing actors to adapt local topics and current events to their improvised plays (Encyclopaedia Britannica, n.d.; Holdhus et al., 2016; Vera & Crossan, 2004). This early Italian theatre form was known as *commedia dell'arte (*also, *commedia all'improvviso),*

[4] However, certain forms of applied theatre include an audience, which can also be invited to participate in the play, e.g., Forum theatre (Augusto Boal, 2002) or Theatre in Education (Jackson, 2002).

which translates roughly to 'the theatre of the professionals'. The art form as such vanished by the eighteenth century, largely due to the development of enclosed and decorative theatre spaces and the rise of the function of the director (Frost & Yarrow, 2015, p. 19). Yet, improvisational techniques prevailed, and, even today, the lack of scripts and the use of existing environments remain the core characteristics of improvisation, whether the method is used as an on-stage performance, actor training method or an applied tool for nondramatic purposes.

Improvisation as a component of actor training draws from Konstantin Stanislavski's (1863–1938) approach to acting, which he identified as *the psychotechnique* or *the system.* Stanislavski was a Russian actor–director, who strived for natural and truthful role-playing and experimented with various physical, mental and emotional techniques to create a systematic and teachable methodology of acting (Frost & Yarrow, 2015, p. 29; Noice & Noice, 2018). He used improvisations (or *etudes*) during the rehearsal process as a tool to evoke actors' creativity and stimulate their emotions so that the inner lives of the characters might merge with the actors' own inner selves (Barton, 2018; Scholte, 2010; Stanislavski, 2011; Trenos, 2014). Thus, the actor would be able to create and live the role truthfully and authentically night after night throughout the performance period.

In developing pioneering methods to build and teach an improvisational mindset, the works of Viola Spolin (1906–1994) and Keith Johnstone (1933–) remain seminal. Viola Spolin, who was profoundly influenced by educational theorist Neva L. Boyd's (1876–1963) methods for stimulating creative expression, began developing her training method in 1939 in an attempt to encourage immigrant youth to integrate into American society (Frost & Yarrow, 2015, pp. 64–65; Spolin, 1999; Szuster, 2019). In the 1950s, she began cooperating with her son Paul Sills,[5] a director and also an improvisation teacher. They founded the Game Theatre in 1965 in Chicago to provide improvised performances, where the audience was invited to participate and play along in improvisation games. In the 1960s, Keith Johnstone, originally a classroom teacher, used improvisation to spark the spontaneity and creativity of actors at the Royal Court Theatre Studio in London. Amongst other skills, he coached actors to trust their spontaneous impulses without evaluating emerging ideas as good or bad (Drinko, 2013a; Johnstone, 1989, 1999). He also introduced the concept of *status transactions* as a tool to generate authentic behaviour during improvisational scenes. Status transactions refer to behaviours reflecting the social value, including dominance and submission, of the interacting partners (Johnstone, 1989). Later, he continued

5 Paul Sills (1927–2008) was a co-founder of The Second City theatre in Chicago in 1959. His daughter, Aretha Sills, continues the legacy of Viola Spolin by teaching improvisational theatre workshops in the USA and abroad.

his work in Calgary, Canada, where he established the Loose Moose Theatre in order to teach improvisation.

Both Spolin and Johnstone emphasise spontaneity, creativity and collaboration, despite differences in their approaches in terms of focus and planning (e.g., Koponen, 2004, pp. 66–73). In Spolin's teaching, the focus—or point of concentration, as she termed it—lies in the action or the goal of the action. Johnstone, on the other hand, places the main focus on supporting the partner. Regardless, directing one's attention outwards frees the actors from concentrating on themselves (Drinko, 2013b).

I am familiar with both Spolinian and Johnstonian improvisation, since I have been fortunate enough to receive instruction on both approaches. My first improvisation instructor was only familiar with Spolin, while subsequent instructors were influenced by Johnstone. In terms of planning and focus, I recall how during a Spolinian class following the task instruction we gathered to plan for a few minutes who we were, where we were and what we were doing (Spolin, 1999). Yet, we did not rehearse any dialogue or details of the scene. Then, we improvised the scene, after which the only question our instructor asked from other participants was, 'Did they complete the task?' That is, no emphasis was placed on the quality of our choices nor the finesse of acting, but the focus lay on solving the assigned problem or task. Later, when studying Johnstonian improvisation, we did not discuss the 'who, what and where' before performances, but co-created them during the scene or relied on suggestions from the audience (other participants of the improvisation course), after which the scene immediately began. The instructor side-couched performers to accept and say 'yes' to the reality of the scene and to the ideas emerging during the performance, the ultimate and often the only focus within those improvised scenes.

Over time, these intertwined approaches have evolved to represent the modern, global improvisation scene (Rossing & Hoffmann-Longtin, 2016). The present field of improvisation embraces a large variety of on-stage forms from theatre sports competitions to full-length plays as well as applied forms beyond performance which utilise improvisation as a tool to benefit personal growth, education or business (Aadland et al., 2017; Benjamin & Kline, 2019; Frost & Yarrow, 2015; Kirsten & du Preez, 2010; Schwenke et al., 2020; Vera & Crossan, 2004).

1.1.2 Theoretical approach

Given the ubiquitous nature of improvisation, from the arts to everyday life, it is unsurprising that a strictly hierarchical or canonised curriculum of improvisation does not exist. Frost and Yarrow summarised that 'improvisation has always been good at escaping categories and crossing borders' (Frost & Yarrow, 2015, p. 9).

Thus, the method continually evolves (Paul, 2015), whereby exercises are modified and new ones emerge. A myriad of improvisation games and exercises are accessible online[6] and in printed format. Varying lists of the basic principles of improvisation with slightly different terminologies have been produced (e.g., Aadland et al., 2017; Berk & Trieber, 2009; Ratten & Hodge, 2016; Trotter et al., 2013), providing a rough consensus on the core components of improvisation, such as trust, acceptance, attentive listening, spontaneity, storytelling and nonverbal communication (Zondag et al., 2020) or rapid decision-making, risk-taking, presence, accepting ideas, trust and collaboration (Schwenke et al., 2020).

DeMarco (2012, 2020) provides a more general, theoretical means of structuring improvisation.[7] He discusses improvisation primarily within the context of music, but the theoretical construct remains sufficiently general with a high level of abstraction[8] to fit all art forms and aesthetic tastes. Here, I briefly present DeMarco's two continuum models (artistic versus nonartistic and improvisation versus composition) as the general framework for improvisation. A continuum may represent a superior model (relative to a hierarchical model) to interpret vague concepts such as improvisation, since a continuum allows for middle or grey areas, whereby neither end dominates (DeMarco, 2020). I adopt these two continua to create a two-dimensional model to capture the theoretical background of improvisation in this dissertation (Figure 2).

[6] For example, see https://spolingamesonline.org/ (Spolin Games Online, n.d.).

[7] A few other theoretical models have been presented that situate improvisation in a specific context, such as in organisation theory (Dehlin, 2008) or in literacy (Welsh, 2014).

[8] I have added examples from theatre improvisation to more precisely clarify some of the conceptions.

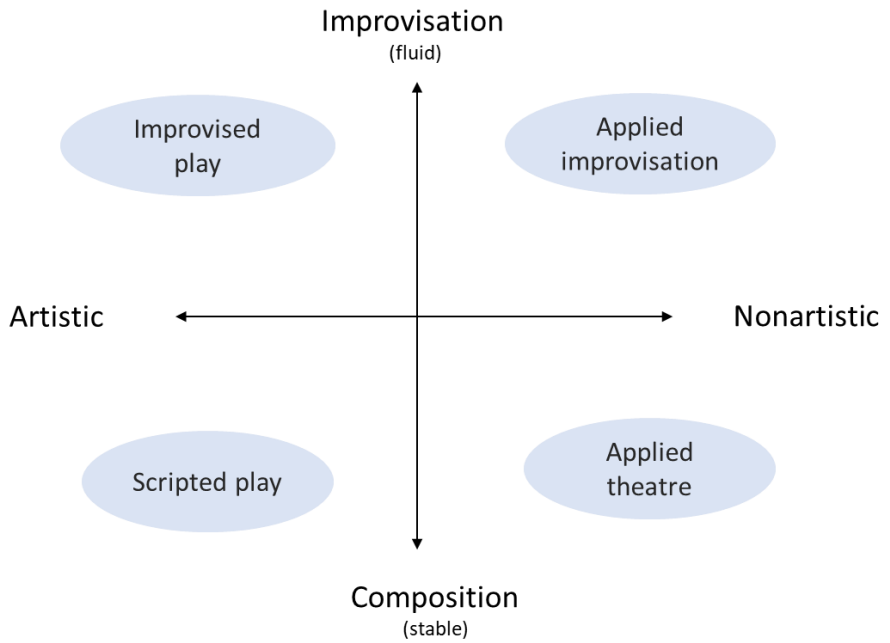

Figure 2. The two-dimensional model of theatre improvisation adapted from DeMarco (2012)

DeMarco claims that we are too involved in improvisation in our everyday lives to possess the intellectual distance necessary to consider and analyse it (2012, p. 113). [9] Therefore, artistic improvisation encapsulates a more distant, yet recognisable analogy for understanding the phenomenon of improvisation. The improvisation that occurs during everyday tasks transfers rather easily to entertainment and to a means of expressing oneself through the arts. The continuum from *artistic* to *nonartistic* improvisation captured in Figure 1 stems from this conceptualisation.

The second continuum involves *improvisation* and *composition* (a melody, text, movement, illustration, etc.) as the opposing ends (DeMarco, 2012, p. 148, 212). DeMarco argues that improvisation and composition share the same fundamental, cognitive state—that is, *selection*. When either improvising or composing, one selects something from *a set of possibilities*. For instance, when an actor improvises a dialogue, at each point a set of possible words, prosodic elements or gestures exist from which one or another may be chosen. This selection can be tacit (implicit, beyond conscious awareness) or explicit

[9] In addition, Heathcote (1967) refers to the nature of improvisation as an inborn quality, as natural as breathing.

(deliberately chosen) (DeMarco, 2012, p. 161). Composition differs from improvisation, whereby one revises or edits what was previously selected.

The continuum allows for the distinction between composition and improvisation to represent a matter of degree. For example, improvising the role of a priest might rely on both improvised and composed elements. Playing a Christian priest in an improvised wedding scene might involve using a commonly known repertoire of gestures and vocabulary, such as the ceremonial phrase, 'Should anyone present know of any reason why this couple should not be joined in holy matrimony, speak now or forever hold your peace'. On the other hand, composing a tune, dance or play may begin by improvising and later develop into a stable work of art (see section 1.1, p. 21). According to DeMarco (2012, p. 231), most improvisations and compositions mix elements from along this continuum.

DeMarco claims that improvisation does not represent a completely free action, but rather an improviser operates under various *constraints*, both internal and external. These constraints refer to rules or restrictions on what can or should be done within an environment and a tradition. Physical, cognitive, spatiotemporal and technological limitations exist. For example, a theatre actor is constrained by the conventions of a given genre (e.g., comedy or melodrama), an emotional state (e.g., anger or happiness) or a selected game or drill. However, there is much room for freedom and originality within these constraints (DeMarco, 2012, p. 107).

Risk represents a common theme in both artistic and nonartistic improvisation. Improvisation requires risk-taking since improvisation goes beyond the planned, and the *uncertainty of outcome* (positive or negative) is always present. Therefore, 'to be prepared when one is unprepared' represents a particular improvisational skill that can be developed through training (DeMarco, 2012, p. 93). Another significant element to the idea of improvisation is *spontaneity*, that is, not planned beforehand, but relying on intuition in the spur of the moment. DeMarco highlights that spontaneous thoughts and actions do not lie in opposition to rationality and logic, as suggested by a common misconception. For instance, theatre improvisers can fly, breathe under water or travel in time within improvisational scenes, but not all improvisations lack rationality and logic (DeMarco, 2012, pp. 63–64).

This dissertation combines the two continuums presented separately by DeMarco (2012) in a novel two-dimensional model of improvisation (Figure 2). This combination allows for greater possibilities in comprehending the versatile forms, goals and contexts of improvisation. The two-dimensional model also refines the position and focus of this dissertation within the field of theatre previously illustrated in Figure 1. That is, improvised and scripted plays are both closer to the artistic endpoint of the continuum, but are situated differently in relation to the stability of the form. The context and goal of both applied theatre and applied improvisation are nonartistic, although applied theatre can include

scripted components,[10] whilst applied improvisation remains more fluid, allowing for the on-the-spot improvisation of scenes. This dissertation focuses on applied improvisation with a nonartistic goal and context, specifically, to promote student teachers' interpersonal competence in teacher education.

1.1.3 Applied improvisation

Applied improvisation is an umbrella term referring to an approach to use the tenets and techniques of theatre improvisation in off-theatre and nonartistic contexts as a tool to pursue specific goals.[11] Since, by definition, the core characteristic of improvisation is the lack of preparation, this feature links to several capabilities. Given an unknown course of events, a tolerance for uncertainty, risk-taking and an ability to remain present and in the moment are all required. Furthermore, the ability to identify and use momentary impulses of both one's own and others' imagination as well as utilising environmental cues are essential. These capabilities can be practiced (e.g., Hoffmann-Longtin et al., 2018; Pereira Christopoulos et al., 2016; Trotter et al., 2013) in order to acquire an improvisational mindset and to benefit multiple purposes.

Previously, Spolin stated that 'the techniques of the theatre are the techniques of communicating' (1999, p. 14). Furthermore, while the foundation of improvisation lies in the realm of theatre, communication skills are needed in everyday life. In other words, if improvisation contributes to the holistic development of actors in the theatre, it can also benefit actors in society (Frost & Yarrow, 2015, p. 66). Improvisation may serve as an experiential learning environment, where personal capabilities can be renegotiated (*ibid*.). In fact, instead of listing disciplines wherein improvisation can be applied, McDermott and Simpson stated, 'You don't apply improvisation, it simply applies', in their foreword to the book *Applied Improvisation: Leading, Collaborating, and Creating Beyond Theatre* (ed. by Dudeck & McClure, 2018). They recommend not focusing merely on the technical skillset of improvisation (games and drills that can be taught and learnt), but also on understanding the 'meta-skills' at play, such as those previously mentioned which include tolerating uncertainty, risk-taking, an ability to remain present and using signals and impulses within oneself and in the environment. In other words, applied improvisation serves as a tool to

[10] For instance, a short, rehearsed performance at the beginning of a forum theatre or as a pretext in a process drama.

[11] Likewise, the Applied Improvisation Network (AIN) defines applied improvisation as 'the use of principles, tools, practices, skills and mindsets of improvisational theatre in nontheatrical settings that may result in personal development, team building, creativity, innovation and/or meaning' (Tint & Froerer, 2014).

access and bring awareness to processes that happen anyway (*ibid*.). This idea agrees with DeMarco's theoretical premise, which explains the analogy of artistic improvisation and everyday life (2012; see also section 1.1.2, p. 26).

In particular, fields requiring adaptability, creativity, reciprocity and a tolerance for uncertainty have benefited from applied improvisation. For example, research on creativity[12] and divergent thinking have consistently identified the positive effects of improvisation interventions (Celume et al., 2019; DeBettignies & Goldstein, 2019; Felsman et al., 2020; Hainselin et al., 2018; Schwenke et al., 2020; West et al., 2017). Alongside individual creativity, co-creativity has been studied within contexts such as teaching (Drinko, 2018; Sawyer, 2003, 2004, 2011, 2012; West et al., 2017) and organisational creativity (Gerber, 2009; Hodge & Ratten, 2015; Ratten & Hodge, 2016; Vera & Crossan, 2004, 2005). Furthermore, fields such as medical education (Gao et al., 2018; Hoffmann-Longtin et al., 2018), marketing skills (Mourey, 2020), clinical social work and psychotherapy (Romanelli et al., 2017; Romanelli & Tishby, 2019) and humanitarian aid (B. S. Tint et al., 2015) have all benefited from improvisation interventions.

Apart from investigating applied improvisation in the context of teacher education, this dissertation examines applied improvisation in the context of social stress—that is, the fear of being negatively evaluated by others relevant to the individual (Wiggert et al., 2015). Research suggests an association exists between improvisation training and diminished social anxiety (Casteleyn, 2019; Felsman et al., 2018; Krueger et al., 2017; Phillips Sheesley et al., 2016). In the research summarised here, I used the Trier Social Stress Test (TSST) to study the impact of improvisation training on the social stress of student teachers. TSST is a highly standardised procedure inducing an acute social-evaluative threat in a laboratory environment (Kirschbaum et al., 1993). TSST includes two tasks: an impromptu speech and a challenging mental arithmetic task performed in front of a jury (Allen et al., 2016). In addition, the preparatory phase (a short period for planning the speech) is considered an essential part of the protocol, which allows researchers to study the anticipatory anxiety of public speaking as well (Boehme et al., 2014; Gonzalez-Bono et al., 2002; Lorberbaum et al., 2004). The stress induction of TSST consists of two factors: uncontrollability and social-evaluative threat (Dickerson et al., 2004; Frisch et al. 2015). Uncontrollability refers to a novel test condition, wherein participants only partially know what to expect. By contrast, a social-evaluative threat refers to the cover story leading participants to believe that their highly personal qualities (assertiveness and nonverbal behaviour) will be

[12] In DeMarco's model, creativity is included in the fundamental idea of selection. Creation involves the selection of material, and both improvisation and composition share the basic process of selection (DeMarco, 2020).

evaluated during the tasks. Here, the impromptu speech was additionally modified to mirror the context of teacher education.

Applied improvisation in teacher education

The idea of applying improvisation to education is not new. For instance, in 1967, Dorothy Heathcote, a pioneer of educational drama, argued that improvisation is not merely a subject area, but a tool for teachers of science as well as of the arts (Heathcote, 1967). Özmen (2010) provided the justification for incorporating theatre acting theories into teacher education. For example, acting resembles teaching in capturing and holding the attention of the audience (or class), using one's voice and body language effectively, and following a script (or a lesson plan) to communicate predefined meanings. Therefore, certain areas of actor training might contribute to teacher education and the development process of teacher identity. Specifically, Özmen highlights the impact of fostering teachers' nonverbal immediacy behaviour, such as nonverbal actions signalling warmth, communicating their availability, decreasing distance and promoting involvement between teacher and students.

The relationship between performing and teaching has also been studied by researchers such as Whatman (1997), Sawyer (2004), Morales–Almazan (2021) and Maheux and Lajoie (2011). Whatman emphasised the similarity between role adoption in performing and teaching and proposed re-examining teaching as art, specifically as an improvisational art. In addition, Sawyer extended the metaphor of teaching as an improvised performance by including classroom discussions. Thus, a classroom discussion is understood as improvisational because the flow of the class is unpredictable, emerging from teacher and students together similar to processes in theatre improvisations (see also Barker, 2019). Morales–Almazan used improvisation as a metaphor for active and creative teaching, which aligns with the emotional and cognitive state of students (see also Lehtonen et al., 2016). Since improvisation in the arts can be taught and mastered systematically, the same approach applies to developing and promoting active teaching. Furthermore, Maheux and Lajoie (2011) state that improvisation takes place in teaching whenever a teacher allows for students' questions or explanations, solicits their reasoning or observations or asks them to explore and come up with their own procedures. The point of departure lies in recognising the presence of unpredictability, which bridges teaching with improvisation. In line with this, Toivanen et al. (2011) suggest that, since teachers must possess the ability to manage unrest, uncertainty and unpredictable situations, improvisation training serves as one way of improving teacher education.

1.1.4 Applied improvisation intervention in this study

The intervention employed in this dissertation was developed based on the core concepts of improvisation as presented by Johnstone and Spolin (Johnstone, 1989, 1999; Spolin, 1999) and in accordance with subsequent literature on the characteristics of improvisation (e.g., Lobman, 2005; Weis & Arnesen, 2014). In addition, I relied on my own experience as an improvisation instructor since 2008. The improvisation course (7 weeks x 2.5 h) aimed to increase student teachers’ 1) awareness of their interpersonal competence, 2) ability to assess how improvisation contributes to constructive interaction and 3) ability to apply the principles of improvisation in their teaching. Figure 3 illustrates the model of the course’s stepwise learning process in terms of the fundamentals of improvisation. The following description of the learning process is peppered with topic-related excerpts from participants of this improvisation course. Additional details of the course appear in section 2.2.1 (p. 46).

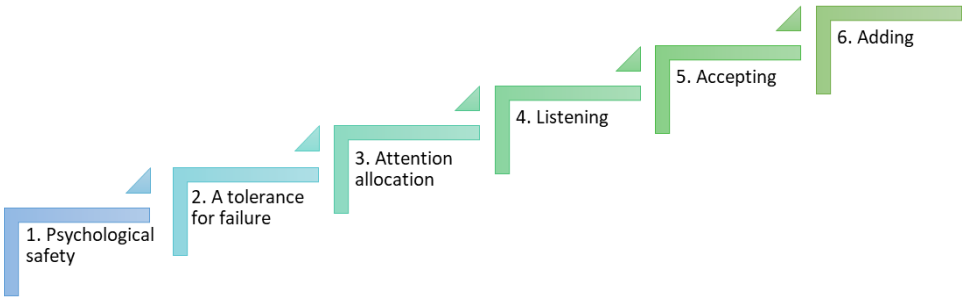

Figure 3. Learning process in improvisation

Step 1. Psychological safety

> ‘If I want people to free-associate, then I have to create an environment in which they aren’t going to be punished or in any way held responsible for the things their imagination gives them’ (Johnstone, 1989, p. 118).

> ‘The first class began with a drama contract. I believe this was a vital component to this kind of work. If I teach similar classes in future, I will certainly begin the course with such a contract’ (Student teacher, learning diary, 2018).

> ‘“That was just my character fooling around”, I focus on thinking and laughing at myself’ (Student teacher, learning diary, 2018).

A ‘drama contract’ refers to a working agreement, wherein the ground rules (behavioural and procedural expectations during the dramatic work) for the group are discussed and agreed upon in order to create a psychologically, socially and physically safe learning environment (Baldwin, 2008, pp. 46–47; Baldwin & Neelands, 2012, p. 102). A core component in generating psychological safety is the use of fiction. Each individual improvisational scene is fictional, where participants assume roles, allowing them to ‘walk in the shoes of others’. This mutually agreed upon fiction creates cognitive and emotional distance,[13] allowing experimentation with new attitudes and modes of behaviour and facilitating the confrontation of sensitive topics (Mendelson & Papacharissi, 2007). Furthermore, the drama contract should be continually monitored by the facilitator and readjusted in case fictional content generates stress or anxiety within the group. While the drama contract initiates psychological safety, the next steps strengthen it.

Step 2. A tolerance for failure

> ‘I also learned to appreciate “mistakes” because I learned the most from them’ (Student teacher, learning diary, 2017).

> ‘During the sessions, I developed a tolerance for failure and also brought up my unfinished ideas—that is, in a way, agreeing to be vulnerable’ (Student teacher, learning diary, 2018).

When experimenting with something new, there is always a possibility of failing. A tolerance for failure is practised with exercises, whereby succeeding in a task is nearly impossible often due to the time pressure. When inevitable mishaps occur, they are applauded and embraced instead of shamed and hidden. The purpose of these exercises is to desensitise individuals to the fear of failure and to reframe mistakes merely as events, whereby something happens other than what was anticipated or expected (Barrett, 1998; Vera & Crossan, 2005). The emotional

[13] Bertolt Brecht (1898–1956), a German playwright, poet and theatre theorist, introduced the principle of the ‘distancing effect’ (*Verfremdungseffekt*, also referred to as the *V effect*), which refers to inhibiting the emotional engagement of the audience to the reality of the play (Brecht & Bentley, 1961). Instead of empathising with actors, Brecht attempted to entice spectators to critically view the reality on stage and encouraged them to reflect upon, for example, social injustice. The V effect was accomplished by actions such as interrupting the reality of the play with music or film clips, revealing the plot beforehand or by actors addressing the audience directly (Kilkku, 2017, pp. 135–154). The V effect has provided a foundation for using fiction in applied theatre to achieve psychological distancing.

connotation of mistakes shifts from negative to positive, [14] and becomes crystallised as '*a mistake is a gift'*, a common motto among improvisers (Weis & Arnesen, 2014). Embracing a mistake means that it is woven into the scene, and given a context where it actually benefits the scene.[15] Thus, there is no need to protect oneself from making mistakes, which helps risk-taking and both spontaneous acting and reacting (Rossing & Hoffmann-Longtin, 2016).

Step 3. Attention allocation

> 'I began to trust the circumstances and I let go of planning' (Student teacher, learning diary, 2017).
>
> 'Interacting with another person is so inherently interesting and demanding that my own performance was pretty easy to forget' (Student teacher, learning diary, 2018).
>
> 'For me, giving up planning took several sessions, but luckily I learned to let go of it' (Student teacher, learning diary, 2018).

Another benefit of the diminishing need to monitor possible mistakes is that attention can be allocated to others rather than worrying about the success of one's own actions (Drinko, 2013b). In other words, improvisation trains individuals to focus on the present instead of clinging to the past or anticipating the future. Exercises that achieve an 'empty mind' help to develop skills related to being present and resisting planning.

Step 4. Listening

> 'I felt that by learning improvisation I also learned to listen and react' (Student teacher, learning diary, 2018).

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[14] The emotion regulation theory (Gross, 1999, 2015; McRae, 2016) comprises five categories of emotion regulation strategies (situation selection, situation modification, attentional deployment, cognitive restructuring and response modulation) in order to regulate emotions of the wrong magnitude, type or duration. Reframing mistakes as positive resembles the emotion regulation strategy of cognitive restructuring or *cognitive reappraisal*. Cognitive reappraisal refers to changing the way we think about a situation in order to change how we feel about it (Brooks, 2014; Kalisch et al., 2005; McRae, 2016).

[15] As the famous quote from Miles Davis points out, 'There are no wrong notes in jazz. It's the note you play afterwards that makes it right or wrong' (see also Mike del Ferro, 2020).

> ‘It’s like having new eyeglasses while watching other people’ (Student teacher, learning diary, 2017).

Disengaging self-centred rumination and allocating attention outwards allows individuals to listen closely in the present moment: what happens, who talks and how others react. According to Frost and Yarrow, listening without preconceptions helps individuals to allow the present condition be what it *can* be rather than making it something it *ought to* be (2015, p. 12, original italics). Listening exercises train individuals to concentrate on the verbal and nonverbal expressions of the partner and group, referred to as ‘offers’ in improvisation, as well as environmental cues. In this sense, listening means more than hearing what is said—an offer can be ‘any behaviour that can be noticed’ (Wiener, 1999, p. 60) or a subtle change in partners’ attitudes or behaviours. After all, it is possible to improvise an entire scene without any spoken dialogue, such as through miming.

Step 5. Accepting

> ‘For me, the course emphasis on not needing to be funny was particularly significant. All ideas are equally valid and there is no reason to assess them based on whether the association or idea is strange or boringly ordinary’ (Student teacher, learning diary, 2018).

No harmful consequences follow whether you robbed a bank or unleashed a wild beast in an improvised scene. In fiction, there is no need to censor or reject any idea or offer; they are unconditionally accepted. Offers are not evaluated as good or bad, boring or funny. Instead, absolute support is extended to any idea a co-improviser presents. This acceptance, once again, promotes and maintains psychological safety, since all ideas are woven into a scene one way or another.

A special emphasis is placed on accepting the first idea that comes to mind, even though it might feel bland or banal. What seems boring to one, might be brilliant to another. Johnstone underlines this with his repeated advice to avoid trying to be original (Johnstone, 1989, pp. 87–88). An attempt at originality, cleverness or humour creates a pressure to succeed, shifting attention inwards (evaluating and selecting one’s actions), thereby disengaging the individual from the present moment. Acceptance exercises train individuals in skills related to intuition and spontaneity, and building the mindset that ‘everything is a gift’, that is, a useful input (Rossing & Hoffmann-Longtin, 2016).

In addition, the opposite of accepting—that is, rejecting an idea (also ‘negating’ or ‘blocking’)—is addressed at this point. The goal is to learn to identify even the most indirect and subtle verbal and nonverbal rejections and avoid using them since even partial rejections inhibit collaboration between improvisers (Weis & Arnesen, 2014). For example, the common expression ‘but’

devalues and partially negates the meaning of a previously mentioned topic, even when beginning with an affirmative 'yes' *('Yes, I like your idea of free seating, but we aim to organise a more formal dinner')*. Furthermore, interrupting a conversation partner and nonverbal rejecting (showing signs of boredom, avoiding eye contact and the like while the partner speaks) represent commonly occurring subtle rejections. The negative consequences of rejection behaviour, in particular, interrupting, was described as early as 1728 by Luigi Ricoboni, a renowned *commedia dell' arte* actor:

> 'But the drawback of improvisation is that the success of even the best actor depends upon his partner in the dialogue. If he has to act with a colleague who fails to reply exactly at the right moment or who interrupts him in the wrong place, his own discourse falters and the liveliness of his wit is extinguished' (Darius, 1996, p. 14).

At times, accepting the idea of a partner means abandoning one's own idea. This ability to adapt for the benefit of a scene or accept constant change (Wiener, 1999) is also practised at this point.

Step 6. Adding

> 'I realised, at that moment or just after that, how we encouraged each other with a "yes and" style and everyone tried to make each other look good. For me, it was significant because before that I was just thinking about how I could make myself look good' (Student teacher, learning diary, 2018).

The final step builds upon the previous stages, and introduces the ability to contribute a new offer to the improvisational scene. The basic 'yes and' rule of improvisation (Johnstone, 1989) consists of a categorical acceptance of any verbal or nonverbal offer as a part of a scene ('yes') accompanied with a new spontaneous, related association ('and'). When the co-improviser 'yes ands' you back, a reciprocal interdependence or dialogue emerges. When you succeed, I succeed, or, as Johnstone states, 'Your work is good if your partner enjoyed working with you' (1999, p. 59). Improvising is nothing more or nothing less.

Following this stepwise learning process, wherein the basics of improvisation are practised, exercises may be more difficult by varying the specified circumstances (e.g., a sudden change of emotion or style). Additionally, further elements such as narrative skills and character-building possibilities may be introduced. Here, *status expression,* a key concept in Johnstonian improvisation, was included in the course. In improvisation, status does not refer to social standing or occupational prestige, but is understood as a variety of verbal and nonverbal behaviours indicating the social dominance of a person (Johnstone,

1989, pp. 33–39; Mason et al., 2014; Wiener, 1999). Status exercises comprise a repertoire of gestures, voice prosody, body postures and the use of space. They highlight one's ability to perceive as well as produce the bodily nuances of interpersonal behaviour. Status behaviour is often subtle and subconscious, but status exercises help one become aware of and manipulate one's verbal and nonverbal behaviour. Therefore, status is not a permanent feature of an individual, but can be chosen and displayed according to situational requirements.

In summary, to learn to improvise is to learn to be present, accept the present and intuitively and reciprocally build upon elements of the present situation. Wiener (1999, p. 52) characterises improvisation as an activity in which participants 'continually adjust to changes in circumstance and character as those are invented in the moment'. Later on, this acquired improvisational skillset can be advanced and refined by practising skills such as dramaturgy, character building, vocal expertise and other elements relating to an actor's training, which fall beyond the scope of this dissertation.

1.2 Fact or fiction?

> 'As early as during the pretest, I was surprised that rejections annoyed me, even though I knew the situation was fictional. The same happened during the second class when we were blocking each other's ideas' (Student teacher, learning diary, 2017).

Engaging in fictional works of art—films, theatre plays or novels—can elicit screams of fear or tears of joy and sorrow. Why do we engage in such intense emotions, despite knowing that the works of art are pure fiction? This phenomenon, known as *the paradox of fiction* (also *the suspension of disbelief)*, refers to emotions we feel towards fictional characters and events despite knowing that they do not exist (Coleridge, 1817; Cova & Teroni, 2016; Muckler, 2017; Radford & Weston, 1975; Young, 2010).

The paradox of fiction relates to improvisation and experiential learning (Kolb, 1984) through its fictional and experiential nature. In particular, applied improvisation, wherein various learning objectives are pursued via improvising fictional scenarios, may benefit from understanding the nature of the paradox of fiction. That is, while improvisational scenes frequently simulate reality, they are always and entirely fictional. If genuine emotions, comparable to those elicited in the real world, emerge within a fictional context, improvisation may provide a safe, fictional environment in which to explore sensitive and challenging topics reflecting everyday life.

Previous research suggests that holistic engagement (Hatton & Nicholls, 2018; Henry, 2000; Sperduti et al., 2016; Toivanen et al., 2011) and experiential learning

may emerge despite a fictional context. In other words, reality is not a necessary condition for evoking genuine emotions and experiences. Since emotional experiences comprise biological and psychological factors, both physiological measurements and self-assessments have been employed to evaluate these experiences (Kim et al., 2018).

Several studies on the paradox of fiction have reported contradictory responses when comparing real-life and fiction-induced contexts. Geen (1975), Mendelson and Papacharissi (2007) and Mocaiber et al. (2010) found stronger electrophysiological and self-rated emotional responses to real-life versus fictional stimuli (videos and pictures). In addition, Sperduti et al. (2016) found a diminished subjective emotional experience in response to fictional versus real videos, but observed no difference in physiological arousal measured through electrodermal activity. In relation to the lack of a difference in emotional responses, Zadro et al. (2004) reported hurt feelings during a computer game despite players understanding that they were competing against a computer. Similarly, Goldstein (2009) found equivalent emotional responses elicited by identical film clips labelled as fiction or based on real events.

The degree of realism or the authenticity of stimuli has been manipulated using other comparisons rather than the real versus fiction dichotomy, such as real versus digital or real versus virtual stimuli. For instance, Siri et al. (2018) compared real and digitally reproduced stimuli and reported similar physiological arousal from authentic works of art (paintings) and their digital reproductions. However, the original works of art were attributed to higher subjective ratings of emotions than their reproductions. Likewise, Hietanen et al. (2020) found that direct gaze increased autonomic arousal measured with skin conductance responses (SCRs) during live interactions and reciprocal video calls, but not when watching a prerecorded video. This finding suggests that physical presence is not necessary in order to elicit physiological responses to eye contact stimuli. In virtual reality contexts, exposure to real and virtual food (Gorini et al., 2010) and an extreme height experience (Kisker et al., 2019) elicited similar emotional, behavioural and physiological responses.

Since the focus of this dissertation lies in theatre improvisation, studies on theatre actors' experiences of the paradox of fiction are relevant. When actors adopt a role, they enter a fictional world in which they pretend to be another person, thinking and behaving not as themselves but as their characters. Brown et al. (2019) studied actors in order to identify the brain areas involved in acting. While in a functional magnetic resonance imaging (fMRI) scanner, actors responded to a series of hypothetical questions from either their own first-person perspective or from a fictional first-person perspective, that is, while in the character of Romeo (male actors) or Juliet (female actors) from Shakespeare's play. Brown et al. (2019) found that, compared to self-processing, acting modulated processes related to attention, perspective taking and embodiment, and

produced deactivations in the cortical midline network of the frontal lobe. These findings were interpreted as representing a 'loss of self' while playing a fictional role.

In sum, experimental studies on the paradox of fiction have primarily employed visual and audiovisual stimuli (photographs and video clips), although related manipulations of the authenticity of stimuli have also employed multimodal stimuli (such as engagement in a video game or exposure to food and heights). To expand this literature, this dissertation explored the paradox of fiction in the ecological context of face-to-face interactions using social rejections as stimuli.

1.3 Methodological perspectives

Previous research on the impact of improvisation training has employed a large variety of self-assessment instruments to measure numerous psychological constructs. These constructs include self-concept (DeBettignies & Goldstein, 2019); divergent thinking, uncertainty tolerance and affective wellbeing (Felsman et al., 2020; Hainselin et al., 2018); and self-esteem, self-efficacy and resilience (Schwenke et al., 2020). While this dissertation relies on data collected through self-reports, psychophysiological measurements as indices of physiological arousal and emotional valence play an important role as well, since questionnaires may not be sufficiently sensitive to detect rapid and subconscious bodily reactions. On the other hand, the interpretation of bodily reactions without knowledge of a subjective, self-reported experience can lead to erroneous conclusions.

1.3.1 Subjective self-reports

Although improvisation has been used to promote social interaction competence, this dissertation focused on using improvisation to develop student teachers' *interpersonal confidence*. Interpersonal confidence refers to the belief in one's capability to interact effectively in social situations. In doing so, I distinguish between the concepts of interpersonal competence and interpersonal confidence, given that individuals might have abundant knowledge and skills related to social interaction behaviour, whilst lacking sufficient confidence to use these resources. Furthermore, I understand interpersonal confidence as a situationally specific feature, focusing on social situations rather than the more general trait of self-confidence. Moreover, rather than relating to trust among interacting partners (Dontsov & Perelygina, 2014), interpersonal confidence refers to trust in oneself. Interpersonal confidence can be measured using the Interpersonal Confidence Questionnaire (ICQ) developed by Novák (2017).

In addition, I was interested in the impact of improvisation on self-esteem, that is, one's perceived self-worth and self-acceptance. Self-esteem can be measured using Rosenberg's self-esteem scale, a validated and widely used self-report measurement tool for research purposes (Robins et al., 2001; Rosenberg, 1965). Self-esteem has been considered a relatively stable trait in a person, although evidence exists for fluctuations in self-esteem across one's lifespan (see Orth & Robins, 2014). Like interpersonal confidence, self-esteem does not necessarily reflect an individual's objective skills and abilities in the context of social interactions. In other words, people with a low self-esteem may not reach their full potential during social interactions.

Alongside measuring self-reported interpersonal confidence and self-esteem, within this dissertation research, I also measured self-reported stress during experimental tasks. These tasks included social-evaluative threats (Trier Social Stress Test; see section 1.1.3, pp. 29–30) and social rejections (i.e., situations that threaten or reject an individual's social value) in order to generate social stress. People's fundamental needs to belong are threatened by social rejections, possibly eliciting a negative mood, emotional distress and reduced feelings of belonging, self-esteem and control (Iffland et al., 2014; Kross et al., 2011).

1.3.2 Biosignals of social stress

The psychophysiological measurements used in this dissertation comprise various biosignals including the electrical activity of the brain, the autonomous nervous system (ANS) and facial muscles along with neuroendocrine (hormonal) reactivity. In what follows, I briefly introduce these biosignals as they are employed and used within the context of this research, specifically as measures of social stress. More precisely, I describe their ability to measure physiological responses generated by social rejections (Iffland et al., 2014; Koslov et al., 2011; Kross et al., 2011; Papousek et al., 2014; van der Veen et al., 2014). According to previous research, social and physical pain partially share a common neuroanatomical basis in the human brain (Eisenberger et al., 2003; Hari & Kujala, 2009; Kross et al., 2011). From an evolutionary perspective, a common neuronal circuitry seems adaptive given that social exclusion might have posed a major threat to an individual's personal safety and survival (Kelly et al., 2012). Consequently, a social-evaluative threat triggers a coordinated behavioural and psychophysiological response in an attempt to prevent social exclusion or the loss of an individual's social status (Dickerson et al., 2004; Gruenewald et al., 2004).

Cortisol is a neuroendocrine marker indicative of activity in the hypothalamic–pituitary–adrenocortical system (HPA axis) (Erickson, Drevets, and Schulkin, 2003). The increased cortisol level is a strong indicator of a neuroendocrine stress response to a social-evaluative threat (Blackhart et al., 2007; Düsing et al., 2016). The cardiovascular measurements employed in this

dissertation research comprise the **heart rate** (HR) and **heart rate variability** (HRV). HR acceleration is associated with an increased arousal under a perceived social threat and social rejection (Iffland et al., 2014; Massey-Abernathy et al., 2015; Taelman et al., 2009). HRV, the oscillation in the interval between consecutive heartbeats, yields information on the ability of the cardiovascular system to adjust to sudden physical and psychological challenges (Malik et al., 1996; Shaffer et al., 2014; Shaffer & Ginsberg, 2017). A lower HRV is associated with cognitive, emotional and social stressors (e.g., Chanwimalueang et al., 2017; Kim et al., 2018; Trotman et al., 2018). Additionally, the **HR deceleration effect**, a transient deceleration of the heart rate associated with feedback processing, such as social rejection (De Pascalis et al., 1995; Eisenberger et al., 2003; Gunther Moor et al., 2010; van der Veen et al., 2014), was included as a cardiovascular index of social stress in this dissertation. The **electrodermal activity** (EDA), or a change in skin conductance, is an index of autonomic arousal under a social stress (e.g., the sweating of palms during a stressful situation) (Cacioppo et al., 2007; Kelly et al., 2012; Levenson, 1992). Human sweat glands are linked to the sympathetic activity of the ANS, which stimulates the body such as when the fight-or-flight response is activated when confronting a stressor.

While cortisol, cardiovascular measures and EDA represent biomarkers of arousal, facial muscle activity and an asymmetry in the frontal cortical activity appear to convey information on the valence of an individual's psychophysiological state. The augmented activity of the ***zygomaticus major***—the facial muscle used to generate a smile—is associated with positive emotion expression, and an increased activity of the ***corrugator supercilii***—the muscle that pulls the eyebrows downwards and together—associates with negative emotion expression (Cacioppo et al., 1986; Wiggert et al., 2015). **A frontal EEG alpha asymmetry** (EEG asymmetry), a relative hemispheric difference in the frontal cortical activity, is associated with a motivation to approach or withdraw. That is, high levels of relative left-frontal activity associate with positive approach–related emotions, whilst high levels of relative right-frontal activity associate with negative, withdrawal–related emotions (Davidson, 1993; Davidson et al., 2000).

The rationale for measuring these biosignals lies in their potential to provide information about basic biological and unconscious processes associated with arousal and emotional valence which cannot be accessed through self-reports. Furthermore, the continuous data and temporal precision of biosignals supplement the information provided in self-reports, since remembering the details of the experience might suffer when using a retrospective self-report. Additionally, biosignals remain unaffected by the linguistic and conceptualisation abilities of participants, and they are not confounded by social desirability (Mauss & Robinson, 2009; Ravaja et al., 2006). For example, a study by Corbett et al. (2019) used a measure of brain activity (event-related potential, ERP) to evaluate the effect of a theatre-based intervention on social information processing among

youth with an autism spectrum disorder. Moreover, McRae's study (2016) on cognitive emotion downregulation included 1) a self-reported emotion, 2) measures of peripheral psychophysiology and 3) functional signals from brain regions thought to be involved in emotional processing. Decreases in multiple measures produced more convergent evidence of successful emotion downregulation than any of these measures alone.

However, experimental research integrating theatre-based improvisation with psychophysiological measurement remains scarce.[16] This might be due to technological challenges. Only recently have neuroscientific experiments been able to engage participants in face-to-face interactions (see Hari, Sams, and Nummenmaa, 2016). Theatre-based exercises such as *the mirror game* (a silent pair exercise where one leads the movement and the other follows, including a variation where both can lead or follow simultaneously) and *a word-by-word exercise* (joint storytelling by saying one word in turn) have been studied using psychophysiological measurements (Goregliad Fjaellingsdal, Schwenke, Ruigendijk, et al., 2020; Goregliad Fjaellingsdal, Schwenke, Scherbaum, et al., 2020; Himberg et al., 2015; Noy et al., 2015). During a dyadic mirror game, both players exhibited increased cardiovascular arousal and increased alignment of players' heart rates during spontaneously emerging states of togetherness (Noy et al., 2015). Himberg et al. (2015) used magnetoencephalography in the study of interpersonal synchrony during a word-by-word exercise and found a strong spontaneous entrainment, that is, the adaptation of a speech rhythm between conversation partners. Finally, electroencephalography (EEG) has been used when studying the word-by-word exercise as a paradigm for investigating social interaction (Goregliad Fjaellingsdal, Schwenke, Ruigendijk, et al., 2020; Goregliad Fjaellingsdal, Schwenke, Scherbaum, et al., 2020). In line with these studies, this dissertation utilised psychophysiological measurements to provide a novel, biological layer of knowledge on the effects of improvisation training.

[16] Yet, neuroscientific methods have been used in studying professional theatre actors' cognitive and emotional processes (see, e.g., J. Gruzelier et al., 2010; J. H. Gruzelier, 2014; Pelletier et al., 2003; Rodionov, 2013; Rodionov & Starchenko, 2013; Tucker & Dawson, 1984).

1.4 Research questions

Original studies I–IV of this dissertation were guided by two primary research questions:

1. What are the effects of improvisation training on interpersonal competence and social stress?
2. How do real versus fictional social rejections impact experienced stress and psychophysiological responses?

Studies I, II and IV expand upon the first research question, focusing on the behavioural and physiological effects of improvisation training. Specifically, study I examined whether improvisation increased student teachers' self-reported interpersonal confidence and self-esteem. Study II extended that perspective to physiological reactivity, examining whether improvisation decreased student teachers' behavioural and physiological stress responses during acute social stress and whether interpersonal confidence moderated the stress response. Furthermore, the association between self-reported and physiological stress responses was examined in study II. Study IV, relying on a larger sample, examined the impact of improvisation training on interpersonal confidence and explored whether this impact was maintained over time. Moreover, study IV validated the Interpersonal Confidence Questionnaire (ICQ) utilised in study I and examined the dimensionality of the questionnaire. Finally, study III addressed the second research question by investigating the relationship between real-life and fiction-induced social rejections as measured by psychophysiological reactivity.

2 Overview of studies I–IV

This chapter presents the four studies summarised in this dissertation. Section 2.1 introduces the outline and participants of all of the individual studies (studies I–IV), followed by overviews of the procedures, measurements, data processing, statistical analyses, results and discussions of each study separately (sections 2.2, 2.3, 2.4 and 2.5, respectively). The primary results of the studies are presented here, whilst more detailed findings from each study can be found in the original research articles.

2.1 Participants and outline

In total, 39 undergraduate students from the University of Helsinki in Finland participated in studies I, II and III (Figure 4). Participants consisted of 38 student teachers and one student from a different albeit related discipline (for further details on participants, see study I). Participants were right-handed and non-smoking, and no participants reported present or past neurological disorders, the use of psychiatric medication or a current illness at the time of participation. All participants hoped to mitigate their social stress and had either no or negligible prior experience with improvisation. The participants self-registered for the study and received course credit for study participation. In studies I and II, participants were blinded to the study condition (intervention versus control) upon registering for the course. The sample size was determined by the requirements of participatory teaching during the intervention, and aimed to enable all participants to engage in active, experiential learning (intervention group, $n = 19$; wait-listed control group, $n = 20$). Three participants discontinued the study, one was omitted due to participation in another concurrent social interaction skills training course and 1–4 participants were excluded depending on the analysis due to a poor signal quality or missing data (see Figure 4 for further details).

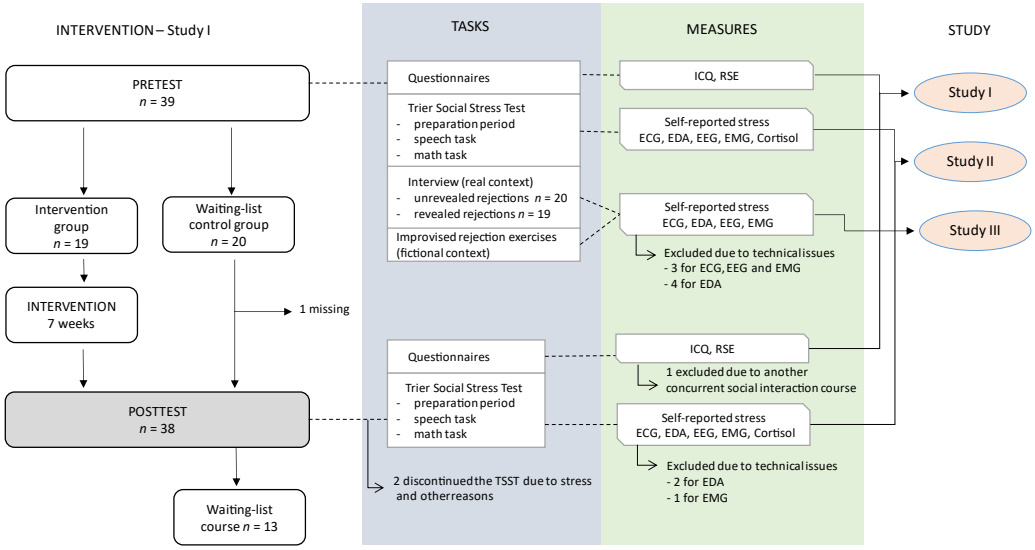


Figure 4. Flowchart of studies I, II and III. Abbreviations: ICQ, Interpersonal Confidence Questionnaire; RSE, Rosenberg's Self-Esteem Scale; ECG, electrocardiography; EDA, electrodermal activation; EEG, electroencephalography; EMG, electromyography; TSST, Trier Social Stress Test.

In study IV, an additional sample (n = 160) was recruited from the participants of several improvisation courses offered at the University of Turku in Finland. This sample was combined with the participants of studies I, II and III. Participants either enrolled in an improvisation course aimed at enhancing social interaction skills or in a wait-listed control group. All participants were undergraduate students recruited from nine universities in Finland. Two subsamples were used to examine the impact of improvisation training. First, a subsample consisting of participants who completed the ICQ both before and after improvisation training was used to test the immediate effect of improvisation training. Second, a follow-up subsample consisting of the participants in study I was used to examine the long-term effects of improvisation training. Figure 5 shows the flowchart of study IV.

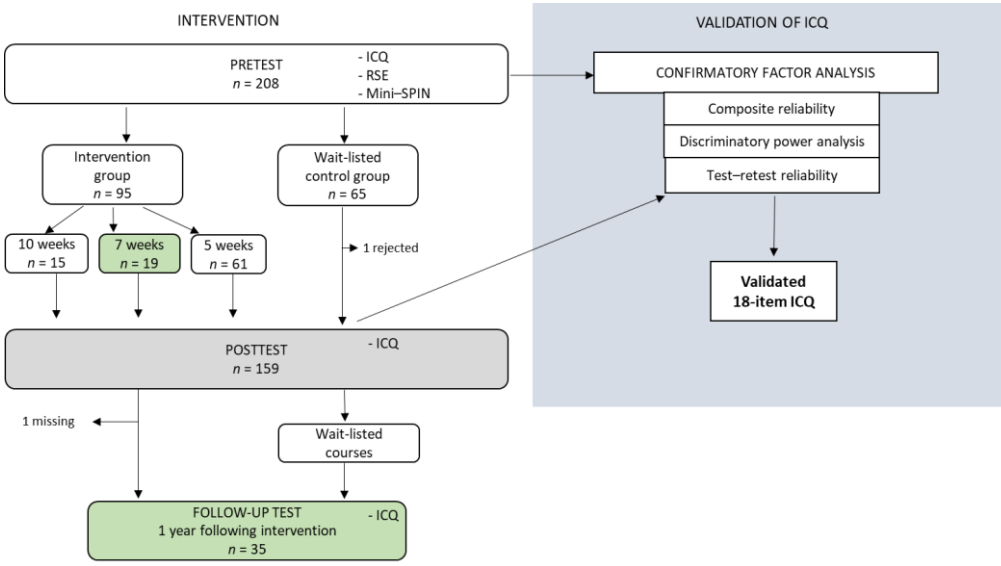


Figure 5. Flowchart of study IV. Abbreviations: ICQ, Interpersonal Confidence Questionnaire; RSE, Rosenberg’s Self-Esteem Scale; Mini-SPIN, mini-social phobia inventory. Green boxes depict the sample used in study I (adapted from Seppänen, Novák, et al., 2021).

Table 1 presents a summary of all participants in studies I–IV.

Table 1.

Summary of participants in studies I–IV

	n	Final *n*	Women	Men	Other	Age M	Age range
Study I	39	37	33	5	1	27.1	20–40
Study II	39	35*	33	5	1	27.1	20–40
Study III	39	39*	33	5	1	27.1	20–40
Study IV							
validation	204	204	157	40	7	27.3	19–58
pre–post	160	160	124	32	4	27.1	19–58
follow-up	35	35	31	3	1	27.6	20–40

** 1–4 participants were excluded depending upon the analysis (EEG, ECG, EDA or EMG) due to technical issues (see Figure 4 for further details).*

Participants’ rights

Participation in studies I–IV was completely voluntary. Participants were informed about the study aims and procedures, and were provided with the contact information for the principal investigator. Participants provided their written

informed consent prior to participation. Participants were also told that they could discontinue their participation at any time without providing a reason and without any sanctions or consequences to them. Their privacy was protected and insured based on the guidelines of the EU General Data Protection Regulation (GDPR). The results of the studies were made available to participants at the group level upon completion of the analysis. The University of Helsinki Ethical Review Board for the Humanities and Social and Behavioural Sciences approved the study protocol (statement 25/2017).

2.2 Study I – Impact of improvisation on interpersonal confidence

2.2.1 Procedure

To address the first research question regarding whether improvisation training influenced interpersonal competence, we conducted a controlled improvisation intervention. Before the intervention, participants completed a demographic survey and self-report questionnaires. Following the intervention, they completed the same self-report questionnaires, and controls received an improvisation course.

I conducted the intervention given my experience as a drama pedagogue specialised in theatre improvisation. Participants submitted a precourse task which focused on their previous experiences with social stress and their expectations from the improvisation course. Each improvisation class lasted for 2.5 h, meeting once a week for seven weeks, the standard teaching period at the University of Helsinki. Participants learned the basics of improvisation described in Figure 3 (page 31). Furthermore, the intervention included weekly tasks centred on observing everyday social interactions outside the class, such as finding examples of topics addressed during the improvisation sessions. Additionally, participants kept a learning diary to reflect upon the feelings they experienced and their insights throughout the course, and submitted a summary of their learning diaries as their final course assignment. If participants missed a session, additional sessions were organised, whereby peer participants guided absentees through the exercises they missed. Additional details regarding the improvisation intervention appear in the original article.

2.2.2 Measures

Interpersonal confidence and self-esteem were measured before and following the improvisation intervention.

Interpersonal Confidence Questionnaire (ICQ)
The ICQ is a measure of self-reported interpersonal confidence (Novák, 2017, 2020), which refers to confidence related to social interactions rather than the more general trait of self-confidence. The questionnaire consists of 30 positively and negatively worded statements, which respondents rate on a Likert scale from 0 to 5 (0, strongly disagree; 5, strongly agree).

Rosenberg's Self-Esteem Scale (RSE)
Rosenberg's Self-esteem Scale (RSE) is an established and widely used measure of self-esteem (Robins et al., 2001; Rosenberg, 1965). The questionnaire consists of ten positively and negatively worded statements regarding the self-worth and self-acceptance of the respondent.

2.2.3 Data processing

The negatively worded statements from both the ICQ and RSE were transformed into positive values, and summation variables were calculated, producing each participant's mean score (range, 0–5). Higher scores indicated higher levels of interpersonal confidence and self-esteem.

2.2.4 Statistical analyses

For all statistical analyses, we set the alpha level to 0.05. The independent samples t-test was used to evaluate differences between groups at baseline. The primary statistical analysis in study I was the Johnson–Neyman (JN) procedure (Johnson & Neyman, 1936; Potthoff, 1964; Preacher, Curran & Bauer, 2006). The JN procedure determines *a region of significance* within which the scores between experimental groups differ for posttest scores (Carden et al., 2017; D'Alonzo, 2004; Ji, 2016; Johnson, 2016; Tunca, 2016). In other words, the JN procedure identifies a possible heterogeneous treatment effect (Lazar et al., 2013), which allows us to determine if the baseline measures influence the outcome of an intervention. In addition, the JN procedure requires no transformation of continuous variables into categories, but analyses the statistical between-group difference at all levels of a continuous variable. If a heterogeneous treatment effect is identified, the division for demarcating categories is obtained directly from the JN procedure.

In addition, we performed paired samples t-tests for follow-up analyses, comparing the pre- and posttest scores for interpersonal confidence and self-esteem. Cohen's effect size value was calculated to evaluate the strength of the treatment effect. The association for any prior improvisation experience as well as the missed intervention sessions and interpersonal confidence were examined using the Spearman's rank correlation test.

2.2.5 Results

Results from the JN procedure revealed that the improvisation intervention increased interpersonal confidence amongst participants with low pretest scores (≤2.67), but not amongst those with high pretest scores (>2.67; Figure 6). The Cohen effect size, with a value of $d = 0.96$, suggests a large effect size for the intervention. Moreover, the effect size within the low interpersonal confidence category was larger ($d = 1.04$) than in the high interpersonal confidence category ($d = 0.13$).

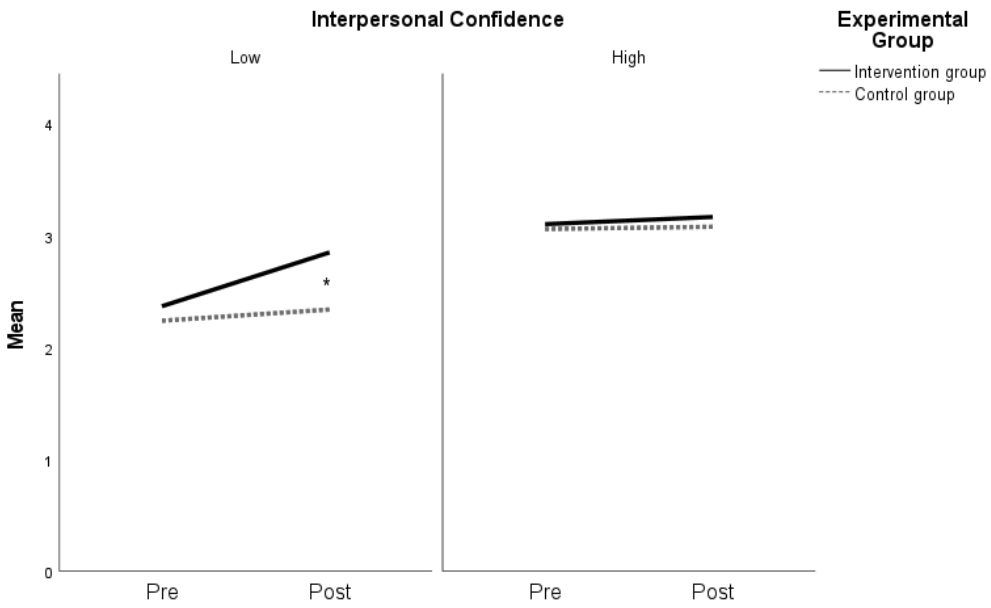


Figure 6. Pre- and posttest interpersonal confidence. Experimental groups were divided into lower and higher interpersonal confidence categories based on a pretest score of 2.67, identified through the Johnson–Neyman analysis ($p < 0.05$*) (adapted from Seppänen et al., 2019).

In terms of self-esteem, the JN procedure revealed no difference between the intervention and control groups. Furthermore, the Cohen's effect size value indicates a low effect size ($d = 0.14$) for the intervention.

2.2.6 Discussion

The primary finding from study I was that not all participants responded similarly to the improvisation intervention. Improvisation training fostered interpersonal confidence amongst those who scored lower on the pretest. This differential treatment effect might be explained by the emotion regulation strategy of cognitive reappraisal (Brooks, 2014; Gross, 1999, 2015; Kalisch et al., 2005; McRae, 2016) in relation to the meaning of mistakes. Redefining mistakes as events, whereby merely something other than what was anticipated happens, and changing the emotional connotation of mistakes from negative to positive may reduce social stress since no pressure to succeed exists. As the fear of failure diminishes, it is possible to allocate attention-related resources outward, instead of monitoring one's own feelings of distress (Drinko, 2013a, p. 73,82; Rapee & Heimberg, 1997). Assuming that less confident student teachers were more stressed during social encounters, they would likely benefit more from learning to tolerate mistakes and disengage from rumination. This might channel their cognitive resources to perceive the subtleties of the social situation (e.g., voice prosody and nonverbal expression), leading to more situation-sensitive social interactions, which in turn might promote interpersonal confidence. However, we observed no between-group differences in self-esteem. This unexpected finding might result more from the permanent nature of self-esteem comparable to basic personality traits such as extraversion or neuroticism (Robins & Trzesniewski, 2005).

2.3 Study II – Impact of improvisation on acute social stress (TSST)

Study II aimed to address the first research question regarding the effects of improvisation training on interpersonal competence and social stress by extending the perspective to physiological reactivity. Thus, study II determined whether improvisation decreased student teachers' behavioural and physiological stress responses during acute social stress and whether interpersonal confidence moderated stress responses. In addition, in study II, we examined the association between self-reported and physiological stress.

2.3.1 Procedure

In study II, the impact of the improvisation intervention (see study I) on acute social stress was assessed using the Trier Social Stress Test (TSST). The TSST consists of two tasks: a 5-min impromptu speech followed by a 5-min challenging mental arithmetic task. Speech topics (presenting oneself at a job interview or at a parent–teacher conference) and maths tasks (counting backwards either from 6537 by subtracting 13 or from 5674 by subtracting 7) were counterbalanced across pre- and post-TSST (Boesch et al., 2014) and experimental groups. The pre- and post-TSST sessions began at between 14.00 and 16.00 to control for circadian oscillations in physiological measures and lasted approximately 1.5 h. Upon arrival at the laboratory, participants were introduced to the general outline of the study and the laboratory facilities, and were asked to sign a consent form. Then, participants were equipped with a mobile EEG recording device. Baseline data were recorded 1) when reading a nonemotional text and 2) when describing the laboratory room, taking turns with the researcher. Following the baseline recording, participants were given 6 min to prepare their speech. Participants were told that the jury would evaluate their assertiveness and nonverbal behaviour, and that their task performances would be video recorded for subsequent analysis. Tasks were performed in an adjacent room. Each task was preceded by a silent 30-s waiting period, during which physiological data and a video were recorded as well. Following the TSST, the participant was brought back to the preparatory room, where they completed self-report scales on the stress they experienced during the TSST. Participants were thoroughly debriefed regarding the study specifics following the last TSST session. More specific details regarding the TSST appear in the original article.

2.3.2 Measures

Self-reported stress

Participants reported the stress they experienced during 1) the preparatory phase, 2) the speech and 3) the maths task using a simple six-point Likert scale (from 0 to 5, where 0 indicates not stressed at all and 5 indicates extremely stressed). These reports were completed following the TSST procedure.

Physiological measures

Several physiological signals were collected, including an ECG, EDA, EEG and electromyography (EMG), from which the physiological measures were analysed. We also measured the cortisol levels. Cortisol samples were collected using Salivette® saliva collection tubes at four time points: before the baseline data recording, after the preparation phase for the TSST, immediately following the

TSST and before leaving the laboratory. Physiological signals (ECG, EDA, EEG and EMG) were recorded using the LiveAmp wireless amplifier (Brain Products GmbH, Germany) with the sample rate set to 500 Hz. The EEG was recorded using a standard 32-channel electrode cap (EASYCAP GmbH, Germany) according to the International 10–20 system (Jasper, 1958; Pivik et al., 1993) from 26 electrode sites. Two sites were used to record the bipolar ECG and four sites were used for the facial EMG. Recordings were completed using the actiCAP active electrodes with the ground electrode at location Fpz and the reference electrode at FCz. All electrode–skin impedances were at or below 25 kOhm. ECG electrodes were positioned at approximately 2 cm below the right and left collar bones. The bipolar electrode pairs for recording the facial muscle activity of the *corrugator supercilii* and *zygomaticus major* were placed according to international guidelines (Fridlund & Cacioppo, 1986) on the left side of the face. The Ag/AgCl electrodes for the EDA assessment were placed on the first phalanx of the index and middle fingers of the nondominant hand (Boucsein et al., 2012).

2.3.3 Data processing

Salivary cortisol samples were stored at -20˚C until analysis, and analysed using a chemiluminescence immunoassay based on the competition principle (LIA, IBL Hamburg, Germany). An unknown amount of antigen present in the sample and a fixed amount of enzyme-labelled antigen compete for the binding sites of the antibodies coated onto the wells. The measuring range of the method was 0.41 to 88 nmol/l. The coefficient of variation for the intra- and interassay of the method was 5% and 8%, respectively.

The biosignal analyses were conducted using Matlab R2018a (Mathworks Inc., USA) and EEGLAB 14.1.1b (Delorme and Makeig, 2004) unless otherwise stated. We excluded from analysis the first and last 10 s during the TSST conditions and the first and last 5 s of the epoched signal during the baseline and waiting periods. The ECG signals were digitally filtered (1–30 Hz, FIR, cut-off frequencies at -6 dB 0.95 Hz and 35.6 Hz, respectively) and epoched according to the tasks and waiting periods. R peaks were extracted from the ECG signals using the Pan-Tompkins algorithm (Sedghamiz, 2018). The RR intervals, or the time between two successive R peaks, were visually inspected for large artefacts and corrected using the mean of the previous and next valid value if the extreme values represented outliers (J. R. Jennings et al., 1981).

We performed the HRV analysis using the Kubios HRV Standard software version 3.0.2 (University of Kuopio, Finland). Data were visually inspected by two researchers for artefacts and the correction level was adjusted individually using the Kubios software. Overall, we analysed six parameters: 1) heart rate (HR), 2) the root-mean-square of successive RR interval differences (RMSSD),

3) the proportion of successive RR intervals reaching more than 50 ms (pNN50), 4) the standard deviation of the heart rate (STDHR), 5) a high frequency (HF) and 6) a low frequency (LF) (Castaldo et al., 2019; see Shaffer and Ginsberg, 2017). Since the HF and LF domains require a minimum of 1–2-min recording times to yield reliable results, these were excluded from the 30-s waiting period analyses (Berntson et al., 1997).

EDA signals were low-pass filtered with a cut-off frequency of 15 Hz (FIR, a finite impulse response) and epoched according to the tasks and waiting periods. Data were visually inspected for large artefacts. For frequent artefacts during a task, the EDA signal was recovered using third-order polynomial fitting. The mean of the EDA signal was calculated for each epoch.

For the EMG analyses, only data from the silent waiting periods (before the test conditions) were used to reduce the artefacts caused by speaking during the test conditions. The raw EMG signal was filtered (FIR with 30–130 Hz passband) and epoched according to the waiting periods.

The EEG analysis began with the use of the BESA software version 7.0 (BESA GmbH, Germany) and comprised low-pass filtering at 100 Hz (zero phase, slope 24 dB/octave), high-pass filtering at 0.5 Hz (forward, slope 6 dB/octave), automatic and manual eye-blink correction using principal component analysis (PCA) and the visual inspection of data. Continuous EEG signals were exported from BESA and further processed in Matlab. The power spectral density at an alpha frequency (8–12 Hz) (Klimesch, 2012; Nuwer et al., 1999) was calculated for the re-referenced (Cz) and epoched signals using the spectopo function of EEGLAB. A window size of 500 samples, an overlap of 50% and zero padding for 1024 samples were used, resulting in a frequency resolution of 0.49 Hz. Asymmetry values were calculated by subtracting the log-transformed power spectral density at the alpha frequency of the left-electrode site from that of the right-electrode site (F4–F3), where negative scores indicated a relatively stronger right-sided activation (Sutton and Davidson, 1997). The mean (whole epoch) and the max peak of the power spectral density values within the alpha frequency band were analysed.

2.3.4 Statistical analyses

We set the alpha level to 0.05 for all statistical analyses. The independent samples t-test was used to test for differences between groups at baseline. The composite baseline for physiological measures was computed by averaging the pre- and posttest baseline values. Next, difference values were calculated by subtracting this composite baseline score from the response scores. These differences were used to analyse the difference between the pre- and posttest measurements.

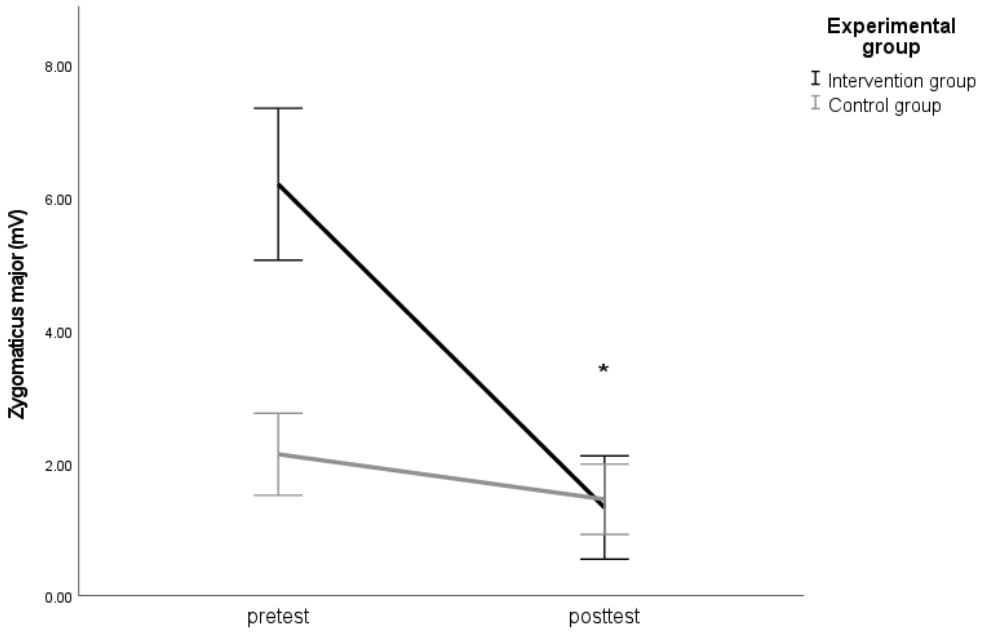
The statistical analysis primarily identifies between-group differences following the improvisation intervention, relying on a three-way analysis of variance (ANOVA) for mixed methods. The model included TIME (pretest vs. posttest) as a within-group factor, and GROUP (intervention vs. control) and interpersonal confidence (low IC vs. high IC) as between-group factors. Paired-samples t-tests or nonparametric Wilcoxon signed-rank tests allowed us to analyse follow-up tests. We employed Bonferroni corrections to counteract the problem of multiple comparisons, while estimates of the effect size were reported using the partial eta squared (η_p^2). To examine the association between self-reported stress and the physiological responses during the TSST, we calculated the Pearson's correlation coefficients.

2.3.5 Results

At both the pre- and posttests, the stress-inducing effect of the TSST was verified by the cortisol, HR, HRV and EMG *zygomaticus major* values, which differed from the baseline ($p < 0.05$ for all), whilst the EMG *corrugator supercilii*, EDA and EEG asymmetry values did not differ from the baseline ($p > 0.05$ for all).

During the prespeech waiting period, an interaction effect for TIME x GROUP (F (1, 30) = 16.786; $p < 0.001$; $\eta_p^2 = 0.359$) and for TIME x IC (F (1, 30) = 6.808; $p = 0.014$; $\eta_p^2 = 0.185$) indicated a decrease in the *zygomaticus major* facial muscle activity for the intervention group relative to the control group in the posttest scores (Figure 7a). Follow-up tests confirmed this decrease in both the low and high interpersonal confidence subgroups. For the *corrugator supercilii* facial muscle activity, we detected a TIME x GROUP interaction (F (1, 32) = 5.117; $p = 0.031$; $\eta_p^2 = 0.138$), indicating a decrease in activity amongst the intervention group relative to the control group in the posttest scores (Figure 7b).

7a)



7b)

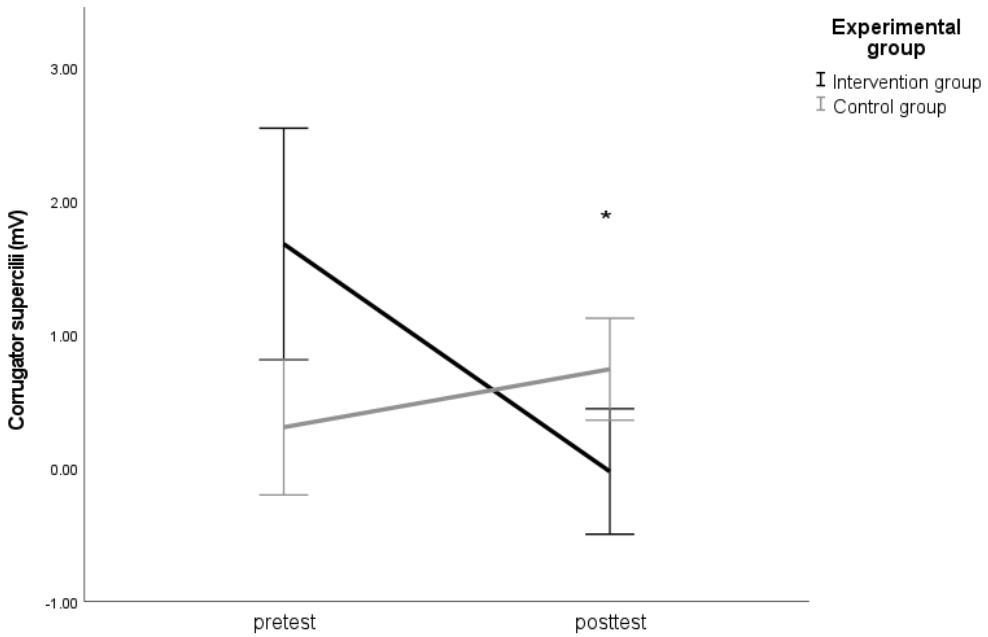


Figure 7. a) *Zygomaticus major* activity and b) *corrugator supercilii* activity during the silent 30-s waiting period before the TSST speech task ($p < 0.05$*, error bars +/-1 standard error). Values represent the change scores (baseline subtracted).

During the speech task, the results for STDHR showed a three-way interaction for TIME x GROUP x IC (F (1, 31) = 6.539; p = 0.016; η_p^2 = 0.174). The adjacent paired t-tests confirmed that in the posttest low interpersonal confidence controls exhibited increased STDHR values (T(6) = -1.959; p = 0.49) compared to the intervention subgroup (T(6) = 1.030; p = 0.171; Figure 8).

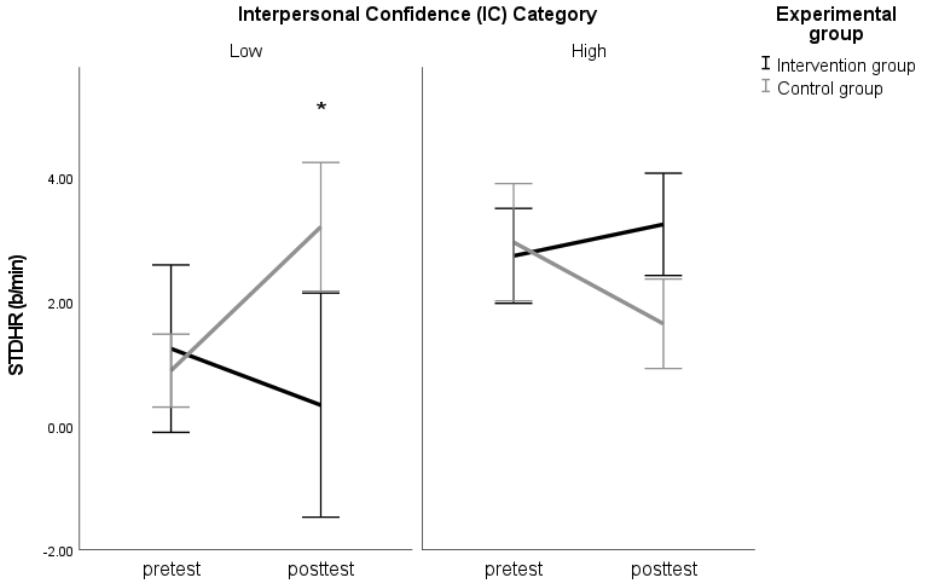
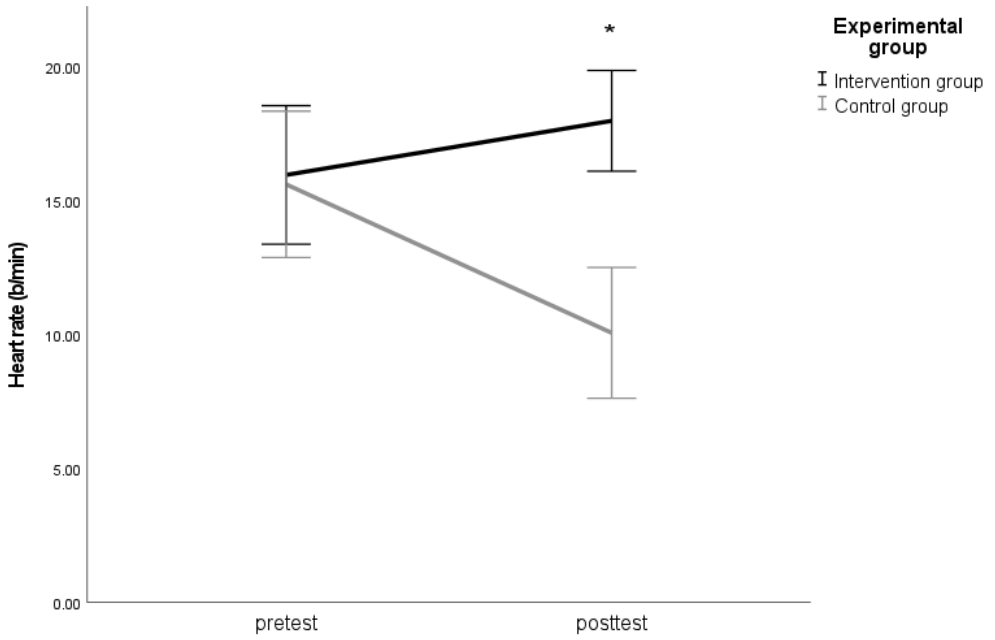


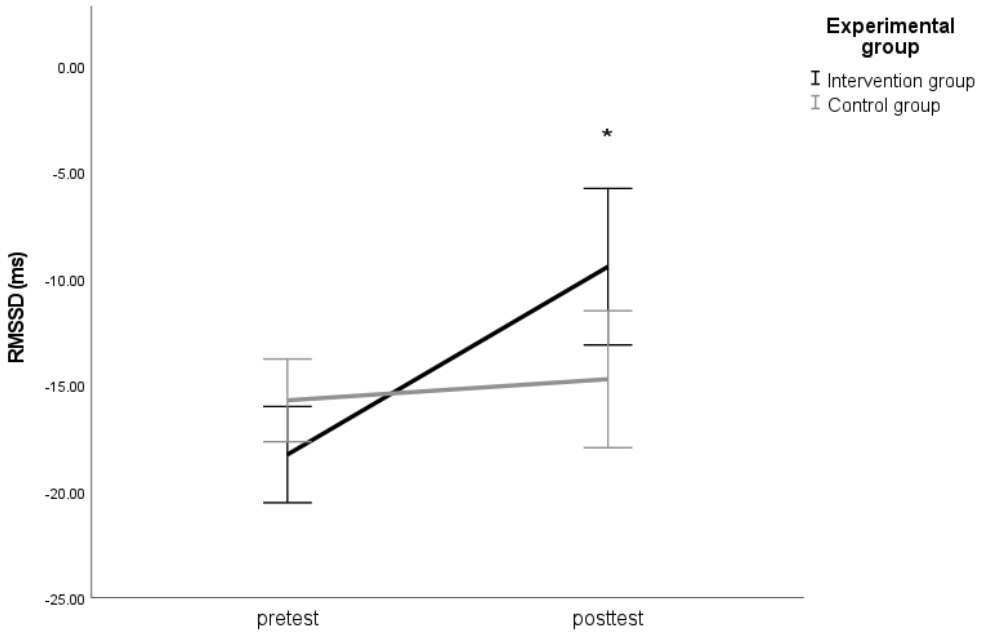
Figure 8. STDHR during the TSST speech task clustered by interpersonal confidence (IC) (*p* < 0.05*, error bars +/-1 standard error). Values represent the change scores (baseline subtracted).

During the premath task waiting period, the results for HR revealed a TIME x GROUP interaction (F (1, 31) = 5.433; p = 0.023; η_p^2 = 0.141) indicating a decreased HR among controls relative to the intervention group for the posttest score (Figure 9a). For RMSSD, interactions for TIME x GROUP (F (1, 31) = 4.740; p = 0.037; η_p^2 = 0.133) and TIME x IC (F (1, 31) = 7.616; p = 0.010; η_p^2 = 0.197) indicated an increased RMSSD for the intervention group relative to the control group for the posttest scores (Figure 9b). The adjacent paired t-test confirmed that RMSSD increased for the low interpersonal confidence intervention subgroup (T(6) = -3.932; p = 0.008), but not for the low interpersonal confidence controls (T(6) = -0.858; p = 0.424). For STDHR, an interaction for TIME x GROUP (F (1, 31) = 4.502; p = 0.042; η_p^2 = 0.127) indicated increased STDHR values among the intervention group relative to controls in the posttest score (Figure 9c).

9a)


Experimental group
Intervention group
Control group
Heart rate (b/min)
20.00
15.00
10.00
5.00
0.00
*
pretest
posttest

9b)


Experimental group
Intervention group
Control group
RMSSD (ms)
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
*
pretest
posttest

9c)

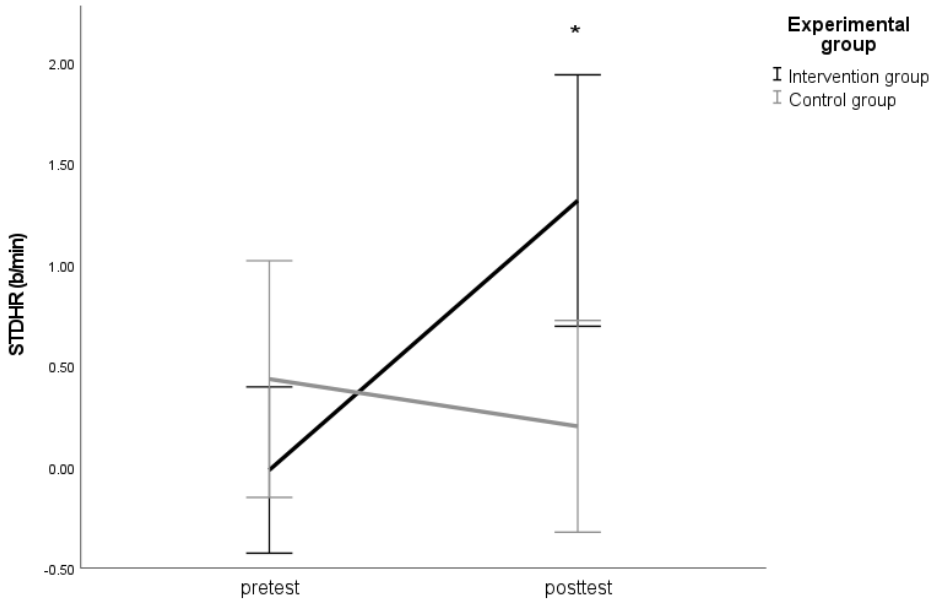


Figure 9. a) Heart rate, b) RMSSD and c) STDHR during the silent 30-s waiting period for the TSST maths task ($p < 0.05$*, error bars +/-1 standard error). Values represent the change scores (baseline subtracted).

During the maths task, we identified a three-way interaction of the TIME x GROUP x IC for self-reported stress (F (1, 31) = 15.845; $p < 0.001$; $\eta_p^2 = 0.338$). The adjacent Wilcoxon signed-rank tests confirmed that the low interpersonal confidence intervention subgroup reported less stress during the posttest (M = 2.71; Z = -2.414; p = 0.016) than the control subgroup (M = 4.14; Z = -1.667; p = 0.157; Figure 10).

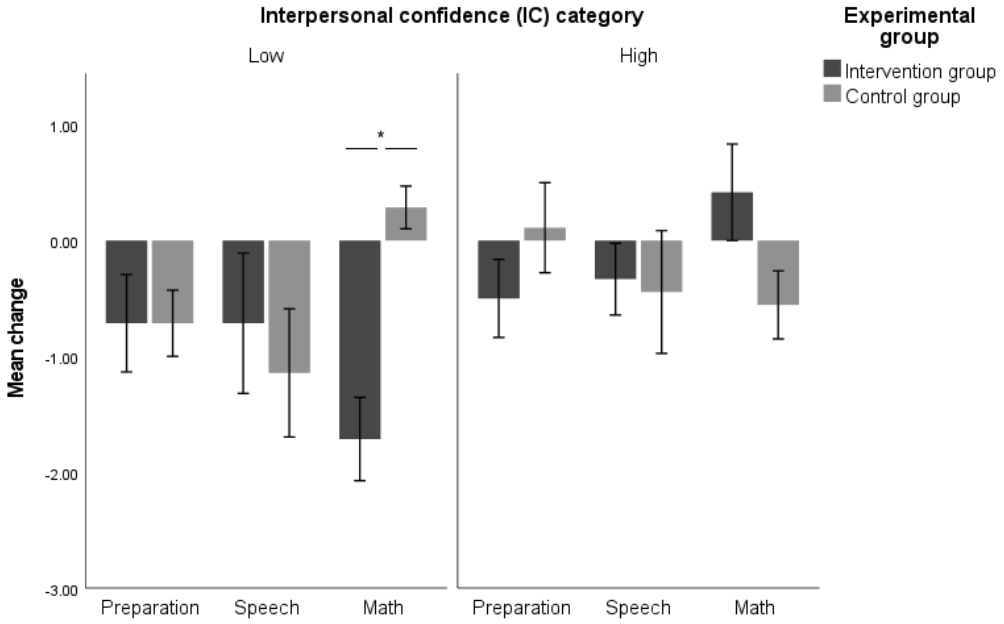


Figure 10. Change in self-reported stress across the TSST conditions clustered by interpersonal confidence (IC) (*p* < 0.05*, error bars +/-1 standard error).

No significant effects were observed for cortisol, even after dividing the participants into cortisol responders and nonresponders ($p > 0.05$ for all). Furthermore, the pNN50, LF, HF, EDA and EEG asymmetry levels revealed no between-group effects ($p > 0.05$ for all).

2.3.6 Discussion

Anticipatory anxiety (Boehme et al., 2014) preceding a performance may be lessened through an improvisation intervention, as indicated by a decrease in the *corrugator supercilii* activity and an increased HRV. Moreover, the self-rated stress level during the maths task decreased among the low interpersonal confidence intervention subgroup. Given the desensitisation related to the fear of failure during improvisation training, it seems reasonable that self-reported stress diminished during the maths task, where mistakes were explicitly noted. This result supports the findings from study I, where the low interpersonal confidence intervention subgroup benefitted the most from improvisation training.

However, we also found that the control group exhibited diminished arousal and stress levels (lower HR during the premath waiting period and an increased HRV during the speech task for the low interpersonal confidence subgroup). The lower cardiovascular stress response indicates a habituation related to the TSST through repetition, particularly amongst controls with low interpersonal confidence. This unexpected finding raised the question of why the intervention

group did not adapt to the speech task given their training on confronting unpredictable situations and performing intuitively without preparation. Perhaps, having completed an improvisation course, the intervention group experienced more pressure to succeed. Yet, the physiological parameters showed no indication of anticipatory anxiety immediately before the speech. On the contrary, facial EMG indicated a diminished negative affect in the intervention group relative to controls. However, the positive affect indicated by the *zygomaticus major* decreased as well, contrary to our expectation. Yet, in terms of the intensity of the affect, both facial EMG results suggest a diminished emotional intensity when waiting for the speech task, possibly indicating a more relaxed emotional state. In addition, instead of a successful performance, improvisation training emphasised presence, outwards attention allocation and building upon cues from the environment. During the speech task, these cues comprised the stoic faces of the jury and a lack of reciprocity. Given both the recently learned principles of status behaviour and a heightened awareness of social rejections, it is unsurprising that the stress response persisted during the posttest speech.

This study directs future research towards examining the influence of an absence of reciprocity as a stress-provoking component in social interactions, as also suggested by Celume et al. (2019). Reciprocity does not merely refer to verbal feedback, since even the absence of nonverbal behavioural imitation or *social mirroring* elevated cortisol levels as acute physiological stress reactions (Kouzakova et al., 2010). Furthermore, interpersonal confidence moderated the self-reported and cardiovascular (HRV) stress responses. Thus, interpersonal confidence may be worth controlling for in future research when examining the effects of social stress–relieving interventions.

2.4 Study III – Difference between real-life and fictional social rejections

Study III addressed the second research question regarding the difference between real-life and fiction-induced social rejections through the measurement of psychophysiological reactivity.

2.4.1 Procedure

For study III, data were collected immediately following the first TSST session described in study II. To study the difference between real-life and fiction-induced social rejections, psychophysiological responses during an interview (real-life context) were compared to those during improvisation exercises (fictional context) (Figure 11).

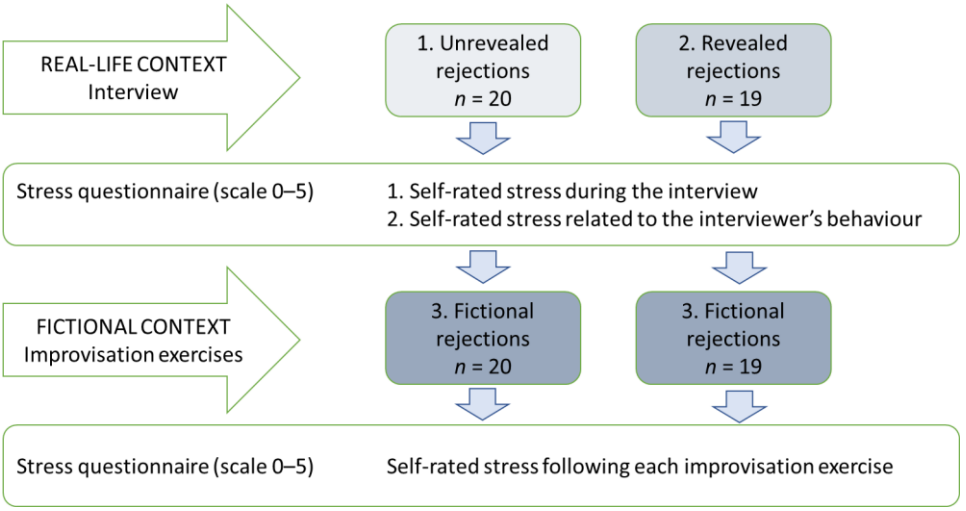


Figure 11. Experimental design of study III (adapted from Seppänen, Toivanen, et al., 2021).

Participants sat for a 10-min interview, which involved general questions about being a university student. Participants were unaware that the interviewer was an actor trained to include subtle social rejections during the interview. Participants were randomly assigned to two groups: 1) unrevealed rejections group and 2) revealed rejections group, in which participants understood that the interviewer would act impolitely, but were not told how. The actor was unaware of the participant's group assignment. Following each question, the actor subtly rejected the participant by 1) devaluing, 2) interrupting or 3) behaving nonverbally in a negative manner. Following the interview, participants reported the stress they experienced related to the interview, the setup was revealed and the actor was dismissed.

Next, I conducted an improvisation exercise training session, which lasted approximately 25 min. The session comprised 2- to 2.5-min improvisation exercises, including the same subtle rejections as those experienced during the interview. Participants were told beforehand which rejection would be employed and, then, following each exercise, reported the stress they experienced. Each task was preceded by a silent 30-s waiting period during which physiological measurements and a videorecording were already in progress. Synchronisation between the video recording and data was achieved by playing a short sine-wave sound after each waiting period.

2.4.2 Measures

Self-reported stress

Participants reported the stress they experienced during the tasks using a simple six-point Likert scale (from 0 to 5, where 0 referred to not stressed at all and 5

represented extremely stressed). This scale was completed following both study conditions:

1. following the interview: a) self-reported stress during the interview and b) self-reported stress related to the interviewer's behaviour; and
2. self-reported stress following each improvisation exercise.

The physiological measures analysed included an ECG, EDA, EEG and EMG as in study II (see section 2.3.2, pp. 50–51).

2.4.3 Data processing

The silent 30-s waiting period preceding the interview was used as the baseline for the HR, facial EMG and EEG asymmetry (data from the first and last 10 s for the HR and the first and last 5 s for the facial EMG and EEG were excluded due to a possible physiological reaction caused by the event signal). Epochs of 5 s (beginning with a rejection statement or the onset of a nonverbal rejection) were analysed. Rejection onsets were marked in relation to the physiological data based on the video recording using the ELAN 5.1 software (The Language Archive, Max Planck Institute for Psycholinguistics, the Netherlands). The biosignal analyses were conducted using Matlab R2018a (Mathworks Inc., USA), EEGLAB 14.1.1b (Delorme & Makeig, 2004) and BESA 7.0 (BESA GmbH, Germany) as in study II.

ECG signals were digitally filtered, the R peaks extracted, and the RR intervals visually inspected and corrected, identical to the procedure described in study II. For the HR deceleration analysis, HR time series from the 6 s preceding a rejection onset to 6 s following a rejection onset were segmented into 2-s intervals. Mean values (in beats per minute) for these six 2-s intervals were analysed. The HR deceleration effect was analysed for devaluing alone, since the more robust effect of turn-taking confounded the effect of the rejection during the interruption and the nonverbal rejection.

EDA signals were low-pass filtered, visually inspected and interpolated identically to the method in study II. The EDA signals were epoched based on the rejections, and the mean of the signal was calculated for each epoch. Data from the first second following a rejection onset was used as the local baseline and data within 2 to 5 s were analysed for a rejection response. The extraction of the skin conductance responses (SCRs) was completed using the SimpleEDA algorithm (Schleicher, 2005).

The facial EMG signals were filtered (FIR with 30–130 Hz passband) and converted to a bipolar measurement data by subtracting the channel data (lower minus upper for the *zygomaticus major*, central minus distal for the *corrugator supercilii*) from each other. The resulting signals were rectified and epoched according to rejections. The mean values from each 5-s epoch were calculated.

The EEG data processing was carried out identically to that in study II. Details on data processing can be found in the original article.

2.4.4 Statistical analyses

We set the alpha level to 0.05 for all statistical analyses. To test whether rejection responses differed from baseline, repeated-measures analyses of variance (RM-ANOVA) were conducted. Change scores for the rejection-related reactivity were calculated by subtracting the baseline from the rejection response values. Each physiological parameter (HR, EDA, facial EMG and EEG) was analysed separately using these change scores.

We examined the primary research question regarding the difference in the psychophysiological responses between real-life and fictional rejections (devaluing, interruption and nonverbal) using ANOVA for mixed measures with CONTEXT (real-life vs. fictional) as a within-subject factor and GROUP (unrevealed vs. revealed interview) as a between-subject factor. The GROUP factor was omitted from the statistical model since no main or interaction effects for the GROUP factor were observed, rendering repeated-measure ANOVAs with CONTEXT the final test. In addition, the three rejection types were averaged as one variable (TOTAL) and separate, repeated-measure ANOVAs with CONTEXT were performed to examine the difference between real-life and fictional contexts across all rejections.

To analyse the HR deceleration effect, the mean for the six 2-s intervals was subtracted from each interval, producing a more time-sensitive index for a phasic HR change. An ANOVA for mixed measures was performed using TIME (six intervals) and CONTEXT as within-subject factors and GROUP as a between-subject factor. Again, the GROUP factor was excluded from the ANOVA due to the absence of main and interaction effects. Paired-samples t-tests were calculated as follow-up tests.

The difference in self-reported stress between unrevealed and revealed interviews were analysed using the Mann–Whitney U test given the nonnormal distribution of the data. During the improvisation exercises, the difference in the self-reported stress between rejection types was analysed using the RM-ANOVA with REJECTION (devaluing, interruption and nonverbal) as a within-subject factor.

To counteract the increased probability of a type 1 error (false-positive) in multiple comparisons, we employed the false discovery rate (FDR) procedure (Benjamini & Hochberg, 1995) for post-hoc comparisons across the study. An *a priori* threshold of $q < 0.1$ was applied to retain the balance between false-positive and missed findings (false-negatives or type II errors). Finally, Spearman's rank correlations were calculated to examine the association between the

psychophysiological reactivity for real-life and fictional rejections and for each rejection type separately.

2.4.5 Results

To determine whether rejection responses differed from baseline, we conducted RM-ANOVAs for planned contrasts. Social rejections elevated the SCR and *zygomaticus major* activity across all conditions relative to baseline ($p < 0.05$ for all, all FDR-corrected p at $q < 0.1$; Table 2; Tables 3 and 4 for baseline and rejection response values). For other physiological measures, the rejection type modified the responses. HR decelerated during devaluing and nonverbal rejections, the c*orrugator supercilii* activity increased during interruptions and the EEG asymmetry values decreased during nonverbal rejections relative to baseline. The context modified the responses as well: the mean EDA increased during fictional devaluing but not during other conditions, and the *corrugator supercilii* activity increased during real-life but not during fictional nonverbal rejections.

Table 2.

Differences between baseline and social rejection responses.

			Devaluing vs. baseline			**Interruption vs. baseline**			**Nonverbal rejection vs. baseline**		
	n	df	F	*p*	ηp^2	F	*p*	ηp^2	F	*p*	ηp^2
Real-life context (interview)											
Heart rate (HR)	36	(1,35)	13.594	**0.001****	0.280	2.509	0.122	0.067	4.335	**0.045***	0.110
Mean EDA	38	(1,37)	2.902	0.097	0.073	0.001	0.978	0.000	1.202	0.280	0.031
Skin conductance response (SCR)	38	(1,37)	10.131	**0.003***	0.215	12.406	**0.001****	0.251	22.751	**<0.001****	0.381
Zygomaticus major	36	(1,35)	25.509	**<0.001****	0.422	23.791	**<0.001****	0.405	28.141	**<0.001****	0.446
Corrugator supercilii	36	(1,35)	0.895	0.351	0.025	6.171	**0.018***	0.150	5.410	**0.026***	0.134
EEG asymmetry, mean	36	(1,35)	1.621	0.211	0.044	3.642	0.065	0.094	10.754	**0.002***	0.235
EEG asymmetry, peak	36	(1,35)	0.435	0.514	0.012	2.810	0.103	0.074	7.503	**0.010***	0.177
Fictional context (improvisation exercises)											
Heart rate (HR)	36	(1,35)	20.662	**<0.001****	0.371	2.685	0.110	0.071	9.131	**0.005***	0.207
Mean EDA	36	(1,35)	7.793	**0.008***	0.182	2.472	0.125	0.066	2.799	0.103	0.074
Skin conductance response (SCR)	36	(1,35)	4.183	**0.048***	0.107	19.908	**<0.001****	0.363	14.537	**0.001****	0.293
Zygomaticus major	36	(1,35)	15.109	**<0.001****	0.302	42.371	**<0.001****	0.548	27.320	**<0.001****	0.438
Corrugator supercilii	36	(1,35)	3.652	0.064	0.094	17.078	**<0.001****	0.328	3.131	0.086	0.082
EEG asymmetry, mean	36	(1,35)	2.660	0.112	0.071	3.541	0.068	0.092	7.366	**0.010***	0.174
EEG asymmetry, peak	36	(1,35)	0.708	0.406	0.020	1.116	0.298	0.031	5.589	**0.024***	0.138

Abbreviations: df, degrees of freedom; ηp2, partial eta squared (effect size); EDA, electrodermal activity; EEG, electroencephalography.

**p < 0.05; FDR < 0.1.*

***p ≤ 0.001; FDR < 0.1.*

***p ≤ 0.001.*

Table 3.

Baseline values and social rejection responses (HR, facial EMG and EEG asymmetry)

		Heart rate (HR)		***Zygomaticus major***		***Corrugator supercilii***		**EEG asymmetry, mean**		**EEG asymmetry, peak**	
		M	SD	M	SD	M	SD	M	SD	M	SD
	Baseline	83.44	14.22	6.81	4.9	6.42	4.74	−0.02	3.38	−0.24	3.5
Real	Devaluing	78.7	10.27	14.34	11.31	6.81	4.86	−0.65	2.66	−0.32	2.8
	Interruption	81.29	10.66	15.55	13.68	7.51	4.77	−0.94	3.09	−0.98	3.45
	Nonverbal rejection	80.5	10.24	14.4	9.48	7.41	5.62	−1.95	3.22	−1.89	3.41
	TOTAL	80.16	10.1	14.77	10.59	7.25	4.95	−1.18	2.46	−1.06	2.68
Fict.	Devaluing	75.09	8.12	11.71	9.2	7.39	6.03	−0.85	2.71	−0.60	3.13
	Interruption	80.52	9.01	24.17	16.98	8.44	5.11	−1.17	3.03	−0.84	3.32
	Nonverbal rejection	78.32	7.8	16.46	12.23	7.41	4.74	−1.46	2.64	−1.50	2.99
	TOTAL	77.92	7.78	17.16	11.07	7.7	4.91	−1.10	2.28	−0.94	2.62

Abbreviations: EEG, electroencephalography; M, mean; SD, standard deviation; TOTAL, mean of combined rejection types (devaluing, interruption and nonverbal); Fict, fictional.

Table 4.

Baseline values and social rejection responses (EDA)

		Mean EDA Baseline (1 s)		**Mean EDA Response (2–5 s)**		**SCR Baseline (1 s)**		**SCR Response (2–5 s)**	
		M	SD	M	SD	M	SD	M	SD
Real	Devaluing	18.87	7.48	18.92	7.51	18.95	7.51	19.1	7.58
	Interruption	18.96	7.53	18.96	7.53	19.02	7.54	19.16	7.58
	Nonverbal rejection	18.89	7.46	18.92	7.46	18.96	7.47	19.09	7.5
	TOTAL	18.91	7.48	18.93	7.49	18.98	7.5	19.12	7.54
Fict.	Devaluing	21.5	10.24	21.42	10.27	21.61	10.29	21.67	10.39
	Interruption	21.9	10.83	22.01	10.79	22.05	10.87	22.38	10.99
	Nonverbal rejection	21.59	10.08	21.69	10.1	21.69	10.12	22.04	10.26
	TOTAL	21.88	10.46	21.88	10.5	22	10.51	22.18	10.65

Abbreviations: EDA, electrodermal activation; SCR, skin conductance response; s, second; M, mean; SD, standard deviation; TOTAL, mean of combined rejection types (devaluing, interruption and nonverbal).; Fict., fictional.

The frequency of the rejection types appear in Table 5.

Table 5.

Frequency of rejection types in study III

Context	Devaluing	Interruption	Nonverbal rejection	TOTAL
Real (interview)	151	163	122	436
Fictional (improvisation drills)	128	116	198	442

Self-reported stress

For self-reported stress ($M \leq 1.74$, $Md \leq 2.00$ on a Likert scale from 0 to 5 for all conditions) during the improvisation exercises (Figure 12), nonverbal rejection appeared more stressful than devaluing to participants ($F(2, 76) = 4.777$; $p = 0.011$; $\eta_p^2 = 0.112$).

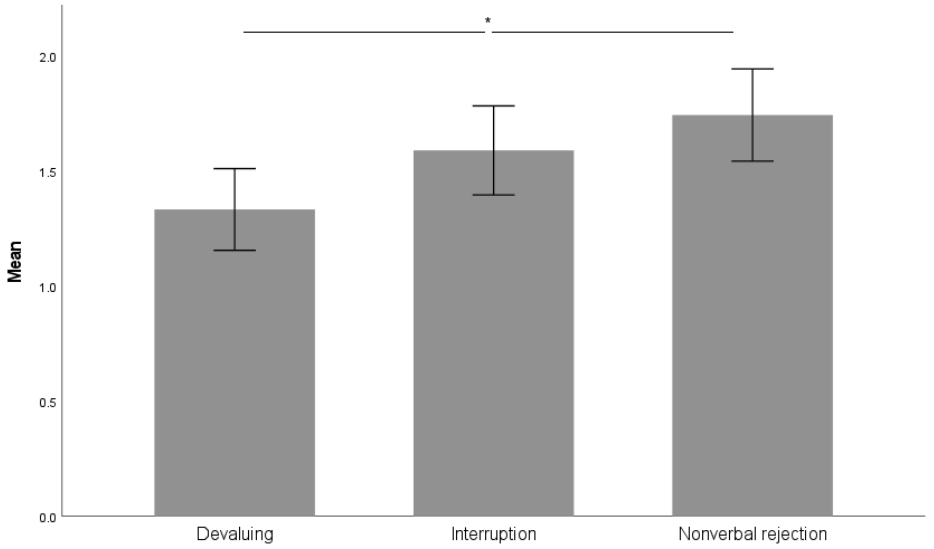


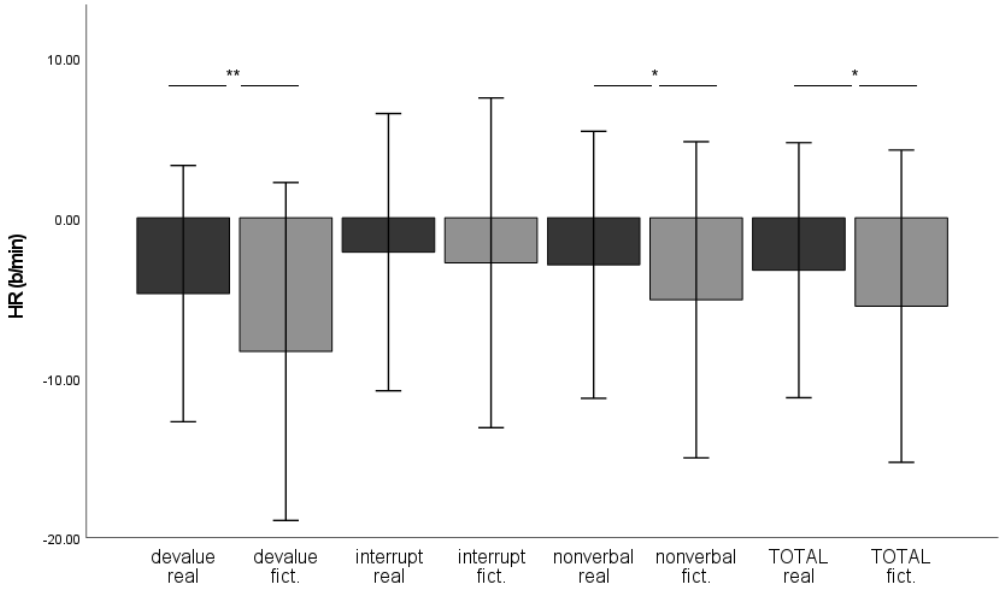
Figure 12. Self-reported stress during improvisation exercises. Scale 0 to 5 (0, not stressed at all; 5, extremely stressed). Error bars: +/-1 standard error; *$p < 0.05$; FDR < 0.1 (adapted from Seppänen, Toivanen, et al., 2021).

Physiological differences between real-life and fictional social rejections

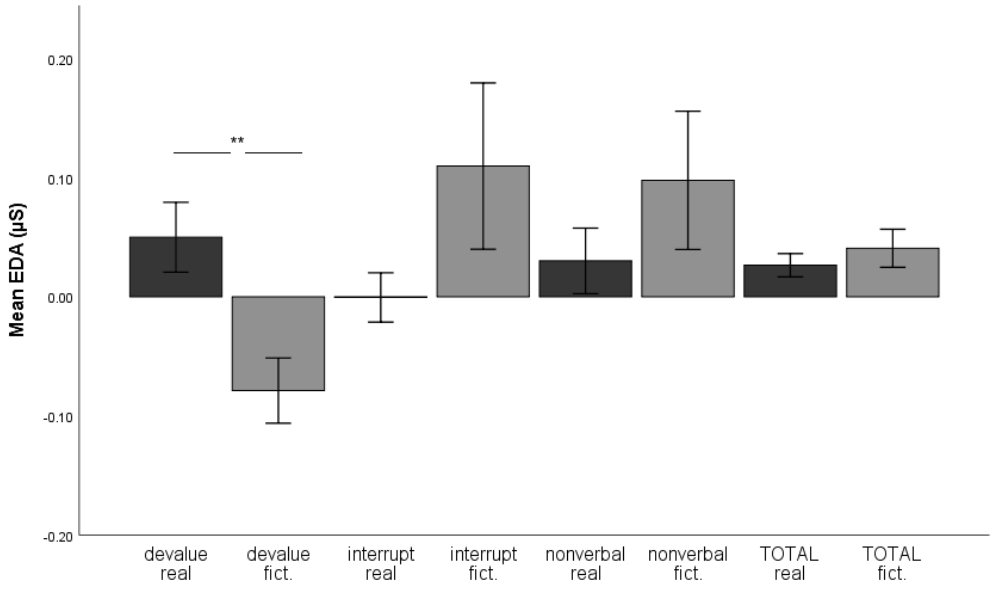
Relative to the real-life context, post-hoc tests indicated a lower HR (Figure 13a) during a fictional devaluing ($F(1,35) = 11.552$; $p = 0.002$; $\eta_p^2 = 0.248$) and nonverbal rejection ($F(1,35) = 5.579$; $p = 0.024$; $\eta_p^2 = 0.137$), a lower mean EDA (Figure 13b) during a fictional devaluing ($F(1,34) = 13.590$; $p = 0.001$; $\eta_p^2 = 2.814$), a lower SCR (Figure 13c) during a fictional devaluing ($F(1,34) = 6.148$; $p = 0.018$; $\eta_p^2 = 0.153$), a higher SCR during a fictional interruption ($F(1,34) = 10.482$; $p = 0.003$; $\eta_p^2 = 0.230$) and greater *zygomaticus major* activity (Figure 13d) during a fictional interruption ($F(1,35)$ 10.482; $p = 0.003$; $\eta_p^2 = 0.230$). We observed no differences for the *corrugator supercilii* activity (Figure 13e) nor EEG asymmetry (mean in Figure 13f; peak in Figure 13g; $p > 0.05$ for all).

When rejection reactivity was examined across all rejections (TOTAL), a lower HR (Figure 13a; $F(1, 36) = 7.556$; $p = 0.009$; $\eta_p^2 = 0.170$) and higher SCR (Figure 13c; $F(1, 36) = 10.693$; $p = 0.002$; $\eta_p^2 = 0.229$) in the fictional context was observed relative to the real-life context.

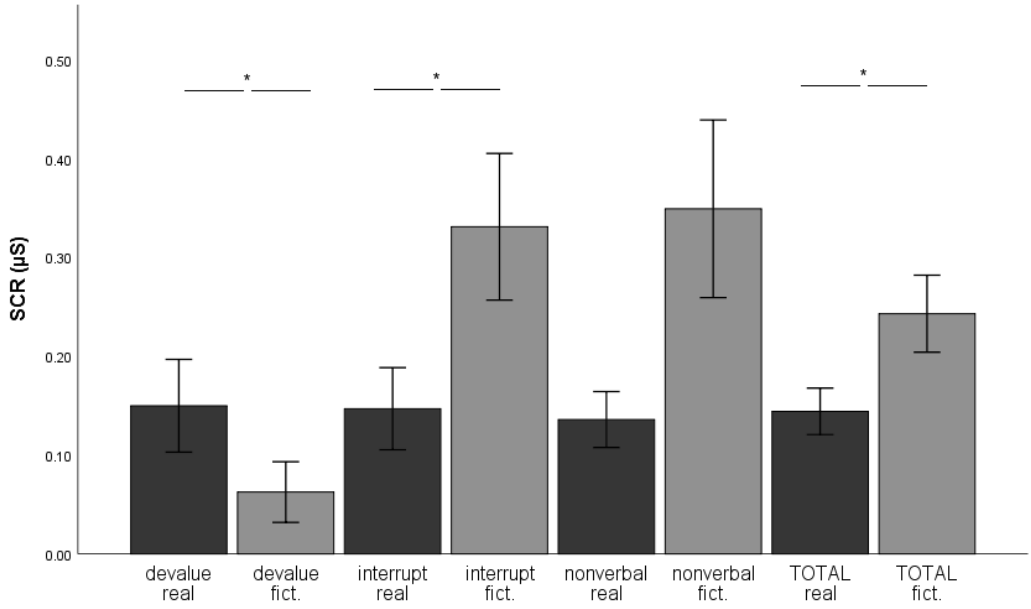
13a)



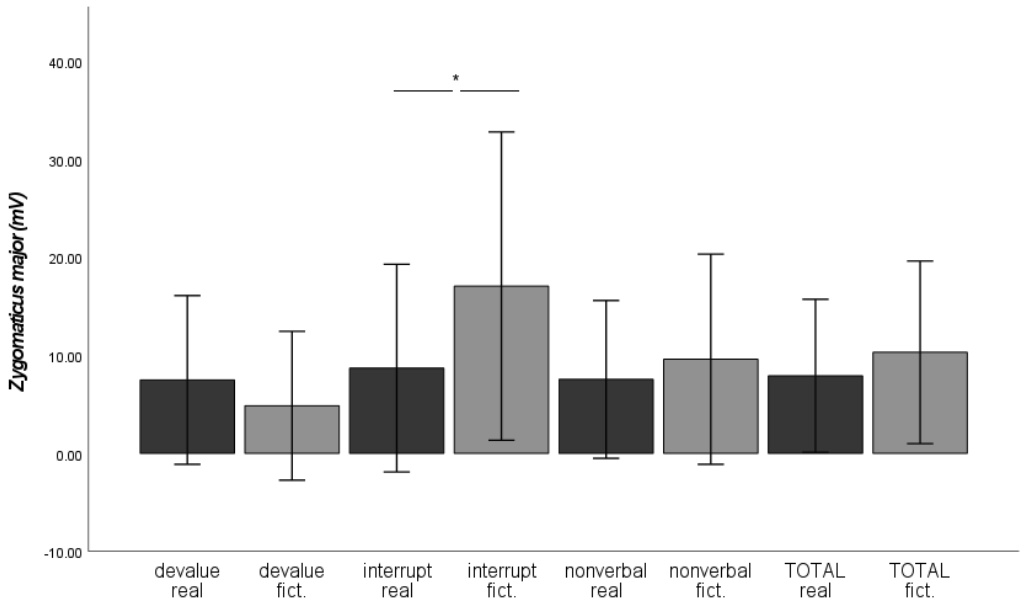
13b)


Mean EDA (µS)
0.20
0.10
0.00
-0.10
-0.20
**
devalue real
devalue fict.
interrupt real
interrupt fict.
nonverbal real
nonverbal fict.
TOTAL real
TOTAL fict.

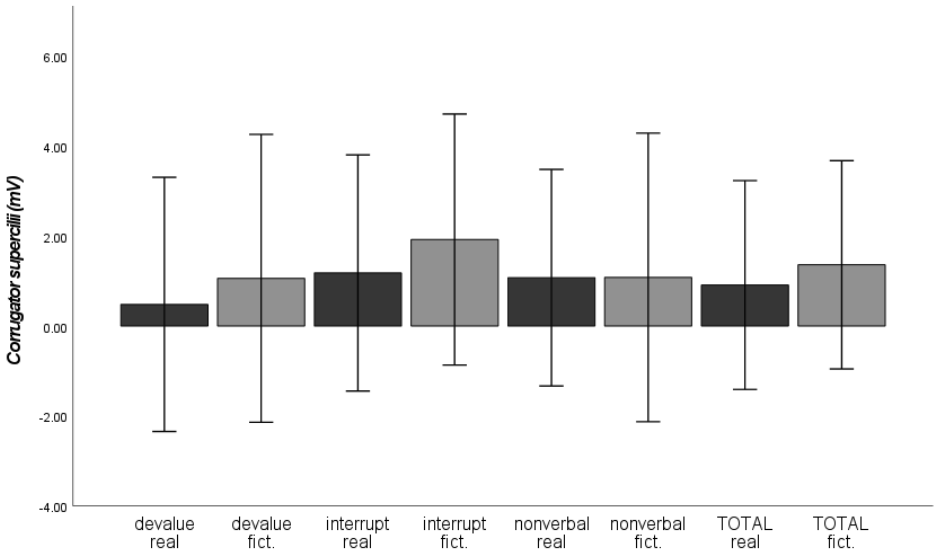
13c)


SCR (µS)
0.50
0.40
0.30
0.20
0.10
0.00
*
*
*
devalue real
devalue fict.
interrupt real
interrupt fict.
nonverbal real
nonverbal fict.
TOTAL real
TOTAL fict.

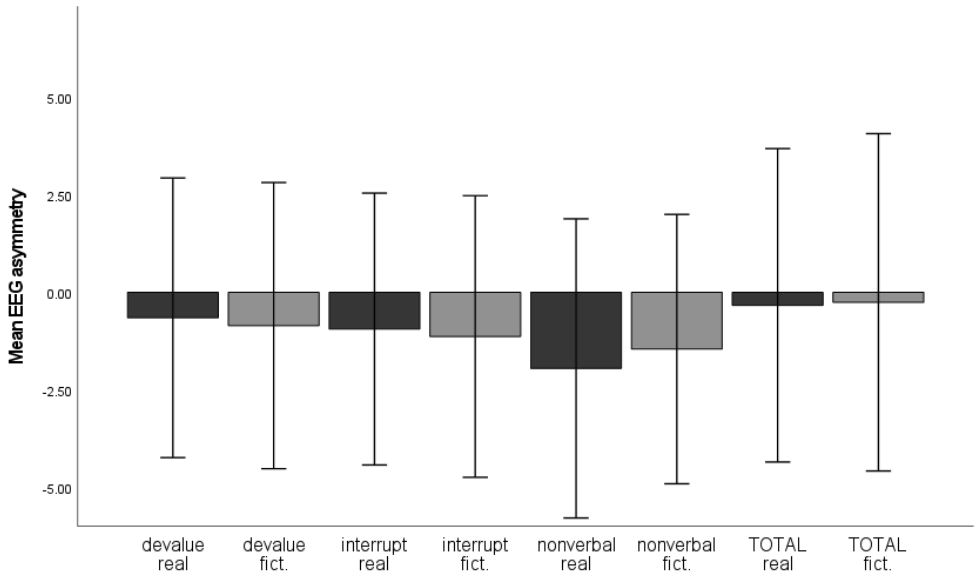
13d)


Zygomaticus major (mV)
40.00
30.00
20.00
10.00
0.00
-10.00
*
devalue real
devalue fict.
interrupt real
interrupt fict.
nonverbal real
nonverbal fict.
TOTAL real
TOTAL fict.

13e)


Corrugator supercilii (mV)
6.00
4.00
2.00
0.00
-2.00
-4.00
devalue real
devalue fict.
interrupt real
interrupt fict.
nonverbal real
nonverbal fict.
TOTAL real
TOTAL fict.

13f)



13g)

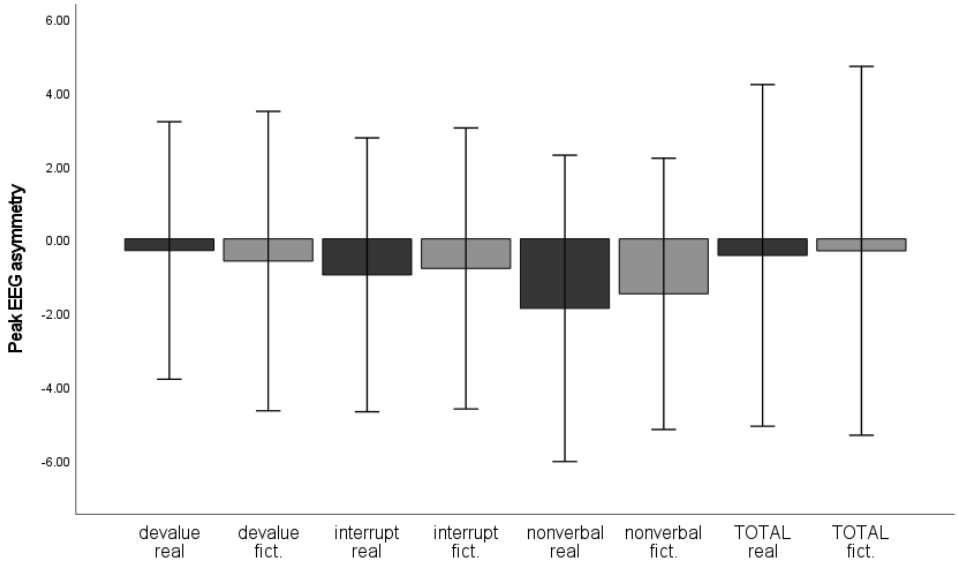


Figure 13. Physiological responses during real-life (real) and fictional (fict.) social rejections. Values represent the change scores (baseline subtracted). a) Heart rate (HR), b) mean EDA, c) skin conductance response (SCR), d) *zygomaticus major*, e) *corrugator supercilii*, f) mean EEG asymmetry and g) peak EEG asymmetry. TOTAL = rejection reactivity across all rejection types. Error bars: +/-1 standard error; **p* < 0.05, ***p* ≤ 0.001, FDR < 0.1 (adapted from Seppänen, Toivanen, et al., 2021).

All RM-ANOVA results regarding the differences in psychophysiological reactivity between real and fictional social rejections appear in Table 6. The RM-ANOVA results for rejection reactivity across all rejections (TOTAL) appear in Table 7.

Table 6.

Differences in psychophysiological reactivity between real-life and fictional social rejections

			Real-life vs. fictional devaluing			**Real-life vs. fictional interruption**			**Real-life vs. fictional nonverbal rejection**		
	n	df	F	*p*	ηp^2	F	*p*	ηp^2	F	*p*	ηp^2
Heart rate (HR)	36	(1,35)	11.552	**0.002***	0.248	0.182	0.672	0.005	5.579	**0.024***	0.137
Mean EDA	35	(1,34)	13.590	**0.001***	0.286	2.814	0.103	0.076	0.962	0.334	0.028
Skin conductance response (SCR)	35	(1,34)	6.148	**0.018***	0.153	4.945	**0.033***	0.127	3.795	0.060	0.100
Zygomaticus major	36	(1,35)	3.192	0.083	0.084	10.482	**0.003***	0.230	2.323	0.136	0.062
Corrugator supercilii	36	(1,35)	1.266	0.268	0.035	1.736	0.196	0.047	0.008	0.927	0.000
EEG asymmetry, mean	36	(1,35)	0.193	0.663	0.005	0.003	0.955	0.000	0.831	0.368	0.023
EEG asymmetry, peak	36	(1,35)	0.167	0.685	0.005	0.158	0.693	0.005	0.355	0.555	0.010

Abbreviations: df, degrees of freedom; ηp2, partial eta squared (effect size); EDA, electrodermal activity; EEG, electroencephalography.

**p < 0.05; FDR < 0.1.*

Table 7.

Differences in psychophysiological reactivity for combined social rejections between real-life and fictional contexts

			Real-life vs. fictional TOTAL rejections		
	n	df	F	*p*	ηp^2
Heart rate (HR)	38	(1,37)	7.556	**0.009***	0.170
Mean EDA	37	(1,36)	1.277	0.266	0.034
Skin conductance response (SCR)	37	(1,36)	10.693	**0.002***	0.229
Zygomaticus major	38	(1,37)	3.129	0.085	0.078
Corrugator supercilii	38	(1,37)	1.183	0.284	0.031
EEG asymmetry, mean	38	(1,37)	0.032	0.859	0.001
EEG asymmetry, peak	38	(1,37)	0.068	0.796	0.002

Abbreviations: df, degrees of freedom; ηp2, partial eta squared (effect size); EDA, electrodermal activity; EEG, electroencephalography.

**p < 0.05; FDR < 0.1.*

HR deceleration

A closer HR deceleration analysis revealed an interaction for TIME and CONTEXT ($F(5,180) = 2.344$; $p = 0.043$; $\eta_p^2 = 0.061$). Subsequent paired-samples t-tests identified a difference between real-life and fictional rejections at the first postrejection interval ($t(37) = 3.245$; $p = 0.002$), indicating a larger HR deceleration during fictional devaluing relative to real-life devaluing (Figure 14).

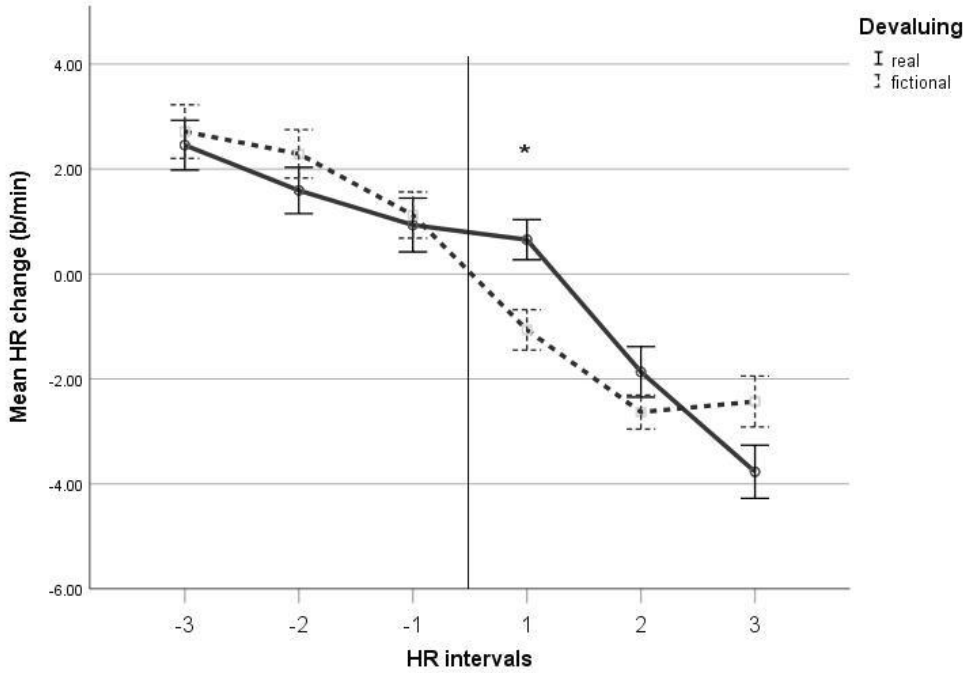


Figure 14. Phasic heart rate (HR) response to social rejection (devaluing). HR intervals of 2-s from the 6 s preceding the onset of a rejection (-3, -2 and -1) through 6 s after the onset of a rejection onset (1, 2 and 3). The vertical line indicates the time of the rejection onset. Error bars: +/-1 standard error. *$p < 0.05$, FDR < 0.1 (adapted from Seppänen, Toivanen, et al., 2021).

The association between real-life and fictional rejections

All significant associations between real-life and fictional rejections were positive. The strength of the association varied depending upon the measure, with the strongest association found for HR. HR and facial muscle activity were associated across all conditions, whilst mean EDA did not associate with any condition. For SCR and EEG asymmetry, rejection type modified the association (see Table 8 for details).

Table 8.

Spearman's rank correlations for physiological responses between real-life and fictional social rejections

	Real-life vs. fictional devaluing			**Real-life vs. fictional interruption**			**Real-life vs. fictional nonverbal rejection**			**Real-life vs. fictional TOTAL rejections**		
	rho	*p*	*n*	*rho*	*p*	*n*	*rho*	*p*	*n*	*rho*	*p*	*n*
Heart rate (HR)	**0.805****	<0.001	38	**0.718****	<0.001	36	**0.812****	<0.001	38	**0.843****	<0.001	38
Mean EDA	-0.078	0.644	37	-0.062	0.725	35	-0.014	0.932	37	0.315	0.057	37
Skin conductance response (SCR)	-0.016	0.925	37	0.103	0.555	35	0.053	0.756	37	**0.515****	0.001	37
Zygomaticus major	**0.551****	<0.001	38	**0.531****	0.001	36	**0.686****	<0.001	38	**0.617****	<0.001	38
Corrugator supercilii	**0.592****	<0.001	38	**0.495****	0.002	36	**0.733****	<0.001	38	**0.412***	0.010	38
EEG asymmetry, mean	**0.450****	0.005	38	0.091	0.596	36	**0.337***	0.038	38	**0.627****	<0.001	38
EEG asymmetry, peak	**0.468****	0.003	38	0.158	0.358	36	0.294	0.073	38	**0.677****	<0.001	38

Abbreviations: rho, Spearman's rho; TOTAL, mean of the combined rejection types (devaluing, interrupting and nonverbal), EDA, electrodermal activity; EEG, electroencephalography.

**p < 0.05*

*** p ≤ 0.001*

2.4.6 Discussion

Whilst participants evaluated rejections as mild, the rejections nevertheless elicited physiological arousal, indicated by the elevated levels of SCRs compared to the baseline measurements. Additionally, the EEG asymmetry values were negative across all conditions, indicating that rejections evoked withdrawal-related behaviour as expected. These results confirmed the success of stimulus manipulation. However, the HR unexpectedly decreased across all conditions relative to baseline. Possibly, the previous test condition (TSST) might have inflated the baseline measurements (the silent waiting period before the interview) or participants might have been nervous whilst anticipating the interview. Nevertheless, the HR change score served as an acceptable measure to indicate the relationship between real-life and fictional social rejections, the primary research question in this study.

The main finding from study III lay in the absence of any systematic attenuation of the psychophysiological reactivity to fictional versus real-life stimuli. This is highly interesting, novel information for both theatre-based

practices and research on the paradox of fiction. The literature on the paradox of fiction reports either an emotional and physiological downplaying associated with fictional stimuli (e.g., Abraham et al., 2008; Mocaiber et al., 2010; Sperduti et al., 2016) or similar emotional and physiological responses in real-life and fictional contexts (Goldstein, 2009; Gorini et al., 2010; Kisker et al., 2019; Zadro et al., 2004). Interestingly, this study also found a stronger physiological reactivity during a fictional relative to a real-life context, a finding that contradicts previous studies.

Personal relevance might explain why we observed no systematic attenuation of arousal or valence related to the fictional stimuli. Personal relevance refers to processes such as personal memory retrieval and the processing of personally salient information (Abraham et al., 2008; Abraham & Cramon, 2009; Sperduti et al., 2016). The tasks performed in this study required personal engagement using participants' imagination and resulting in spontaneous associations and input during the tasks. In other words, participants were active agents rather than passive observers of stimuli. Perhaps, the rejection of these personally constructed associations might have counteracted the fiction-related downplaying processes and resulted in a relatively comparable reactivity to those that occur during real-life rejections.

Apart from the paradox of fiction, study III extends our understanding of the improvisation method. Regardless of the perceived fictionality, bodily responses during improvisation associated with those that occurred during the real-life condition. In addition, the bodily responses remained relatively similar, since during most conditions (20 of 28) fictional and real-life responses did not differ. The relevance of these findings extends to theatre-based practices in general, which rely on holistic actions and personal engagement in fictional contexts. Additionally, the educational field benefits from this further understanding since theatre-based practices are frequently applied to simulate everyday social interactions for learning purposes.

Finally, the results of this study highlight the importance of psychological safety in improvisation training (see also Siljamäki, 2021) as in theatre-based practices in general. Although this study compared real-life and fictional contexts, the findings do not imply that fictional experiences in an educational context should equate with real-life experiences. Equivalent experiences might even become harmful when the topic is challenging, such as bullying at school or work as well as other forms of violence. Given that fictional rejections can elicit emotional arousal comparable to real-life situations, a teacher or facilitator should carefully monitor the psychological wellbeing of participants when simulating challenging social encounters.

2.5 Study IV – Validation study and immediate and long-term impact of improvisation

First, since no validated self-report instrument existed for measuring the multidimensional skillset acquired through improvisation training, study IV attempted to validate the Interpersonal Confidence Questionnaire (ICQ), which was developed to evaluate improvisation training, and examine its psychometric properties. Second, study IV utilised the validated ICQ to examine the impact of improvisation training on interpersonal confidence using a larger sample than that in study I, and to determine whether this impact persisted over time.

2.5.1 Procedure

Study IV included other improvisation interventions in addition to the intervention described in study I. Here, another teacher, specialised in theatre improvisation, conducted one 10-week and several 5-week improvisation courses, with class meetings spanning two hours. Participants were taught the basics of improvisation and submitted precourse tasks and learning diaries comparable to those from study I. The 10-week course was aimed at student teachers, during which the last three course meetings consisted of student teachers themselves teaching improvisation exercises to one another.

2.5.2 Measures

Interpersonal Confidence Questionnaire (ICQ)

The ICQ is a measure of self-reported interpersonal confidence (Novák, 2017, 2020), which refers to a situationally specific context, focusing on social interactions rather than on the more general trait of self-confidence. The questionnaire used in study I consisted of 30 positively and negatively worded statements, which respondents rate using a Likert scale ranging from 0 to 5 (0, strongly disagree; 5, strongly agree). The validated 18-item ICQ used in study IV contains six subscales: performance confidence, flexibility, listening skills, tolerance for failure, collaboration motivation and presence.

Rosenberg's Self-Esteem Scale (RSE)

Rosenberg's Self-Esteem Scale (RSE) is an established and widely used measure of self-esteem (Robins et al., 2001; Rosenberg, 1965). This questionnaire consists of ten positively and negatively worded statements related to the respondent's self-worth and self-acceptance. In study IV, the RSE was used to investigate the relationship between self-esteem and interpersonal confidence.

Mini-Social Phobia Inventory (Mini-SPIN)

Mini-SPIN is a three-item, validated self-rated scale to screen for generalised social anxiety disorder (Connor et al., 2001; Ranta et al., 2012; Seeley-Wait et al., 2009). The scale was used to investigate the discriminant validity of the ICQ.

2.5.3 Data processing

The negatively worded statements from both the ICQ and RSE were transformed to positive values, and summation variables were calculated, producing each participant's mean score (range, 0–5). Higher scores indicated higher interpersonal confidence and self-esteem. For mini-SPIN, a summation variable (range, 0–5) was computed with high scores indicating a higher social anxiety.

2.5.4 Statistical analyses

We set the alpha level to 0.05 for all statistical analyses. The independent samples t-test was used to test for differences between groups at baseline. A confirmatory factor analysis (CFA) was conducted to validate the measurement model of the ICQ. The internal consistency of the six factors confirmed by the CFA was examined by calculating their composite reliability (Raykov, 1997). The test–retest reliability of the ICQ was established using the Spearman's rank correlation. The discriminatory power of the ICQ was inspected using a contrasting groups method, that is, through testing with an independent samples t-test to determine if the upper and lower quartiles of the data differed. To investigate the relationship of interpersonal confidence to self-esteem and social phobia, the Pearson's correlation coefficient was calculated using the RSE (Robins et al., 2001; Rosenberg, 1965) and the mini-SPIN (Connor et al., 2001; Ranta et al., 2012; Seeley-Wait et al., 2009), respectively.

To identify the immediate effects of the improvisation interventions, a two-way ANOVA for mixed measures was conducted including TIME (pretest vs. posttest) as a within-group factor and GROUP (intervention vs. control) as a between-group factor. Paired-samples t-tests for pre–post results were performed as follow-up tests. Bonferroni corrections were used to counteract the problem of multiple comparisons, while estimates of the effect size were reported using the partial eta squared (η_p^2). To identify the long-term effects of improvisation training, the JN procedure was used instead of an ANOVA. Since this follow-up subsample mirrored that from study I, wherein we identified a heterogeneous treatment effect, we performed the same statistical test to determine whether this effect persisted one year later.

2.5.5 Results

The first part of study IV investigated the psychometric properties of the ICQ used in study I. A CFA established an 18-item scale with six factors (Figure 15): 1) performance confidence (four items), 2) flexibility (three items), 3) listening skills (three items), 4) a tolerance for failure (four items), 5) collaboration motivation (two items) and 6) presence (two items). The ICQ demonstrated a satisfactory model fit using the following criteria: 1) the ratio of chi-square to degrees of freedom (χ^2/df = 1.52); 2) the comparative fit index (CFI = 0.94); 3) the Tucker Lewis index (TLI = 0.93); 4) the root mean square error of approximation (RMSEA = 0.05); and 5) the standardised root mean square residual (SRMR = 0.05). Excluding the factor presence, which failed to reach the cut-off value of 0.60, the internal consistency of the ICQ and its factors were adequate, indicated by the composite reliability values ranging from 0.66 to 0.83 (for presence, 0.57). The level of interpersonal confidence remained stable across the relatively long test–retest interval of eight weeks (r_s = 0.853, p < 0.01), indicating a high test–retest reliability. Furthermore, the ICQ exhibited a discriminatory power since the mean values between the highest and lowest percentiles differed significantly [t (99) = -30.478, p < 0.001]. The Pearson's correlation coefficients revealed a positive correlation between interpersonal confidence and self-esteem, measured using the RSE (r = 0.486, p < 0.001). Interpersonal confidence and social phobia, measured using the mini-SPIN, revealed an inverse relationship (r = - 0.646, p < 0.001).

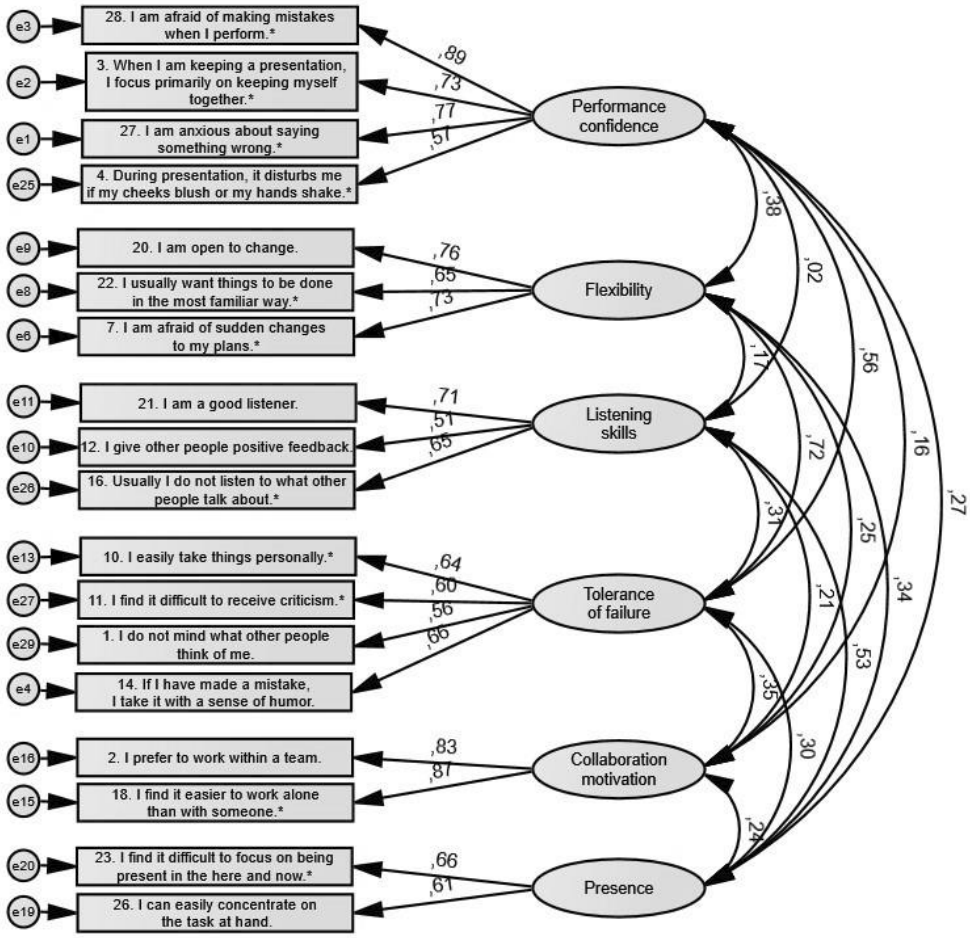
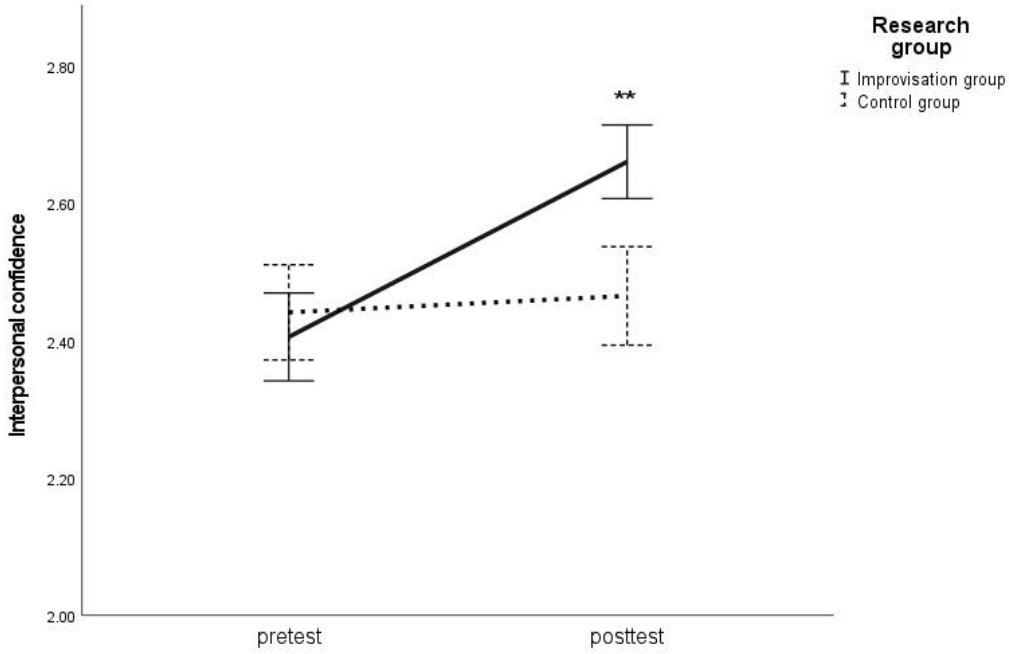


Figure 15. The 18-item, six-factor measurement model of the Interpersonal Confidence Questionnaire (ICQ). The small circles on the left signify the error terms, the squares provide the original individual statements, and the ovals signify the ICQ factors. Factor loadings are depicted with arrows from the factors to the statements, and the correlations between the factors are indicated by the curved multidirectional arrows on the right (adapted from Seppänen, Novák, et al., 2021).

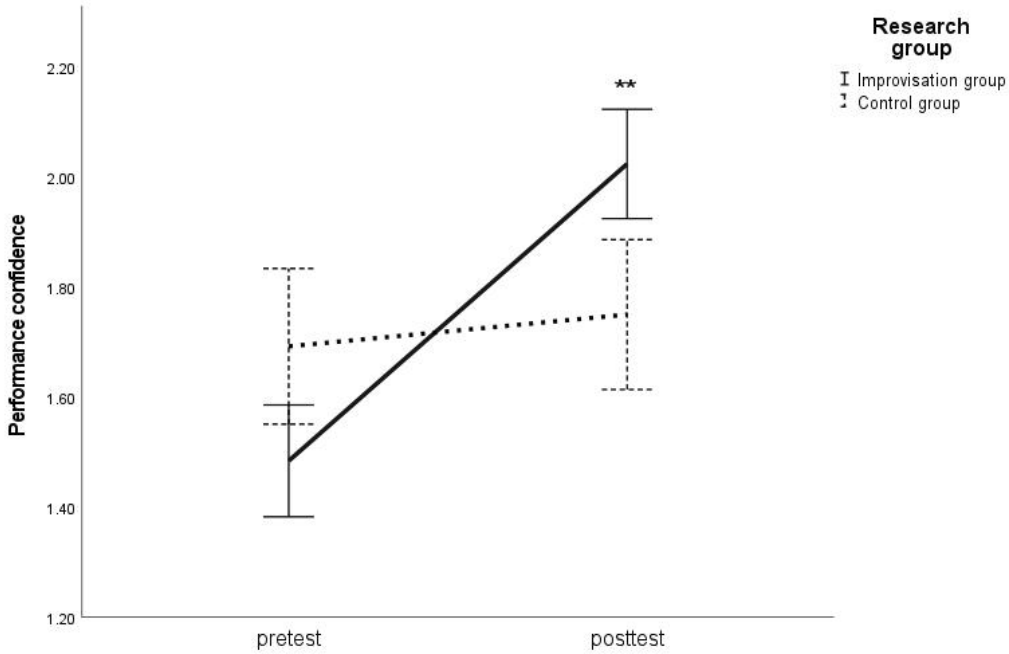
The second part of study IV used the 18-item ICQ to investigate the immediate and long-term impact of improvisation training. In terms of the immediate effects at posttest, the results revealed a TIME x GROUP interaction for interpersonal confidence (Figure 16a; F (1, 158) = 12.400; $p < 0.001$; $\eta_p^2 = 0.073$), performance confidence (Figure 16b; F (1, 158) = 13.858; $p < 0.001$; $\eta_p^2 = 0.081$) and a tolerance for failure (Figure 16c; F (1, 158) = 5.525; $p = 0.020$; $\eta_p^2 = 0.034$). For flexibility, the interaction remained marginally significant (Figure 16d; F (1, 158) = 3.238; $p = 0.074$; $\eta_p^2 = 0.020$). Adjacent paired t-tests confirmed that the scores increased for the improvisation group, but not for controls. For the collaboration

motivation, a significant main effect for TIME was identified (F (1, 159) = 12.257; p = 0.001; η_p^2= 0.072), but we observed no interaction, indicating that the level of collaboration motivation increased irrespective of the group.

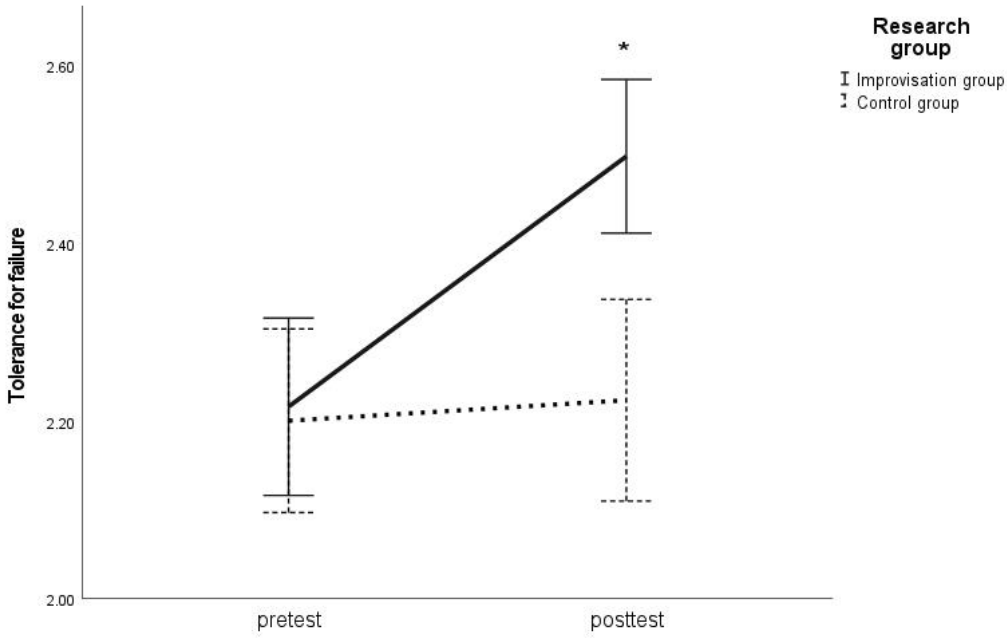
16a)



16b)



16c)



16d)

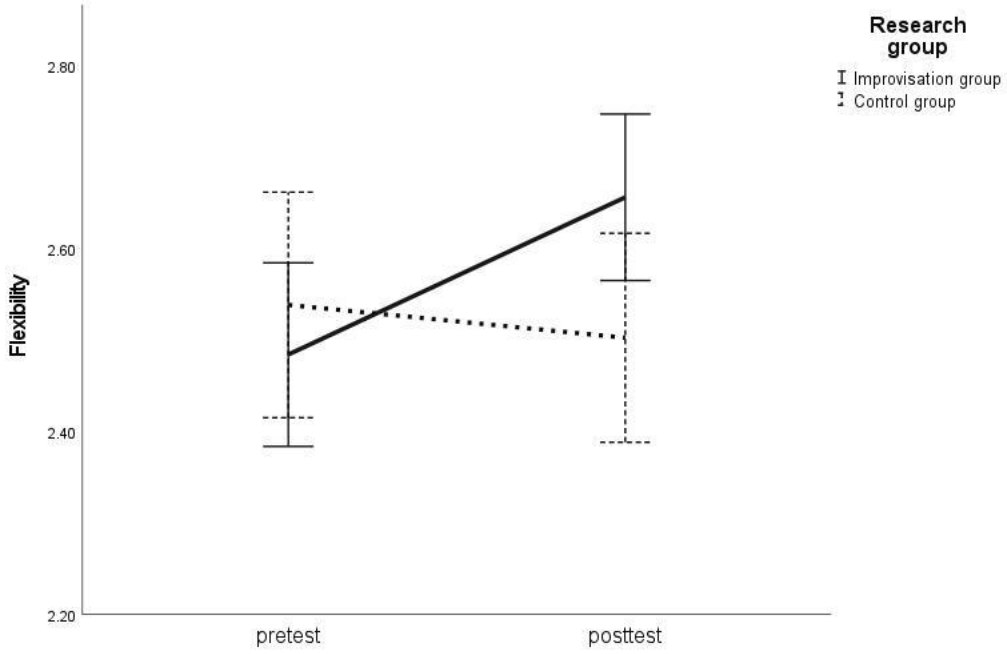


Figure 16. a) Interpersonal confidence as measured by the 18-item ICQ, b) performance confidence, c) tolerance for failure and d) flexibility before and after improvisation training. $^{**}p < 0.001$, $^{*}p < 0.05$; error bars: ±1 standard error (adapted from Seppänen, Novák, et al., 2021).

In terms of the long-term effects, which we examined using the same participants as in study I, improvisation training enhanced performance confidence relative to the control group and this between-group difference persisted for one year. Again, participants with low initial levels of performance confidence gained the most benefit from the intervention. For interpersonal confidence, the increase relative to controls that was observed at the posttest amongst participants with low pretest levels was not detected at the follow-up test. For the remaining ICQ factors, no between-group differences at the post- or follow-up tests were identified. Table 9 summarises the regions of significance for the differences between research groups revealed through the JN analyses. Figure 17 illustrates the mean values for performance confidence at the pre-, post- and follow-up tests.

Table 9.

Johnson-Neyman regions of significance for the differences between experimental groups

	Region of significance	
	T1 vs. T2	T1 vs. T3
Interpersonal confidence	1.23–2.74	-
Performance confidence	0.04–2.51	< 1.96
Flexibility	-	-
Listening skills	-	-
Tolerance for failure	-	-
Collaboration motivation	-	-
Presence	-	-

Note: The range of the Interpersonal Confidence Questionnaire is 0–5. The region of significance reveals the range of pretest (T1) values, where the difference between groups at the posttest (T2) and follow-up test (T3) is significant.

Abbreviations: T1, pretest; T2, posttest; T3, follow-up test.

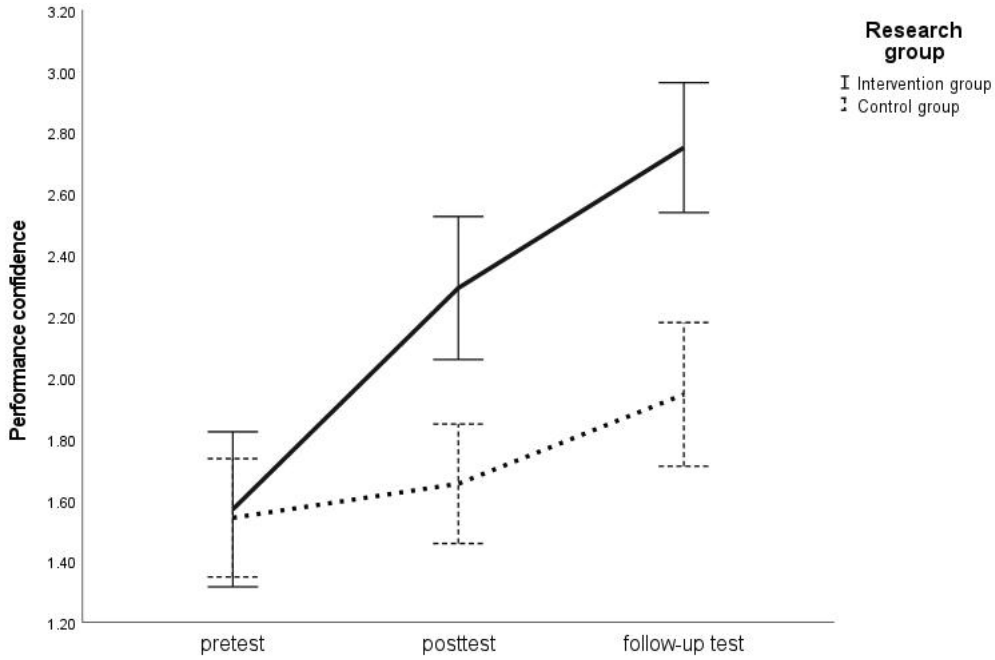


Figure 17. Mean values for performance confidence at the pre-, post- and follow-up tests (one year later). Error bars: ±1 standard error (adapted from Seppänen, Novák, et al., 2021).

2.5.6 Discussion

Findings from study IV provided evidence of the validity and reliability of an 18-item ICQ as a self-report measure of interpersonal confidence. A confirmatory factor analysis revealed that six factors—performance confidence, flexibility, listening skills, a tolerance for failure, collaboration motivation and presence—contribute to interpersonal confidence. The ICQ showed a composite reliability, test–retest reliability, discriminatory power and a positive association with self-esteem as well as a negative association with social phobia. When the validated ICQ was employed to measure the impact of improvisation training, the results demonstrated that at the posttest interpersonal confidence, performance confidence and a tolerance for failure increased relative to controls. The improvement to flexibility remained marginally significant.

One year later, performance confidence persisted at a higher level than that found among the control group, while between-group differences among the other factors were nonexistent. Perhaps the development of interpersonal confidence ceased once improvisation training ended (none of the participants reported attending improvisation courses following the intervention). Additionally, since the wait-listed control group participated in a shorter improvisation course following the study, attending this course possibly confounded our findings by diminishing the between-group difference. However, performance confidence persisted over time irrespective of the discontinued improvisation training and the

improvisation course for the control group. This might be explained by the lower initial level of performance confidence versus other factors, that is, there might have been more potential for change in performance confidence. Furthermore, participants might have been motivated to improve their performance confidence specifically, since the improvisation course advertisement encouraged ‘persons struggling with performance anxiety’ to participate in the course. Finally, a transfer effect might explain this result. Student teachers confront performance situations frequently in their studies (e.g., presentations and teaching practice) such that regardless of the discontinuation of improvisation training, the improved performance confidence transferred from the improvisation training context to performance situations in their everyday lives.

3 Conclusions

This dissertation contributes to the literature on educational research by examining the behavioural, neuroendocrine and psychophysiological effects of a theatre-based improvisation method in the context of student teachers' interpersonal competence. Two primary research questions guided this research. First, I examined what impact improvisation training had on interpersonal competence and social stress, and second, I examined the impact of real versus fictional social rejections on experienced stress and psychophysiological responses. To respond to these questions, I relied on an interdisciplinary approach consisting of self-reports, neuroendocrine and electrophysiological measures. Measurements were conducted at several time points: before an improvisation intervention, during improvisation, following the intervention and one year later.

3.1 Summary of results

The four primary findings summarised in this dissertation are as follows: 1) a heterogeneous treatment effect was found, whereby those with a lower interpersonal confidence gained the most from improvisation training; 2) improvisation training reduced social stress; 3) psychophysiological responses to social rejections in real-life and fictional contexts were associated and relatively similar; and 4) an improved performance confidence following improvisation training persisted over time.

The results from study I suggest that a relatively short improvisation intervention promotes interpersonal confidence. In terms of Spitzberg's (1981) competence theory (knowledge, skills and motivation as components of competence), interpersonal confidence represents a motivational element of competence. Specifically, one might possess abundant knowledge about interpersonal behaviour as well as skills to perform during social interactions, whilst lacking the confidence to use these resources. Furthermore, a heterogeneous treatment effect was found, indicating that less confident student teachers benefited the most from the intervention. One possible explanation for this finding is the alleviation of a fear of failure due to the reappraisal of mistakes from negative to neutral or positive. This explanation is supported by our findings from study IV amongst a wider sample, whereby a tolerance for failure, a subfeature of interpersonal confidence, increased following improvisation training relative to controls. Disengaging attention from one's own mistakes might channel attention outwards, leading to a situation-focused sensitivity and context-related behaviour, which, in turn, might foster confidence during interpersonal

encounters. Perhaps there was greater potential for this change amongst less confident student teachers, whereby they gained more from the intervention.

Study II focused on the physiological effects of improvisation intervention during acute social stress, illustrating that improvisation intervention may lessen preperformance stress, indexed by diminished facial muscle activity and an increased HRV. In addition, interpersonal confidence appears to associate with lower stress responses. The lower stress responses in the control group suggest that the repetition of a challenging task, such as a public speech, generates habituation, particularly amongst those with low interpersonal confidence.

Study III compared the psychophysiological responses elicited by real-life and fictional improvised social rejections in an attempt to examine how the fictionality of the context influences the experience of social rejection. Overall, we detected no systematic fiction-related attenuation of the psychophysiological arousal or valence. Psychophysiological responses in real-life and fictional contexts associated with one another, and the rejection type modified the responses. Notably, all rejections elicited a negative EEG asymmetry, associated with behavioural withdrawal motivation. The facial *corrugator supercilii* activity and EEG asymmetry did not distinguish between real-life and fictional contexts during any of the social rejections.

Finally, study IV provided evidence of the validity and reliability of the 18-item ICQ and identified six factors—performance confidence, flexibility, listening skills, a tolerance for failure, collaboration motivation and presence—that contribute to interpersonal confidence. With a sample size extended from that included in study I, improvisation interventions promoted interpersonal confidence, performance confidence and a tolerance for failure relative to the control group. One year later, a follow-up study conducted amongst the same sample from study I showed that performance confidence persisted at a higher level than that found amongst the control group. Thus, a relatively short improvisation intervention may carry positive long-term effects on performance confidence.

In summary, these findings extend our understanding of the impact of improvisation training, demonstrating that a relatively short improvisation intervention promotes interpersonal confidence, specifically amongst less confident individuals. These findings also provide novel, biological evidence for the application of improvisation as a tool to improve skills related to interpersonal competence, such as within professions where face-to-face interaction is required.

3.2 Theoretical contributions

This dissertation draws from DeMarco's philosophical conceptualisation of improvisation (2012) and develops a novel two-dimensional model to illuminate the theoretical background of improvisation. The model comprises two continua:

artistry (from artistic to nonartistic) and the *stability of the form* (from stable to fluid). This combination allows us to comprehend versatile forms, goals and contexts of improvisation regardless of the genre (theatre, music, dance, etc.). The framework also allows for relevant comparisons between various forms of improvisation.

The results from this dissertation link with the artistry continuum. DeMarco argues that nonartistic, everyday improvisations transfer easily to artistic forms of improvisation (2012, p. 100). Furthermore, this dissertation experimented with the opposing direction, from improvisation as an artistic actor training method to a nonartistic context within teacher education. In study III, improvisational and fictional social rejection exercises positioned the location at the artistic end of the continuum, whilst the interviewer's realistic social rejections situated the location at the nonartistic, everyday end. Interestingly, the results from study III suggest that on a bodily level the rejection-related physiological responses remained rather similar regardless of the location along the artistry continuum. These findings support the notion that reality is not a necessary prerequisite to evoke emotional experiences, but fictional representations of reality can generate genuine emotional experiences as well. These results also provide empirical support for the theory of using artistic improvisation as a conceptual—as well as embodied—analogy for everyday phenomena. Consequently, the results strengthen the theoretical foundation for using theatre improvisation as a tool to simulate everyday encounters for educational purposes.

Through fictionality, a core component of improvisation, these findings may extend to drama education in general, since drama education is based on improvisational actions and using fictional time, roles and situations as well (Neelands & Goode, 2015, p. 3). Like learning to fly in a flight simulator or practising medical skills in an emergency room simulation, drama education provides a safe, fictional context within which to explore and practise realistic social interaction situations experientially for learning purposes. Improvisation serves to create an interactive and positive learning environment in which participants' construction of knowledge and learning takes place through functional and interactive social relationships. By alternately assuming a role and behaving as themselves, learners acquire operating experiences and create new knowledge of the phenomena under review. Regardless of the fictionality of the context, genuine emotions and experiences may emerge, thereby serving experiential learning.

In addition, this dissertation suggests that improvisation might represent a cognitive reappraisal strategy surrounding a fear of failure, that is, changing the way we think about failure in order to change how we feel about it. Cognitive reappraisal represents a component of the emotion regulation theory (Gross, 1999, 2015; McRae, 2016) serving as one strategy to regulate emotions of the wrong magnitude, type or duration. Improvisation trains individuals to process both the

possibility and consequences of failure, changing its connotation from negative to neutral or positive (hence, the improvisation practitioner slogan, 'a mistake is a gift'). However, since no study within this dissertation directly measured emotion regulation (e.g., using the Emotion Regulation Questionnaire (ERQ), Gross & John, 2003), this remains speculation and would benefit from further research.

According to the social self-preservation theory of Gruenewald et al. (2004), the threats to the social self (i.e., situations that threaten or reject an individual's social value) elicit cognitive, emotional and physiological responses associated with stress. The diminished fear of failure following improvisation training may generalise to diminished social stress, since mistakes are appraised as less threatening to one's social self. The findings related to a lower preperformance stress in study II support this hypothesis and agree with previous studies that reported lower levels of social stress and anxiety following an improvisation intervention (Casteleyn, 2019; Felsman et al., 2018; Krueger et al., 2017; Phillips Sheesley et al., 2016).

3.3 Practical applications and relevance

Working life today and in the future requires competencies related to sharing and developing ideas together and managing uncertainty, complexity and time pressures (Hill et al., 2017; Hodge & Ratten, 2015; *New National Core Curriculum for Basic Education*, 2016). Improvisation responds to these requirements by building skills for establishing genuine encounters, reciprocity, adaptability and creativity applicable to professional social interactions. In particular, this dissertation offers practical implications for fields where interpersonal competencies are required.

Applications in teacher education

> 'Throughout the course, I processed topics on two levels: 1) on myself, currently within this course and otherwise in life, and 2) on how my students in future could also benefit from these topics' (Student teacher, learning diary, 2018).

Coppens (2002) suggests that a teacher should establish a safe place where students can experiment and learn, and should always be ready to integrate unexpected contributions from students and the environment. Since "to be prepared for when one is unprepared (DeMarco, 2012, p. 93) lies at the heart of improvisation, improvisation training might prepare student teachers to understand how to deal with the unexpected in their future profession as teachers (Maheux & Lajoie, 2011; Toivanen et al., 2021, p. 12). To understand its potential

for teacher education, I revisit the stepwise learning process within improvisation (see Figure 3, p. 31).

Step 1 in improvisation training targets building psychological safety within a group, which is essential to promoting learning (Paul, 2015). Alongside offering student teachers a rich toolset of exercises to build psychological safety, the personally experienced, safe learning environment in improvisation training allows students to understand the importance of a supportive classroom climate. A supportive emotional climate in the classroom has been linked to greater student conduct, motivation, engagement and academic achievement (Brackett et al., 2011). **Step 2**, a tolerance for failure, may lead to greater tolerance of mistakes in the classroom, beginning with the teacher her-/himself. Treating teachers' own mistakes with ease and humour may encourage students to tolerate their own mistakes as well (Morales-Almazan, 2021; Paul, 2015). Students learn that making mistakes does not necessarily lead to negative consequences, and instead develop an appreciation for learning from mistakes and proceeding onward. **Step 3**, practising attention allocation, together with **Step 4**, listening exercises, may enhance student teachers' abilities to tune in to the classroom environment with a greater sensitivity, possibly promoting responsive and situation-oriented teaching. **Step 5**, accepting, and **Step 6**, adding, constitute the fundamental 'yes and' principle of improvisation, which trains student teachers' intuitive and dialogical thinking, as well as to spontaneously adapt to constant changes in the classroom.

> 'After the class, I could not help but notice statuses in everyday life. I began to pay more attention to interpersonal relationships and statuses at university, at home, on the subway or while walking outdoors. My status will not remain unnoticed and unassessed. I feel I can express myself better with body language because I am more aware of it' (Student teacher, learning diary, 2018).

In addition to training on the basic principles of improvisation, training related to status transactions can benefit student teachers to become more aware of the social dominance processes that exist in the classroom. Through status exercises, teachers learn to adapt their verbal and nonverbal behaviour to the constantly changing demands that accompany teaching. In other words, teachers learn to oscillate between low-status (empowering a student by asking for guidance on a topic with which the student is more familiar than the teacher) and high-status (controlling the pace of the conversation, assigning tasks, forming groups, etc.) behaviours. Teachers may also support their students to achieve an equal status in their peer interactions. Status behaviour bares a close resemblance to the concept of verbal and nonverbal immediacy, which has been studied in the context of teacher education (e.g., Andersen et al., 1979; Liu, 2021; McCroskey et al., 2016; Toivanen et al., 2021). A recent review by Liu (2021) found that teacher

immediacy, that is, the psychological intimacy between teachers and their students, associates with an increased student motivation. They also found moderate correlations between students' higher achievements and teacher immediacy, and recommend knowledge of teacher immediacy behaviours as an important component of teacher education.

However, as Maheux and Lajoie (2011) remind us, improvisation does not always lead to fruitful, enriching or productive outcomes in teaching. Thus, improvisation should also not be understood as a one-size-fits-all solution to teacher education, but as one possible way to address the improvisational nature of teaching. Siljamäki (2021) highlights the importance of acknowledging the diversity of learners, as well as conditions that may hinder participation in collaborative improvisation. Siljamäki also argues that improvisation generates a versatile range of benefits to learners, depending on their personal needs, challenges and resources. More generally, the findings summarised in this dissertation concur with previous research, recommending the inclusion of improvisation in teacher education curricula (Aadland et al., 2017; Ben-Horin, 2016; Graue et al., 2015; Holdhus et al., 2016; Lehtonen et al., 2016; Maheux & Lajoie, 2011; Morales-Almazan, 2021; Sawyer, 2004; Zondag et al., 2020).

A tool to relieve performance anxiety

> 'When I reflect on the contents of the course and my learning, I find it really gave me performance confidence. It didn't make me a star performer, but I gained tools to ponder my performance and anxiety and how to deal with them' (Student teacher, learning diary, 2018).

In performance anxiety, the social-evaluative threat, which previously generated adaptive emotional reactions to prevent social exclusion, transforms to prompt psychological and physiological arousal of the wrong magnitude, paradoxically hindering social inclusion. Performance anxiety may be sufficiently severe to cause individuals to discontinue their studies, change career ambitions and even prevent initiating an everyday conversation with others (Allen, 2013). Psychological, pharmacological and physiological treatments have been developed to reduce performance anxiety (for music performance anxiety, see Kenny, 2005). For instance, *beta blockers* have been used to ease performance anxiety by reducing an ANS response during stressful situations (James et al. 1977; Allen 2013). In addition, hypnotherapy, the Alexander technique, breathing exercises and treatments based on free musical improvisation have decreased performance anxiety (Allen, 2013; Wells et al., 2012).

The results summarised in this dissertation revealed a diminished performance-related stress following improvisation training, indexed by more relaxed facial muscles and a higher HRV preceding a performance, as well as lower self-reported stress during a maths task measured using the TSST. In addition, self-reported performance confidence improved and persisted over time at a higher level relative to controls. Therefore, improvisation might serve as a relatively brief intervention to address performance anxiety, since the duration of the interventions described in this dissertation lasted from five to ten weeks. Alongside a nonpharmacological approach, improvisation as a group activity may represent an economical option for private tuition. In addition, a nonclinical improvisation course might appear more accessible to those who avoid clinical treatment for fear of social stigma, such as that which is common amongst adolescents (Felsman et al., 2018).

Relevance to social neuroscience

This dissertation contributes to social neuroscience by suggesting how naturally unfolding social interaction can be achieved in an experimental design using improvisation. Przyrembel et al. (2012) state, 'It is only when the design of the experiment allows for an action possessing four specific criteria (dynamic interplay, a virtually unlimited range of responses, living and uncontrolled partners and emergent qualities) that we can speak of real social interaction.' They also introduce the idea of using musical improvisation in order to fulfil the conditions for real social interaction. Indeed, jazz music in particular has been studied as a tool to understand the core components of improvisation (Barrett, 1998; Ben-Horin, 2016; Landau & Limb, 2017; Limb & Braun, 2008; Vera & Crossan, 2004). However, theatre improvisation meets all four of the criteria for real social interactions without requiring musical expertise. In addition, improvisational face-to-face exercises can be performed whilst sitting still and possess a certain recurring shape, allowing the necessary repetition required in neuroscientific experimental designs. Moreover, one narrowly defined topic related to social interaction can be presented at a time, such as approval, blocking or different levels of subtle rejections. Finding an appropriate structure and level of repetition requires more research, but it should be worthwhile, since the complex and life-like stimuli seem to activate the brain more and differently than discrete and static stimuli (Hietanen et al., 2008; Jääskeläinen et al., 2021; Myllyneva & Hietanen, 2015; Risko et al., 2016).

3.4 Critical reflections

Several critical flaws and limitations emerged during this dissertation project. First, the generalisability of the results warrants caution given the modest sample size. Therefore, the findings from this dissertation would benefit from replication

amongst a larger and more heterogeneous sample. Second, the intervention studies within this project included passive, wait-listed control groups. However, the results from this dissertation would be more robust if between-group differences were replicated using an active control group. For instance, a control group rehearsing nonimprovised plays would clarify whether other factors contributed to the change in interpersonal confidence and preperformance stress, such as the social cohesion of the group or acting out different roles within the play, thereby expanding participants' self-expression skills. Nevertheless, this kind of intervention would not prepare participants to tolerate mistakes or unexpected events, skills which emerge through improvisation training.

In addition, the ecologically valid methodological approach described in this dissertation entailed several potential weaknesses. In relation to the paradox of fiction, the controllability of the stimuli (social rejections) was compromised. Each rejection was unique, shaped by the dynamic interaction, wherein both participants responded to each other's spontaneous behaviours. Therefore, the content and duration of the stimulus varied, which deviates from the recommended identical set of stimuli traditionally used in psychophysiological experiments. In addition, participants possibly doubted the authenticity of the interview conducted following the TSST and perhaps assumed that the interview was just another staged test condition. This interpretation might explain the congruent physiological responses during the interview and improvisation exercises. However, half of the participants were naïve to the intention of the experiment to study the effects of social rejections. The other half, who were informed about the impoliteness of the reviewer (the revealed rejections group) and might have further suspected the authenticity of the setup, showed no differences in their physiological reactivity relative to the naïve group. Comparably, awareness of the intention of the experiment did not alter the physiological and affective stress reactivity in a study by Linden et al. (2010). Nevertheless, since the research summarised in this dissertation represents one of the first of its kind to integrate theatre improvisation and psychophysiological measurements, replication is essential.

The ICQ represents a useful tool to evaluate the impact of improvisation training, since it comprises the multifaceted set of improvisational skills in a single questionnaire instead of relying on several questionnaires. However, the ICQ does not include all elements promoted through improvisation, such as creativity and storytelling. Therefore, when attempting to gain a comprehensive understanding of the impact of improvisation interventions, a larger set of measures is recommended. Additionally, the findings acquired using the ICQ should be replicated and extended to different cultural groups, since cross-cultural differences affect how social interactions are defined and valued. This research is influenced by Western, individualistic cultural conceptions of social interaction,

which might differ from those of collectivist cultures (e.g., Kizilcec & Cohen, 2017; Moss et al., 2007).

Lastly, as a researcher, I must acknowledge that I am a part of the reality I study, which I interpret according to those cultural schemes and structures with which I have socialised. The significance of my own assumptions or 'self-understanding' (Kerdeman, 2015) must be identified in the interpretation of the data. I have addressed my assumptions, beliefs, interests and values in the prologue, expressing my passion for understanding human interactions and related to improvisation as a tool to structure interpersonal communication. As an 'insider', specifically, an improvisation practitioner, I cannot erase my lived understanding of improvisation whilst pursuing objectivity. However, the reader can reflect upon the claims presented within this dissertation based upon my own background and knowledge.

3.5 Future directions

The limitations of the dissertation outlined in the previous section (3.4) provide some insights into potential directions for future research. For example, a larger sample would enable a comparison with the findings obtained here, whilst a larger gender variability would allow for an analysis of possible gender effects in changes to interpersonal confidence and physiological reactivity to acute social stress following improvisation training. In addition, during this dissertation research process, additional novel questions and research interests emerged related to improvisation.

Whilst this dissertation project provided insight into the discussion on the stress-provoking components of the TSST, the results raise the question of whether the social-evaluative threat is a more influential stressor relative to unpredictability. The stress response that persisted amongst the intervention group during a speech irrespective of their training to adapt to unanticipated situations calls forth this notion. Although this dissertation project did not aim to differentiate between unpredictability and the social-evaluative threat as a stressor, this unexpected finding encourages an analysis of the stress-provoking effect of the absence of reciprocity during interpersonal communication.

Future research might also investigate the connection between experiential learning and memory formation, that is, the neural modulation and consolidation of memory traces (Hari, 2015; Hofer & Bonhoeffer, 2010). Experiential learning in improvisation and theatre-based practices in general possibly creates and activates memory traces connecting several neural networks (motor, visual, auditive, emotional and social) as we watch, listen and act together during the experiential learning process. This multimodal activation might strengthen memory traces as well as memory retrieval. In particular, an experience that contains self-relevant emotional information is retained in memory over time

(Cahill & McGaugh, 1995; Dolcos et al., 2005; McGaugh, 2013). This study raises the question of whether multimodal theatre-based practices can evoke stronger learning experiences (Costa et al., 2014; Hainselin et al., 2017) resulting in more enduring memory traces relative to learning, which includes fewer modalities such as visual (reading a book) or audiovisual (listening to a lecture) modalities.

Furthermore, it would be interesting to study creativity, a generic skill applicable to various professional fields and academic disciplines, in the context of improvisation. The positive impact of improvisation on creativity and divergent thinking appears robust and consistent (Celume et al., 2019; DeBettignies & Goldstein, 2019; Felsman et al., 2020; Hainselin et al., 2018; Schwenke et al., 2020; West et al., 2017). Indeed, improvisation encourages risk-taking and engaging in an intuitive, reciprocal and creative process. This process is supported by psychological safety, where making mistakes is not punished and experimentation is allowed (Vera & Crossan, 2005). The change in creativity has been assessed with a variety of alternate use tasks (Guilford, 1967), whereby participants are asked to list as many uses for a common object as possible within a limited time, or through creative verbal or problem-solving tasks. Additionally, the neural correlates of creativity have been studied since the pioneering work of Martindale and Hasenfus (1978). A majority of EEG studies have found that brain oscillations within the alpha frequency are sensitive to creative task performance (Arden et al., 2010). For instance, a study by Rodionov et al. (2013) demonstrated the positive influence of a single session of actors training on creativity and alpha band oscillations relative to the control condition. Evaluating the impact of improvisation training on the creative process by measuring the alpha oscillation represents an exciting possibility for future research.

Whilst this dissertation measured the physiological responses of a person during improvisation, the next step might include measuring physiological synchrony (e.g., Järvelä, 2020; Jiang et al., 2012) between two skilled improvisers during improvisation. Could improvisation training promote an implicit ability to synchronise with a conversation partner (Frost & Yarrow, 2015, p. 72) due to a learned, flexible status behaviour, active listening and the constant pursuit of finding common ground to build upon, that is, constructive social interactions? Physiological synchronisation has been linked to promoting cooperation (Salminen et al., 2019) and, since improvisation training includes bodily synchronisation exercises (e.g., mirror game), this connection might not be so far-fetched. Therefore, improvisation and theatre-based practices, in general, have the potential to develop multiperson neuroscientific experimental paradigms in a naturalistic and ecological direction. Moreover, combining the aspect of creativity with physiological synchrony might yield a new understanding of co-creativity, which, again, lies at the heart of improvisation. After all, to improvise is to engage in a shared creative process.

Finally, I argue that the relationship between an improvisational mindset and a growth versus a fixed mindset might represent an intriguing topic for future study. A growth mindset refers to a belief that talents and basic qualities such as intelligence and competence can be developed through learning and effort, whilst individuals with a fixed mindset believe their talents are innate gifts that are static and unalterable (Dweck & Leggett, 1988). Fundamentally, improvisation might associate with a growth mindset, due to its emphasis on tolerating mistakes and a constant readiness for change. Furthermore, could improvisation be influential in shifting from a fixed to a growth mindset? According to the literature, mindsets are malleable and can be influenced by interventions (see Ng, 2018; Tirri & Kujala, 2016). If so, integrating improvisation during the early stages of education might help to build solid ground for resilience, embracing challenges and lifelong learning.

Epilogue

In their learning diary, one participant of the improvisation intervention of this study wondered, ‘What would happen if I said “yes”?’ more often in their life. This question is crucial to improvisation and serves well as the title of this dissertation. This question should also remind all teachers and facilitators who apply improvisation to their work to remain committed to and ensure the psychological safety of the learning environment. Saying ‘yes’ during a fictional exercise, let alone in real life, can evoke unease and stress due to the unknown consequences of doing so. For me, having said yes to the impulse of writing a doctoral dissertation about improvisation lead me on an exciting academic adventure. I could immerse myself in the theory and practice of improvisation and fulfil my aim of increasing knowledge and understanding of social interactions through the lens of improvisation. To study improvisation means studying social interactions and vice versa. In addition, since I believe the mind and body cannot be separated, the bodily approach represented an essential component of this study.

The Covid-19 pandemic that has crippled the world for nearly two years as I write highlights the meaning and importance of genuine face-to-face communication, since technologically mediated communication appears not to meet the need for embodied human encounters. The education system in particular has been challenged by pandemic-related lockdown periods, despite teachers quickly adopting online teaching methodologies and digital learning solutions. Whilst I am fascinated by the possibilities of digitalisation, I also find it important to focus on human strengths, such as imagination, attentive listening, reciprocity and co-creativity. Improvisation training appears capable of building these skills.

However, whilst I share this disposition, I am inclined to think that this ‘building’ metaphor might not be the best representation of what improvisation encompasses. What if improvisation training does not build or teach anything new? Instead, I propose that improvisation gently removes mental barriers, such as excessive self-criticism or sociocultural demands that prevent us from using our inherent capabilities. For me, improvisation simply empowers human beings to be human.

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