THE SCIENCE OF ACTING

THE SCIENCE OF ACTING: EXAMINING AND MODELING THE BEHAVIOURS OF ACTORS DURING CHARACTER PORTRAYAL

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Lay Abstract

When acting, actors change their outward physicality to portray another person and persuade audiences that they are that person. Regardless of training or method employed by an actor, this production is ultimately physical and can therefore be recorded, analyzed, and modeled. I investigated this using a novel character classification scheme. I found that stock characters taken from Western literature were shared conceptually amongst a large group of raters and could be modeled along the two personality-trait dimensions of assertiveness and cooperativeness. I tested this new model in a performance experiment, measuring the vocal and facial gestures of a group of professional actors. I found that actors used their vocal and facial gestures to differentiate between characters that differed in personality. I discovered that vocal gestures could be predicted by changes in the level of a character’s assertiveness and, complementary to this, that facial gestures could be predicted by changes in the level of a character’s cooperativeness. Finally, I examined character and emotion performances in both the voice and face and found that characters and emotions share a similar dimensional relationship. My research extends previous findings on acting and emotions and provides new evidence for modeling of the products and processes of acting as a whole.

Abstract

Acting is a fascinating phenomenon whereby individuals modify their physicality to portray another person and persuade audiences that they are indeed said person. Historically, and with the goal of creating realistic characterizations, acting theorists have debated if actors must begin either from the internalized driving forces of the characters or from external manifestations of the characters' physical expression. However, regardless of whether actors have to actually feel the emotions of the characters who they portray during a performance, the challenge for the actor remains the same: to produce compelling representations of persons who they themselves are not. This production is physical by its very nature and can therefore lend itself to being gesturally coded, systematized, and modeled. To explore the question of whether character performances can be modeled, I designed and validated a classification scheme of character conceptualizations. I examined if a set of prototypical characters extracted from the literature were conceptually shared amongst a large group of raters, and found that character concepts were indeed shared. In addition, I found that character concepts could be modeled along the two orthogonal personality-trait dimensions of assertiveness and cooperativeness. I then sought to validate this model behaviourally. I designed a novel performance experiment whereby a group of professional actors performed a subset of characters from the model while I recorded their vocal and facial gestures. I found that actors used their vocal and facial gestures contrastively to differentiate between the characters, as well as between their performance-related and non-performance selves. Furthermore, I found that vocal gestures could be predicted by changes in the level of a character's assertiveness. Complementary to this, I

found that facial gestures could be predicted by changes in the level of a character's cooperativeness. Finally, I conducted a cross-modal examination of character and emotion performances and found that characters and emotions, as testable or "functional" units of performative behaviour, share a similar dimensional relationship. My data provide validated support for a dimensional behavioural model of character performance and character classification. My research extends previous findings on acting and emotions and provides new evidence for the quantification and predictive modeling of the products and processes of acting as a whole.

Author Biography

Matthew Berry was born in Hamilton and raised in Burlington, Ontario, Canada. He attended Aldershot High School where he developed a keen interest in both the arts and science, specifically chemistry, biology, and psychology. Knowing he wanted to be a doctor of some kind, he pursued an Honours Bachelor of Science with a specialization in Psychology at the University of Ottawa. There, Matthew became interested in improv. He joined the university's troupe, played some great shows, befriended some great people, and met his wife. In his third year, Matthew traveled to Ireland to attend the National University of Ireland at Galway. NUIG was where he discovered the joy of acting, played in some more great shows, befriended some more great people, and became interested in positive psychology. Returning to U of O, Matthew completed his undergraduate thesis in developmental psychology focusing on theory-of-mind, and became enamored with research and experimental psychology. Seeking graduate study, Matthew moved to Hamilton and on to McMaster University to attain a PhD in Experimental Psychology. There, he has worked in the *NeuroArts* Lab under the supervision of Dr. Steven Brown. Matthew's research focus has been on the science of acting – the culmination of a lifetime of theatrical and scientific inspiration – and he has published in several high-profile scientific journals.

During his tenure in McMaster's department of Psychology, Neuroscience & Behaviour, Matthew has achieved more than high-quality, cutting-edge, research. Passionate about science communication, he has represented his graduate peers, department, faculty, and university as the 2018 champion of both the McMaster and Ontario Three Minute Thesis

Competition. Matthew has also represented his department on numerous occasions as an event-planner, committee member, and host for The Unification of the Arts Conference, the Annual PNB Graduate Research Day and the 51st Annual Ontario Psychology Undergraduate Thesis Conference. An avid theatre-goer and thespian, Matthew has performed in several plays including *Macbeth, Romeo and Juliet,* and *The Three Ladies of London*. He is a decent third base in softball, and is a known social quantity in the department.

Above all else, Matthew is a dependable entity in the lab. He looks forward to continuing his research into the science of acting under the larger umbrella of the cognitive neuroscience of theatre and literature as a Postdoctoral Fellow in the *NeuroArts* Lab at McMaster University. He hopes to establish a prolific career in academia, extending our understanding of the products and processes of acting. Matthew will always be a staunch supporter, and explorer, of the arts.

Matthew currently resides in Hamilton, Ontario, with his lovely wife and son.

For my grandfathers,

Robert and George, two kings and

My heroes, revered.

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First of all, I would like to thank the Academy. Specifically, McMaster University, the Faculty of Science, and the department of Psychology, Neuroscience & Behaviour for accepting me so readily and completely. To quote Sally Field, “You like me! You really like me!” To join the ranks of an illustrious department with world-renown scholars, at a premier research institution that is ranked within the top 100 in the world, is no small thing. In fact, it can be very intimidating. I remember stepping into the department for the first time and thinking that everyone around me knew so much more than I. I never thought I would be able to match up. But I did, and I do, and in no small part because of the fantastic department in which I found myself. Despite my personal ups-and-downs – imposter syndrome chief among them – I have always felt encouraged and well supported to achieve my full potential as an academic, scientist, science communicator, educator, friend, and as a person more broadly. I have been encouraged and supported by so many: the faculty, the staff, and my fellow graduate students. Whether you know it or not, each person has given me a small part of themselves that has, most assuredly, left a resounding impact on my soul. I am extremely grateful for the opportunity to have known you all and to be able to thank you all here. Those who have helped me, you know who you are. Please know that my thanks run much deeper than my words will ever be able to convey. Suffice it to say that I am delighted and proud to call this department my home. The time I have had here has been nothing short of sublime.

Above all others, I need to thank my once-and-future supervisor Steven Brown for seven years of dedicated mentorship and unfailing friendship. Poetically, the number seven can

be found in Icelandic sagas indicating something that has taken place over a long period of time or completeness. Call it chance, coincidence, delusion, or destiny but it turned out that (seven years ago) the only lab that wanted me was the perfect fit for me. A real Cinderella story; a happy ending complete with a perfectly fitting glass slipper. Well, glass skull. Steven, if you recall my first day in the lab you gave me a gift, a glass skull. Part paperweight, part candle/pen holder, part inspiration for the Cognitive Neuroscience of Theatre and Literature (CNTL, formerly CNDL), part homage to *Hamlet* ("Alas, poor Yorick! I knew him, Horatio…"), part *memento mori*. You sir, are a fellow of infinite jest, indeed. I shall have you know that I have kept that skull by my side for the last seven years. It is beside me right now as I type this, complete with feathered fountain pen. It has resided on every desk I have written on as a reminder. Life is *fleeting*, science is *forever*, and never *forget* to be the *fellow* of infinite jest, of most excellent *fancy*. I think our time together has struck that balance of serious and light-hearted, the tragic and the comedic. You have challenged me (to read), inspired me (to read), and driven me (to madness, just kidding, to read). You have given me the freedom to play, to bring theatre, literature, acting, and stories into the lab and explore new methods and old theories. You have trusted me with your ideas, findings, theories, processes, heck you even trusted me enough to plan a conference together! You have given me the space to develop and present my own ideas and findings at conferences and competitions. I know I made you proud on that account. You have let me form collaborations with lab-mates and beyond, plan and execute conferences with my peers, and even mentor students. What is more, when I was hurt and needed time away, you gave me the space and time that I needed to heal and welcomed me back with open arms when I was ready to return. You have always been in my corner and for that I am forever grateful. The truth is that my time in academia would have been greatly diminished without your considerable mentorship. You always say that you don't direct graduate students, you steer graduate students. With your stalwart navigation I made it through troubled waters and found the sunny coast on the other side. Thank you.

I would be remiss if I did not offer a special thanks to the members of my committee – Sukhvinder Obhi and Peter Cockett. I could not have asked for two finer gentlemen to offer me their insight, wit, and British charm. Sukh, it was an absolute pleasure TAing for you in 2XF3. I learned a lot about the performance of science from you in your course. I have applied most of it. In addition, you gave me my first ever guest-lecturing spot that sparked my love-affair with teaching – probably much to Steven's chagrin – and taught me that a good scientist is also a good science communicator. I promise I will one day write a positive review about your book, when I get around to it. Peter, I was lucky enough to be able to bookend my time at Mac with two of your courses. I have learned so much about acting both practically and theoretically under your tutelage. Not only that, but because of your directing, I was even able to act one of my favourite parts (Judge Nicholas Nemo) in *The Three Ladies of London*. From this role sparked many friendships and other opportunities to act with your talented alumni. Through you I have been given many ideas, memories, and friendships – thank you.

I would not be here today without the added mentorship and companionship of the denizens of the The *NeuroArts* Lab both old and new. To the old guard, Dr. Michel Belyk, Dr. Léa Chauvigné, Dr. Ye Yuan, and Blair Ellis, I owe much. Michel, you taught me that a good scientist must play many roles: scholar, theorist, statistician, writer, presenter, and designer. I try to emulate your example and be the well-rounded scientist I know I am capable of being. You also taught me that life is too short for bad coffee. Léa, you taught me that one can indeed have it all: have a family and be an excellent scientist. I try to live by your example in this way. What is more, you showed me that there is always time for chocolate. Ye, you inspired me to try new things, be it food or technology. Without you, I would not computer so well. Cerebro and I both thank you for your dedicated service in I.T. and unwavering friendship. Blair, you taught me that the opposite of not, is. I promise to never not, and to always is. To the new guard, Kiran Matharu, Carmen Tu, Elizabeth Phillips, Kiah Prince, and Zoë Lazar-Kurz, I have a lot to live up to. I do certainly hope I can provide you with a fraction of the love and mentorship my old lab-mates gave me. I will try my best to pay it all forward. Though I am only tangentially a small mammal, I will endeavor to instill both elegance and fierceness in my mentorship and provide you with the wordsmithing necessary to lead you to prosperity. You have my word.

A big thank you needs to go out to the unofficial *MaTT* Lab (the *Motion and Theatrical Technologies* Lab, a subsidiary of the *NeuroArts* Lab). Without all of your help on projects – specifically with data cleaning and management – none of this research would have been possible. My deepest thanks go out to my former students: Sarah Lewin, Alex Almeida, Kiran Matharu, Ember Dawes, Ryan Olup, Miriam Armanious, Julianna Charles; Samson Yeung, Grace Lu, Omar Khafagy, and Samra Ebadi.

I certainly would not have made it to completing my doctorate without the constant love and support of my family. We are a large clan, consisting of many names: The Greenlees,

The Berrys, The Hardies. If there is one thing that unites us, it is the motto *Nothing Without Labor*. Everything worth having is worth working hard for. And indeed, I have worked very hard for this but I would not have come close to achieving it without all of your by my side. Thank you for cheering me on. I hope I have made you proud.

To my parents, Scott and Cheryl Berry, I know I have made you proud. I do not know if you could have predicted that your dramatic little kid would one day grow up to be a researcher at the intersection of theatre and psychology. That would have been one heck of a guess. You had always said I was either going to be a teacher or a preacher, or maybe something that involved me talking a lot, at any rate. Turns out you were right! I literally won two awards based on talking. It brings me great joy to be our family’s first PhD and I am so happy that I am able to share this accomplishment with you both. Thank you for always believing in me and encouraging me to pursue my passions, my education, and my humor.

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To my siblings Alyssa, Rob, Mitchell, and John thank you for being the best brothers and sister anyone could ask for. Aly, you and I go way back and you have always been my best friend and biggest cheerleader. Even though you and Rob are far away, I feel your presence in everything I do, especially if it involves a little fun. Thank you both for being great

listeners and always taking the time to hear me out. Mitz, I aspire to be half as funny as you are someday. I have a lot to live up to, and a lot to look up to. You're tall. There, I said it. Thank you for being such a dependable brother and friend. John, you inspire me to become a better storyteller. With you I am never shy to embrace my inner nerd, geek, fantasy-lover, and dungeon master. Thank you for getting weird with me.

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Finally, to my family the McBerrys, I love you all so very, very much. Clover, my faithful pup, I thank you for your energy which has been refreshing and reassuring. You never fail to put a smile on my face every day. I am sorry I am so sneaky, but you always find me. I love your hugs. Pippin, my familiar, your consistent companionship has been nothing if not constant. Thank you for keeping me sane, I guess. To my beloved and darling wife Kathleen, I could not have done any of this without you. You have been by my side since before moving to Hamilton and you have never wavered. You have encouraged me at every turn. When things got hard, you took care of me. When things were easy, you made me feel lighter than air and like I could do anything. You have given me everything you have and more than I could ever ask for. I am so immensely happy to be your husband and father to your son. Thank you for blessing me so richly. Always.

To my son Terrance, you were my light at the end of the tunnel. Thank you.

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List of Abbreviations and Symbols

Dimensions & Theories

Action unit(s)	AU; AUs
Assertiveness	Assert
Basic Emotion Theory	BET
Before common era	BCE
Big 5; Openness to experience, Conscientiousness, Extraversion, Agreeableness, & Neuroticism	Big 5; OCEAN
Cooperativeness	Coop
Facial Action Coding System	FACS
Ortony, Clore, & Collins model of emotion	OCC
Thomas-Kilmann Conflict Mode Instrument	TK

Methods & Statistics

Alpha	α
Analysis of variance	ANOVA
Coefficient of determination for effect size	R^2
Cohen's *d* for effect size	d
Conditional *r* squared for effect size	R_{cond}^2
Degrees of freedom	DF
Denominator degrees of freedom	DenDF
Eta-squared for effect size	η^2

High end of confidence interval	High conf.
Hoeffding's D test for dependence	D
Linear mixed-effects regression model	LMER; LME
Low end of confidence interval	Low conf.
Marginal *r* squared for effect size	R_{marg}^{2}
Mean	M
Mean squares	MS; Mean sq.
Multivariate analysis	MVA
Numerator degrees of freedom	NumDF
Number of subjects	N; n
Not significant	n.s.
Partial eta-squared for effect size	η_{p}^{2}
Pearson product-moment correlation	r
Principal component(s)	PC; PCs
Principal components analysis	PCA
Repeated measures analysis of variance	RM-ANOVA
Rotated component(s)	RC; RCs
Significance level	Sig.
Standard Deviation	SD
Sum of squares	SS; Sum sq.
Omega squared for effect size	ω^{2}

Variables, Parameters, & Measurements

Decibels	dB
Euclidean distance	d
Fundamental frequency	F_0
Hertz	Hz
Jitter	Jit.
Kilohertz	kHz
Loudness mean	LdM
Loudness standard deviation	LdSD
Loudness range	LdR
Millimeters	mm
Milliseconds	ms
Motion capture sample rate	sr
Noise-to-harmonics ratio	NHR
Number of pauses	PNum
One-degree-of-freedom	1DoF
Pause duration	PDur
Percent change	% change
Pitch mean	f0m
Pitch standard deviation	f0SD
Pitch range	f0R
Shimmer	Shim.

Signal duration	SDur
Six-degrees-of-freedom	6DoF
Sum	$\sum$
Three dimensions	3D
Two dimensions	2D
Time	t

Declaration of Academic Achievement

The present dissertation constitutes a “sandwich” thesis as defined by the School of Graduate Studies, McMaster University. I am the primary author of the three articles included in this dissertation. I conducted the literature reviews and wrote the manuscripts, designed the studies, and collected and analyzed all data. These studies comprised my doctoral research and are therefore included in the thesis. The roles of the co-authors for each paper are outlined below.

Chapter 1 – Introduction

Author: Matthew. A. Berry

Chapter 2 – *A classification scheme for literary characters* is a reprint of a published article in *Psychological Thought*.

Berry, M., & Brown, S. (2017). A classification scheme for literary characters. *Psychological Thought*, *10*(2), 288–302. https://doi.org/10.5964/psyct.v10i2.237

M.B. conceived the experimental design; M.B. conducted the research; M.B. analyzed the data; M.B. drafted the manuscript and figures; M.B., and S.B. edited and revised the manuscript. Research was funded by a grant to S.B.

Chapter 3 – *Acting in action: Prosodic analysis of character portrayal during acting* is a reprint of a published article in the *Journal of Experimental Psychology: General*.

Berry, M., & Brown, S. (2019). Acting in action: Prosodic analysis of character portrayal during acting. *Journal of Experimental Psychology: General*, *148*(8), 1407–1425. https://doi.org/10.1037/xge0000624

M.B. conceived the experimental design; M.B. conducted the research; M.B. analyzed the data; M.B. drafted the manuscript and figures; M.B., and S.B. edited and revised the manuscript. Research was funded by a grant to S.B.

Chapter 4 – *The dynamic mask: Facial correlates of character portrayal in professional actors* is an article under review in the *Quarterly Journal of Experimental Psychology*.

Berry, M., & Brown, S. (submitted). The dynamic mask: Facial correlates of character portrayal in professional actors. *Quarterly Journal of Experimental Psychology.*

M.B. conceived the experimental design; M.B. conducted the research; M.B. analyzed the data; M.B. drafted the manuscript and figures; M.B., and S.B. edited and revised the manuscript. Research was funded by a grant to S.B.

Chapter 5 – Discussion

Author: Matthew. A. Berry

Additional Achievements

In addition to what is presented in within the chapters of this thesis, the author was a primary contributor on two other studies.

Brown, S., Berry, M., Dawes, E., Hughes, A., & Tu, C. (2019). Character mediation of story generation via protagonist insertion. *Journal of Cognitive Psychology*, *31*(3). https://doi.org/10.1080/20445911.2019.1624367

Matharu, K., Berry, M., and Brown, S. (2020). Storytelling as a fundamental form of acting. *Psychology of Aesthetics, Creativity, and the Arts.* Advance online publication. https://doi.org/10.1037aca0000335

Chapter 1 – Introduction

Matthew Berry

1.1 – Thesis Overview

"To be, or not to be: that the question…" (Shakespeare, 1599/2019, 3.1.56-89, pp. 49). In all likelihood, this is the most famous question within – and beyond – the theatre. Spoken by the titular Hamlet, Shakespeare's melancholic Prince of Denmark, this question is an excellent jumping-off point to get at the very heart of performance, theatre, and acting. Although Shakespeare posed the question with regards to mortality, it is a question that every actor has posed as well: "To be a character, or not to be a character?" Put another way, "To perform in this production, should I do so as a/the character? And if so, must I take on all of the qualities of my character and *be* said character, or simply *be like* the character?" The answer to the inevitable follow-up question of "How?" has been attempted by numerous acting theorists, teachers, and practitioners (Adler, 1988; Archer, 1888/2019; Barba, 1995; Benedetti, 2012; Brestoff, 1995; Diderot, 1888/2019; Deshpande-Hutchison, 2021; Foley, 1995/2002; Gordon, 1995/2002; Grotowski, 2002; Hagen, 1973; Kemp, 2012; Mirodan, 2019; Stanislavski, 1936/1987, 1936/1989; States, 1995/2002; & Suzuki, 1995/2002). Indeed, some acting theorists like William Archer (1888/2012) argue that actors need to undergo a type of transformation and experience the emotions of their characters (i.e., "to be"). In contrast to this perspective, Denis Diderot, in writing about this dilemma in *The Paradox of the Actor,* states that great actors do not need to experience the emotions of their characters but rather act more as the character's puppeteer (i.e., "not to be"; Diderot, 1888/2019, although wirtten in 1773).

While not all performance is acting, and not all acting is constituted of characterization, teachings on acting involving characters tend to only address the process of *becoming* a character. In other words, there has been little research on what constitutes the *aspects* of a character (i.e., the "be" in "to be, or not to be"). Paradoxically, before one can know that one is becoming or has become a character, one has to understand the goal, or the final product. An actor has to know and/or develop what the character looks like, sounds like, and acts like before they can become said character. What is more, questions related to portraying a character – both in the character's becoming and their aspects – have not been widely investigated in a psychological or systematic manner (Goldstein, 2015). Instead, actors have used findings from psychology – and science at large – to inform their portrayals (Goldstein & Bloom, 2011; Panero, 2019; for acting exercises, see Kemp, 2012). My thesis is an initial attempt to empirically investigate aspects of character portrayal in actors. I have broken new ground by examining the behaviours of actors and modeling the products of acting and performance during character portrayal. As a scientist, I have investigated the "be" in "to be, or not to be". We can let the actors decide whether "to" or "not to".

1.2 – Background

1.2.1 – What is performance and acting?

The iconic representation of performance and modern-day staged theatre is that of the "Comedy" and "Tragedy" masks, featuring their distinctive, exaggerated expressions: a juxtaposition of upturned smile and downturned grimace. The use of masks in the tradition of Western acting stems from Ancient Greek plays, which were performed by a chorus and a handful of selected actors decorated in various costumes, including built-up shoes and masks (Benedetti, 2012; Meinek, 2011; Panero, 2019). For the Ancient Greeks, live theatre was considered an *imitative* art, with masks representing imitations of real – but exaggerated and static – emotions, the implementation of which actors needed in order to command the attention of several thousand audience members (Benedetti, 2012; Berry & Brown, 2019; Kristeller, 1951; Mirodan, 2019). The adoption of masks by actors persisted beyond Ancient Greece, with continued use in the West, as seen in Roman, Elizabethan, Jacobian, and contemporary theatre and theatre training (such as Lecoq's neutral mask; Kemp, 2012), as well as cross-culturally in Japanese Noh drama and performances in West Java (Benedetti, 2012; Foley, 1995/2002; Meinek, 2011; Suzuki, 1995/2002). Japanese Noh masks were artfully crafted to feature real – but exaggerated semi-static – emotions. Using changes in light and viewing angles, actors could directly change the expression on the mask, as perceived by the audience with deliberate and precise movements (Meinek, 2011; Suzuki, 1995/2002).

Over the next several centuries, masks continued to evolve in two directions. First, they moved beyond static representations of emotions, as seen with the adoption of semi-static masks that subtly change in the light, as in Japanese Noh, or with the half-mask in *commedia dell'arte* style, which left the mouth and chin visible for clearer speech and expression of the lower face. Second, masks moved beyond being emotive, eventually showcasing overarching attitudes, characteristics, or specific characters and archetypal roles (Mirodan, 2019). As more-modern techniques of acting evolved, static and semi-static masks became outmoded, and actors opted to create more realistic – but exaggerated and, particularly, dynamic – portrayals of both emotions and characters barefaced. Actors thus adopted the *persona* – Latin for "mask" – of the character onto themselves, physically altering their facial features to persuade others that they were another individual entirely (Benedetti, 2012). The modern-day process of this type of performance, or *acting*, can be operationalized as embodying or taking onto oneself the *persona* of a character. And anyone who does this is an actor. Well, not quite.

1.2.2 – What is an actor?

One definition could be that an actor is an individual who makes a living acting/performing on the stage or screen. However, this is a description of the profession of acting, not necessarily the craft of acting. A more apt definition would be that an actor is an individual who simulates and imagines what is happening to a character and then physicalizes the words and actions (Goldstein, 2015). An actor is thus an individual who can physically create a portrayal of a character (fictional or otherwise) and act as that person would act within the scenario of the presented storyworld (Berry & Brown, submitted). This definition could be viewed as limited since it only focuses on one aspect of the actor's purpose, to *portray* the character. The second aspect of an actor is that they must also *persuade others* that they are indeed the character they are portraying (Dusinberre, 1998; Smith, 1971; Weinbren, 2020). Indeed, Weinbren (2020) writes:

> "So the challenge …is for the actor to find methods through which *external manifestations* of emotion can be realized effectively enough to convince audience and fellow players of *aliveness*: the sense that these emotions are really being felt by the character in the moment." [p. 127; emphases in the original.]

Therefore, when on the stage or the screen, 1) it is the actor's job to imagine a character, imagine what is happening to the character, and then simulate and physicalize it through external manifestations, while 2) simultaneously being cognizant of others and attempting to successfully convince the audience (also fellow performers and perhaps themselves) of being alive by "feeling" the spontaneous emotions of the character at a given moment. In other words, an actor can be considered being the sum of two integral parts: they have the job of a *conceivable portrayal* (production) and the challenge of *compelling persuasion* (perception).

Going forward, we can operationalize the definition of an actor as an individual who can produce a conceivable and compelling representation of a character, in other words of someone who they themselves are not. This operationalization along two lines grants acting and theatre researchers the opportunity to pose two separate and but ultimately synergistic questions: what external manifestations constitute a *portrayal* (either generally or for each specific character), and, subsequently, what makes that portrayal *compelling* to others? These questions can be investigated within or beyond the context of actor training. It also stands to reason that the first question must be attempted, if not fully or partially answered, before attempting the second question. The present thesis endeavors to provide an answer to the first question by quantifying the multimodal external manifestations of basic character portrayals in a group of professional actors of varying types of acting training.

1.2.3 – Who are the major acting theorists and what are their methods?

At present, there is no universal acting protocol. That is to say, there is no "one true method" that anyone at any level of practice or experience can follow to become a great, awardwinning actor in every style or performance. It should be noted that were there such a method, it would a) be incredibly difficult to encompass all forms of role-playing and acting due to the purpose and stylistic differences of performance both within and between contexts and cultures (Barba, 1995; Zarrilli, 1995/2002) and b) if accomplished, it would become the predominant form of acting training. This second point would lead to stylistic and creative stagnation with little variation within or between performances. However, this is not the case, and there are varied and numerous classes, trainings, and techniques extolled by the acting community that one can use to begin to produce a conceivable and/or compelling representation of a character. A detailed exploration or analysis of all of these techniques is beyond the scope of this thesis but has been provided by others. Benedetti (2012) provides a detailed historical summary of acting methods, while Kemp (2012) and Panero (2019) provide analyses of these methods through neuroscientific and psychological lenses, respectively. What I discuss here is a brief summary of select Western acting techniques.

The predominant Western acting methods are most associated with their respective founders, that is to say *Method Acting* with Konstantin Stanislavski, Lee Strasberg, Stella Adler, Sanford Meisner, Michael Chekhov and Uta Hagen, *Biomechanics* with Vsevolod Meyerhold, *Brechtian Acting* with Bertolt Brecht, and *Poor Theatre* with Jerzy Grotowski. While some scholars have sought to dichotomize these and other techniques in distinct ways – such as Barba's (1995) rule-based *North Pole performer* and rule-less *South Pole performer*, or Kemp's (2012) *persona acting* and *transformational acting* – a more popular dichotomy has been through methodology: actors either work from the *inside-out* or the *outside-in.* In other words, with regards to Western acting theorists and their methods, we can roughly divide the approaches into two general styles or modes: a physical-first mode and a mental-first mode. The physical-first mode is advocated for by theorists like Diderot (1830/2019), Meyerhold (Gordon, 1995/2002), Brecht (Brestoff, 1995), Chekhov (Deshpande-Hutchison, 2021), Grotowski (2002), and even Stanislavski in his later work (Stanislavski, 1936/1987). The physical-first mode has been described as *traditional stylized* acting (Goldstein & Bloom, 2011), *technique* acting (Carroll & Russell, 1997; Gosselin et al., 2012) or acting from the *outside-in.* In the physical-first mode, actors identify how a character would appear, perform their physicalizations, mask their own personal behaviour while accentuating the character's, and let the character's feelings develop and be inspired through this enactment (Goldstein, 2015; Kemp, 2012).

By contrast, the mental-first mode is advocated by Stanislavski's earlier work (Stanislavski 1936/1989) and that of his followers Adler (1988), Strasberg (Brestoff, 1995), Meisner (Deshpande-Hutchison, 2021), and Hagen (1973). The mental-first mode has been described as contemporary *realistic* acting (Goldstein & Bloom, 2011); *method* acting (Carroll & Russell, 1997; Gosselin et al., 2012), or acting from the *inside-out*. In the mental-first mode, actors identify how a character might think or feel, then they imagine the character's experiences, in some cases relate them to their own experiences, and let the character's motivations and actions be inspired and develop through this mentalization (Goldstein, 2015; Kemp, 2012).

Contemporary acting training focuses on providing actors with a wide variety of tools to choose from, with a fewer number of actors subscribing to a mono-technique approach and a greater number striving for a combination approach (e.g., a hybrid of Chekhov and Meisner), or multi-technique approach (i.e., eclectic or toolbox; Deshpande-Hutchison, 2021). As a result, actors are trained in, and tend to use, a complex combination of these two modes, making idiosyncratic role- and performance-dependent choices on the specific use of techniques, teachings, and theories (Goldstein, 2015).

1.2.4 – What of the connections of acting to contemporary research?

Although the aspects and processes of acting have rarely been directly studied, acting does have some connections to contemporary research in psychology. Specifically, acting has impacted research on deception (Anolli & Ciceri, 1997; Ekman, Friesen, & Scherer, 1976; Villar, Arciulia, & Paterson, 2013); memory (Noice & Noice, 1996; 1999); empathy, mentalizing, and theory-of-mind (Goldstein, 2009; Goldstein & Winner, 2010; Nettle, 2006; Panero, 2019; Panero & Winner, 2020); embodiment (Carney, Cuddy, & Yap, 2010; Flack, 2006; Flack, Laird, & Cavallaro, 1999; Strack, Martin, & Stepper, 1988); emotions and emotion regulation (Carroll & Russell, 1997; Ershadi et al., 2018; Goldstein, 2009; Juslin & Laukka, 2003; Juslin & Scherer, 2005; Murray & Arnott, 1993; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986); and personality (Burgoyne et al., 1999; Hannah et al., 1994; Nemiro, 1997; Neuringer & Willis, 1995; Panero, 2019; Smith, 1971; Timmons, 1945). It is these last two connections that I will expand on in the following sections.

1.3 – Emotion

One scientifically-operationalized definition of emotions is that they are visceral in nature, with each individual emotion being biologically hardwired to address a distinct function

(Frijda, 2007; Izard, 1971, Ekman Friesen 1975, 1976; Panksepp, 2010) and being cross-culturally recognizable via patterns of external manifestations of behaviour (i.e., voice, face, and body gestures; Scherer & Ellgring, 2007b; Wallbott, 1998; Wallbott & Scherer, 1986). However, there is little scientific agreement on how the emotions should be categorized, and there is no single accepted system for their representation. At present, there are two distinct approaches to emotion classification: the first looking at relationships between categories of emotions (i.e., emotions as discrete, individual units), and the second looking at relationships of emotions in a larger dimensional array. Both approaches have been strongly validated in the analysis of both vocal correlates (Banse & Scherer, 1996; Goudbeek & Scherer, 2010; Juslin & Laukka, 2003; Juslin & Scherer, 2005; Konijn, 2000; Laukka, 2005; Laukka, Juslin, & Bresin, 2005; Murray & Arnott, 1993; Scherer, 2003; Schröder, 2004 Scherer et al., 1991; Scherer & Ellgring, 2007b; Wallbott & Scherer, 1986) and facial correlates (Carroll & Russell, 1997; Mehu & Scherer, 2015; Scherer & Ellgring, 2007a, 2007b).

Categorical schemes of discrete emotions date back historically to Darwin (1872/1998), with further development by Tomkins (1962, 1963, 1984), Izard (1971, 1992, 1993b, 1993a) and Ekman and his colleagues (Barrett et al., 2019; Bartlett et al., 2005; Ekman, 1984, 1992, 1993; Ekman & Friesen, 1972, 1978a, 1978b; Ekman & Rosenberg, 2005, 1997; Plutchik, 2002; Rosenberg & Ekman, 2020). The most popular of the categorical emotion models is Basic Emotion Theory (BET; as coined by Russell, 2009), which posits that there are a limited number of distinct emotions, with each individual emotion having a specific behavioural affect program, for example one that organizes the muscles of the face into a facial response pattern (Ekman, 1972). The canonical basic emotions include happiness, surprise, fear, anger, disgust, and sadness, with later additions including hot and cold anger, amusement, contentment, satisfaction, embarrassment, excitement, guilt, pride, relief, and shame (see Chapter 3 in Dalgleish & Power, 1999). However, Ekman (1972) states that each individual emotion can actually be associated with more than one behavioural response pattern, including more than one facial pattern. Categorical models of emotion have been criticized for their lack of generalizability, with the validity of their cross-cultural recognition also in question. Critics argue that studies exploring basic emotions utilize artificial materials, amateur expressions of emotions, and some critics argue that the images used to study facial expression do not depict expressions in everyday life (Carroll & Russell, 1997; see Mirodan, 2019, and Barba, 1995, for daily vs. extra-daily behaviours in the context of acting).

The alternative organization for classifying emotions is a dimensional approach. The most popular of the dimensional emotion models is the "core affect" theory, which utilizes a circumplex model to examine the distribution of emotions along two theoretically orthogonal continua: *valence* (i.e., pleasure-displeasure) and *arousal* (i.e., activation-deactivation; Posner et al., 2005; Russell, 1980, 1994, 2005, 2009; Schröder, 2004; Schröder et al., 2001). Dimensional models have been used to examine the vocal correlates of emotion (Bachorowski & Owren, 2008; Owren & Bachorowski, 2007; Goudbeek & Scherer, 2010; Juslin & Scherer, 2005; Laukka et al., 2005; Owren & Bachorowski, 2007; Pereira, 2000; Schröder, 2004; Schröder et al., 2001) as well as the facial correlates of emotion expression (Mehu & Scherer, 2015; Russell & Bullock, 1985; Vesker et al., 2018), with greater stability in *arousal* for the voice (Belyk & Brown, 2014; Douglas-Cowie, Campbell, Cowie, & Roach, 2003; Owren & Bachorowski, 2007; Schröder, 2004) and equal stability in both dimensions for the face (Barrett et al., 2019; Rosenberg & Ekman, 2020). Additional benefits to dimensional approaches in classifying emotions are that 1) they provide a universal umbrella that can accommodate all emotions, including all known and future categorical emotions; 2) they incorporate the element of emotional intensity (e.g., the difference between *fear* and *terror*), 3) they allow for more-subtle differences between emotions to emerge along dimensional lines, rather than across discrete categories, and 4) they allow for categorical comparisons between emotion-classes to be retained in their analyses (Gunes & Schuller, 2013). For all of these reasons, the research presented in this dissertation utilizes a dimensional approach to best capitalize on these benefits.

As mentioned earlier, there are research connections between acting and emotions. Experimental studies of emotion have employed professional actors for the creation of images or videos of prototypical facial expressions so as to serve as stimuli for perceptual-discrimination studies of emotional expression (Carroll & Russell, 1997; Ershadi et al., 2018; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986). Interestingly, the vast majority of studies that examine the vocal expression of emotion (>85%) have used professional actors to portray the emotions (Juslin & Laukka, 2003; Juslin & Scherer, 2005; Murray & Arnott, 1993). For example, in a standard facial-expression recognition study, actors or amateurs (producers) are told by experimenters to create facial expressions that are then recorded and presented to observers (perceivers) who must distinguish what emotion the producer has produced (Carroll & Russell, 1997; Gosselin et al., 2012).

However, *there has been far less interest in looking at the acting-emotion production process itself*. For example, in an alternative study to the one just described, perceivers had to describe the producers' facial movements *instead of* their emotional expressions (Carroll & Russell, 1997; Gosselin et al., 2012). A benefit of this type of paradigm is that researchers can shift from pure emotion discrimination and evaluate more-nuanced behaviour during acting. However, this type of paradigm, although more production-oriented, does not directly measure production, since it requires perceivers to describe producers' facial movements. Paradigms that measure performance more directly can increase our understanding of the inherent diversity of gestural expressions for any given behaviour (i.e., not just emotion) across any group of actors without any perceiver bias (Mehu & Scherer, 2015; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986). The research presented in this dissertation utilizes a production-focused paradigm to directly explore the process of character portrayal in acting.

1.4 – Personality

Personality is fundamental to human behaviour. It has a "nature" component – our inherited familial traits – and a "nurture" component, the gradual summation of all of our life experiences (Timmons, 1945). There are several ways to measure personality, each with different scales and dimensions of measurement. An observation of the extant literature on personality assessment in actors is that there is no clear consensus as to which scales and dimensions should be used. Another curious observation is that the field devoted to the empirical study of personality in relation to acting tends to resurface once every 20-25 years. A search through *Google Scholar* reveals the citation count for the following papers that attempt to quantify the processes of acting, specifically investigating the personality relationship between actors and their characters: Timmons (1945) – 8 citations; Smith (1971) – 7 citations; Hannah and colleagues (1994) – 46 citations; Neuringer and Willis (1995) – 9 citations; Burgoyne (1999) – 86 citations; Nettle (2006) – 153 citations. Two salient points emerge: 1) the popularity of such investigations have not been realized until more recent decades (but are still woefully unpopular in comparison to the psychological study of other arts like music), and 2) despite the increased popularity of more recent work, older work is almost entirely ignored. This ignorance can lead to needless repetition of past mistakes or the missing of findings that may prove informative to contemporary investigative directions and decision making.

One such finding is the difficulty in assessing character personality and/or changes in actor's personalities when they take on the roles of characters. Previous work has investigated the role of personality in acting, but from an actor-character relationship perspective (Hannah et al., 1994; Neuringer & Willis, 1995; Smith, 1971; Timmons, 1945), rather than from a strictly actor (Nettle, 2006) or strictly character perspective (Berry & Brown, 2017, 2019, submitted) and with no thought towards a predictive model. Results are also mixed, with evidence of no effect of character personality on actor personality (Neuringer & Willis, 1995; Timmons, 1945), slight modifications of character personality in the direction of the actor's personality (Smith, 1971), or slight modifications of actor personality in the direction of their character's personality (Hannah et al., 1994).

Timmons (1945) directly investigated how a character's personality may impact that of the actor, in other words *character invasion* (Neuringer & Willis, 1995). He analyzed four personality traits (neurotic tendency, self-sufficiency, dominance-submission, and sociability) in three groups of actors, one normal group of actors and two organized into subsets of actors into two conditions of crossed actor-trait and character-role (i.e., dominant and submissive actors playing submissive and dominant characters, respectively). While the results indicated changes in all three group means along the four trait dimensions over the course of the study, there were no significant or reliable changes in personality beyond one chance finding. Indeed, the author and others (see Gunkle, 1971) noted that the one significant difference in dominant actors playing submissive characters on the self-sufficiency dimension is most likely due to chance, unreliable measures, participant sample issues, or a combination of these factors.

Smith (1971) similarly investigated how a character's personality may impact that of the actor (and vice versa). He measured a group of student actors along 11 dimensions in a longitudinal study across nine time points when staging a production. The results demonstrated that, while rehearsing and staging a play, an actor's personalities did not significantly change to match that of the character. He found that an actor's conceptualization of their character's personality held greater variance than their self-concepts, and that the character's concepts could be significantly shaped/changed by the actor in the direction of the actor's self-concept. In other words, an actor's personality remained stable when measured longitudinally, and actors modified their characters' personalities to better fit their own self-conceptualizations. This reducing of the separation between self and character via a character-to-actor modification is not dissimilar to the idea of *boundary blurring* mentioned by Burgoyne (1999) or dissociation (Panero, 2019). This is in contrast to findings of an actor-to-character modification or its extreme state of *character carry-over*, where character personality effects linger after a performance has completed (Burgoyne, 1999; Hannah et al., 1994). Indeed, in contrast to the previous two studies, Hannah and colleagues (1994) found in their student sample that the degree of difference between an actor's personality and their character's decreased over time and was marginally retained up to a month after production. An explanation for the mixed results of these studies could be that they are products of their time, utilizing inconsistent and insufficient measures of personality.

A more modern and popular method of personality measurement is the Five Factor model of personality, which measures personality on the trait dimensions of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (collectively abbreviated as OCEAN or the Big 5; Costa & McCrae, 1992; Digman, 1990; Meyers, 2010). Through the combination of these five dimensions, a coarse-grained generalized representation of an individual's personality can be achieved. The Big 5 has even been used to assess the personalities of actors. Indeed, Nettle (2006) compared personality scores from a large group of professional actors and non-actors, and found that actors were higher in extraversion, openness, agreeableness, as well as in empathizing cognitive style, as taken from Baron-Cohen (2002; Baron-Cohen et al., 2003). These results indicate that there is perhaps a natural personality component to being an actor, although an assessment of character personalities was not been conducted. Indeed, another finding of the extant literature is that when characters are assessed in previous work, there is a lack of a unified character theory.

While research in the area of the actor-character personality relationship is not without merit, the initial groundwork of understanding personality-traits in the context of characters and their conceptualizations (i.e., separate from actors) has not been laid. In other words, the relationship between characters and their personalities needs to be understood on its own before investigations into the actor-character relationship can be developed. Furthermore, a multicomponent model like the Big 5 may be too unwieldy and difficult to interpret at the character level to offer any useful predictive power.

An alternative personality measure such as the Thomas-Kilmann (TK) Conflict Mode Instrument may be more useful. The TK is a choice candidate as 1) it has been validated and used in applied studies of personality (Barki & Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992), 2) it is based on modes on how to handle conflict (a key element of story and characterization) based on two orthogonal personality measures of *assertiveness* and *cooperativeness* (Jung, 1921/1971, 1968; Kilmann & Thomas, 1975, 1977), 3) it does not require any additional factors (Kilmann & Thomas, 1975, 1977; Ruble & Thomas, 1976), 4) it can be compared to dimensional models of emotion (see section 1.3; Russell, 1980; Woods & Anderson, 2016), and 5) dimensions related to conflict-handling modes allow for added predictability related to character-plot-conflict interactions (Abbott, 2008). In Berry and Brown (2017), we presented a proposal for a systematic classification of literary characters based on personality dimensions, using a modification of the Thomas-Kilmann Conflict Mode Instrument in an attempt to establish a theoretical framework for character-based hypothesis testing (Chapter 2).

1.5 – Unimodal and Multimodal Research

In the previous sections, I have briefly touched on how acting has been analyzed using the individual measurements of psychological surveys or physical behavior. Research in this vein has primarily been focused on only one physical modality at a time (e.g., the voice) while perhaps looking at multiple variable categories (e.g., pitch and timbre) and their constituent parameters (e.g., fundamental frequency mean, frequency variability, jitter, shimmer, harmonics-to-noise ratio). In other words, previous research has primarily been unimodal, rather than multimodal. Acting is, by nature, a multimodal process, involving all physical modalities of the voice, face, whole-body movements, gestures, postures and positions being figured into character portrayals (Carroll & Russell, 1997; Gosselin et al., 2012). Gunkle (1971) describes these modalities as *codes*, acting either *digitally* (i.e., language) or *analogically* (e.g., vocal sounds, facial expressions, body gestures, movements, costuming), with *restrictions* or *reductions* drawing focus away from one code and to another or altering the performance entirely (e.g., towards pantomime, dance, etc. Gunkle, 1971). In the context of acting and the process of characterization, intermodal research needs to be conducted, focusing on multiple physical modalities independently and in synergy while looking at multiple effectors and their subsequent parameters. Thus far, few studies have attempted this in relation to emotion (Scherer & Ellgring, 2007b; Wallbott & Scherer, 1986) and none in relation to characters. However, these studies are limited in that they have utilized actors as proxies for other behaviours, and research goals have not investigated acting as a goal in and of itself. Intermodal and multimodal behavior research, such as that which is presented in this dissertation, is the best way toward a more objective and useful understanding of character physicalization and performance behaviours.

1.6 – Outline of Present Research

The overarching goal of my doctoral thesis is to approach the study of acting from a novel direction, one that is empirically grounded. In my view, the purpose of an empirically-grounded approach to acting is to allow for a testable and revisable system that can be used both in research settings (e.g., academia, education, technology) and in practical settings (e.g., everyday role-playing, acting performances, public speaking, politics). Ultimately, I see such a system as being a multi-purpose tool, one that allows any level of practitioner – be they novice or expert – access to information – both coarse and fine-detailed – to reliably inform their portrayals. In so doing, I would achieve an additional professional goal, which is to disseminate my research findings as outcomes that lend themselves to intuitive applications and yet remain complementary to existing acting training techniques.

Indeed, the work found in my dissertation has emerged around theories of acting as well as previous work explored in different domains in psychology and behaviour that can be considered adjacent to actors and acting. Fields like emotion, personality, and cognition, specifically embodied cognition, have even made use of actors in their experiments. While each of these fields have used actors to some degree, they have not sought to outright explore the process of acting itself. It is this gap in the literature that my dissertation attempts to bridge with the research presented here.

In **Chapter 2**, I sought to create and validate a classification scheme for literary characters that could serve as a predictable model to use in future behavioural experiments. The movement towards characters and away from emotions was driven by my desire to explore aspects of acting that went beyond the direct/indirect study of emotions, either categorically or dimensionally. Because acting is more than just the portrayal of different emotions, I attempted to establish a new "functional unit" for the purposes of experimentation, namely that of a stock or prototypical character. I used a novel psychometric rating study to evaluate four personality-trait scales and 40 stock characters from across Western literature. I found that only the two personality dimensions of assertiveness and cooperativeness were orthogonal, allowing for the classification of characters along these two dimensions. These results suggest that prototypical characters are conceptualized in a predictable manner across participants. The chapter concludes by discussing how participants' conceptions of characters varied, introducing the neologism of *ethotype* as a formalization of this variation.

In **Chapter 3**, I sought to apply and behaviourally validate the classification scheme using actors' vocal gestures during character portrayal. Behavioural piloting revealed differences between character conceptualization and character performance, allowing for a more refined and testable two-dimensional model. I used a novel neutrally-scripted acting paradigm and voice recording technology with 24 professional actors to explore 12 prosodic features of character vocal production related to pitch, loudness, timbre, and duration/timing. I found that actors' vocal productions conformed more to the assertiveness dimension than the cooperativeness dimension. These results suggest that actors modulate their voices to differentiate between different characters and that the personality of the character is predictive of its performance prosody. The chapter concludes by introducing the idea of the *performance persona* while discussing aspects of the self before discussing future explorations in additional modalities (e.g., the face).

In **Chapter 4**, I sought to apply and behaviourally validate the refined two-dimensional character model on actors' facial gestures during character portrayal. In addition, I sought to replicate and extend previous findings on the facial expression of emotion by investigating a dimensional scheme of emotional arousal and valence. I used a novel neutrally-scripted acting paradigm and 3D motion capture technology with 24 professional actors to explore four dynamic facial segments of character and emotion production related to the expansion and contraction of the brow, eyebrows, lips, and jaw. This was done across 9 characters organized in a 3x3 scheme, and 9 emotions organized in a 2x2 scheme. I found that actors' facial productions conformed more to the cooperativeness dimension than the assertiveness dimension. Furthermore, the work established a dimensional connection between character cooperativeness and emotional valence, and between character assertiveness and emotion arousal. These results suggest that actors modulate their faces to differentiate between different characters and emotions, and that the personality of the character is predictive of its performer's facial expressivity. The chapter concludes by discussing the analysis of performance in the context of speech and possible applications.

1.7 – Conclusion

The purpose of the work presented in this dissertation is to explore the products and process of acting by means of creating, validating, and testing a theoretical model based on a predictive character-classification scheme. To achieve this in a practical and meaningful way, I extracted coarse-level variables related to behaviour and performance and analyzed them across multiple actors and multiple modalities (i.e., the voice and face). The results reveal inter- and intra-modal relationships as well as previously unknown relationships between characters, personality, and emotions. The findings presented here constitute the first experimental analysis of acting – more specifically gesturing during character portrayal – and demonstrate that actors predictably manipulate their modal gestures in contrastive and complementary ways to differentiate characters based on their personality traits.

Chapter 2 – A classification scheme for literary characters

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2.1 – Abstract

There is no established classification scheme for literary characters in narrative theory short of generic categories like protagonist vs. antagonist or round vs. flat. This is so despite the ubiquity of stock characters that recur across media, cultures, and historical time periods. We present here a proposal of a systematic psychological scheme for classifying characters from the literary and dramatic fields based on a modification of the Thomas-Kilmann (TK) Conflict Mode Instrument used in applied studies of personality. The TK scheme classifies personality along the two orthogonal dimensions of assertiveness and cooperativeness. To examine the validity of a modified version of this scheme, we had 142 participants provide personality ratings for 40 characters using two of the Big Five personality traits as well as assertiveness and cooperativeness from the TK scheme. The results showed that assertiveness and cooperativeness were orthogonal dimensions, thereby supporting the validity of using a modified version of TK's two-dimensional scheme for classifying characters.

Keywords: literary characters, archetypes, classification, personality, Thomas-Kilmann, assertiveness, cooperativeness

2.2 – Introduction

In what was perhaps the first treatise of literary theory, Aristotle (335 BCE/1996) in his Poetics argued for a prioritization of plot over character in the study of drama, an idea that has come to dominate much literary theory during the last two millennia, including in the contemporary psychological study of "story grammars" (Mandler, 1984; Rumelhart, 1975; Stein & Trabasso, 1981). Indeed, 20th century analysts of folklore developed detailed classification schemes for plot types, whereas no comparable classification of character types was proposed. For example, stories have been classified with respect to plot motifs and tale types (Motif-Index, Tale Type Index, and Aarne-Thompson-Uther Index; Dundes, 1962, 1997; Fischer, 1963; Uther, 2004), paradigmatic patterns (Lévi-Strauss, 1955), and action functions (Fischer, 1963; Propp, 1968, 1984).

It might be expected that, since plot and character are highly related (Elsner, 2012; Mateas & Stern, 2002; Si & Marsella, 2010), there would be a distinct structure to character organization within these classification methods. While some of the plot typologies include character groupings (e.g., animal stories; Fischer, 1963; Propp, 1968), these groupings are limited to superficial features of the characters (i.e., animal stories are about ducks or pigs) and say nothing about the quality of the characters (their personality, agency, etc.), nor do they offer any form of predictability (i.e., what types of characters are associated with what types of plots). As such, there is no established method within literary theory to classify the characters around which narratives develop. Any previous attempts to classify characters are defined strictly within the bounds of the aforementioned structural analyses that feature them, restricting our understanding of characters in these analyses solely to the narrative motif or function they serve (Fischer, 1963; Propp, 1968). Indeed, short of generic categories such as round vs. flat, one-, two-, three-, or multi-dimensional, or protagonist vs. antagonist (Arp & Johnson, 2009), there has been no systematic classification of characters in literature and drama.

Perhaps the closest that previous work has come to character classification is Carl Jung's notion of an "archetype" (Chang et al., 2013, 2014; Faber & Mayer, 2009; Jung, 1921/1971, 1968), as manifested in character-archetypes in folk tales, myths, dreams, religion, fantasies, literature, and other art forms. Work inspired by Jung – spanning from mythology (Campbell, 1949) to mass media studies (Faber & Mayer, 2009) – has honed in on 12 basic character-archetypes. Golden (2011) has provided a dimensional structure to these archetypes, as organized along a wheel with four "cardinal orientations" that reflect the motivation and social values of the character. The categories and constituent archetypes are as follows: ego fulfillment (creator, hero, magician) in opposition to socialness (lover, caregiver, everyman); and freedom (explorer, outlaw, jester) in opposition to order (sage, ruler, innocent). Inspired by Jung's ideas, Faber and Mayer (2009) conducted a factor analysis of people's archetype associations to items from popular music, movies, television, literature, and classic art of the day. In doing so, they were able to identify five clusters of character-archetypes, what they labelled as knower, carer, striver, conflictor, and everyperson. Interestingly, they found that these categories were essentially independent of personality dimensions, as assessed using the Big 5 classification system.

Our work in this area, as with Golden (2011), was motivated by a desire to develop a dimensional scheme that could potentially organize all possible characters along a small number of canonical dimensions. However, we did not find the two dimensions comprising the four cardinal orientations to be a compelling and useful scheme for our work. Likewise, while we wanted to develop a scheme that could be empirically validated by participant ratings of characters, we did not want to use a data-driven approach, such as the factor analysis that Faber and Mayer (2009) had employed, but instead attempt to develop a theory-driven approach based on character concepts coming from personality theory in psychology.

The current study examines a dimensional approach to classifying characters based on a modification of the Thomas-Kilmann (TK) Conflict Mode Instrument used in applied studies of personality (Barki & Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992). The TK scheme classifies Jungian personality correlates of people's conflict-handling modes along the two orthogonal dimensions of cooperativeness and assertiveness (Jung, 1921/1971; Kilmann & Thomas, 1975, 1977). Previous analyses of conflict modes support the validity of a two-dimensional scheme comprised of an evaluative factor (cooperativeness) combined with a dynamic factor (assertiveness), without the need for any additional factors (Kilmann & Thomas, 1977; Ruble & Thomas, 1976). The TK scheme shows parallels to the circumplex model of affect in emotion theory (Russell, 1980; Woods & Anderson, 2016) in that the latter too is comprised of an evaluative factor (valence) and a dynamic factor (arousal). These parallels are important since characters should, in theory, have a meaningful association with emotion (Woods & Anderson, 2016). Hence, an approach to characters that can relate personality dimensions to emotion dimensions should prove advantageous in the analysis and classification of characters. In addition, the use of conflict-handling dimensions in classifying characters opens the possibility of illuminating the relationship between character and plot, since the central conflict of a story is a prominent feature of its plot (Abbott, 2008). Thus, in selecting the TK model as the basis of our proposed classification scheme, we are attempting to provide an underlying framework for the classification and organization of characters, as well as a basis for hypothesis testing.

In order to make the TK scheme more robust and more accommodating for classifying characters, we are proposing a key modification to the structure of the scheme. The published scheme is something of a 3 x 2 model, with 3 parametric levels of assertiveness crossed with 2 levels of cooperativeness. We propose adding a third, neutral level to the middle of the cooperativeness axis so as to make this fully a 3 x 3 scheme (this is presented in Figure 2.1 in the Results section). The principal aim of the current study is to analyze the validity of our modification of the TK scheme as a systematic method for classifying characters in a dimensional fashion with regards to their assertiveness and cooperativeness. In order to do this, we had participants rate a diverse group of 40 characters taken from a broad range of Western literary sources along the lines of four personality dimensions. These included assertiveness and cooperativeness from the TK scheme, as well as two of the Big 5 dimensions of extraversion and conscientiousness (Costa & McCrae, 1992; Digman, 1990; Meyers, 2010). The validity of the TK scheme for classifying characters would be supported by two observations, first that assertiveness and cooperativeness were orthogonal (i.e., uncorrelated and independent) dimensions, and second, that the 40 characters populated the 9 cells of the 3 x 3 scheme in a balanced manner. A second objective of the study was to explore the relative uniformity or diversity of people's conceptions of the characters by looking at the variability of the ratings across characters.

2.3 – Method

2.3.1 – Participants

The sample consisted of 142 participants (114 female, 28 male, age range 18–34), who completed an online rating survey. The task took roughly 30 minutes to complete. Participants were recruited from an undergraduate participant pool and were given course credit for their participation. Prior to the start of the study, participants provided informed consent. The study was approved by the McMaster University research ethics review board.

2.3.2 – Procedure

A rating form was created for the purpose of this study using Google Forms. It was hosted and distributed from the authors' webpage (cntl.science). Participants were provided with a link to the host site and the rating form once they agreed to participate. Due to the absence of a scholarly repository of characters, we pseudorandomly selected character names from a variety of Western sources. They included books and web sites with large listings of literary characters ("Archetypal Character," 2013; Freedman, 2014; Golden, 2011; "List of stock characters," 2012; Propp, 1968; Schmidt, 2001, 2012) and dramatic characters (Landy, 1996). Our goal was to select a range of diverse but recognizable character names from the fields of both literature and drama, resulting in a final list of 40 characters. Character names were incorporated into the study if they 1) were recognized by the authors, 2) were repeated over the several sources, and 3) provided adequate examples of use in well-known literary/theatrical works. The character names were formatted on the rating form exactly as they were presented in the sources. Exceptions to this practice related to the formatting of gendered characters (e.g., heroine vs. hero, queen vs. king), as well as the removal of qualifiers from names (e.g., star-crossed lover became lover), or the simplification of names to increase recognizability (e.g., servant to the rich became butler, intellectual became professor). The full list of characters is shown in Table 2.1.

Table 2.1.

Alphabetical listing of the literary and dramatic characters examined in this study

Action Hero	Critic	Hero	Monster	Scientist
Artist	Crone	Heroine	Old Hag	Self
Average Joe	Cynic	Jock	Politician	Sidekick
Babysitter	Damsel in Distress	King	Priest	Snob
Bimbo	Femme Fatale	Librarian	Professor	Spoiled Child
Bully	Geek	Loner	Queen	Supervillain
Butler	Grandparent	Lover	Recluse	Superhero
Coward	Grump	Miser	Rogue	Teacher

Participants were presented with the names of the 40 characters in a random order. In order to encourage the participants to actively think about the characters when responding, we asked participants to imagine the character being performed on stage by an actor (i.e., as if in a theatrical production). The gender of the character was not specified, although it was implied in the names of a small number of the characters (e.g., queen, heroine, king, hero). Using the rating form, participants rated the 40 characters on 4 personality-trait scales (see below). Ratings were given on a Likert scale from 1 to 9, where 1 represented the character having a low degree of the given personality trait (i.e., unassertive, uncooperative, introverted, and not conscientious) and 9 represented the character having a high degree of the given personality trait (i.e., highly assertive, highly cooperative, highly extraverted, and highly conscientious). One rating was given per personality trait per character.

2.3.3 – Measures

Participants were asked to provide ratings on the 40 characters using 4 personality-trait scales in a fixed order. The scales were presented to participants as follows. 1) Assertiveness (i.e., self-assured without being aggressive): scores range from unassertive to highly assertive. 2) Cooperativeness (i.e., a character being agreeable in their relations): scores range from uncooperative to highly cooperative. 3) Extraversion (i.e., level of outgoingness): scores range from introverted or not extraverted to highly extraverted. 4) Conscientiousness (i.e., being efficient and organized): scores range from not conscientious (i.e., easy-going or disorderly) to highly conscientious.

2.3.4 – Analyses

The raw data were transferred from Google Forms to a Microsoft Excel spreadsheet. They were screened for missing values and outliers, of which none were found. Ratings were collapsed across participants, and repeated measures analysis of variance tests (RM-ANOVAs) were run to determine if there was an effect of gender on any of the four rating scales. Next, character ratings were collapsed across participants, and the mean and standard deviation were determined for each character. Pearson product-moment correlation analysis and Hoeffding's D tests were run on the mean character ratings for each trait to explore the correlations and independence, respectively, of each pair of trait-variables. All statistical data analyses were run in R 3.4.0 (R Core Team, 2013). From the original 4 traits, the 2 least correlated and most independent traits – as established by the Pearson product-moment correlation and Hoeffding's D analyses – were selected to create a two-dimensional scheme.

In order to create a 3 x 3 structure, we employed a binning process such that Likert ratings of 1-3 were considered as low, 4-6 as medium, and 7-9 as high. Next, each of the 40 characters was assigned by the authors to one of the 9 cells of the scheme based on its mean ratings (rounded to the nearest integer) for the two chosen dimensions.

2.4 – Results

The means and standard deviations of the ratings for each character for the 4 personality traits are summarized in Table 2.2. As described in the Introduction, the major objective of the current study was to test out the notion that assertiveness and cooperativeness are two orthogonal personality dimensions that can be used to classify characters. To investigate this, we examined pairwise correlations among the 4 personality scales used in the study, as well as ran Hoeffding's D test to explore independence among the variables.

Table 2.2.

Mean personality ratings for all characters with standard deviations

Character	Assertiveness		Cooperativeness		Extraversion		Conscientiousness	
	M	SD	M	SD	M	SD	M	SD
Action Hero	8.01	1.42	7.11	1.94	7.68	1.66	6.65	2.07
Artist	5.46	2.16	5.25	1.83	4.23	2.27	4.09	2.35
Average Joe	5.07	1.08	5.50	1.12	5.14	0.87	4.87	1.26

Babysitter	6.79	1.51	7.19	1.49	6.32	1.49	6.69	1.73
Bimbo	4.34	2.50	5.27	2.40	6.92	2.09	2.92	2.08
Bully	6.78	3.03	1.94	1.60	6.18	2.23	3.11	1.91
Butler	4.73	2.43	7.89	1.66	4.51	2.07	7.57	1.98
Coward	2.30	1.89	4.17	2.72	2.72	1.97	3.27	2.14
Critic	7.40	2.12	3.89	2.12	5.58	2.33	6.64	2.26
Crone	5.56	2.04	3.87	2.10	4.30	2.01	4.82	2.04
Cynic	6.32	2.23	2.98	1.77	4.64	2.28	5.22	2.23
Damsel In Distress	3.59	2.12	5.87	2.42	4.80	1.91	3.73	1.91
Femme Fatale	7.32	1.83	5.34	2.17	6.93	1.84	6.18	2.07
Geek	3.87	2.52	5.66	2.38	2.49	1.77	6.96	2.49
Grandparent	6.13	1.75	7.15	1.73	5.97	1.86	5.96	2.39
Grump	5.13	2.46	2.37	1.70	3.33	1.97	3.87	2.05
Hero	7.91	1.55	7.83	1.48	7.88	1.32	7.13	1.99
Heroine	7.68	1.68	7.10	1.98	7.46	1.70	7.20	1.82
Jock	6.91	2.26	5.11	2.19	7.99	1.43	3.80	2.23
King	8.18	1.64	5.09	2.48	7.53	1.58	6.64	2.08
Librarian	6.23	2.30	6.58	2.15	3.87	2.10	7.80	2.00
Loner	2.59	2.05	3.66	2.06	1.53	1.18	4.39	2.25
Lover	6.44	1.72	7.22	1.59	6.39	1.76	5.72	1.98
Miser	6.03	1.95	3.73	2.05	4.51	2.04	5.98	2.15
Monster	6.58	2.71	2.03	1.66	4.88	2.76	3.19	2.21
Old Hag	5.27	2.60	2.85	1.72	3.39	2.05	3.66	2.25
Politician	8.20	1.49	5.04	2.53	7.97	1.60	7.23	1.81
Priest	6.55	2.09	6.90	2.16	6.26	1.92	7.08	1.87

Professor	7.72	1.45	6.44	1.91	6.45	2.11	7.36	1.98
Queen	8.20	1.49	6.04	2.42	7.36	1.55	7.85	1.34
Recluse	3.42	2.12	3.47	2.13	2.40	2.06	4.32	2.40
Rogue	6.51	2.20	3.61	2.20	5.37	2.30	5.12	2.34
Scientist	7.04	1.77	6.20	1.95	4.22	2.15	7.35	2.24
Self	6.02	1.85	7.07	1.54	5.05	2.05	6.45	1.94
Sidekick	4.89	2.18	7.85	1.67	5.56	1.83	5.59	2.17
Snob	6.66	2.48	2.42	1.68	5.99	2.29	5.01	2.44
Spoiled Child	6.70	2.70	1.72	1.23	6.73	1.99	3.42	2.18
Supervillain	7.27	2.66	2.15	1.80	6.13	2.55	5.98	2.79
Superhero	8.07	1.55	7.99	1.53	7.90	1.69	7.25	2.06
Teacher	7.58	1.45	7.06	1.64	7.09	1.36	7.49	1.74

2.4.1 – Correlations Between Personality Dimensions

Pearson product-moment correlations for each pairwise combination of the 4 personality-trait variables are shown in Table 2.3. There were strong and significant correlations between the ratings for assertiveness and extraversion, as well as between the ratings for cooperativeness and conscientiousness, with the latter also being highly correlated with extraversion. Of interest to our research question for the present study, there was a weak and non-significant correlation between ratings for assertiveness and cooperativeness ($r(38) = 0.19$, $p = .24$). This result indicates that these two personality features are uncorrelated and thus, potentially, orthogonal. The lack of correlation between the personality dimensions of assertiveness and cooperativeness is, in addition, the predicted negligible correlation based on the TK scheme. These variables were therefore deemed uncorrelated in a linear context, but not necessarily independent. Their independence was assessed using Hoeffding's D test.

Table 2.3.

Pearson Product-Moment Correlation Coefficients Between the 4 Personality-Trait Ratings of the 40 Characters

Measure	1	2	3	4
1. Assertiveness	–			
2. Cooperativeness	0.19	–		
3. Extraversion	0.81***	0.35*	–	
4. Conscientiousness	0.55***	0.66***	0.34*	–

*$p < .05$. **$p < .01$. ***$p < .001$.

2.4.2 – Hoeffding's D Test for Dependence

A Hoeffding's D test for dependence was used to further examine the relationship between the uncorrelated personality-trait scales of assertiveness and cooperativeness. The null hypothesis for Hoeffing's D test is that variables are independent of one another. A significant difference in D results in the alternative hypothesis that the variables are dependent. Values of D range from -0.5 to 1, such that the smaller the value of D, the more independent the variables are. The D statistic is robust against a wide variety of alternatives to independence (Lafaye De Micheaux & Bilodeau, 2008).

The ratings for assertiveness and cooperativeness failed to reject the null hypothesis and were thus deemed independent of one another ($D = 0$, $p = .40$). Overall, the results supported the predicted independence of assertiveness and cooperativeness from the TK scheme, suggesting the possible utility of these two dimensions in a scheme for classifying literary characters.

In order to visualize the placement of the 40 characters in our modified version of the TK scheme, we binned the character ratings to conform to a 3 x 3 scheme (see Methods for details). The results are shown in Figure 2.1. In general, there was a good spread of characters throughout the top two rows of the scheme, but relatively few characters in the bottom row of low assertiveness. The lower right cell (i.e., high cooperativeness + low assertiveness) was empty. Importantly, the figure shows reasonable associations among conceptually similar characters, for example bully with monster, hero with priest, and coward with loner. Participants rated Average Joe as medium in both dimensions (a good quality-control), while they rated themselves as medium in assertiveness but high in cooperativeness.

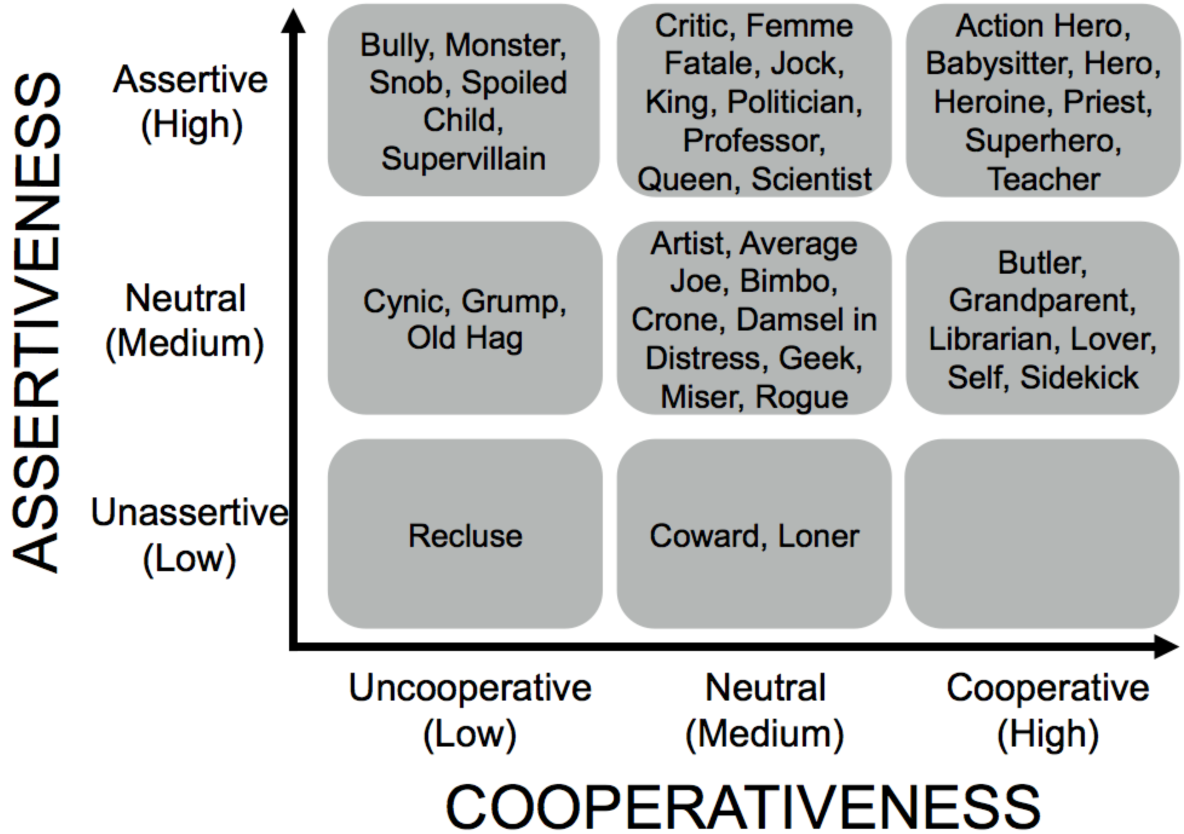

Figure 2.1. Placement of the 40 characters in the modified TK Scheme. Characters are categorized by their binned means on three levels (low, medium, and high) of the two orthogonal personality dimensions (assertiveness and cooperativeness) in our 3 x 3 modification of the TK scheme.

2.4.3 – Variability of Character Concepts

A second important issue that we wanted to address was the variability of how the characters were conceived by participants. We used the standard deviation of the ratings as a measure of this variability. The means and standard deviations of the ratings were calculated for each of the 40 characters along the two orthogonal personality-trait dimensions of assertiveness and cooperativeness. The characters were then plotted with respect to the means of each personality dimension and then color coded with regard to the magnitude of the standard deviations for assertiveness or cooperativeness in separate analyses (see Figure 2.2 and Figure 2.3, respectively). This becomes a measure of how uniform or diverse people's conceptions are of particular literary characters.

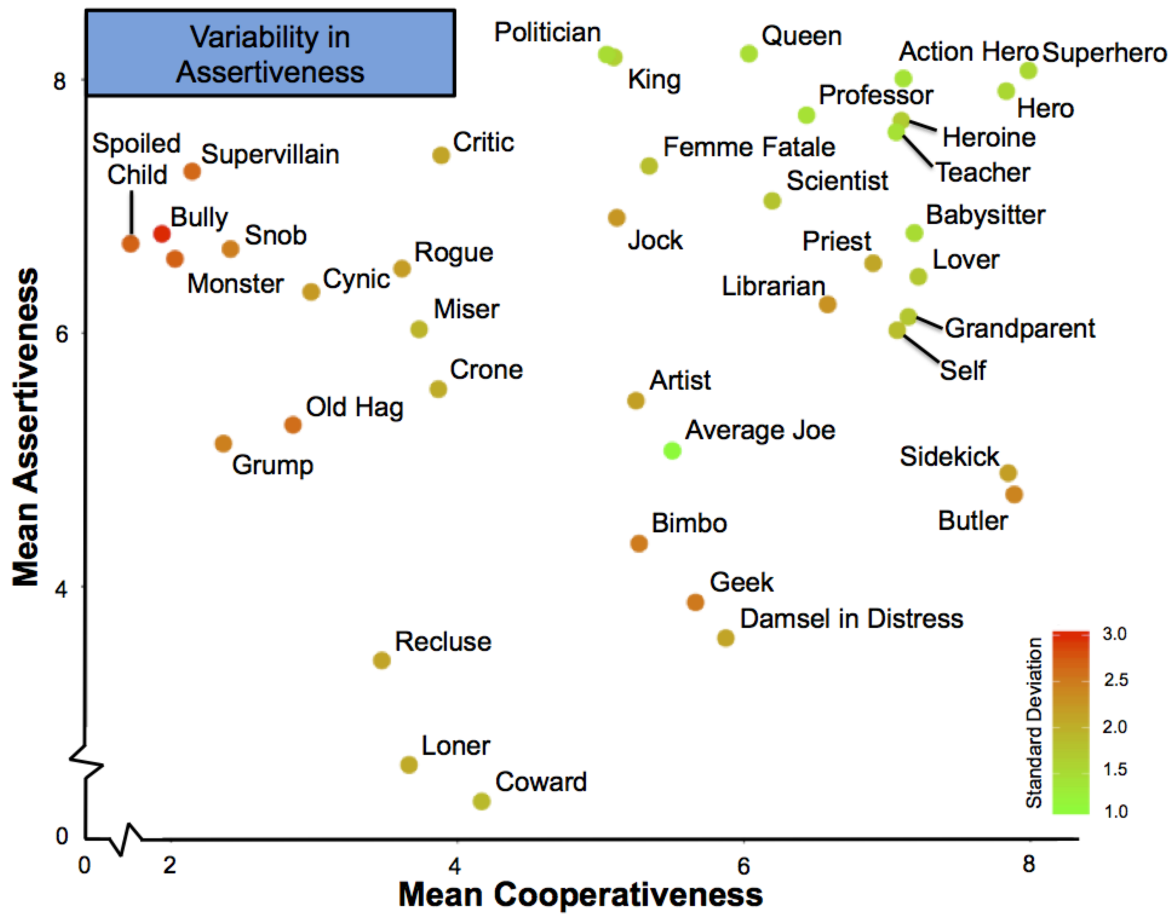

Figure 2.2. Variability of character ratings for assertiveness. Characters are plotted with regard to their mean assertiveness and cooperativeness. The color coding denotes the standard deviation for the assertiveness ratings.

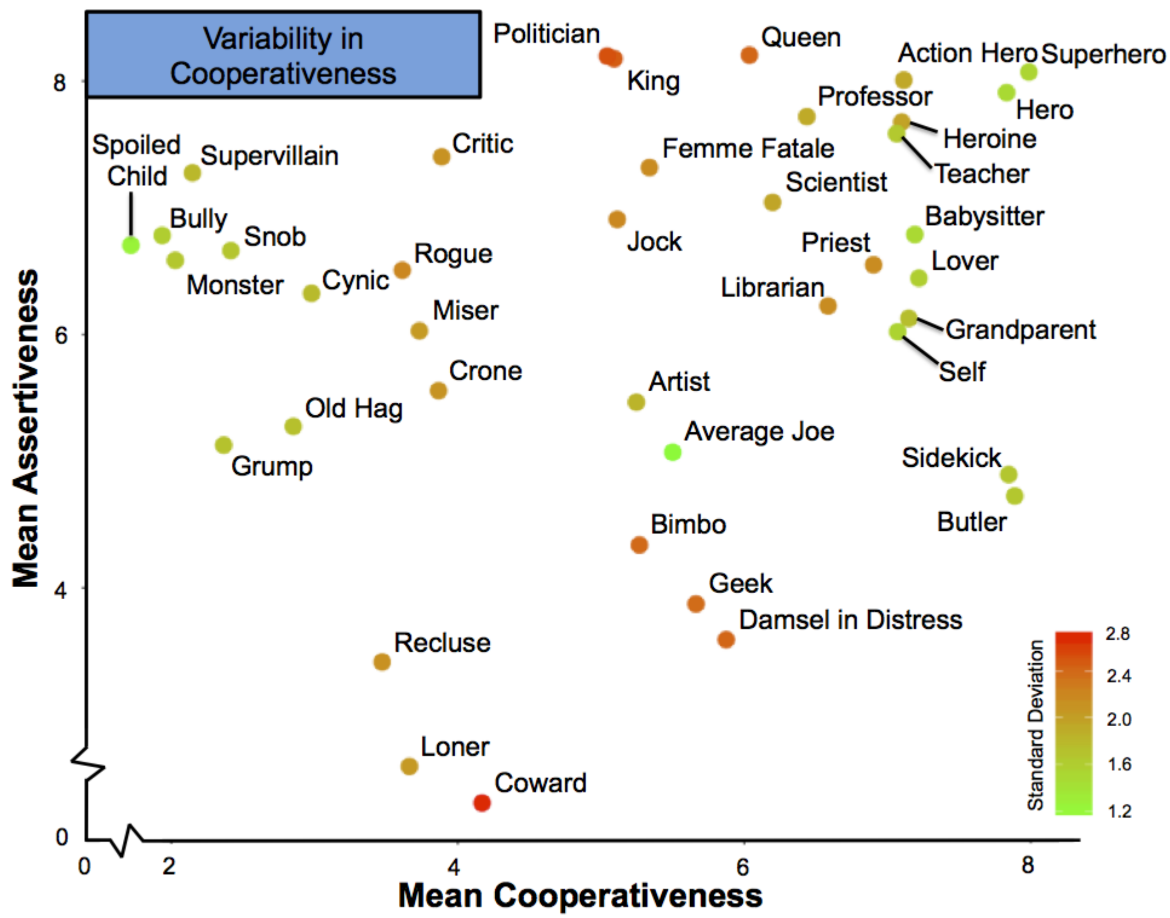

Figure 2.3. Variability of character ratings for cooperativeness. Characters are plotted with regard to their mean assertiveness and cooperativeness, exactly as in Figure 2.3. The color coding denotes the standard deviation for the cooperativeness ratings.

The pattern for assertiveness revealed a possible interaction with cooperativeness ratings: standard deviations for assertiveness increased as cooperativeness ratings decreased, and vice versa (Figure 2.2). This finding indicates that participants had more-uniform conceptions of a character’s assertiveness the higher the character was rated on the cooperativeness dimension, but less uniform the lower it was rated. This is demonstrated by the increase of green color towards the right side of Figure 2.2. Hence, a character like teacher showed low variability in assertiveness ratings, whereas a character like spoiled child showed high variability.

The standard deviations for cooperativeness showed a different type of pattern. They were lowest at the extremes of the scale and highest in the middle, as shown by the highest concentration of red in the center of Figure 2.3. This finding suggests that participants had a more uniform conception of a character's cooperativeness the more extreme this cooperativeness was (either low or high), but a more variable and less certain conception when the cooperativeness was neutral. Hence, a character like superhero showed low variability, whereas a more neutral character like king showed high variability.

Both analyses show that participants had variable conceptions of the characters, but that this variability was apportioned differentially with respect to assertiveness and cooperativeness. Variability for assertiveness was highest for low-cooperative characters, while variability for cooperativeness was highest for cooperatively-neutral characters.

2.4.4 – Ratings as a Function of Participant Gender

As the sample of participants turned out to be predominately female (80%), we were interested in examining if gender had a significant effect on the personality scales employed. One-way repeated measures ANOVAs were conducted on each of the four rating scales using Bonferroni-adjusted alpha levels of 0.0125 per test (0.05/4) to correct for multiple comparisons. There were no significant effects of gender on any of the four rating scales.

2.5 – Discussion

2.5.1 – Toward a Classification of Character Types

The results of the present study validated the predicted orthogonality of the two dimensions present in the TK scheme, as well as showed that the corpus of 40 characters demonstrated a reasonable spread across the cells of our modified 3 x 3 scheme. This supports our contention that the modified TK scheme offers a novel means of classifying characters with regards to the personality dimensions of assertiveness and cooperativeness. Given that the plots of stories are often described with respect to the central conflict between a protagonist and an antagonist (Abbott, 2008; Arp & Johnson, 2009), a classification scheme of characters rooted in conflict mode dimensions (Kilmann & Thomas, 1975, 1977) provides an appropriate association with literary features that unite character and plot. In fact, the central conflict can be conceptualized in terms of the contrastive personality features of the protagonist and antagonist, most especially with respect to cooperativeness, thereby making them complementary characters. Future studies could focus on the interaction between specific characters and the outcomes of these interactions, as perceived by a reader or audience member.

We predicted that assertiveness and cooperativeness would be the most orthogonal personality dimensions out of the four tested. Our rating study confirmed this prediction. As a result, we have chosen to include assertiveness and cooperativeness as the two dimensions in our predictive scheme. This pairing is supported by previous research on personality as well as emotion. The two-dimensional pairing between assertiveness and cooperativeness has been validated by decades' worth of research on the TK scheme (Barki

& Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992). Furthermore, assertiveness has a desirable connection with the emotional dimension of intensity/arousal in the circumplex model of affect (Russell, 1980; Woods & Anderson, 2016), thereby making it a robust candidate for future experimental and conceptual analyses of characters that attempt to unite personality and emotion. Future studies could expand upon this notion, not only by examining the parallels between personality and emotion with regard to characters, but also by examining other dimensional parameters for classification.

An important finding of the results shown in Figure 2.1 is that the 40 characters were distributed relatively smoothly across the scheme. However, we observed that there was an uneven distribution of characters along the assertiveness axis (i.e., more characters at the positive extreme), whereas this was not the case for the cooperativeness axis (i.e., a more even distribution). We would like to offer a provisional interpretation of these trends. The skewed distribution of characters in the direction of medium to high assertiveness suggests that the characters of stories, whether they are cooperative or uncooperative, are required to have assertiveness in order to propel the story's sequence of events. This is related to their sense of motivation, agency, efficacy, and engagement, something that unassertive characters generally lack. On the other hand, the even distribution of characters on the cooperativeness dimension suggests that literature depends on a balance between good and bad characters. In fact, as mentioned above, it is the pairing of characters along opposing lines of cooperativeness that often establishes the central conflict of a plot. This serves to convey the moral message of a story and to make literature an important vehicle for the modeling of prosocial behaviors in all human cultures (Gottschall, 2012).

2.5.2 – "Ethotypes" as Character Variants

Historical and cross-cultural analyses of literature show that stock characters do not have invariant properties across stories, but instead vary in their personality features across traditions and time periods. The character of a king can be benevolent or despotic. Likewise, the character of the snob can be charming (e.g., a dandy) or persnickety (e.g., a critic). It stands to reason that some characters can have only a restricted range of properties in order to be those characters (e.g., a bully or hero), while others can show a diversity of features across stories (e.g., a king or snob). We examined the variability of character ratings across characters in our dataset in order to determine which ones showed the most-variable and least-variable features with respect to both assertiveness and cooperativeness. The results showed that character conceptions, as measured by personality dimensions, did indeed vary across characters, and that the patterns differed between assertiveness and cooperativeness (Figures 2.2 and 2.3).

We would like to propose a formalization of the concept of a character-variant. The ancient Greek word for character is "ethos", applying both to one's own moral character and to the characters that are found in theatrical dramas (Storm, 2016). Borrowing terminological practice from genetics (Jobling, Hurles, & Tyler-Smith, 2004), we would like to propose two new terms applying, respectively, to the variants and to the overall category of a character, what we will call ethotype and ethogroup. For example, the character of king is comprised of a series of king ethotypes that vary along a number of personality and behavioral dimensions. The benevolent king is one ethotype, the despotic king is another, and the collection of all king ethotypes makes up the ethogroup of king, where the average character (or character-archetype) might be thought of as the mean variant of the ethogroup. The present study showed that a basic measure like the standard deviation can effectively capture the variability of character conceptions in a rating study like ours.

2.5.3 – Limitations

Potential limitations of this study are found within its scope of a) characters and b) ratings scales. Although a large cohort examined a large corpus of characters, the findings reported here are preliminary, as there are many characters to be examined across the both the literary and dramatic fields as well as across cultures. Future studies should aim to replicate the findings reported here as well as expand the corpus of characters to include a more culturally diverse sample. Next, only two out of the five Big 5 personality scales were selected and tested directly. Evidence suggested that openness – a Big 5 dimension that was not examined here – is highly correlated with assertiveness and could thus be omitted (Kirst, 2011), while agreeableness is similar to TK's cooperativeness. Future studies should endeavour to include a larger number of dimensions to further replicate and validate the taxonomic scheme.

2.5.4 – Conclusions

We have developed the first systematic scheme for classifying literary characters, basing it on personality dimensions. The results of the rating study showed that the two dimensions of the scheme were uncorrelated and independent. Furthermore, the 40 characters that were analyzed in the study showed a reasonable spread across the cells of the scheme, although with an underrepresentation in the low-assertive cells, in keeping with the idea that narratively-interesting characters require a certain minimum degree of assertiveness in order to propel a story. Finally, the analysis of character ratings showed that people's character conceptions varied, suggesting that there can be a multitude of variants for a given character, something that we refer to using the neologism "ethotype".

2.6 – Declarations

2.6.1 – Funding

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2.6.2 – Competing Interests

The authors have declared that no competing interests exist.

2.6.3 – Acknowledgments

The authors have no support to report.

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Chapter 3 – Acting in action: Prosodic analysis of character portrayal during acting

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3.1 – Abstract

During the process of acting, actors have to embody the characters that they are portraying by changing their vocal and gestural features in order to match standard conceptions of the characters. In this experimental study of acting, we had professional actors portray a series of stock characters (e.g., king, bully, lover), which were organized according to a predictive scheme based on the two orthogonal personality dimensions of assertiveness and cooperativeness. We measured 12 prosodic features of the actors' vocal productions, as related to pitch, loudness, timbre, and duration/timing. The results showed a significant effect of character assertiveness on all 12 vocal parameters, but a weaker effect of cooperativeness on fewer vocal parameters. These findings comprise the first experimental analysis of vocal gesturing during character portrayal in actors, and demonstrate that actors reliably manipulate prosodic cues in a contrastive manner to differentiate characters based on their personality traits.

Keywords: acting, gesture, performance, characters, prosody

Supplemental materials: http://dx.doi.org/10.1037/xge0000624.supp

3.2 – Introduction

In *The Republic*, Plato (380 BCE/1968) made a distinction between two basic modes of storytelling. In "diegesis", a story is told using the voice of a narrator, whereas in "mimesis", a story is told using the voices of the characters, as produced by actors who portray these characters in theatrical (and more recently cinematic) works. For the ancient Greeks, theatre was considered to be an "imitative" art (Kristeller, 1951) because theatre works were seen as mimetic depictions of people and events that could occur in the real world. An actor creates a portrayal of a person who could actually exist, and the challenge of the actor is to produce as realistic and compelling a representation of that person as is possible, not least when the character is quite different from the actor.

How an actor accomplishes this has been the subject of debate for well over two thousand years. Both historically and cross-culturally, the standard method of actor training has been to teach an actor how to create gestural modifications appropriate for a character, including changes in posture, facial expression, movement style, and tone of voice (Benedetti, 2012; Brestoff, 1995; Goldstein & Bloom, 2011; Kemp, 2012; Konijn, 2000; Schechner, 2013; Zarrilli, 2009). An actor should take advantage of established gestural codes for producing representations of characters, as based on a character's gender, age, personality, physicality, and so on. An alternative acting method gained popularity in the early part of the 20th century based on the writings of the Russian acting theorist Konstantin Stanislavski (1936), who argued that acting should be predicated not merely on a character's external gestural features, but on his/her internal emotions, beliefs, and motivations (Brestoff, 1995; Cohen, 2004; Goldstein & Bloom, 2011; Hoffman, 2014; Kemp, 2012; Konijn, 2000; Schechner, 2013; Zarrilli, 2009). Stanislavski advocated for a more psychological approach to character portrayal. However, regardless of the method used to get into character, the ultimate objective for the actor is exactly the same: to create a realistic depiction of a person who the actor is not.

The major question that the current study addresses is less about *how* actors get into a character as about *what* they modify in their gestural features in order to create realistic depictions that are appropriate for the characters they portray, and how this can be achieved across the wide diversity of characters that any given actor might portray during the course of his/her career. While it might be relatively straightforward for an actor to play a character who is very similar to him/herself, the real challenge for an actor – and the true art of acting – is to portray characters who are quite different from the self (Smith, 1971). For example, in Shakespeare's day, male actors generally portrayed female characters, and the aim was to hide any indication of their masculinity (Dusinberre, 1998). For a dramatic play like *Romeo and Juliet*, a boy would portray the female character of Juliet. That same actor might portray male characters, such as Puck, in other plays. The issue we want to explore in this study is how actors are able to create portrayals specific for individual characters, and how this operates across multiple distinct characters. In the current experiment, we had professional actors portray a series of nine contrastive characters, including the self.

In order to examine a wide array of contrastive characters in an experimental study and to do so in a manner that is amenable to quantitative analysis, it is necessary to first have a means of classifying characters. While the literature of the world is full of stock characters, literary theory provides no systematic classification of them. Indeed, short of generic categories such as round vs. flat (Arp & Johnson, 2009) or heroes vs. villains (Schmidt, 2001), or likewise intuitive classifications based on a character's gender, age and species, there has been no classification of characters in literature and drama. In order to address this shortcoming in the field, as well as to lay the groundwork for analyzing the gestural modifications of actors across contrastive characters, we set out in a previous study to establish a classification scheme for characters. In Berry and Brown (2017), we presented a proposal for a systematic classification of literary characters based on *personality* dimensions, using a modification of the Thomas-Kilmann (TK) Conflict Mode Instrument used in applied studies of personality (Barki & Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992). The TK scheme classifies personality along the two orthogonal dimensions of assertiveness and cooperativeness. We conducted a character-rating study in which participants rated 40 stock characters with respect to four personality traits, including assertiveness and cooperativeness. The results showed that ratings of assertiveness and cooperativeness were orthogonal, allowing us to classify characters using these two dimensions. In the current study, we employed this classification scheme in order to organize the series of nine contrastive characters (including the self) with respect to assertiveness and cooperativeness, permitting us to analyze how the prosodic features of an actor's performance vary as a function of these personality dimensions. A major question that we wanted to address was whether a classification of characters based on the subjective assessment of raters (Berry & Brown, 2017) would have behavioral correlates in the prosody of actors portraying these same characters.

Our goal in the present study is to broach the issue of character portrayal by examining the vocal prosody of actors while in character. Only a handful of studies have examined prosodic aspects of character impersonation, although they have primarily focused on simple representations of a particular character or character-type, for example homosexual characters (Cartei & Reby, 2012), Japanese anime characters (Teshigawara, 2004), or fairy tale characters (Doukhan, Rilliard, Rosset, Adda-Decker, & D'Alessandro, 2011). These investigations have only focused on a particular genre of characters and therefore lack a unified perspective on character portrayal as a whole. In addition, the character portrayals in these studies have either come from outside of a lab context using features films (Cartei, & Reby, 2012; Teshigawara, 2004) or from in-lab recordings using non-professional actors (Doukhan, Rilliard, Rosset, Adda-Decker, & D'Alessandro, 2011), and so the present study is, to our knowledge, the first experimental study of character portrayal using professional actors. Relevant research outside of the domain of character portrayal itself includes work on the vocal correlates of lying and of personality traits. For example, studies have shown that lying is reliably associated with an increase in vocal pitch, as well as a greater number of pauses while speaking (Anolli & Ciceri, 1997; Ekman, Friesen, & Scherer, 1976; Villar, Arciuli, & Paterson, 2013). Scherer (1978), in a study of the relationship between personality traits and the perception of voice quality, found that extraversion was associated with loudness. He also showed timbral correlations such that, for example, assertiveness was associated with an absence of breathiness and that agreeableness was associated with an absence of sharpness in the voice.

In contrast to the scant literature on the vocal portrayal of characters, there is a sizable literature on the vocal expression of emotion. This is important since all acting theories agree that a major part of the task of an actor is to convey the emotions of a character (Konijn, 2000). Interestingly, the majority of studies that examine the vocal expression of emotion have used professional actors to portray the emotions (Juslin & Scherer, 2005; Murray & Arnott, 1993). Juslin and Laukka (2003) reported that 87% of a sample of 104 studies examining the vocal expression of emotions employed actors for the creation of stimuli. It is important to point out that using actors to create a stimulus set for a perceptual study of emotion in non-actors is a very different research objective from looking at how a group of actors *themselves* produce portrayals of these emotions. In a perceptual study, the investigators select that actor's rendition of an emotion that is the most unambiguous and prototypical, whereas in a production study like ours, the use of group-level statistics focuses on the analysis of not only mean trends, but also the variability of depictions across a group of actors. This actor-level variability is missing in perceptual studies.

An analysis of the vocal expression of emotion hinges on how emotions themselves should be classified, but there is at present no single accepted system for representing and classifying emotions. Much research is based on the analysis of so-called basic emotions (Darwin, 1872/1998; Ekman, 1992; Izard, 1992; Plutchik, 2002), such as happiness and sadness (Banse & Scherer, 1996; Goudbeek & Scherer, 2010; Juslin & Laukka, 2003; Juslin & Scherer, 2005; Konijn, 2000; Laukka, 2005; Laukka, Juslin, & Bresin, 2005; Murray & Arnott, 1993; Scherer 2003; Schröder, 2004). Juslin and Laukka (2003), in a meta-analysis of five broad emotion categories (anger, fear, happiness, sadness, and love-tenderness) across 104 studies of vocal expression, found a number of specific vocal cues that were strongly associated with the five discrete emotions examined. For example, anger and happiness were marked by increases in speech rate, loudness, loudness variability, high-frequency energy (voice quality), mean fundamental frequency (F_0), mean F_0 variability, and (specific to anger) by a small proportion of pauses. In contrast, sadness and tenderness were marked by decreases in speech rate, loudness, loudness variability, high-frequency energy, mean F_0, mean F_0 variability, and (specific to sadness) by a large proportion of pauses.

An alternative system for classifying emotions is to organize them in a dimensional manner. The circumplex model (Russell 1980, 2003) represents emotions through their placement along the two orthogonal dimensions of arousal (also known as activation; Schröder, 2004; Schröder, Cowie, Douglas-Cowie, Westerdijk & Gielen 2001) and valence (also known as evaluation or pleasure; Schröder, 2004; Schröder et al., 2001). There is considerably stronger support for the mapping of prosodic features onto the dimension of arousal than onto that of valence. Previous research has found that arousal is positively correlated with increases in mean F_0 (Goudbeek & Scherer, 2010; Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Owren & Bachorowski, 2007; Pereira, 2000; Schröder, 2004; Schröder et al, 2001), F_0 standard deviation/variability (Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005 Schröder et al., 2001), F_0 range (Pereira, 2000; Schröder, 2004; Schröder et al., 2001), mean loudness (Goudbeek & Scherer, 2010; Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Pereira, 2000; Schröder, 2004; Schröder et al., 2001), mean loudness standard deviation/variability (Goudbeek & Scherer, 2010; Laukka, Juslin, & Bresin, 2005), “blaring” timbre (Schröder, 2004), high-frequency energy (Juslin & Scherer, 2005; Schröder, 2004), shimmer (perturbations in amplitude; Goudbeek & Scherer, 2010), speech rate (Juslin & Scherer, 2005; Schröder, 2004), longer phrases (Schröder et al., 2001), and shorter pauses (Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Schröder, 2004; Schröder et al., 2001).

In contrast, there is considerably less evidence for the mapping of prosodic features for valence. Parameters correlated with high valence are fewer in number, weaker in effect, and more difficult to demonstrate (Bachorowski & Owren, 2008; Owren & Bachorowski, 2007; Pereira, 2000; Schröder, 2004; Schröder et al., 2001). However, the existing evidence suggests that valence is positively correlated with lower F_0 (Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Schröder, 2004), larger F_0 variability (Laukka, Juslin, & Bresin, 2005), larger F_0 range (Juslin & Scherer, 2005; Schröder, 2004), decreased loudness (Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Schröder et al., 2001), decreased loudness variability (Goudbeek & Scherer, 2010; Laukka, Juslin, & Bresin, 2005), less high-frequency energy (Schröder, 2004), clearer signal (less timbral noise; Goudbeek & Scherer, 2010), "warm" timbral voice quality (Schröder, 2004), increases in speaking rate (Juslin & Scherer, 2005; Laukka, Juslin, & Bresin, 2005; Schröder, 2004), and shorter pauses (Juslin & Scherer, 2005; Schröder et al., 2001). In general, the dimension of arousal has been found to be more stable than that of valence, with listeners capable of making accurate judgments about a speaker's arousal levels from the same acoustic correlates mentioned above (Douglas-Cowie, Campbell, Cowie, & Roach, 2003; Owren & Bachorowski, 2007; Schröder, 2004).

An important linkage between our dimensional classification of character-types and the dimensional study of emotion is the suggestion that assertiveness is an *arousal* factor – since it spans from a low-intensity end (unassertive) to a high-intensity end (assertive) – and that cooperativeness is a *valence* factor, since it spans from a negative end (uncooperative) to a positive end (cooperative). While this relationship between personality dimensions and emotion dimensions has not be verified experimentally, it opens up the possibility of using the vocal emotion literature to make the predictions that the assertiveness of characters should share prosodic features with the vocal expression of arousal and that the cooperativeness of characters should share features with the vocal expression of valence.

In order to examine the impact of acting on vocal prosody, we carried out the first experimental study of character portrayal in professional actors, with an emphasis on the modulations of vocal prosody that actors produce to convey specific characters as well as to differentiate characters from one another during performance. (Related work on facial expression will be reported elsewhere.) We took advantage of our previous work (Berry & Brown, 2017) to organize the characters along the two orthogonal personality dimensions of assertiveness and cooperativeness, resulting in a 3 x 3 scheme based on low, medium, and high values of each dimension (see Figure 3.1). A major issue that we wanted to address was whether a classification of characters based on the subjective assessment of raters would have behavioral correlates in the vocal prosody of actors portraying these same characters. Professional actors performed the same neutral monologue while portraying each of nine different basic character-types (where the central cell of the scheme was the self). Twelve parameters from the four prosodic categories of pitch, loudness, timbre, and duration/timing were examined based on of the previous literature on vocal prosody (Juslin & Laukka, 2003; Laukka, Juslin, & Bresin, 2005; Goudbeek & Scherer, 2010). Our primary prediction was that the actors' prosodic production would conform to the two-dimensional structure of the character scheme. However, this prediction was tempered by observations in the vocal emotion literature. As a result of the presumed connection between the character dimension of assertiveness and the emotion dimension of arousal, and likewise between the character dimension of cooperativeness and the emotion dimension of valence, we predicted that there would be more and stronger prosodic correlates of assertiveness than of cooperativeness in the vocal data. More specifically, as the level of character assertiveness increases, the actors' portrayals of characters should be higher-pitched, louder, timbrally clearer (less noisy), and rhythmically faster. We also predicted that the prosodic variables would show correlations among themselves, for example the robust relationship between pitch and loudness that is found in the vocal emotion literature (Banse & Scherer, 1996; Goudbeek & Scherer, 2010; Laukka, Juslin, & Bresin, 2005). We examined the results using a combination of univariate methods (analysis of variance) and multivariate methods (principal components analysis) with the overarching goal of identifying the prosodic codes used by actors to vocally embody characters while acting.

3.3 – Materials and Method

3.3.1 – Participants

Twenty-four actors (14 males; 20-63 years; $M = 42.5 \pm 14$ years) were recruited for the experiment through contact with theatre companies and academic theatre programs in the local and surrounding areas. All actors spoke English either as their native language or fluently as their second language ($n = 1$). They had a mean of 27.5 years ($\pm$ 14.3 years) of acting experience. Fourteen held degrees in acting, with two pursuing degrees in acting at the time of the experiment, and 17 of the 24 self-identified as professional actors. All participants gave written informed consent, and were given monetary compensation for their participation. The study was approved by the McMaster University Research Ethics Board.

It is important to point out that the actors were not selected for their training method, but only for their overall level of acting experience. An analysis of an acting-experience questionnaire revealed that about half of the actors had a mixed training that incorporated both gestural and psychological methods, while the other half had a more exclusively psychological training (i.e., Method acting). As mentioned in the Introduction, the current study does not address the issue of how actors get into character, but instead how the prosody of actors varies as a function of the personality dimensions of the portrayed characters. In addition, the single script that was used for all trials (see below) was designed to be emotionally and psychologically neutral, hence providing little to no material for a psychological actor to work with.

3.3.2 – Materials

The experiment took place on the stage of a black-box performance laboratory. An 8' x 10' foam mat was placed at the center of the stage and was used as the designated performance area. Actors were instructed not to move beyond this area during experimental trials. They performed the tasks facing an empty audience, behind which there was a control room where the experimenter (MB) was situated. The experimenter was able to monitor the progress of the session via closed-circuit television, as well as to provide instructions or answer questions via an intercom. Actors could not see the experimenter while performing. The stage and house lights were adjusted so that the actor was visible on the stage, but that the actor could not see the empty audience seats. The lab's virtual acoustics were adjusted to mimic the acoustics of a performance hall. This was done to increase the ecological validity of the experimental environment.

Actors performed in the designated performance area while being video- and audio-recorded with a Sony XDCam model PXW-X70. The camera was placed 4 m in front of the actor (i.e., in the second row of the audience) on a tripod raised to head level, and was zoomed to have the actor's body fill the height of the frame within the designated performance area. Each participant's session was recorded in 1080p high-definition video and shot at 60 frames per second. The audio collected from the experimental sessions was extracted for analysis (see Section 2.5), while the video recordings were stored for later analysis. As per the recommendations of Titze and Winholtz (1993), which provided suggestions on microphone usage and placement to reduce sampling error and artefacts, video recordings were synchronized with an Apex 575 wireless dual-channel omnidirectional condenser microphone (50-8000 Hz frequency response) attached to an Apex EA01 headset worn by the actor. The microphone transmitter was attached at the waist via a belt, and all wires were covered to reduce restrictions to actor movement. Audio was recorded in stereo at a sampling rate of 48 kHz. The microphone was adjusted to sit parallel to the actor's mouth (i.e., at an angle of around 90 degrees, just beside the cheek) at a distance of 4-10 cm. It moved jointly with the actor, thus eliminating any concerns about measuring vocal loudness. The spectrograms and audio files from each participant's trial were screened by author MB for sampling errors and artefacts caused by breathiness, large exhalations, aspirated phonations, or fast head movements. No errors were found.

In addition to recording video, we collected 3D motion-capture recordings of the actors' facial expressions and body gestures. Actors were equipped with 60 infrared reflective markers prior to beginning the experiment (20 on the face, 36 on the torso and limbs, and

4 on the head via a flexible cap), providing bilateral coverage. Analyses of facial expression and body movement will be reported elsewhere.

3.3.3 – Character Scheme

Nine basic characters were performed by the actors, as established by the 3 x 3 (assertiveness x cooperativeness) classification scheme validated in Berry and Brown (2017). That rating study showed an absence of stock characters in the bottom-right cell of the scheme (low assertiveness + high cooperativeness). Behavioral piloting of actors' portrayals of stock characters from adjacent cells in the scheme revealed performance differences from the original rating study with regards to the characters of "lover" and "self". They were originally paired with the "librarian" in the medium assertiveness, high cooperativeness cell. However, pilot testing from the current study allowed us to relocate "self" to the central cell and "lover" to the previously-unfilled bottom-right cell. The remaining cells in the scheme were filled with basic characters whose locations in the scheme were validated in the rating study. As a result, nine characters (one from each cell, including "lover" and "self") were selected for the present study, as shown in Figure 3.1.

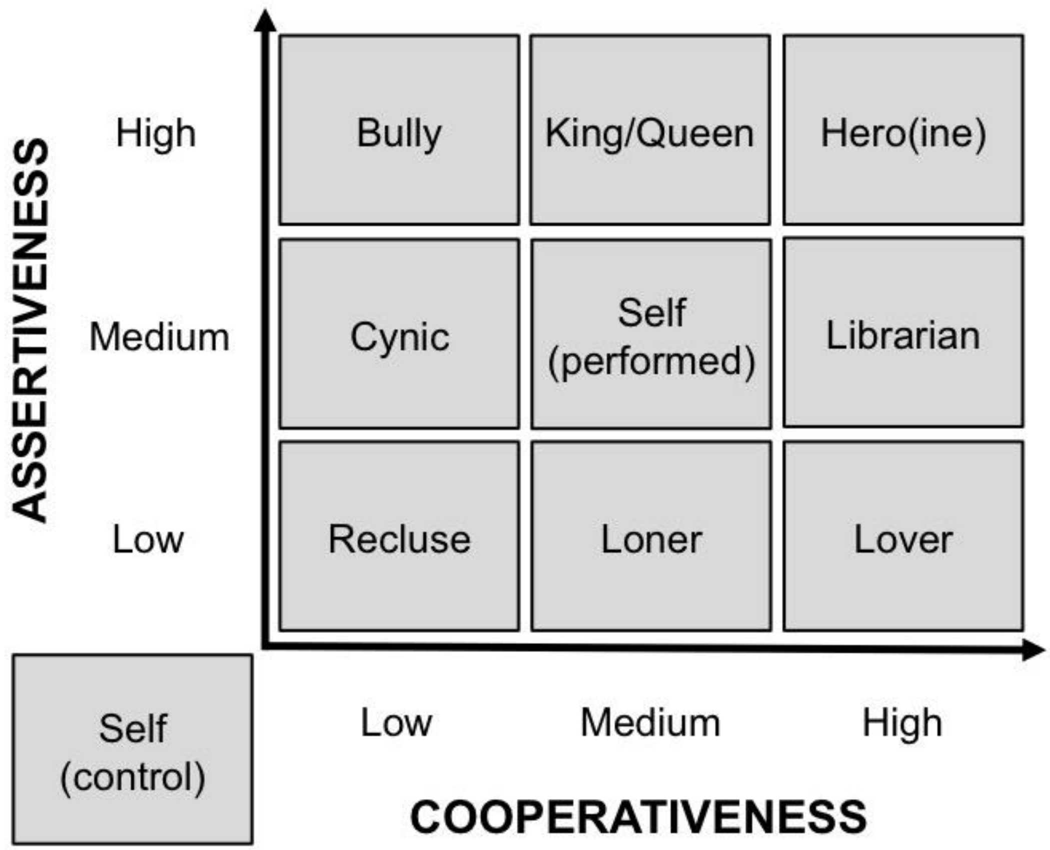

Figure 3.1. Summary of the nine basic character-types portrayed by actors in the study. An orthogonal 3 x 3 character-classification scheme is presented, as adapted from Berry and Brown (2017). Three levels of assertiveness are crossed with three levels of cooperativeness. The control-self condition at the bottom left is not part of the scheme, but instead emerged as a tenth character based on the study's pilot testing.

Actors were given a booklet that listed the names of the nine characters (bully, king/queen, hero/heroine, cynic, self, librarian, recluse, loner, and lover), as well as nine emotions (angry, calm, disgusted, fearful, happy, neutral, proud, sad, and surprised; the emotions are not analyzed here except in one supplementary analysis). There was one character or emotion per page of the booklet, where each character or emotion comprised a single trial. No qualifying information was provided on how to interpret either the characters or the emotions. The order of presentation of the trials was completely randomized across the 18 stimuli for each participant, and no two participants had the same order. Each page consisted of the name of the character (or emotion) that the actor would perform next, in addition to a post-performance questionnaire consisting of four self-rating assessments that the actor filled out immediately after performing a given trial. The four assessments were as follows: 1) Rate your satisfaction with your latest performance, 2) Rate how deeply you connected to or "felt" the character, 3) Rate how well you embodied or portrayed the character, and 4) Rate how believable your character portrayal was. All ratings were given on a 7-point Likert scale, spanning from "Not at All" to "Entirely". The results of the post-performance assessments will not be discussed in the present paper. Upon completion of the assessment, actors turned the page to initiate the next trial. The session was completed when all 18 trials were performed. The booklet was situated on a music stand at the side of the stage, outside of the designated performance area so as not to restrict movement during performance.

A semantically neutral monologue-script was provided to the actors to memorize in advance of the experiment (see the Appendix). Due to the lack of a scholarly repository of emotionally-neutral scripts, we created a custom script for the purposes of this experiment. It was comprised of seven neutral sentences ($M = 6 \pm 1.4$ words/sentence) derived from a set of ten validated and linguistically-neutral sentences (Ben-David, van Lieshout, & Leszcz, 2011). The script was structured such that a small narrative was present (i.e., someone walking into a room and listing the items that they see), but with no indication of emotion or interpersonal interaction. Actors repeated the same monologue for all 18 trials during the session. We decided to use a group of sentences, rather than a single repeated sentence or word (Banse & Scherer, 1996), in order to better approximate the ecological situation of an acting performance. Debriefing revealed that the actors did not find the script difficult to memorize or perform.

3.3.4 – Design and Procedure

The actors were contacted approximately two weeks before their scheduled session and were provided with information pertaining to the study. They were sent the semantically-neutral monologue, and were instructed to commit it to memory for the experiment. On the day of their session, the actors provided informed consent and completed a participant-information form, acting experience questionnaire, and a brief personality questionnaire. Upon completion of the paperwork, the actors were fitted with motion-capture markers and the wireless microphone and transmitter. The microphone was synchronized and calibrated to the camera. The experimenter then brought the actor to the designated performance area on the stage of the lab, and positioned him/her in the center of the foam matting. Actors were instructed to be as expressive and physically active as possible over the course of the session, to move freely anywhere on the matting, to perform to the camera in the audience, and to not turn their back to the camera at any point. They were also instructed to speak clearly and to not whisper.

In order to acquire a measurement of the participant's normal conversational voice separate from acting trials of the "self" condition (see Figure 3.1), we employed a slight deception. The experimenter, standing beside the video camera in the audience, pretended that the camera required additional calibration, and requested that the participant recite the neutral script in a conversational voice as part of the calibration procedure. This recording was used as the "control-self" to compare against the "performed-self" from the acting trial. After the control condition, a practice acting trial (using the character-type of Artist; Berry & Brown, 2017) was then done, after which the experimenter left the theatre and did not physically interact with the actor until the session was completed.

The actors were instructed that they could repeat a trial only once if they were dissatisfied with their performance or if they had a false start (i.e., forgot a number of lines). In the case of repeated trials, the second performance was included for analysis. Actors performed the experiment at their own pace, and were allowed to take breaks as needed. Each trial lasted roughly 2 minutes (no time limit was imposed), and the acting phase of the session lasted no more than 45 minutes. At the end of the session, the actor was debriefed (the deception was explained) and compensated.

3.3.5 – Software and Preprocessing

The videos for each session were imported into Adobe Premier Pro CC 2014. Each trial was extracted and exported as a 1920 x 1080 .mp4-resolution file. Each trial was 13-131 s in duration (M = 34.1 ± 16.4 s). Once the trial videos had been created, the audio was separated from the video using Abobe Premier Pro CC 2014. Audio samples for each trial were exported as .wav files with 16 bits per sample. These samples were then imported into Praat (Boersma, 2001) for the acoustic analysis of vocal prosody.

A custom Praat script was created to automatically remove all pauses from a given audio sample using a two-pass filter derived from Hirst (2011). The two-pass filter works by initially setting the floor and ceiling of the pitch window liberally to 60 Hz and 700 Hz, respectively, for the first analysis pass. During this pass, the first and third pitch quantiles are extracted from the sample and are used to create a new, more specific pitch window for continued analysis. Specifically, the first quantile is multiplied by a factor of 0.75 to create the new pitch-window floor, and the third quantile is multiplied by a factor of 2 to create the new pitch-window ceiling. The resulting pitch window allows for a more accurate extraction of prosodic data for each speech sample. Pauses were specified as silent moments in the audio sample that had a threshold of 45 dB below the sample mean and a minimum silent interval of 20 ms. A non-pause, or sounding, moment had a minimum sounding interval of 10 ms. Aside from the use of the two-pass filter to specify the pitch window, and the specification of silent/sounding intervals and levels, no other Praat settings were altered for the analyses. The duration parameters were extracted as follows. Pause Number was the total number of pauses per trial. In order to look at timing parameters, the original duration of a trial was broken down into Signal Duration, corresponding to the total signal or speaking time, and Pause Duration, corresponding to the total silent time. Using another custom Praat script, we extracted the remaining nine prosodic parameters pertaining to pitch in Hz, loudness in dB, and timbre. Using a two-pass filter again, we extracted the following parameters: the mean, standard deviation, and range of the fundamental frequency in Hz (Pitch Mean, Pitch SD, and Pitch Range, respectively); the mean, standard deviation, and range of the Loudness in dB (Loudness Mean, Loudness SD, Loudness Range); and the means of the Jitter in Hz, Shimmer in dB, and Noise-to-

Harmonic Ratio (NHR) in dB. The extracted parameters were measured across the entire trial (Banse & Scherer, 1996; Goudbeek & Scherer, 2010).

3.3.6 – Data Processing

3.3.6.1 – Normalization of variables. Because of the different measurement units of the 12 dependent variables (see Section 2.5), we employed a standard z-score normalization procedure in order to transform and standardize the raw scores at the participant level before the analysis. The formula to calculate a z-score is $z = (x - M)/SD$, where x is the raw score of the participant's variable for a single trial (for example, the Pitch Mean in Hz for the Bully trial), M is the mean score of the participant's variable for all 10 trials (for example, the averaged Pitch Mean across all character trials), and SD is the standard deviation of the participant's variable for all 10 trials (for example, the standard deviation of the averaged Pitch Mean across all character trials). This normalization procedure was applied to each participant across all 10 roles and all 12 parameters. As a result, the data were normalized both per speaker and per parameter.

The per-speaker-per-parameter z-score normalization was chosen over simply normalizing across the parameters alone. Normalizing across each parameter *and speaker* allows for easier comparison across the data set, as well as for the use of multivariate statistics, such as principal components analysis, since it eliminates participant and gender-related differences at the data level, thereby reducing unwanted participant-induced variance. This transformation also helps satisfy assumptions of normality for the analysis. Similar normalizations have been applied in previous work on emotion and prosody for analyses both within and between studies (Banse & Scherer, 1996; Luakka, Juslin, & Bresin, 2005; Goudbeek & Scherer, 2010).

3.3.6.2 – Univariate analyses. Prior to analysis, each of the 12 normalized parameters was examined for outliers. Any data point beyond a criterion of 2.5 standard deviations away from the mean of a parameter was considered an outlier to be discarded, although no outliers were found for any of the 12 parameters.

Each of the 12 normalized prosodic parameters was analyzed using a linear mixed-effects (LME) regression model with maximum likelihood estimation using the *lme4* package in R (Bates, Maechler, Bolker, & Walker, 2015; R Core Team, 2013). LMEs are similar to repeated-measures analyses of variance in that they control within-subject variance. However, they are not dependent on assumptions or corrections with regards to sphericity and are more robust to missing data. This was useful since two participants whispered during the librarian trials, thus resulting in their data being discarded for these trials. LMEs control within-subject variance through the use of random factors. In the present study, subjects were considered a random factor so as to control for the influence of different subject mean scores on each of the 12 normalized parameters. The two within-subjects factors of assertiveness and cooperativeness were used as fixed effects for the analyses. The control condition (i.e., the control self) was not included in this analysis, whereas the performed self was. The final sample for the univariate analysis was therefore n = 214. For the reporting of *F* values, we used a Type III sum of squares with Satterthwaite approximation for degrees of freedom. Statistical significance was set to α =.05, and adjustments for repeated testing within a variable group were made using Bonferroni corrections (i.e., for the three parameters within each prosody variable, $\alpha = .0167$; Goudbeek & Scherer, 2010). The significance of statistical analyses and estimates of effect size using eta-squared (η^2), partial eta-squared (η_p^2), and omega squared (ω^2) were calculated using the *afex* package in R (Singmann, Bolker, Westfall, & Aust, 2016).

In order to compare the two "self" conditions (i.e., performed vs. control), we conducted paired sample t-tests on each of the 12 normalized parameters. Statistical significance was set to $\alpha = .05$ (two-tailed), and adjustments for repeated testing within a variable group were made using Bonferroni corrections (hence $\alpha = .0167$; Goudbeek & Scherer, 2010).

Previous literature on the vocal expression of emotion has shown a strong positive correlation between pitch and loudness (Banse & Scherer, 1996; Belyk & Brown, 2014; Goudbeek & Scherer, 2010); Juslin & Laukka, 2003; Laukka, Juslin, & Bresin, 2005). As a consistency check, we wanted to explore if this relation would hold up using characters, rather than emotions, as the stimulus material. A simple linear regression was calculated to predict the normalized Loudness Mean based on the normalized Pitch Mean for the nine basic characters and the control. Statistical significance was set to $\alpha = .05$.

3.3.6.3 – Multivariate analysis. Principal components analysis (PCA) was conducted using the *prcomp* function as a part of the *MVA* (classical MultiVariate Analysis) standard library package in R (R Core Team, 2013). The input data were the 12 normalized parameters, which were zero-centred, but which did not need to be re-standardized, since they were all in the same units after normalization. All 10 conditions (i.e., the nine characters plus the control) were included in this analysis for each participant, with the exception of two trials that were omitted due to insufficient data as a result of whispering (n = 238; Section 2.6.2). According to Kaiser's criterion (Cangelosi & Goriely, 2007; Dunteman, 1989), the first four PCs should be adequate to describe the majority of variance in a dataset, while Cattell's Scree Test and the Broken Stick Method suggest that only the first two PCs are necessary to do this (Cangelosi & Goriely, 2007; Dunteman, 1989). Taking a more conservative approach, we examined the first two PCs. Prior to extraction, and to aid in interpretability, the PCs were rotated using a *varimax* rotation using the *principal* function in the *psych* package in R (R Core Team, 2013; Revelle, 2017). The resulting "rotated principal component" (RC) scores are the linear combinations of the 12 normalized parameters, whose weight coefficients are represented by the loadings reported in the Results section.

3.4 – Results

3.4.1 – Univariate Analyses

3.4.1.1 – Main effects of assertiveness and cooperativeness. Table 3.1 summarizes the results of the linear mixed-effects regression model (LME) analysis for the main effects of character assertiveness and cooperativeness on each of the four prosodic variables and their respective parameters. There was a significant main effect of assertiveness on all 12 dependent variables, suggesting that actors modified their vocal prosody – including the pitch, loudness, timbre, and duration/timing of their speech – across the levels of characters assertiveness. These effects remained significant after Bonferroni corrections for repeated testing.

Table 3.1. Linear mixed-effects regression model analysis of variance

	Parameter	Source of Variation	*df*	*Type III SS*	*Mean Square*	*F*-value	*p*-value	η^2	η_p^2	ω^2
Pitch	Pitch Mean	Assertiveness	2	91.18	45.59	101.09	<.001 ***	.47	.49	.47
		Cooperativeness	2	3.26	1.63	3.61	.029 *	.02	.03	.01
		Assert. x Coop.	4	1.79	.45	.99	.412	.01	.02	.00
	Pitch St. Dev.	Assertiveness	2	84.54	42.27	84.85	<.001 ***	.43	.44	.43
		Cooperativeness	2	1.75	.88	1.76	175	.01	.02	.00
		Assert. x Coop.	4	2.90	.72	1.45	.217	.01	03	.00
	Pitch Range	Assertiveness	2	62.03	31.01	52.29	<.001 ***	.32	.33	.31
		Cooperativeness	2	.28	.14	.24	.788	.00	.00	.00
		Assert. x Coop.	4	4.98	1.25	2.10	.082	.03	.04	01
Loudness	Loudness Mean	Assertiveness	2	122.19	61.09	191.59	<.001 ***	.61	.64	.60
		Cooperativeness	2	3.37	1.69	5.29	.006 **	.02	.04	.01
		Assert. x Coop.	4	8.22	2.06	6.45	<.001 ***	.04	.11	.03
	Loudness St. Dev.	Assertiveness	2	21.55	10.78	14.26	<.001 ***	.11	.12	.10
		Cooperativeness	2	1.07	.53	.71	.494	.01	.01	.00
		Assert. x Coop.	4	6.60	1.65	2.18	.072	.03	.04	.02
	Loudness Range	Assertiveness	2	103.00	51.50	126.85	<.001 ***	.52	.54	.52
		Cooperativeness	2	3.99	1.99	4.91	.008 **	.02	.04	.02
		Assert. x Coop.	4	3.27	0.82	2.02	.093	.02	.04	.01
Timbre	Jitter	Assertiveness	2	25.12	12.56	21.13	<.001 ***	.14	.16	.14
		Cooperativeness	2	3.25	1.63	2.73	.067	.02	.02	.01
		Assert. x Coop.	4	19.05	4.76	8.01	<.001 ***	.11	.13	.10
	Shimmer	Assertiveness	2	32.05	16.02	27.58	<.001 ***	.18	.20	.17
		Cooperativeness	2	.49	.24	.42	.658	.00	.00	.00
		Assert. x Coop.	4	22.13	5.53	9.52	<.001 ***	.12	.15	.11
	NHR	Assertiveness	2	28.68	14.34	21.82	<.001 ***	.16	.17	.15
		Cooperativeness	2	3.02	1.51	2.30	.103	.02	.02	.01
		Assert. x Coop.	4	8.26	2.07	3.14	.015 *	.05	.06	.03
Duration/Timing	Signal Duration	Assertiveness	2	21.37	10.69	15.21	<.001 ***	.12	.13	.11
		Cooperativeness	2	7.82	3.91	5.56	.004 **	.04	.05	.03
		Assert. x Coop.	4	9.21	2.30	3.28	.012 *	.05	.06	.03
	Pause Duration	Assertiveness	2	35.75	17.88	34.46	<.001 ***	.22	.25	.21
		Cooperativeness	2	3.97	1.98	3.83	.023 *	.03	.04	.02
		Assert. x Coop.	4	13.88	3.47	6.69	<.001 ***	.08	.11	.07
	Pause Number	Assertiveness	2	38.87	19.44	33.18	<.001 ***	.22	.24	.22
		Cooperativeness	2	.63	.32	.54	.585	.00	.01	.00
		Assert. x Coop.	4	10.02	2.51	4.28	.002 **	.06	.07	.04

Note: Summary of within-subject effects of assertiveness and cooperativeness on the 12 dependent variables. Analysis of variance table with type III sum of squares using Satterthwaite approximation for degrees of freedom (n = 216). Denominator df = 214. * p <.05, ** p <.01, *** p <.001. Measures of effect size include η^2, eta-squared; η_p^2, partial eta-squared, and ω^2, omega squared.

By contrast, the main effect of cooperativeness on vocal prosody was not nearly as robust. Indeed, only a selection of pitch, loudness, and duration/timing parameters showed significant main effects of cooperativeness, as timbre parameters failed to reach significance. Bonferroni correction eliminated the effect on pitch ($F(2,214) = 3.26$, $p = .029$), leaving only weak effects on loudness and duration/timing (Table 3.1). This finding is supported by the significantly lower estimates of effect size for cooperativeness when compared to assertiveness. Overall, prosodic changes were much more strongly associated with the assertiveness level of a character than its cooperativeness level.

Figure 3.2 plots the means of each acoustic parameter in order to further investigate the differences between the levels of assertiveness. The main effect of assertiveness was characterized by monotonic increases in both the pitch and loudness variables, with the six dependent variables demonstrating a low < medium < high increasing trend. As the level of assertiveness of characters increased, vocal expressions became higher pitched and louder, with more variability and range in these parameters. Different effects were observed for timbre and duration/timing. As the level of assertiveness increased, both timbre and duration parameters decreased, with timbre parameters decreasing in a low > medium > high trend (i.e., the character's voices became clearer due to fewer frequency and amplitude perturbations), and duration decreasing in a low > medium = high trend (i.e., characters spoke faster with fewer/shorter pauses). This effect demonstrates that, as the assertiveness level of a character increased, the vocal expressions became clearer and the utterances shorter.

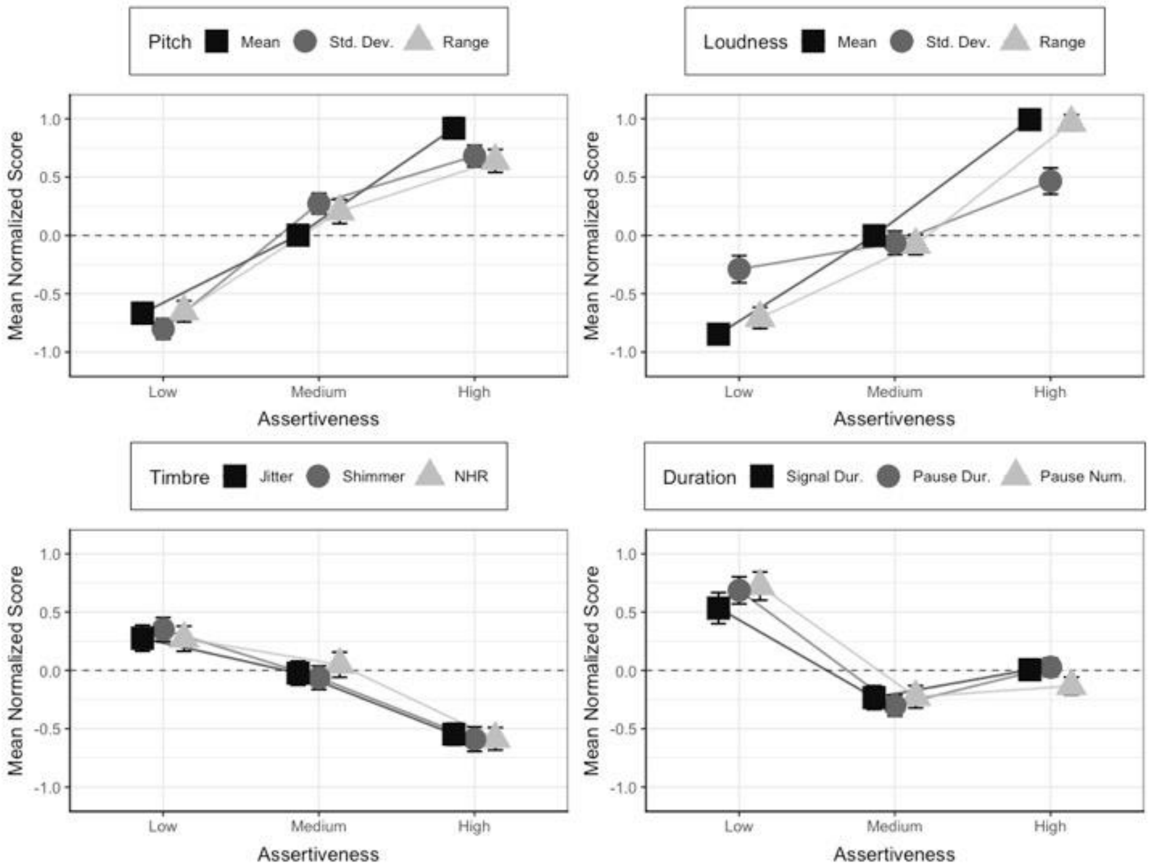

Figure 3.2. Effect of character assertiveness on the 12 prosodic parameters. Axis values are calculated by first averaging the subject-normalized scores across character and then across level of assertiveness. Abbreviations: Dur., duration; NHR, Noise-to-Harmonic Ratio; Num, number (of pauses); Std. Dev., standard deviation. Error bars show the standard error of the mean.

Figure 3.3 shows the same analysis for cooperativeness. The LME analysis revealed that the main effect of cooperativeness after correcting for repeated testing was characterized by loudness and duration/timing parameters, specifically Loudness Mean, Loudness Range, and Signal Duration. The figure demonstrates a slightly decreasing trend in a low > medium > high fashion with regards to Loudness Mean, as well as a decreasing trend in a low > medium = high fashion with regards to Loudness Range. These effects show that, as the cooperativeness level of character increased, the actor's mean loudness and loudness range decreased. The pattern was different for Signal Duration. As the cooperativeness level of characters increased, the signal duration decreased and then increased in a medium < low < high fashion. This non-monotonic effect may reflect idiosyncratic features of the specific characters chosen for the study.

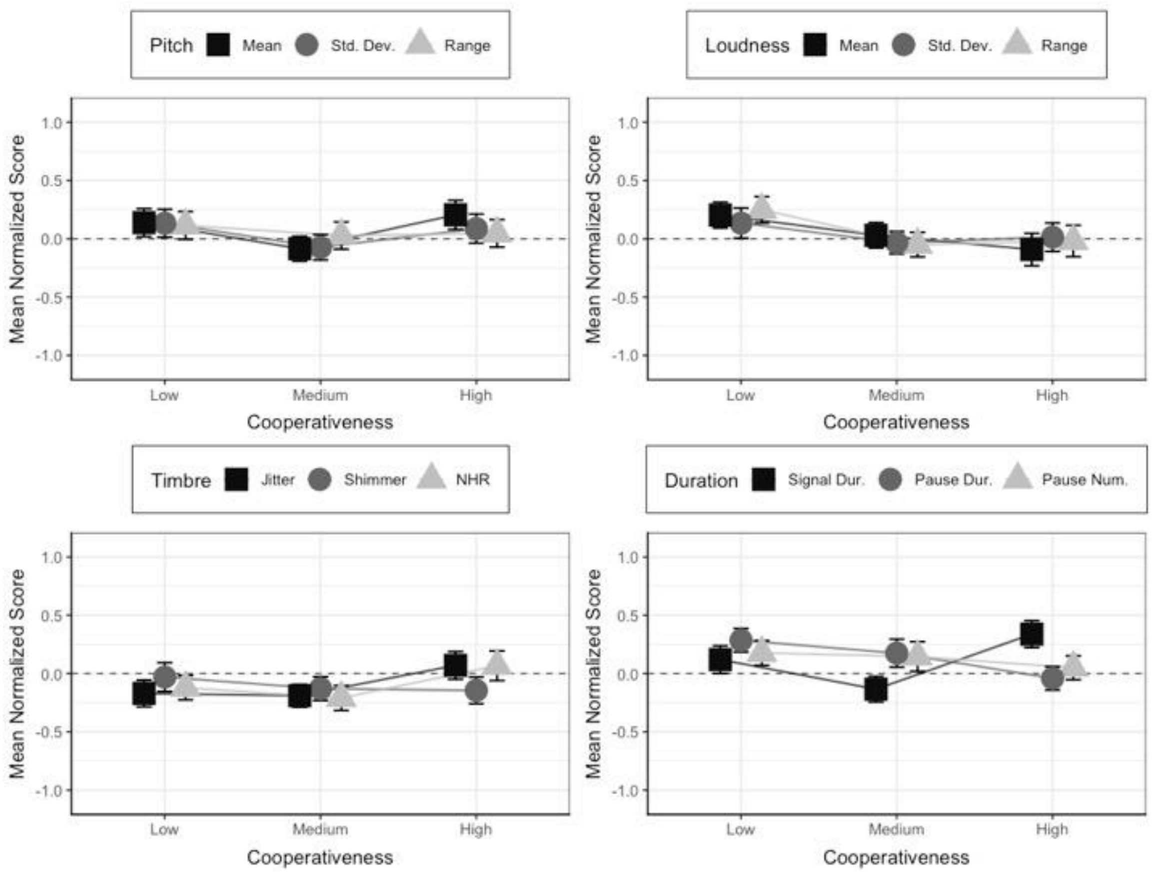

Figure 3.3. Effects of character cooperativeness on the 12 prosodic parameters. Axis values are calculated by first averaging the subject-normalized scores across character and then across level of cooperativeness.

Abbreviations: Dur., duration; NHR, Noise-to-Harmonic Ratio; Num, number (of pauses); Std. Dev., standard deviation. Error bars show the standard error of the mean.

3.4.1.2 – Interactions and simple effects of assertiveness and cooperativeness. The LME analysis revealed several interaction effects between assertiveness and cooperativeness across the prosodic variables of loudness, timbre, and duration, even after correcting for repeated testing. There were no significant interaction effects for pitch. The parameters that did show interactions were Loudness Mean ($F(4,214) = 6.5$, $p < .001$), Jitter ($F(4,214) = 8.0$, $p < .001$), Shimmer ($F(4,214) = 9.5$, $p < .001$), Noise-to-Harmonics Ratio ($F(4,214) = 3.4$, $p = .015$), Signal Duration ($F(4,214) = 3.3$, $p = .023$), Pause Duration ($F(4,214) = 6.7$, $p < .001$), and Pause Number ($F(4,214) = 4.3$, $p = .002$). The interaction effects and effect sizes are summarized in Table 3.1.

To further investigate the interaction effects of the seven parameters, the data were split and averaged by the three levels of cooperativeness, thereby allowing the pairwise comparison of each level of assertiveness within each level of cooperativeness, correcting for multiple corrections. These simple effects are statistically summarized in Supplementary Table 1, and text after the table describes specific interactions in detail. Only the effects for Loudness Mean will be reported here. The simple effects of assertiveness for Loudness Mean revealed a L (low) < M (medium) = H (high) pattern at low cooperativeness, a L < M < H pattern at medium cooperativeness, and a L = M < H pattern at high cooperativeness, indicating a decreasing shift in loudness across performances, and making the Librarian character similar to the Lover with regards to mean loudness across the performance. Due to the structure of the predicative scheme, an interaction effect and simple effect analysis between basic character-types results in a direct comparison between the two basic characters within a given category (in this case it will be cooperativeness). The results thus provide a more specific prosodic profile of the average character type or types being examined.

3.4.1.3 – Analysis of performed-self versus control-self. An incidental finding of the pilot testing of the study was that the "self" condition appeared to be performed as a character, with a different prosody than an actor's conversational voice. It is for this reason that we introduced the microphone-calibration deception described in Section 2.4 to obtain the participant's conversational prosody while reciting the script. Table 3.2 summarizes the results of paired-sample t-tests comparing the performed-self condition to the control-self condition. There were significant differences between conditions for all dependent variables, with the exception of Loudness Standard Deviation and Signal Duration. After applying Bonferroni correction, Loudness Range ($t(23)=2.32$, $p = .029$) and Pause Number ($t(23)=2.53$, $p = .019$) became non-significant. These results indicate that an actor's voice was significantly different when doing a stage performance of him- or herself compared to when talking in his/her conversational voice. Specifically, performing the role of oneself on stage resulted in a prosody that was higher-pitched, louder, slower, and timbrally clearer than one's conversational voice.

Table 3.2. Paired-sample t-tests for performed-self vs. control-self

	Parameter	Condition	*Mean*	*SD*	*t*-value	*p*-value	Cohen's *d*
Pitch	Pitch Mean	Self (control)	-.76	.50	5.75	<.001***	1.17
		Self (performed)	-.06	.49			
	Pitch St. Dev.	Self (control)	-.44	.76	4.37	<.001***	.89
		Self (performed)	.20	.59			
	Pitch Range	Self (control)	-.56	.70	4.31	<.001***	.88
		Self (performed)	.36	.85			
Loudness	Loudness Mean	Self (control)	-.43	.57	4.74	<.001***	.97
		Self (performed)	.13	.43			
	Loudness St. Dev.	Self (control)	-.34	.93	.93	.361	.19
		Self (performed)	-.11	.66			
	Loudness Range	Self (control)	-.54	.64	2.32	.029*	.47
		Self (performed)	-.09	.61			
Timbre	Jitter	Self (control)	.88	.91	-3.31	.001***	.68
		Self (performed)	.09	.61			
	Shimmer	Self (control)	.90	.76	-4.04	.001***	.83
		Self (performed)	.20	.47			
	NHR	Self (control)	.80	.85	-3.05	.006**	.62
		Self (performed)	.13	.71			
Duration/Timing	Signal Duration	Self (control)	-.94	.23	1.34	.194	.27
		Self (performed)	-.74	.67			
	Pause Duration	Self (control)	-1.26	.53	3.16	.004**	.64
		Self (performed)	-.75	.50			
	Pause Number	Self (control)	-1.11	.50	2.53	.019*	.52
		Self (performed)	-.61	.71			

Note: Degrees of freedom = 23 for all tests. For Cohen's *d*, small effect =.2, medium effect =.5, large effect =.8. **p* <.05, ***p* <.01, ****p* <.001.

3.4.1.4 – Correlation between pitch and loudness. A simple linear regression was calculated to look at the relation between normalized Pitch Mean and normalized Loudness Mean (Figure 3.4). A significant regression equation was found ($F(1,236) = 310.6$, $p < .001$), with an r value of .75, and an adjusted R^2 value of .57. This is consistent with previous findings in the study of vocal emotion showing that pitch and loudness are strongly positively correlated (Banse & Scherer, 1996; Goudbeek & Scherer, 2010). This creates an important prosodic parallel between character portrayal and the expression of emotion. This result remained consistent across the different character-types. In splitting the data by character-type, significant positive correlations persisted between normalized Pitch Mean and normalized Loudness Mean for all but two characters, the Bully and the Loner (see Supplementary Table 2 and Supplementary Figure 1).

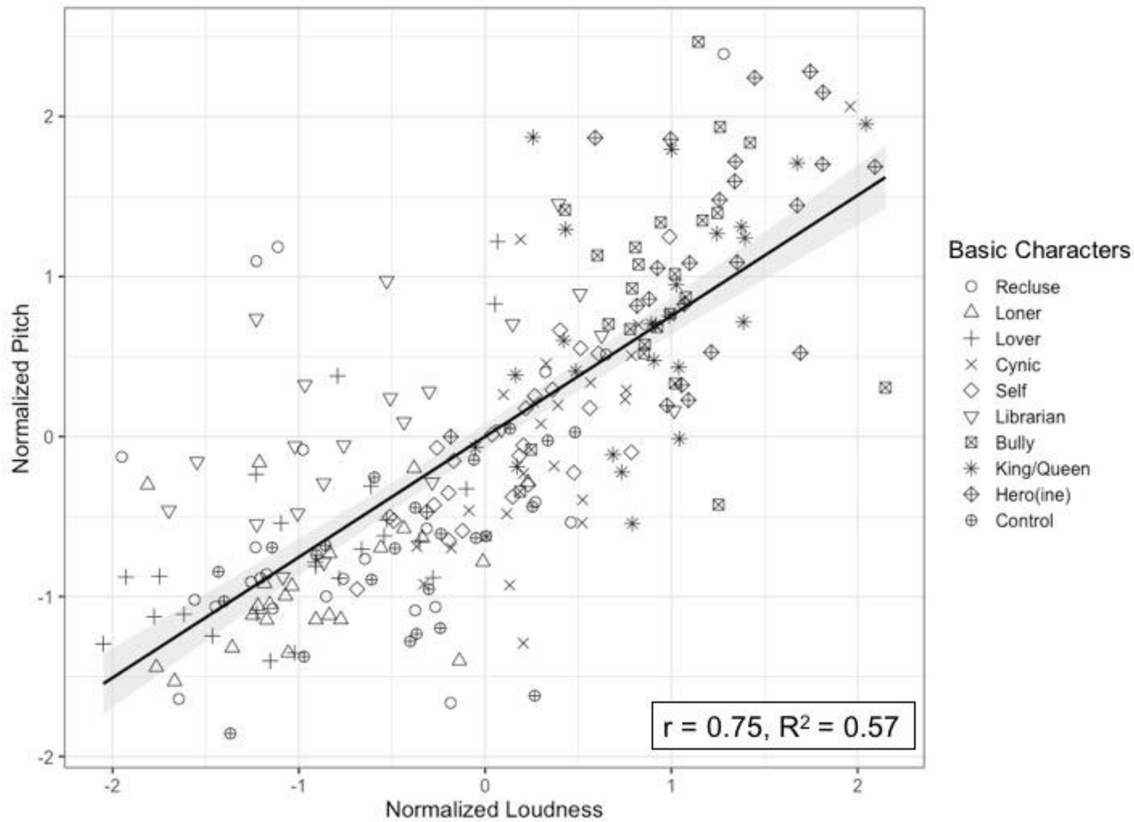

Figure 3.4. Linear regression and correlation of normalized pitch and loudness. Pitch Mean and Loudness Mean values were normalized within participants by applying a z-score transformation. This included data from the control-self trials. $F(1,236) = 310.6$, $p < .001$, $r = .754$, $R^2 = .568$. Each point represents an observation from a single trial. Characters are represented by different shapes. The regression line is depicted in black, while the shaded area indicates the standard error of the regression line.

3.4.2 – Multivariate Analyses

3.4.2.1 – Correlations. Prior to running the PCA, a Pearson product-moment correlation analysis was conducted to determine if any prosodic parameters were too weakly or strongly correlated to be used in the multivariate analysis so as to avoid any block diagonal correlation matrices (Dunteman, 1989). The results of the correlation analysis showed that no variables needed to be excluded from the PCA (Table 3.3).

Table 3.3. Correlation matrix for the 12 prosodic parameters

	Parameter	f0M	f0SD	f0R	LdM	LdSD	LdR	Jit	Shim	NHR	SDur	PDur
Pitch	f0M	-										
	f0SD	.80 ***	-									
	f0R	.73 ***	.88 ***	-								
Loudness	LdM	.75 ***	.64 ***	.58 ***	-							
	LdSD	.37 ***	.29 ***	.28 ***	.24 ***	-						
	LdR	.74 ***	.62 ***	.56 ***	.84 ***	.43 ***	-					
Timbre	Jit	-.39 ***	-.18 **	-.16 *	-.55 ***	-.20 **	-.53 ***	-				
	Shim	-.51 ***	-.38 ***	-.34 ***	-.55 ***	-.26 ***	-.50 ***	.71 ***	-			
	NHR	-.48 ***	-.25 ***	-.22 ***	-.50 ***	-.25 ***	-.47 ***	.83 ***	.76 ***	-		
Duration	SDur	.04	-.02	.05	-.23 ***	.28 ***	-.04	.02	-.14 *	-.01	-	
	PDur	-.14 *	-.18 **	-.16 *	-.17 *	-.15 *	-.14 *	-.15 *	-.08	-.14 *	.28 ***	-
	PNum	-.15 *	-.14 *	-.10	-.33 ***	.04	-.20 **	.05	-.02	-.01	.56 ***	.68 ***

Note: Variable abbreviations are as follows: f0M, Pitch Mean; f0SD, Pitch Standard Deviation; f0R, Pitch Range; LdM, Loudness Mean; LdSD, Loudness Standard Deviation; LdR, Loudness Range; Jit, Jitter; Shim, Shimmer; NHR, Noise-to-Harmonic Ratio; SDur, Signal Duration; PDur, Pause Duration; and PNum, Number of Pauses. n = 238. *p <.05, **p <.01, ***p <.001.

A number of parameters were significantly correlated with one another. In addition to high levels of correlation within a given variable (e.g., pitch parameters being highly positively correlated with other pitch parameters), there was a range of weak to strong correlations between variables as well. For example, Pitch Mean was significantly positively correlated not only with other pitch parameters (Pitch SD, r =.80, p <.001; Pitch Range, r =.80, p <.001), but with loudness parameters (Loudness Mean, r =.75, p <.001; Loudness SD, r =.37, p <.001; Loudness Range, r =.74, p <.001). It was significantly negatively correlated with timbral parameters (Jitter, r = -.39, p <.001; Shimmer, r = -.51, p <.001; NHR, r = -.48, p <.001) and durational parameters (Pause Duration, r = -.14, p <.05; Pause Number, r = -.15, p <.05). Furthermore, while the pitch and loudness variables were positively correlated with one another, both timbral and duration variables were negatively correlated with all other variables.

3.4.2.2 – PCA. Table 3.4 presents a summary of the PCA results. The first two PCs were extracted using a varimax rotation. The bottom part of Table 3.4 describes how the resulting RCs accounted for 61.4% of the total variance in the dataset, with RC1 accounting for around 42.2% of the total and RC2 around 19.2% of the total.

Table 3.4. Varimax-rotated principal component loading matrix

	Parameter	Rotated Components RC1	RC2	Communalities	Uniqueness
Pitch	Pitch Mean	**.86**	-.18	.78	.22
	Pitch St. Dev.	**.74**	-.31	.65	.35
	Pitch Range	**.69**	-.28	.56	.44
Loudness	Loudness Mean	**.85**	-.29	.80	.20
	Loudness St. Dev.	**.46**	.07	.22	.78
	Loudness Range	**.85**	-.17	.75	.25
Timbre	Jitter	**-.70**	-.30	.58	.42
	Shimmer	**-.77**	-.29	.67	.33
	NHR	**-.73**	-.33	.64	.36
Duration/Timing	Signal Duration	.05	**.63**	.40	.60
	Pause Duration	-.05	**.79**	.62	.38
	Pause Number	-.11	**.82**	.69	.31
	Eigenvalue	5.07	2.30		
	% of Explained Variance	42.20	19.20		
	% Cumulative Variance	42.20	61.40		

Note: Principal components analysis extraction method was used in combination with varimax rotation to obtain component loadings. RC1 & RC2 are varimax rotated PCA components. Loadings above.40 are in boldface. Communalities are the proportions of variance in a variable explained by the extracted principal components.

The interpretation of the RCs can be taken from the respective loadings, as summarized in the upper part of Table 3.4. RC1 had high loadings for all of the pitch, loudness, and timbral parameters, whereas RC2 had high loadings for all of the duration/timing parameters. These loadings are consistent with the inter-variable correlations reported in the previous section. Figures 3.5 and 3.6 plot the first two RCs and their generated component scores. They are color-coded to show the three levels of assertiveness and cooperativeness, respectively. The first RC appears to account for variation in the levels of assertiveness, while the second RC appears to account for variation in performance (i.e., performance of characters vs. the non-performed control). There does not seem to be a relation between either RC and levels of cooperativeness. Therefore, the first two RCs can be interpreted as reflecting, respectively, a *dynamic vocal factor* (RC1) and a *performative factor* (RC2). In general, it appears that actors modulate pitch, loudness, and timbral parameters in a combinatorial manner to differentiate between levels of character assertiveness (with higher, louder, and clearer values indicative of higher assertiveness) and that they modulate duration/timing parameters to differentiate between performed speech and regular speech (with slower utterances indicative of the former).

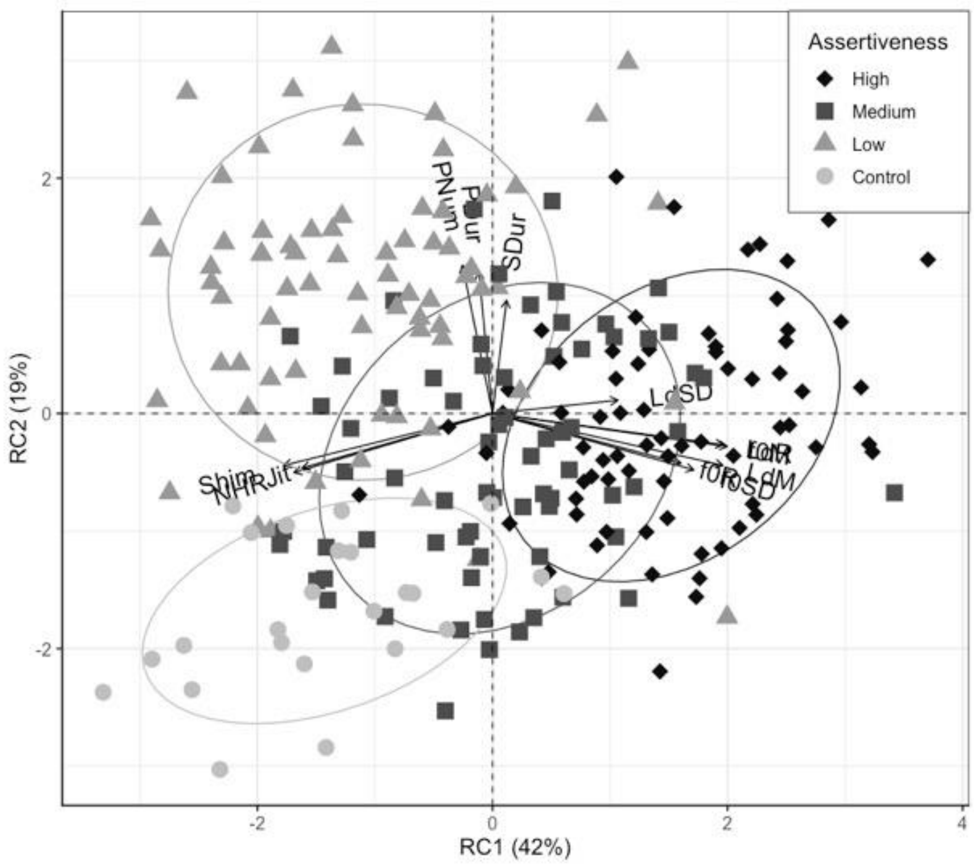

Figure 3.5. Varimax rotated principal components biplot for levels of assertiveness. Biplot axes of the first two extracted varimax rotated principal components account for 42.2% and 19.2% of the explained variance, respectively. Ellipse probability for levels of assertiveness is 70%. Variable abbreviations are as follows: f0M, Pitch Mean; f0SD, Pitch Standard Deviation; f0R, Pitch Range; LdM, Loudness Mean; LdSD, Loudness Standard Deviation; LdR, Loudness Range; Jit, Jitter; Shim, Shimmer; NHR, Noise-to-Harmonic Ratio; SDur, Signal Duration; PDur, Pause Duration; and PNum, Number of Pauses.

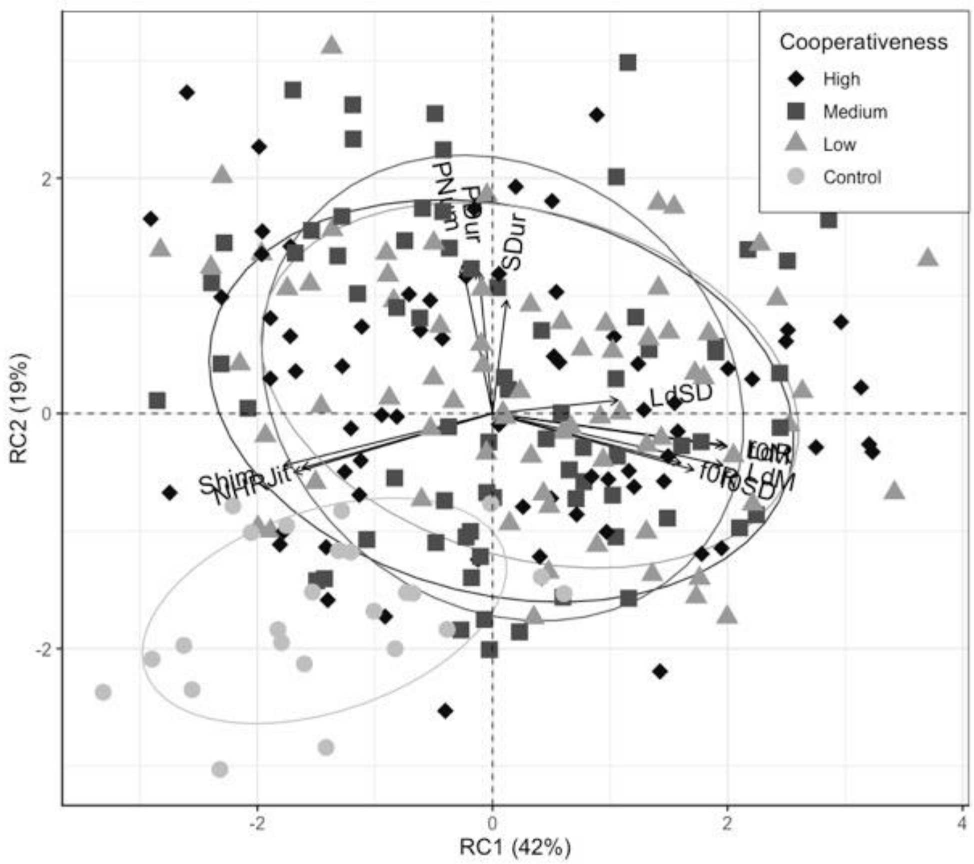

Figure 3.6. Varimax rotated principal components biplot for levels of cooperativeness. Biplot axes of the first two extracted varimax rotated principal components account for 42.2% and 19.2% of the explained variance, respectively. Ellipse probability for levels of cooperativeness is 70%. Variable abbreviations are as follows: f0M, Pitch Mean; f0SD, Pitch Standard Deviation; f0R, Pitch Range; LdM, Loudness Mean; LdSD, Loudness Standard Deviation; LdR, Loudness Range; Jit, Jitter; Shim, Shimmer; NHR, Noise-to-Harmonic Ratio; SDur, Signal Duration; PDur, Pause Duration; and PNum, Number of Pauses.

3.4.2.3 – The character/emotion relationship. Finally, as a purely exploratory analysis, we investigated the relationship between character dimensions and emotion dimensions in order to see if the connection between assertiveness and arousal, on the one hand, and cooperativeness and valence, on the other, was obtained. Supplementary Figure 2 shows a PCA plot of the ten characters (including the control-self) and the nine emotions tested.

High-assertive characters like the king, hero, and bully clustered with high-arousal emotions like happy, angry, and surprised. The control-self clustered with neutral emotion. And low-arousal characters like the loner, recluse, and lover clustered with low-arousal emotions like calm and sad, although they were also proximate to higher-intensity emotions such as fear and disgust. The association between the personality dimension of assertiveness and the emotion dimension of arousal may be underlain by physiological mechanisms related to the level of activation of the autonomic nervous system (Banse & Scherer, 1996; Goudbeek & Scherer, 2010).

3.5 – Discussion

In this first experimental study of character portrayal using professional actors, we found that actors modulated the pitch, loudness, timbre, and timing properties of their vocal productions in order to conform with the personality traits of characters. The effect was much more robust for assertiveness – which has similarities to the arousal dimension of emotion – than for cooperativeness, which has similarities to the valence dimension of emotion. Hence, this mirrors a general finding from the vocal-emotion literature that arousal is much more reliably encoded than is valence. Next, we reported the incidental finding that an analysis of the performed-self showed important prosodic differences from an individual's conversational voice. The performed-self was shown to be higher-pitched, louder, and slower than one's conversational manner of speaking, reflecting what we will refer to below as a "performance persona" of the self. Finally, looking beyond the character scheme, we found that key prosodic variables were correlated with one another across characters, including pitch and loudness, again paralleling findings from the vocal-emotion literature. Overall, the results show that actors employ prosodic codes in order to embody specific characters based on their personality dimensions. The results also show that a classification of characters based on the subjective assessment of raters (Berry & Brown, 2017) had clear behavioral correlates in the prosody of actors portraying these same characters.

3.5.1 – The personality of characters predicts actors' vocal prosody

According to the view of acting as mimesis first espoused by Plato (380 BCE/1968), actors engage in processes of personal mimicry in order to recreate prototypical properties of characters based on their presumed personality and physical features (Kemp, 2012; Schechner, 2013; Zarrilli, 2009). In the present study, we established predictions for some of these features by organizing the selected characters according to a two-dimensional personality scheme that had been previously validated in a study from the lab (Berry & Brown, 2017). By doing so, we were able to provide support for the notion that assertiveness is far more predictive of actors' vocal prosody than is cooperativeness, a finding that matches the perceptual advantage for recognizing arousal more reliably than valence in studies of emotion discrimination (Belyk & Brown, 2014; Douglas-Cowie, Campbell, Cowie, & Roach, 2003; Goudbeek & Scherer, 2010; Owren & Bachorowski, 2007; Schröder, 2004). This was demonstrated both as main effects in the univariate analyses and by the separation of low, medium, and high levels of assertiveness in the PCA analysis, while failing to find such a separation for the levels of cooperativeness. The prosodic correlates of cooperativeness were few in number and weak in effect. Only three parameters remained significant after correcting for multiple comparisons. Increases in cooperativeness were associated with decreases in loudness and loudness range. Signal duration displayed a non-monotonic relation to cooperativeness.

Assertiveness, by contrast, showed effects across the spectrum of prosodic parameters. Increases in character assertiveness were associated with increases in pitch, loudness, voice clarity, and speech rate. These findings correspond with arousal-related effects in the vocal-emotion literature, perhaps with the exception of timbre (Goudbeek & Scherer, 2010; Juslin & Scherer, 2005; Schröder, 2004). However, the current understanding of timbral effects on arousal-related vocal-expression is limited, with some evidence suggesting weak, indirect relationships (Gobl & Ní Chasaide, 2003; Goudbeek & Scherer, 2010; Owren & Bachorowski, 2007). Hence, there seems to be a general concordance between our findings about character portrayal and those about vocally-expressed emotions. The interpretation of such a relationship is not that characters can be equated with specific emotions (i.e., flat characters; Forster, 1927/2005), but that the personality of a character may bias him/her to experience or display some emotions more than others. For example, the hero might show a tendency to experience high-arousal and positive-valenced emotions, while the bully might show a tendency to experience high-arousal and negative-valenced emotions. However, at another level, characters and emotions might interact in a more *combinatorial* manner. For example, there are happy kings and sad kings, and even a congenitally happy king can become sad when a loved one dies. Particular character-archetypes can thus be manifested in characters showing a diversity of emotional traits, and even a character who predominantly shows one particular emotional trait throughout a story can experience a variety of emotional states, including those that defy their general personality. Therefore, the relationship between characters and emotions should be thought of as a complex one-to-many relationship, not a one-to-one relationship. Characters that are archetypal will tend to have more-limited emotional profiles than characters that are more complex. It is probably for this reason that our study of archetypal characters is showing a strong dimensional relationship with emotions. This relationship might turn out to be weaker in a study using more-complex characters.

3.5.2 – The performed-self

An incidental finding of the present study was that the self that was performed during the acting trials had different prosodic parameters than those of the conversational self during control trials. This was shown in both the univariate analyses and the PCA analyses, where the second principal component effectively distinguished the control-self from all of the acted conditions. Despite the fact that the actors were provided with the opportunity to drop their performance façade and to speak the script conversationally, they remained "on" during the self trials and recited the script as a more exaggerated version of themselves. We are calling this effect the adoption of a "performance persona", in accordance with dramaturgical perspectives in social psychology (Goffman, 1959; Landy, 1993; Shulman, 2017), which argue that the self is comprised of a number of context-specific variants that can be considered as personas of the self during everyday social interactions. To the best of our knowledge, this is the first reported instance of a direct comparison between self conditions with regards to prosodic parameters. Acoustically, the performed-self was shown to be higher pitched, louder, clearer, and slower than the conversational manner of speaking. In this regard, it showed strong similarities with the main effect of assertiveness, with the exception of the timing parameters, where the performed-self was intoned more slowly than the control-self, with longer pause duration and a greater number of pauses. Hence, the performed-self is an assertive persona in which speech rate is reduced, perhaps as a form of demonstration.

The performed-self shows tantalizing similarities with other well-known prosodic phenomena in the literature, most especially infant-directed speech (sometimes called "motherese"), in other words the manner in which caregivers interact vocally with their babies. Infant-directed speech is characterized by the same prosodic suite of higher pitch, larger pitch-variability, increased loudness, and slower tempo as compared to adult-directed speech (Fernald, 1989; Papoušek, Papoušek, & Symmes, 1991; Ma et al., 2013; McMurray et al., 2013). We believe that this combination of features comprises a *performance persona* that is expressed when a solo speaker is interacting with an attentive audience that is generally listening passively, rather than engaging in a dialogue. Such is the characteristic situation of caregiver-infant interaction, but is also the discursive arrangement of a seminar speaker, a tour guide, the narrator of a story, and many other situations where one speaker plays a dominant role in an interaction with attentive, but typically silent, recipients. The prosody of the performance persona is designed not only to capture attention (high pitch, high amplitude; Brosch, Grandjean, Sander, & Scherer, 2008), but also to be demonstrational (reducing ambiguity via slow tempo and the use of pausing; Snedeker & Trueswell, 2003). In the case of infant-directed speech, it also supports language learning (Ma et al., 2011) and social bonding (Benders, 2013). Overall, this is a type of prosody that is optimized for situations where one person is actively conveying important information to one or more recipients of this information. It is this communicative goal that most likely unites the prosodies of a caregiver and a university lecturer.

3.5.3 – Correlations among prosodic variables

In addition to looking at the predictive potential of the character scheme, we wanted to examine correlations among the prosodic parameters themselves. Consistent with findings from the vocal-emotion literature (Banse & Scherer, 1996; Goudbeek & Scherer, 2010; Scherer, 2003), we found a strong and significant correlation between pitch and loudness across character trials. This correlation is known in the performance literature as the "high-loud" rule of expression (Friberg, Bresin, & Sundberg, 2006), indicating that an increase in pitch is often accompanied by an increase in loudness (Belyk & Brown, 2014; Laukka, Juslin, & Bresin, 2005; Goudbeek & Scherer, 2010), both vocally and instrumentally (Friberg, Bresin, & Sundberg, 2006). Our results indicate that this expression rule is very robust, being active not only in the vocal expression of emotions, but also in the portrayal of characters during acting. Hence, it might reflect a general physiological relationship between pitch and loudness during sound production.

3.5.4 – Limitations

There are a number of limitations of this study. First, only a select number of basic characters could be examined within the scope of this performance study. Berry and Brown (2017) established a corpus of 40 basic characters to draw upon for the present study, of which only nine were used. However, this is comparable to the number of emotions that are tested in many studies of vocal emotion (Juslin & Scherer, 2005; Laukka, 2005; Murray

& Arnott, 1993; Schröder, 2004). Next, because of the exploratory nature of the study, we wanted to start out with a set of simple, rather than complex, characters. Hence, all of the characters were basic, archetypal character types, rather than complex and/or more realistic characters like Romeo or Juliet. Despite this, our use of a dimensional approach ensures that future acting studies using more-complex characters can generate predictions about character prosody based on features like personality traits. This can be useful to account for 1) the expression of different personality traits for a single character over the course of a drama, and/or 2) relative differences among the dramatis personæ of a story. In *Romeo and Juliet*, for example, Romeo goes from being a prototypical lover to being a vengeful hero when he kills Tybalt in response to Tybalt's slaying of his best friend. Likewise, Romeo and Tybalt have starkly different personalities between themselves throughout the drama; they represent different character archetypes. These features of drama and literature can be better addressed using a dimensional approach than by using one that views all characters as singular, unrelated entities.

Another limitation of the study relates to the categories of traits that were used for the predictive scheme. While they turned out to be effective at predicting prosodic changes in the current analysis (mainly for assertiveness), the personality dimensions of assertiveness and cooperativeness are by no means the only personality traits that are relevant for describing characters. Other important traits include intelligence, extraversion, introversion, to name a few, or even valence and arousal more directly. Extraversion/introversion has been used to describe social stereotypes through associative tasks (Andersen & Klatzky, 1987), and was also included in the character-rating study conducted by Berry and Brown (2017). An expansion of this work on the classification of literary characters is needed in order to optimize the categories of traits that are used in creating predictive dimensional schemes for experimental analyses of acting.

While the current study focused exclusively on a within-subject analysis, namely the 3 x 3 character scheme, and did so across 12 prosodic variables, there are a number of critical between-subject questions that should be addressed in future studies. One is the contrast between actors and non-actors, and a second is the contrast within the population of actors between different methods of getting into character. While we are not aware of any studies that have compared actors and non-actors using a character-portrayal task, a number of studies have looked at the comparison with respect to the expression of emotion, focusing on perceivers' ratings of authenticity between spontaneous and acted-out emotional expressions. Jürgens et al. (2015) compared examples of spontaneous emotional speech from radio interviews with re-enactments of these samples for four basic emotions, as produced by both professional actors and non-actors. Spontaneous speech was rated as more authentic than the re-enactments by the two groups, which didn't differ from one another, hence failing to show an advantage for professional actors. Anikin and Lima (2018) had listeners rate the authenticity of both spontaneous and acted-out nonverbal vocalizations from published corpora of recordings. Listeners were able to distinguish the authentic versions for certain emotions more so than others, where the perceptual difference in authenticity was largest for those emotions for which acoustic differences were the largest, such as for anger, fear, and pleasure. Juslin et al. (2018) compared spontaneous and acted-out emotions by examining a large number of samples of verbal speech (single sentences) from existing databases. Acted-out clips were rated as having higher emotional intensity than spontaneous clips, but spontaneous clips were rated as being more genuine, even after controlling for emotional intensity. Finally, Krahmer and Swerts (2008) compared acted-out emotions with those produced through an emotion-induction procedure for positive, negative, and neutral sentences, and did so with both professional actors and non-actors. Facial expression, rather than vocal expression, was examined. It was found that actors produced more-extreme versions of the emotions than did the non-actors, and that the actors' renditions were further removed from the authentic emotions produced by emotion induction than were the non-actors'. Overall, these studies suggest that, despite the intuition that actors perform realistic portrayals of emotions, actors often produce more-extreme renditions of emotions that are appraised in some cases as being less authentic than spontaneous emotional expressions or the expressions of non-actors.

We suspect that a comparative prosodic analysis of character portrayal would show that actors create more-expansive renditions of characters than do non-actors, with greater use of pitch range and dynamics. A study of poetic recitation by Menninghaus et al. (2018) demonstrated that a (single) professional actor produced renditions of poems that were rated as being significantly more melodious than the renditions produced by several non-actors. Hence, we predict that a group analysis of actors vs. non-actors would demonstrate a similar result with respect to not just pitch, but also loudness, timbre, and timing. The next between-subject issue relates to actor training, and we can imagine two different ways of addressing this. A between-subject study could compare a group of actors trained exclusively with gestural methods to a group of actors trained exclusively with psychological methods. However, given that many actors have a mixed training (as in the present study), a more fruitful approach might be to employ a within-subject design in which actors of mixed training are instructed to employ either gestural methods or psychological methods to get into the same set of characters. For both such studies, it would be important to use scripts that have more psychological detail than the script used in the current study, which was designed to be as neutral as possible so as to highlight character-based differences.

Finally, the modulation of vocal prosody is but one facet of the art of impersonation by actors. Facial expression and body gestures (Dael, Mortillaro, & Scherer, 2012; Ekman, & Friesen, 1978; Wallbott, 1998) are equally important for conveying the impression of being a character. Ongoing motion-capture analyses from the present experiment are examining these features of character portrayal, with the ultimate aim of exploring if there are any relationships among prosody, facial expression, and body gesture, either pairwise or as a three-way relationship. For example, Thompson, Russo and Livingstone (2010) demonstrated that when singers increased the size of sung pitch-intervals, there were corresponding facial changes, such as increases in brow height and mouth opening. Scherer and Ellgring (2007), in a study using professional actors, searched for the presence of “multimodal clusters” in the expression of basic emotions across vocal prosody, facial expression, and body gesture. They found such multimodal effects for a small number of emotions, mainly agitation, resignation, and joyful surprise, all of them emotions associated with high urgency. Acting is ultimately about creating displays of emotional expression during public performance. Hence, the relationships that we and others are observing might be components of "display rules" (Ekman & Friesen, 1969; Friberg et al., 2006) that mediate the expression of emotion in the performing arts and most likely the emotional communication that occurs during everyday social interactions as well

3.6 – Conclusions

The present study represents a first step towards establishing a psychology of acting using trained actors as the participants, as envisioned by Goldstein and Bloom (2011). The results showed that actors' prosodic productions conformed with the predictions of a two-dimensional personality scheme for characters, with much stronger effects seen for assertiveness than for cooperativeness. This supports Plato's view of acting in which actors aim to mimic the presumed personality and physical features of the portrayed characters in order to create a believable depiction of the character. The study of acting provides a means of investigating a number of issues of importance in cognitive psychology, including the multimodal expression of emotion, the impact of personality on action tendencies and social interaction, the sense of identity and the self, the nature of pretense, the manner in which consciousness can be split between the self and a portrayed character, and the means by which actors are able to embody a character through empathic mentalizing and/or gestural mimicry.

Related to this latter point, the results of the current study can be generalized to a broader perspective of role playing which views all social behavior in daily life as involving a process of playing various context-specific roles (Goffman, 1959; Landy, 1993; Shulman, 2017). In general, people modulate their vocal prosody in everyday situations to conform with their interaction partners and/or the context of the social interaction, a phenomenon that is studied in the field of interactional prosody (Auer, 2015; Couper-Kulhen, 2014; Szczepek Reed, 2012, 2013). One indicator of this was found in the performed-self condition in the current experiment, in which the context of stage performance altered an actor's prosody compared to a conversational context. Finally, there are intermediate situations where people briefly impersonate other individuals, such as when quoting one's mother when talking about her with a friend, and doing so by raising one's vocal pitch (Stec et al., 2015). This general process of impersonation has been referred to as "proto-acting" (Brown, 2017), and represents yet another large domain of character portrayal that can be examined in the emerging psychology of acting and role-playing.

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3.9 – Appendix

Semantically Neutral Monologue Script: I walked into the room. A bag is in the room. It sits on the cabinet beside a clock. Digital clocks are common. There are four drawers in the cabinet. I see a rug on the floor. It looks to be expensive.

Chapter 4 – The dynamic mask: Facial correlates of character portrayal in professional actors

Matthew Berry and Steven Brown

4.1 – Abstract

Actors make modifications to their face, voice, and body in order to match standard gestural conceptions of the fictional characters they are portraying during stage performances. In order to quantify the facial correlates of character portrayal in professional actors for the first time, we had 24 actors portray a contrastive series of nine stock characters (e.g., king, bully, lover) that were organized according to a predictive scheme based on the two orthogonal personality dimensions of assertiveness and cooperativeness. We used 3D motion capture to examine changes in facial dimensions, with an emphasis on the relative expansion/contraction of four facial segments related to the brow, eyebrows, lips, and jaw, respectively. The results revealed a number of strong facial correlates of the cooperativeness of characters, but relatively few effects for assertiveness. These findings demonstrate that actors reliably manipulate their facial features in a contrastive manner in order to differentiate characters based on their underlying personality traits.

Keywords: acting; characters; embodiment; emotions; facial expression; facial expansion; facial contraction; performance

4.2 – Introduction

During theatrical performances on stage and screen, an actor has to create the physical portrayal of a fictional character, one who could reasonably exist within the scenario of the presented storyworld. An actor not only has to *portray* this person, but also has to *persuade others* that they are indeed this person, doing so using physical alterations to their face, voice, and body (Dusinberre, 1998; Smith, 1971). Many theatrical traditions cross-culturally have relied on the donning of masks by actors in order to convey a character's prototypical facial expressions (Benedetti, 2012; Meineck, 2011; Storm, 2016). The nature of masks has evolved over the last two millennia from being the most static representations of expressions to being highly dynamic (Benedetti, 2012; Kristeller, 1951; Meineck, 2011; Mirodan, 2019). However, our interest in the present study is to quantify the actual facial changes that actors generate when portraying contrastive characters, where these facial changes serve metaphorically as a type of "dynamic mask" for each character. We do this in the context of emerging research programs on the nature of acting that attempt to systematize the "gestural codes" used by actors to create portrayals of fictional characters on stage (Berry & Brown, 2019; Kemp, 2012; Konijn, 2000). While acting theorists since the time of Aristotle have debated about whether actors have to actually feel the emotions that they are portraying on stage (Archer, 1888/2012; Aristotle, 335 BCE/1996; Diderot, 1830/2019; Stanislavski, 1936/1989), our focus will be on the external manifestations of such expressions, rather than on their internal driving forces. The challenge for an actor is the same regardless of the method they use to get into character: they have to produce a realistic and compelling representation of a person who they themselves are not, and to persuade an audience that they are indeed the embodiment of this person (Weinbren, 2020).

While there has been a rich tradition of looking at the facial correlates of *emotion* – one that dates back to Darwin, if not before – there has not been a comparable research program on the facial correlates of *character*. To the best of our knowledge, the present study is the first one to quantify the facial correlates of character portrayal separate from emotions associated with characters. While a small number of studies have examined characters as vehicles for expression – for example using cartoon characters (Liu et al., 2019; Zhao et al., 2019), virtual models (Hahn et al., 2019), avatars (Ennis et al., 2013; Tinwell et al., 2011; Wallraven et al., 2007), and robots (Lin et al., 2013) – the tasks analyzed in these studies have been firmly rooted in measurements of emotion, rather than the characters themselves.

In like form, there has been a long practice in experimental studies of facial emotion of employing professional actors to create images of prototypical facial expressions so as to serve as stimuli for perceptual-discrimination studies of emotional expression (Carroll & Russell, 1997; Ershadi et al., 2018; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986). However, there has been far less interest in looking at the production process itself and of understanding the inherent diversity of expressions for any given emotion across a group of actors (Mehu & Scherer, 2015; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986), instead placing the focus on the highly discriminable prototypes that are used in perceptual experiments. (For studies examining actors' portrayals of emotions, see Carroll & Russell, 1997; Ershadi et al., 2017; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986.) Indeed, Scherer and Ellgring, (2007a) remarked that Darwin (1872/1998) may have been the first and last scholar to independently address the underlying principles of facial configurations and to detail the conditions under which particular facial configurations are produced for specific emotions.

4.2.1 – Categorical vs. dimensional models of emotion

Two general approaches to the classification of emotions have looked at the relationships among the emotions as being either categorical or dimensional, respectively. The validation of such approaches has been strongly grounded in the analysis of the facial correlates of the emotions. Categorical schemes of discrete emotions date back historically to Darwin (1872/1998), but were developed in great detail by more recent scholars such as Tomkins (1962, 1963, 1984) and most especially Ekman and his colleagues (Barrett et al., 2019; Bartlett et al., 2005; Ekman, 1984, 1992, 1993; Ekman & Friesen, 1972, 1978a, 1978b; Ekman & Rosenberg, 2005, 1997; Izard, 1971, 1992, 1993b, 1993a; Rosenberg & Ekman, 2020; for a comparison between discrete and componential emotion theories, see Scherer & Ellgring, 2007a). Basic Emotion Theory (BET; as coined by Russell, 2009) is the most popular categorical scheme of the emotions, positing that there is a small number of categorically distinct emotions, each of which addresses a distinct biological function (Frijda, 2007; Panksepp, 2010). Canonical basic emotions include anger (i.e., hot and cold), happiness (i.e., amusement, contentment, satisfaction), disgust, embarrassment, excitement, fear, guilt, pride, relief, sadness, and shame (see Chapter 3 in Dalgleish & Power, 1999).

Different numbers and combinations of basic emotions have been used to study actor-generated emotional displays for perceptual-discrimination studies across multiple modalities, such as the voice (Scherer et al., 1991; Scherer & Ellgring, 2007b; Wallbott & Scherer, 1986), body (Scherer & Ellgring, 2007b; Wallbott, 1998; Wallbott & Scherer, 1986), and face (Carroll & Russell, 1997; Mehu & Scherer, 2015; Scherer & Ellgring, 2007a, 2007b). In such cases, distinct emotions are analyzed categorically, and patterns of findings are reported for each emotion on its own. For example, Scherer and Ellgring's (2007a) facial analysis of actors demonstrated that displays of happiness were accompanied by facial configurations involving smiles (i.e., cheeks raising, lip corners pulling out, and jaw lowering), whereas displays of panic or fear were accompanied by facial configurations resembling a scream (i.e., brow movement and jaw lowering). One critique of categorical schemes is that they lack any concept of emotional intensity, such as that between happiness and elation or between fear and terror (Scherer & Ellgring, 2007a).

In contrast to categorical schemes, dimensional schemes classify the emotions along a number of continua. A prominent example is the “core affect” theory and its structural analogue, the circumplex model, which have been used to examine the distribution of emotions along the two emotion dimensions of valence (the pleasure-displeasure continuum) and arousal (the activation-deactivation continuum (Posner et al., 2005; Russell, 1980, 1994, 2005, 2009). Dimensional models have been used to examine facial expression in both children and adults (Russell & Bullock, 1985; Vesker et al., 2018). For example, Mehu and Scherer (2015) conducted a joint production and perception study of professional actors, comparing categorical and dimensional models of emotion. Their results demonstrated that displays of positive-valence + high-arousal emotions correlated with raising of the brow, raising of the cheeks, parting of the lips, and lowering of the jaw. By contrast, negative-valence + high-arousal emotions were correlated with both raising and lowering of the brow (depending on the emotion), widening of the eyes, lowering of the lip and jaw, and pressing of the lips together. The authors pointed out that "...rather than being specific to discrete emotions or emotional dimensions, facial behavior reflects combinations of the general dimensions underlying emotional experience, combinations that appear to cut across discrete emotion categories" (Mehu & Scherer, 2015:807).

4.2.2 – Analyzing facial expression: Modular and segmental approaches

4.2.2.1 – Modular approaches. The parameterization of actor-generated depictions of facial expressions for perceptual studies has been predominately based on a modular scheme of facial "action units" (AUs) derived from the Facial Action Coding System (FACS) developed by Ekman and colleagues (Barrett et al., 2019; Bartlett et al., 2005; Ekman, 1984, 1992, 1993; Ekman & Friesen, 1972, 1978a, 1978b; Ekman & Rosenberg, 1997, 2005; Izard, 1971, 1992, 1993b, 1993a; Rosenberg & Ekman, 2020; Zhi et al., 2020). FACS is a descriptive coding system for facial movement based on observable actions of the underlying musculature (Rosenberg & Ekman, 2020; Zhi et al., 2020). There are 46 unique AUs, and they are coded either symmetrically or asymmetrically. They are organized according to the areas of the face corresponding to specific facial muscles (e.g., AU 12 is the *zygomaticus major* muscle, a lip corner puller). There are 12 AUs associated with specific actions in the upper face, 18 associated with specific actions in the lower face, and 16 associated with relatively non-specific actions in the lower face (Zhi et al., 2020). AUs can function either singularly or combinatorially, and facial analyses from the BET perspective describe how prototypical facial expressions of emotion are the result of particular combinations of AUs. For example, the facial expression of fear is proposed to be a combinatorial recruitment of AUs for the brow (AUs 1, 2 & 4), eyelids (AUs 5 & 7), and lips (AUs 20 & 25).

4.2.2.2 – Segmental approaches. While most approaches to facial expression look at the face as a collection of individual, muscle-related units, there is also the sense in which the face has larger functional units than that. For example, a view of facial expression from the standpoint of neuroanatomy reveals that the upper face is innervated by the facial nerve in a bilateral manner – thereby making lateralized movements like lifting a single eyebrow difficult – whereas the lower face has a lateralized (crossed) innervation pattern, making unilateral movements much easier (Wilson-Pauwels et al., 2002). Likewise, there is an intuitive sense that an expression like a smile, for example, is not just the activation of a collection of individual action units, but that it is the expansion of a horizontal *segment* extending between the lateral edges of the lips, whereas a frown is a retraction of that same segment. Similarly, the expression of surprise is an expansion of a vertical segment extending between the upper and lower lips through a lowering of the jaw, whereas the expression of disgust is a retraction of that same segment.

A number of studies have applied segmental approaches to the analysis of facial expression, employing geometric, or point-to-point distance-based, features to analyze changes in segment length caused by the recruitment of the underlying musculature (Fasel & Luettin, 2003; Hammal et al., 2007; Hammal & Massot, 2010; Kanade et al., 2000; Livingstone et al., 2015; Sandbach et al., 2012; Schmidt et al., 2003; Soyel & Demirel, 2007; Valstar et al., 2007; Yacoob & Davis, 1996; Zhang et al., 2015). For example, Schmidt and colleagues (2003) measured participants' smiles by analyzing a segment extending from the center of the lip to the lip corner (AU 12, *zygomaticus major*), and obtained continuous data for its position, duration, amplitude, velocity, and acceleration. Soyel and Demirel (2007) used multiple distance-vectors extracted from three-dimensional data in order to classify seven basic emotions (anger, disgust, fear, happiness, sadness, surprise, and neutral) based on segmental changes. They extracted and analyzed five characteristic distances using 11 selected points from a larger set of 84 feature points. These distances were related, respectively, to eye opening, eyebrow raising, mouth opening vertically and horizontally, and lip stretching. The authors found that expansion and contraction of these five segments provided adequate information to automatically discriminate facial emotions with a mean accuracy of 91.3%, outperforming other 2D and 3D recognition systems in their analysis (Soyel & Demirel, 2007).

4.2.3 – Multimodal expression

Emotional expression is an intrinsically multimodal activity, producing correlated changes in the face, body, and voice. While certain types of actors do not speak while acting, most notably mime actors, the vast majority of actors do. Hence, the production of emotional expression with the face during acting interacts with the articulatory movements of the lips, cheeks, and jaw necessary for the production of phonemes, as well as with the facial movements that contribute to the vocal expression of emotion separate from articulation. The majority of studies of emotional expression are unimodal. As Scherer and Ellgring (2007b) noted, multimodal analyses of emotional expression, specifically speech, are rare despite the clear integration of the face, voice, body, and postural communicative channels. Some multimodal studies of facial expression in the context of vocal production have focused singing (Livingstone et al., 2015; Thompson & Russo, 2007), where correlations have been observed between vocal pitch and both raising of the brow and lowering of the jaw, and some have focused on speech (Livingstone et al., 2015; Scherer & Ellgring, 2007b). In their study of multimodal expression, Scherer and Ellgring (2007b) observed correlated changes between the voice and face for several basic emotions, including correlations of both high pitch and loudness with activations in AUs for the brow, cheek, and jaw. In the present study, we take a multimodal approach to acting by examining facial expression in the context of speech production, and attempt to disambiguate movements of the lower face associated with emotional expression from those associated with speech articulation. We also look at correlations between facial changes observed in this study and vocal changes observed in our previous study for the same set of characters (Berry & Brown, 2019).

4.2.4 – Character classification

A first step toward quantifying the facial correlates of character during acting is to develop a means of classifying characters dimensionally. In Berry and Brown (2017), we presented a proposal for a systematic classification of literary characters based on personality dimensions, using a modification of the Thomas-Kilmann Conflict Mode Instrument used in applied studies of personality (Kilmann & Thomas, 1975, 1977; Thomas, 1992) The Thomas-Kilmann scheme classifies personality along the two orthogonal dimensions of *assertiveness* and *cooperativeness*. We conducted a character-rating study in which participants rated 40 stock characters with respect to their assertiveness and cooperativeness, and the results demonstrated that these ratings were orthogonal. The scheme is shown in Figure 4.1, in which a crossing of 3 levels of assertiveness and 3 levels of cooperativeness results in 9 character types. In Berry and Brown (2019), we employed this scheme to examine the vocal correlates of character portrayal by analyzing the vocal prosody of professional actors as they performed portrayals of the 9 characters shown in the figure. The results revealed strong effects of character assertiveness on vocal prosody

– both pitch and loudness increased monotonically with increasing assertiveness – but relatively weak effects of character cooperativeness on the voice.

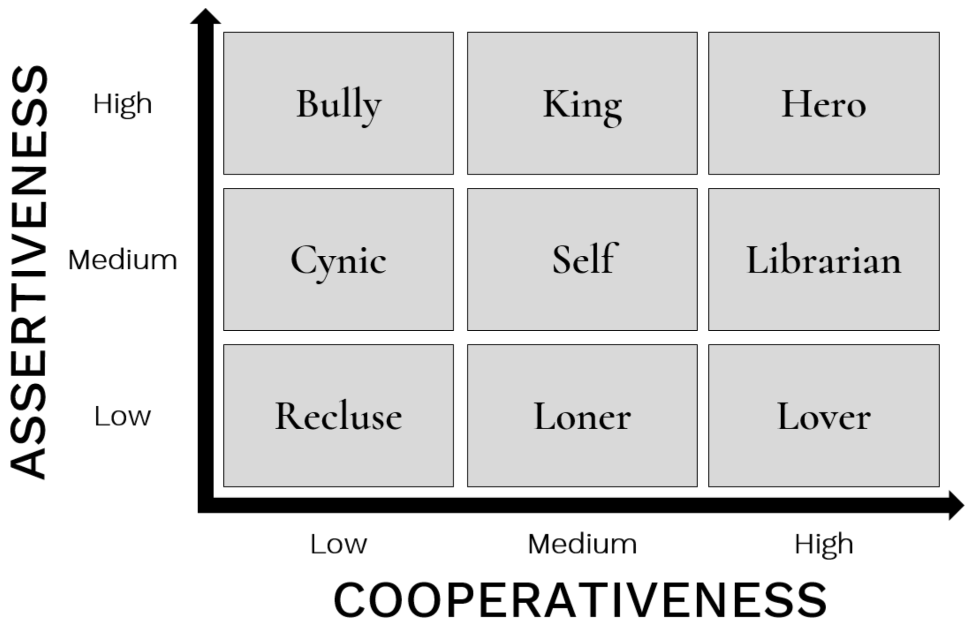

Figure 4.1. Character scheme. The figure shows the 9 stock characters used in the study, as organized into a 3 x 3 scheme based on a crossing of 3 levels of assertiveness and cooperativeness, respectively. The scheme is adapted from Berry and Brown (2019).

4.2.5 – Objectives

The primary objective of the current study was to follow up on our prosody findings by looking at the facial correlates of character portrayal in an experimental study for the first time. We did this using professional actors and a high-resolution 3D motion capture set-up in a black-box performance laboratory. A group of 24 actors performed a semantically-neutral script (see Appendix A) while portraying 8 stock characters and the self, as per the assertiveness/cooperativeness scheme shown in Figure 4.1. They also performed the script while depicting 9 basic emotions so as to allow us to examine the relationship between character and emotion. From a group of 20 facial markers employed in the study, we created 4 facial segments derived from a subset of 7 selected markers in order to explore the mean expansion and/or contraction of the brow, eyebrow, lips, and jaw, respectively, across the roughly two-minute performance trials. To control for movement of the face due to speech articulation, we subtracted out the *neutral* emotion condition from each character or emotion trial, and then normalized this difference relative to the *neutral* condition. The overall aims of the study were 1) to examine the expansion/contraction of the 4 facial segments as a function of character assertiveness and cooperativeness; 2) to examine the same segments as a function of emotional valence and arousal; 3) to analyze the relationship between stock characters and basic emotions; and 4) to use the vocal data from our previous study (Berry & Brown, 2019) to look multimodally at the correlation between facial movement and vocal prosody during acting. Given that assertiveness showed a much larger effect than cooperativeness in our previous study, we predicted that we might observe a similar effect for the face as well. In addition, given that both Scherer and Ellgring (2007b) and Thompson and Russo (2007) observed that vocal pitch-register correlated with upward movement of the brow, we predicted that we might see a correlation between vocal pitch and expansion of the brow segment; Thompson and Russo (2007) also found a correlation between vocal register and mouth opening. Finally, we carried out an exploratory analysis to examine if there was a relationship between stock characters and the basic emotions that are intuitively associated with them (e.g., hero and proud, loner and sad, bully and angry).

4.3 – Methods

4.3.1 – Participants.

Participants and procedures are similar to those reported in Berry and Brown (2019). Twenty-four actors (14 males; 20-63 years; M_{Age} = 42.5 ± 14 years) were recruited for the experiment through contact with theatre companies and academic theatre programs in the local and surrounding areas. All actors spoke English either as their native language or fluently as their second language (n = 1). They had a minimum of three years of acting experience (M_{Exp} = 27.5 ± 14.3 years). Fourteen held degrees in acting, and two were pursuing degrees in acting at the time of the experiment. More than half of the participants (i.e., 17 of the 24) self-identified as professional actors. All participants gave written informed consent and were given monetary compensation for their participation. The study was approved by the McMaster University Research Ethics Board.

4.3.2 – Motion capture.

The experiment took place on the stage of a black-box performance laboratory, where the actors performed the tasks facing an empty audience. The experimenter was located in a control room behind the audience section, and the actors could not see him while performing. Three-dimensional (3D) motion-capture recordings of the actors' facial expressions and body gestures were acquired using a Qualisys motion capture system. Sixteen Qualisys Oqus 7 infrared cameras were used to track marker movement in three dimensions at a sampling rate of 120 Hz. The participants were equipped with 61 passive markers that were placed on key landmarks on their face and body in order to provide bilateral full-body coverage (20 markers on the face, 37 on the torso and limbs, and 4 on the head via a cap). For the face, marker placement was chosen to correspond to the general locations of key facial AUs (e.g., AUs 1, 2, & 4 for the upper face; and AUs 11, 12, 23, 26, & 27 for the lower face; see Barrett et al., 2019; Rosenberg & Ekman, 2020).

4.3.3 – Characters and emotions.

Nine stock characters were performed by the actors, as established by the 3 x 3 (assertiveness x cooperativeness) classification scheme that was validated in Berry and Brown (2017) and that was implemented in the vocal analysis of Berry and Brown (2019) (see Figure 4.1). In addition to the characters, we selected 8 basic emotions for the actors to perform, as based on previous studies with actors (see Introduction). The selected emotions were *happy, sad, angry, surprised, proud, calm, fearful,* and *disgusted*, with *neutral* serving as a baseline condition. We sought to create an approximate dimensional analysis of these emotions (e.g., Russell, 1980), rather than examine them individually. We therefore grouped these basic emotions into a 2 x 2 scheme according to their valence and arousal as follows: positive valence + high arousal (*happy*, *proud*, *surprised*), negative valence + high arousal (*angry*, *fearful*, *disgusted*), positive valence + low arousal (*calm*), and negative valence + low arousal (*sad*; see Supplementary Figure 1). The order of presentation of the 9 characters and 9 emotions was randomized across the 18 trials for each participant.

4.3.4 – Performance script.

A semantically neutral monologue-script was created for the study that the actors memorized in advance of the experiment (see Appendix A). It was comprised of seven neutral sentences (M = 6 ± 1.4 words/sentence) derived from a set of ten validated linguistically-neutral sentences (Ben-David et al., 2011; Berry & Brown, 2019). The script was structured such that a small narrative was presented (i.e., someone walking into a room and listing the items that they see), but with no indication of emotion or interpersonal interaction. The same monologue was used for all 18 character and emotion trials. Each trial lasted approximately 2 minutes, and the full set of trials lasted no more than 45 minutes. At the end of the session, the actor was debriefed and compensated. In order to acquire a measurement of the participant's normal conversational expressions separate from the acting trials, the experimenter (MB) indicated that a piece of equipment required additional calibration, and requested that the participant recite the neutral script in a conversational manner as part of the calibration procedure. This recording was used as the *control-self* to compare against the *performed-self* from the acting trial (see Results).

4.3.5 – Data processing and cleaning.

2D motion data was processed using the Qualisys reconstruction algorithm into a proper 3D model (Qualysis, 2006). Following this, each trial was cleaned and processed manually in three dimensions via the Qualisys system interface. Errors (i.e., noise or unassigned markers) and outlying markers were removed. No interpolation was done. If there were gaps in the 3D motion reconstruction, they were not filled. Instead, the data from that particular marker was temporally omitted. This was done to prevent the system from incorrectly interpolating and/or skewing the motion data and thereby artificially changing the mean. The cleaned X coordinates (anterior-posterior movement), Y coordinates (right-left movement), and Z coordinates (superior-inferior movement) were exported into data tables for further analysis.

4.3.6 – Transformation of variable parameters.

The variables of interest in this study are those related to expansion and contraction of facial segments. From the 20 available facial markers, we selected a subset of 7 for the current analysis: the brow (corresponding approximately to AUs 1 & 2), the left and right eyebrow (AU 4), the bridge of the nose, the left and right lip corners (AUs 11, 12, & 23), and the jaw (AUs 26 & 27; see Barrett et al., 2019; Rosenberg & Ekman, 2020). Pairs of markers were combined into 4 facial segments whose expansion and contraction were measured in three dimensional space, as shown in Figure 4.2. These segments permitted an analysis of 1) vertical raising and lowering of the *brow*, 2) horizontal movement of the *eyebrows* towards or away from the midline of the nose, 3) horizontal movement of the corners of the *lips* to or away from the midline of the mouth, and 4) vertical lowering and raising of the *jaw*. Each segment's length was calculated from the raw exported X, Y, and Z coordinates for the pair of contributing markers using the following formula for Euclidean distance:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

where d is the Euclidean distance (i.e., the absolute geometric distance) between two points in 3D space, and x, y, and z are the 3D coordinates of a single sample at time (2) and time (1), respectively. A time series of the Euclidean distance for each facial segment was then created for each approximately 2-minute trial. The mean segment length across this time series was calculated for the 4 facial segments using the following formula:

$$M_{d\,ij} = \sum d_{ij} / sr^*(t_{ij})$$

where M_d is the mean Euclidean distance in mm between marker pairs over the length of the entire trial (i.e., the mean segment length), d is the segment length, sr is the motion capture sample rate (i.e., 120 Hz) and t is the time in seconds of the entire trial. This resulted in a total of 4 parameters for the analysis (i.e., 4 facial-segment means). Each facial-segment parameter mean was extracted for each participant (i) for each character or emotion condition (j).

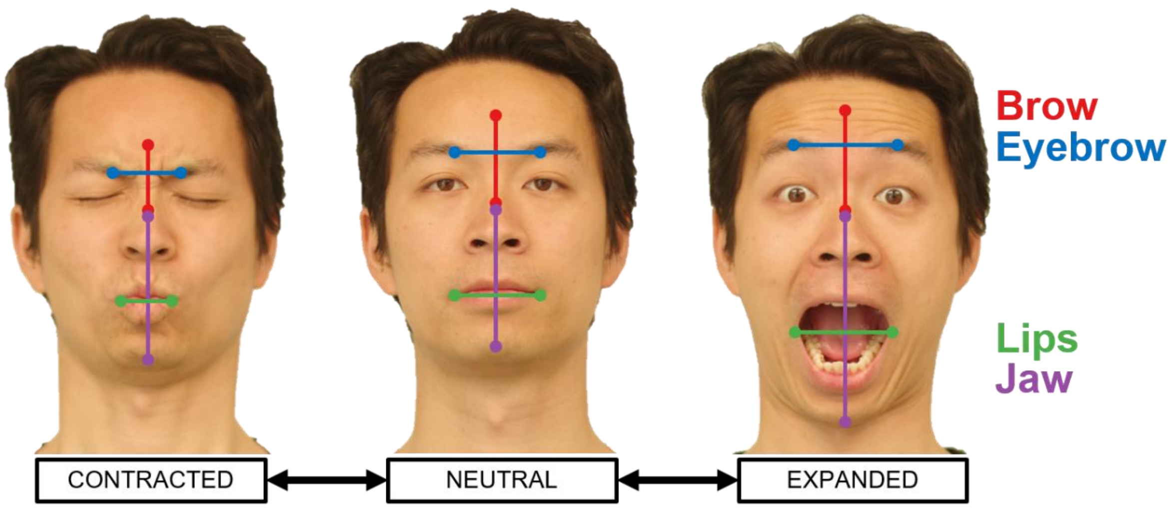

Figure 4.2. Facial segments. The figure presents a visual representation of the 4 facial segments analyzed in the study (brow, eyebrow, lips, and jaw), as well as the approximate locations of the facial markers used to measure them. Facial contraction (left) and expansion (right) are shown with reference to a resting state (center). Photos are courtesy of author MB. The model gave consent for the use of these photographs.

4.3.7 – Correcting for speech-related movements and facial-size differences.

A "percent change" transformation was applied to the 4 segmental parameter means in order both to eliminate the impact of speech articulation on facial movements – especially for the jaw and lip segments – and to remove any bias caused by subject-related differences in facial size. This was carried out by subtracting out the mean segmental lengths for the *neutral* emotion condition (i.e., speaking the script devoid of any emotion or character) from the means for each character and emotion trial, as per the following formula:

$$\% \text{ change} = 100 * ((M_{d[\text{performance}]} - M_{d[\textit{neutral}]}) / M_{d[\textit{neutral}]})$$

where the percent change is the difference between the mean Euclidean distance for a participant's given performance condition (character or emotion) and the participant's *neutral* emotion condition, scaled to that *neutral* condition, and then multiplied by 100. As a result, all data for the characters and emotions are reported as a percent change relative to the *neutral* emotion condition. Following this correction, each parameter was visually screened for extreme outliers, of which none were found.

4.3.8 – Univariate analyses.

Each of the 4 transformed parameters was analyzed using a linear mixed-effects regression model (LMER) with maximum likelihood estimation using the *lme4* package in R (Bates et al., 2015; R Core Team, 2013). For the character trials, a two-way repeated measures analysis of variance (ANOVA) was conducted for each of the 4 parameters. For the character trials, the two orthogonal dimensions of assertiveness and cooperativeness were treated as within-subject factors, while subject was treated as the random effect. For the emotion trials, the two approximated dimensions of valence and arousal from the circumplex model of emotion were treated within-subject factors (i.e., fixed effects), while subject was treated as the random effect. The *neutral* emotion condition – which was used as the baseline condition for data normalization – was not included in either of these analyses, but was only included in the multivariate analysis, described below. The final sample for the univariate analysis was therefore n = 216 for characters (9 characters x 24 participants) and n = 192 for emotions (8 emotions x 24 participants). For the reporting of *F* values, we used type III sums of squares with Satterthwaite approximations for degrees of freedom. Statistical significance levels were set to $\alpha < .05$. The significance of statistical analyses and the estimation of effect sizes examine how much of the model's variance is explained by the fixed effects only (R_{marg}^2) and how much of it is explained by the complete (fixed + random effects) model (R_{cond}^2). These were calculated using the *afex* package in R (Singmann et al., 2016).

4.3.9 – Correlation analysis.

Correlations between the segmental parameters and the vocal parameters of pitch (in cents) and loudness (in decibels) were carried out using the vocal data reported in Berry and Brown (2019) using the same trials. Statistical significance was set to $\alpha < .05$, and adjustments for repeated testing of the group of 4 segmental parameters were made using Bonferroni corrections (i.e., $\alpha/4$ for each segment, resulting in a new threshold of $\alpha < .0125$; Berry & Brown, 2019; Goudbeek & Scherer, 2010).

4.3.10 – Multivariate analysis.

In order to look at the relationship between characters and emotions, we carried out a Principal Components Analysis (PCA) using the *principal* function in the *psych* package in R (Revelle, 2017; R Core Team, 2013) in which data from the characters and emotions were combined into a single analysis. This included the 4 facial parameters described above and the 12 vocal parameters described in Berry and Brown (2019). Due to the differing scales employed for each parameter, all parameter scores were normalized within-subject using z-scores prior to analysis. Normalizing the data also corrected for the presence of extreme outliers. Two *librarian* trials were omitted due to whispering, and so these missing data were imputed using "similar case imputation" of the mean. The final sample for the multivariate analysis was n = 432 (9 characters + 9 emotions x 24 participants). Cartell's Scree Test and the Kaiser Criterion suggested that the first two principal components were sufficient for extraction and interpretation (Berry & Brown, 2019; Cangelosi & Goriely, 2007; Dunteman, 1989). The first two components were therefore rotated using the *varimax* rotation in the *psych* package and extracted for interpretation.

4.4 – Results

4.4.1 – Univariate analyses

Table 4.1 provides a summary of the analyses of variance (ANOVA) conducted on the linear mixed-effects regression model (LMER) for the 4 facial segment means across the 9 characters. The characters are collapsed across the 3 levels (low, medium, and high) of each personality dimension (cooperativeness and assertiveness), and the main effects of each dimension, as well as their interaction, are presented in the table. The results for the mean displacement of the 4 facial segments are shown in Figure 4.3 (for character cooperativeness and emotional valence) and Figure 4.4 (for character assertiveness and emotional arousal). The left panel of each figure provides results for the character dimension, and the right panel for the related emotion dimension. All results are controlled for the speech-related movements of the *neutral* emotion condition.

4.4.2 – Cooperativeness.

There were significant main effects of cooperativeness on both the vertical and horizontal segments of the upper and lower face. These results reflect an increase in mean segment expansiveness with increasing character cooperativeness. Monotonic increases in segment expansion were most pronounced for the brow and lips (Figure 4.3a), with a smaller but significant effect for the eyebrow. The effect of character cooperativeness on jaw expansion was significant but non-monotonic, showing a "V" pattern of greater expansion for low and high cooperativeness than for medium cooperativeness. Next, when the basic emotions were organized in a manner that is most analogous to character cooperativeness – namely according to emotional valence – parallel results were obtained, with significantly greater expansion in all 4 facial segments for positive-valence emotions than negative-valence emotions (Figure 4.3b). Supplementary Table 2 provides the ANOVA and LMER analyses for the emotion data.

4.4.3 – Assertiveness.

The segments that showed the greatest mean expansiveness for character cooperativeness showed null effects for character assertiveness (Figure 4.4a). This applied to the brow, eyebrow, and lips. By contrast, the jaw showed monotonic increases in expansiveness with increasing assertiveness (Figure 4.4a). When the basic emotions were organized in a manner that is most analogous to character assertiveness – namely according to emotional arousal – parallel results were obtained, with null effects for the brow, eyebrow, and lips, but a significant expansive effect for the jaw segment (Figure 4.4b). Overall, a dissociation between cooperativeness and assertiveness was observed for the 4 segments, with the brow, eyebrow, and lips showing significant and monotonic effects for cooperativeness (and emotional valence) and the jaw for assertiveness (and emotional arousal).

Table 4.1. ANOVA results for the character dimensions

Segment	Effect Type	Sum Sq.	Mean Sq.	NumDF	DenDF	*F value*	*p value*	Sig.	R_{marg}^2	R_{cond}^2
BROW	Coop	38.35	19.18	2	192	7.83	0.001	***	0.08	0.48
	Assert	5.27	2.64	2	192	1.08	0.343	n.s.		
	Coop x Assert	34.35	8.59	4	192	3.51	0.009	**		
EYEBROWS	Coop	154.20	77.10	2	192	4.78	0.009	**	0.04	0.61
	Assert	20.98	10.49	2	192	0.65	0.523	n.s.		
	Coop x Assert	192.65	48.16	4	192	2.99	0.020	*		
LIPS	Coop	87.71	43.85	2	192	10.40	0.000	***	0.26	0.41
	Assert	16.75	8.38	2	192	1.99	0.140	n.s.		
	Coop x Assert	295.20	73.80	4	192	17.51	0.000	***		
JAW	Coop	46.10	23.05	2	192	8.46	0.000	***	0.17	0.33
	Assert	81.25	40.63	2	192	14.91	0.000	***		
	Coop x Assert	21.27	5.32	4	192	1.95	0.103	n.s.		

Note: Summary of the repeated measures analysis of variance (ANOVA) for each segment, after controlling for speech-related movements using the *neutral* emotion condition. A linear mixed-effects regression analysis (LMER) was computed, with subjects listed as the random effect and the two character dimensions (cooperativeness and assertiveness) as the fixed effects. The ANOVA table includes type III sum of squares using Satterthwaite approximation for degrees of freedom. Measures of effect size indicate how much of the model's variance is explained by the fixed effects only (R_{marg}^2), and how much of it is explained by the complete (fixed + random effects) model (R_{cond}^2). * $p < .05$, **$p < .01$, ***$p < .001$, n.s., not significant.

Abbreviations: Assert (assertiveness), Coop (cooperativeness), DenDF (denominator degrees of freedom), MeanSq. (mean squares), NumDF (numerator degrees of freedom), n.s., not significant, R_{marg}^2 (marginal r squared), R_{cond}^2 (conditional r squared), Sig. (significance level), SumSq. (sum of squares).

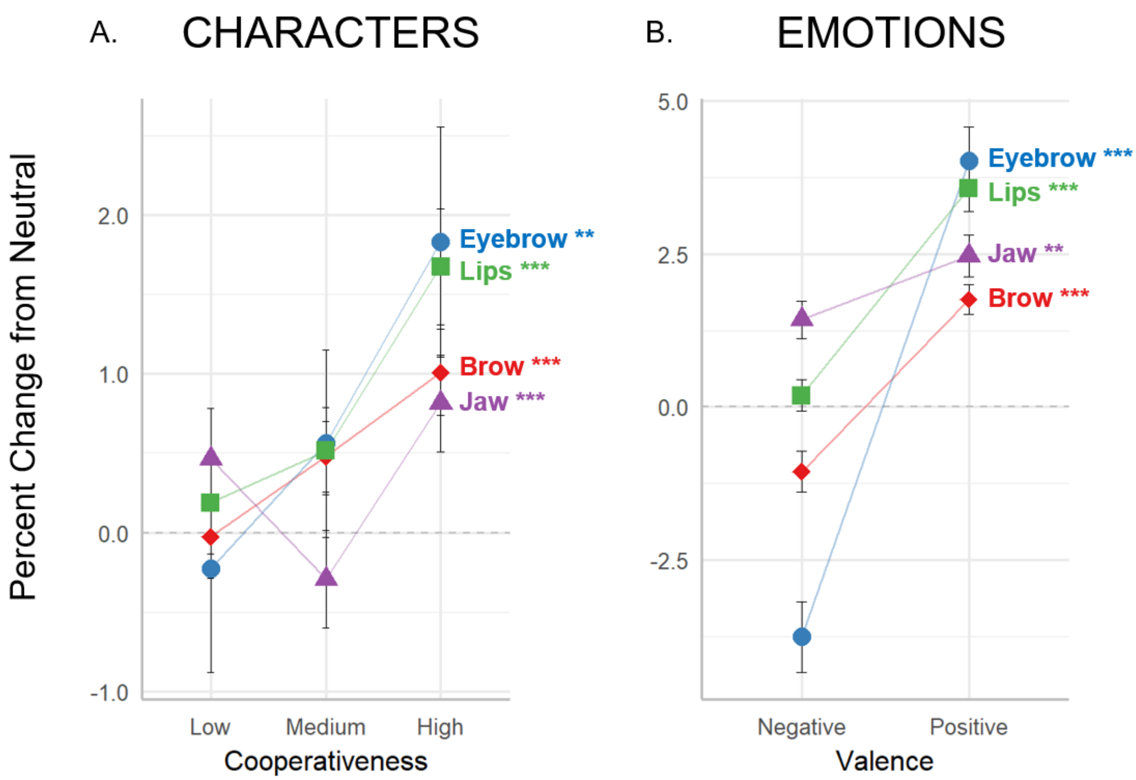

Figure 4.3. Cooperativeness and valence. Effect of (A) character cooperativeness and (B) emotional valence on the parameter means of the 4 facial segments**.** Values for each facial segment are the percent change relative to the participant's *neutral* emotion condition, which corrects for speech articulation and the diversity of facial dimensions across participants. Error bars indicate the standard error of the mean. Significance values are from a linear mixed-effects regression model for the main effects of the character and emotion dimensions. $^{**}p < .01$, $^{***}p < .001$, n.s., not significant. See Table 4.1 (character) and Supplementary Table 2 (emotion) for full descriptions.

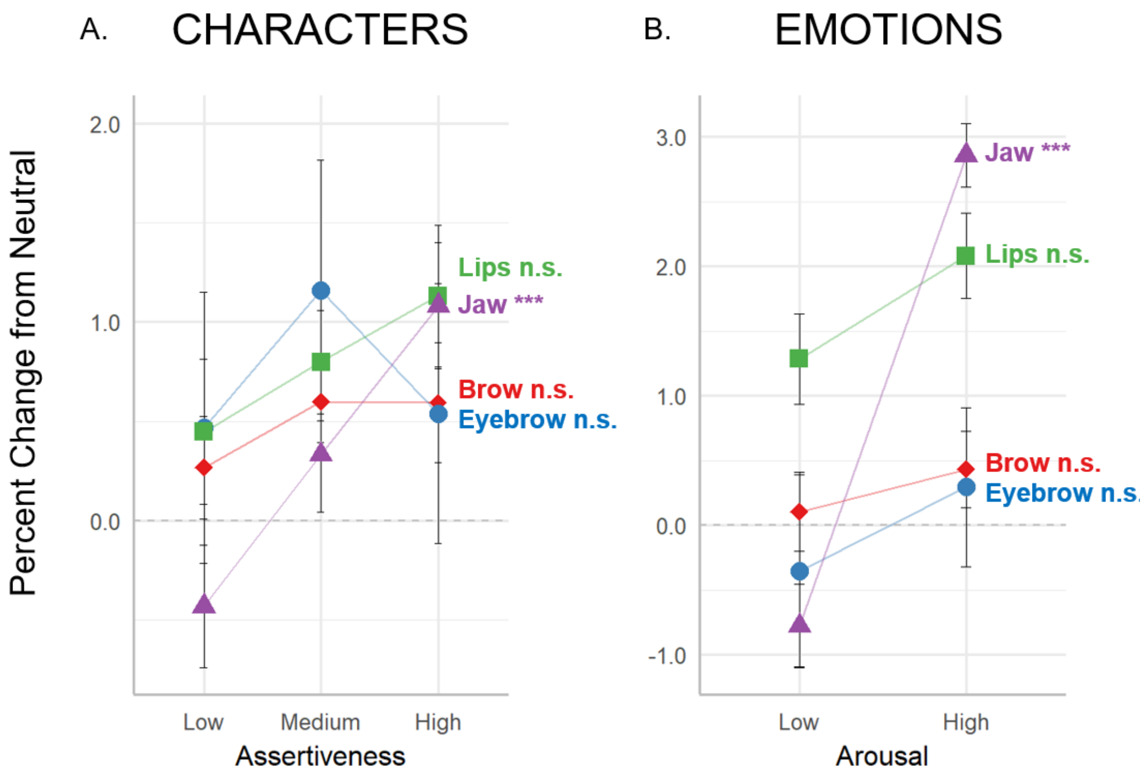

Figure 4.4. Assertiveness and arousal. Effect of (A) character assertiveness and (B) emotional arousal on the parameter means of the 4 facial segments**.** Values for each facial segment are the percent change relative to the participant's *neutral* emotion condition, which corrects for speech articulation and the diversity of facial dimensions across participants. Error bars indicate the standard error of the mean. Significance values are from a linear mixed-effects regression model for the main effects of the character and emotion dimensions. ***$p < .001$, n.s., not significant. See Table 4.1 (character) and Supplementary Table 2 (emotion) for full descriptions.

4.4.4 – Correlations with vocal parameters

Table 4.2 presents correlations between the mean displacements of the 4 facial segments and both vocal pitch (in cents) and loudness (in decibels) for the same trials (see Supplementary Figures 2 and 3 for the character-condition regressions and Supplementary

Figures 4 and 5 for the emotion-condition regressions). As per one of our predictions, based on the findings of Scherer and Ellgring (2007b) and Thompson and Russo (2007), a significant correlation was found between vocal pitch and upward movement of the brow, although this effect was only significant for the emotions (but not the characters) after correcting for multiple comparisons (α = .0125; Berry & Brown, 2019). The most significant finding of the analysis was a correlation between *jaw expansiveness* and both pitch and loudness in the voice (see also Thompson and Russo, 2007, for singing), an effect that was seen for both the characters and the emotions, although more strongly for the emotions. The results remained significant after correcting for multiple comparisons. These findings point to a synergy between the voice and the face during acting, one that applies to both character portrayal and the expression of emotions. It is important to keep in mind that the facial data were transformed to eliminate speech-related movements separate from character and emotion. Hence, the observed jaw/voice and brow/voice correlations are present above and beyond an influence of speech articulation alone and are thus performance-related effects.

Table 4.2. Correlations between facial and vocal parameters

Segment	Regressor	Condition	*r*	R^2	*p value*	Sig	Low Conf.	High Conf.	DF	*t value*
BROW	Pitch	Character	0.14	0.02	0.039	*	0.01	0.27	212	2.1
		Emotion	0.28	0.08	0.000	***	0.15	0.40	214	4.3
	Loudness	Character	0.14	0.02	0.041	*	0.01	0.27	212	2.1
		Emotion	0.25	0.06	0.000	***	0.12	0.37	214	3.7

EYEBROWS	Pitch	Character	-0.04	0.00	0.557	n.s.	-0.17	0.09	212	-0.6
		Emotion	0.15	0.02	0.023	*	0.02	0.28	214	2.3
	Loudness	Character	0.08	0.01	0.240	n.s.	-0.05	0.21	212	1.2
		Emotion	0.17	0.03	0.011	*	0.04	0.30	214	2.6
LIPS	Pitch	Character	0.18	0.03	0.008	**	0.05	0.31	212	2.7
		Emotion	0.28	0.08	0.000	***	0.15	0.40	214	4.2
	Loudness	Character	0.16	0.03	0.019	*	0.03	0.29	212	2.4
		Emotion	0.17	0.03	0.012	*	0.04	0.30	214	2.5
JAW	Pitch	Character	0.40	0.16	0.000	***	0.28	0.50	212	6.3
		Emotion	0.74	0.55	0.000	***	0.68	0.80	214	16.2
	Loudness	Character	0.29	0.08	0.000	***	0.16	0.40	212	4.4
		Emotion	0.62	0.39	0.000	***	0.53	0.70	214	11.6

Note: Pearson's product-moment correlation, two tailed * $p < .05$, **$p < .01$, ***$p < .001$. Abbreviations: DF (degrees of freedom), High conf. (high end of confidence interval), Low conf. (low end of confidence interval), n.s., not significant, Sig. (significance level).

4.4.5 – Performed- vs. Control-Self

Our previous study demonstrated that when the self was performed as a character, it showed increases in pitch and loudness compared to the *control-self* that was done during the instrument calibration (Berry & Brown, 2019). We wanted to examine whether parallel effects would be observed for the face as well. Significant, small-to-moderate expansive effects were seen for the eyebrow, lips, and jaw for the *performed-self* compared to the *control-self* (Supplementary Table 3). These results are consistent with the observation that the actors approached the self in a more performative manner during the acting trials.

4.4.6 – Relationship between character and emotion

In order to look at the relationship between character and emotion, we ran a principal components analysis (PCA) that combined the modalities of the current facial dataset with our previous vocal dataset (Figure 4.5). We reduced the parameters of the combined dataset from sixteen variables to two underlying components that accounted for 52% of the total variance in the combined dataset. These first two principal components were extracted using a *varimax* rotation, with the first rotated component (RC1) accounting for 33.5% of the variance, and the second rotated component (RC2) for 18.2%. We would expect a total of only 12.5% of the variance (i.e., 2/16 variables) if the results were due to chance alone. A summary of the loadings for each rotated component can be found in Supplementary Table 1. These loadings provide information about how to interpret the RCs, as well as the placement of the individual conditions on the plot. Note that each individual condition's location is the average across all 24 participants.

RC1 is primarily characterized by strong (|0.60| < x < |0.79|) to very strong (|0.80| < x) positive loadings for jaw expansion, pitch, and loudness. It is additionally characterized by moderately low (|0.35| < x < |0.49|) negative loadings for pause duration and shimmer for the voice. These loadings are consistent with RC1 accounting for variation in the levels of character assertiveness and emotional arousal, suggestive of an *intensity* dimension. RC2 is primarily characterized by moderate (|0.50| < x < |0.59|) to strong (|0.60| < x < |0.79|) positive loadings for expansion of the brow, eyebrow, and lips. It is additionally characterized by moderately low (0.35| < x < |0.49|) to moderate (|0.50| < x < |0.59|) negative loadings for duration and timbre for the voice. These loadings are consistent with

RC2 accounting for variation in the levels character cooperativeness and emotional valence, suggestive of a *quality* dimension.

The PCA reveals four important features of the relationship between characters and emotions. First, the emotions themselves approximate the structure of a circumplex model of emotions in the rotated principal component (RPC) dimensional space. Hence, the use of a segmental approach to facial expression, combined multimodally with a series of prosodic vocal parameters, leads to a result that resembles a standard circumplex organization for emotion. Second, the characters themselves approximate the structure of the 3 x 3 predictive character scheme in the RPC dimensional space. Third, the characters as a whole are contained within the overall emotion space, suggesting that the character portrayals were less extreme from an expressive standpoint than the emotion trials (rather than being distinctively different, which would have placed them in separate clusters from the emotions). Fourth, and perhaps most importantly, the characters are situated in the RPC space in a location that is proximate to or approximating towards the basic emotions that are intuitively associated with such characters. For example, *hero* and *king* are proximate to *proud*, *lover* is proximate to *calm* and *neutral*, *recluse* and *loner* are proximate to *sad*, and *bully* is approximating towards *angry*. Overall, the characters are contained within the general space of the emotions and are oriented in such a way as to approximate certain basic emotions intuitively associated with them.

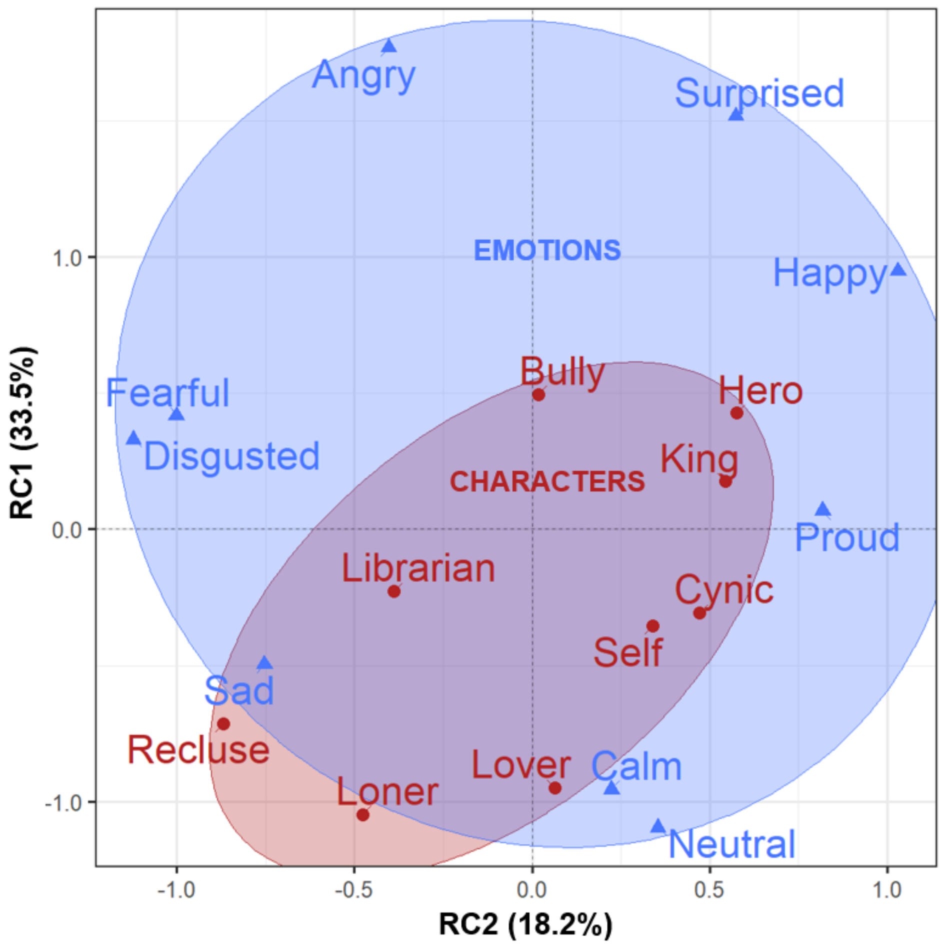

Figure 4.5. Varimax-rotated principal components plot for the characters and emotions. The characters are color-coded red, and the red circle contains the space of all characters. The basic emotions are color-coded blue, and the blue circle contains the space of all emotions. This multimodal analysis combines all of the facial parameters from the current analysis (i.e., the facial segments of the brow, eyebrow, lips, and jaw) with all of the vocal parameters (i.e., pitch, loudness, duration, and timbre parameters) reported in Berry and Brown (2019). Rotated component 1 (RC1) is suggestive of an *intensity* dimension, while rotated component 2 (RC2) is suggestive of a *quality* dimension. Condition locations are averaged across all participants.

4.5 – Discussion

We carried out the first production-based experimental study of the facial correlates of character portrayal, looking at mean trends and variability across a cohort of 24 professional actors. The characters were organized along the two orthogonal personality dimensions of assertiveness and cooperativeness. We found a significant main effect of cooperativeness on facial expression – with monotonic increases in facial expansiveness as the characters were increasingly cooperative in nature – but fewer facial correlates of character assertiveness, the jaw being the main effector to convey this. This is in contrast to our predictions based on the profile that we observed in our previous study of the vocal correlates of character portrayal (Berry & Brown, 2019), in which the strongest prosodic effects were found for assertiveness, rather than cooperativeness. A comparison between the results for the face and voice showed that the jaw was the clearest interface between facial expression and vocal prosody during spoken character portrayals, where increased mouth opening via jaw lowering correlated with increases in both pitch and loudness at the vocal level. Finally, the PCA analysis demonstrated that the stock characters in our two-dimensional scheme were proximate to the basic emotions that one might intuitively associate with these characters, but that the characters overall occupied a subset of the expressive space of the emotions, arguing that, while characters might have associations with particular emotions, they are not limited to these emotions and are not as extreme, from an expressive or performative standpoint, as individual emotions in isolation (Berry & Brown, 2019).

4.5.1 – Analyzing facial expression using segments

Most quantitative studies of facial expression examine individual action units (AUs) within the face, as seen most notably in methods based on the FACS (Barrett et al., 2019; Bartlett et al., 2005; Ekman & Friesen, 1978a, 1978b; Ekman & Rosenberg, 1997, 2005; Rosenberg & Ekman, 2020). We followed the lead of a number of previous studies in looking at facial segments (Fasel & Luettin, 2003; Hammal et al., 2007; Hammal & Massot, 2010; Kanade et al., 2000; Livingstone et al., 2015; Sandbach et al., 2012; Schmidt et al., 2003; Soyel & Demirel, 2007; Valstar et al., 2007; Yacoob & Davis, 1996; Zhang et al., 2015), instead of the combinatorial activation of facial AUs. In addition, we used a high-resolution motion capture system to examine the expansion and contraction of these segments in 3D, rather than in two dimensions (for 2D see Schmidt et al., 2003; for 3D see Livingstone et al., 2015; Soyel & Demirel, 2007; Zhang et al., 2015; for a review, see Zhi et al., 2020). In doing so, we were able to observe monotonic changes in segment expansiveness as a function of dimensional features of the characters and emotions that were analyzed in this study. The use of 3D facial segments might serve as a useful complement to studies of AUs that focus on the role of specific muscles in producing facial expressions.

Compared to the level of an action unit, a segment deals with a more integrative and more communicative level of facial expression, one that is intuitively understandable for most people. We analyzed four segments in this study, two vertical segments (the brow and the jaw) and two horizontal segments (the eyebrows and lips). While the contrast between a happy and sad facial expression can certainly be analyzed in terms of the underlying changes in AUs (Barrett et al., 2019; Scherer & Ellgring, 2007a, 2007b), they can also be analyzed as changes in the expansiveness of facial segments (Livingstone et al., 2015; Schmidt et al., 2003; Soyel & Demirel, 2007). In particular, happiness is associated with relative expansion in all four of the segments we used, while sadness is associated with relative contraction. The study of segments highlights the fact that, due to the differing innervation patterns of different facial zones by the descending motor system (Wilson-Pauwels et al., 2002), the lower face is activatable in a more lateralized fashion than the upper face, allowing people to raise just one cheek or abduct the jaw to one side. It will be important to ground the study of facial expression into particular facial zones (Guha et al., 2018), based in part on the innervation pattern of the face by the orofacial motor cortex. This is well-established in the distinction between the Duchenne smile and the fake smile, where the fake smile replicates features of the genuine smile in the lower face, but not the upper face (Carroll & Russell, 1997; Ekman et al., 1990, 2002a, 2002b; Gunnery & Hall, 2014).

4.5.2 – Analyzing facial expression in the context of speech

Facial expression was studied here in the context of spoken performance, rather than by looking at the static and posed depictions of emotional expressions that have been prevalent in much of the literature (Barrett et al., 2019; Carroll & Russell, 1997; Ekman et al., 2002a; Ekman & Friesen, 1975, 1976, 1978a, 1978b). This was done by normalizing the acting performances to the *neutral* emotion condition (Zhang et al., 2015), thereby correcting for general articulatory movements of the facial segments while still preserving the facial actions used for character portrayal. This not only allowed for a multimodal analysis of emotional expression between the face and voice, but also a more naturalistic manner of analyzing facial expression, since much facial expression occurs in the communicative context of conversation. Indeed, Girard and colleagues (2014), in their investigation of spontaneous expressions in non-scripted social interactions, noted that, while automatic AU detection of multiple conversing individuals is possible, the influence of speech on AU classification and intensity is difficult to assess and could not be evaluated using their methodology. Alternative methods of assessing the recruitment of AUs during facial expression and co-articulation have been used, such as assessing their presence/absence via coders while not directly correcting for speech confounds (Benitez-Quiroz et al., 2016) or analyzing facial expression functionally in conjunction with speech (Livingstone et al., 2015). Livingstone and colleagues (2015) found that co-articulated facial movements for happy and sad expressions were relatively similar to their non-speech forms (e.g., happiness exhibited increased movements of the eyebrows, lip corners, and jaw). This highlights the point that facial expression is not purely a spontaneous, static activity, but that it contains important dynamic and communicative information. People engaged in a conversation show a great deal of facial mirroring (Hatfield et al., 2014; Hess & Blairy, 2001; Seibt et al., 2015), a process that is thought to increase the social cohesion of the interlocutors.

The multimodal analysis revealed a series of correlations between the four facial segments and the two prosodic parameters of pitch and loudness analyzed previously (Berry & Brown, 2019). The results showed that, even after controlling for speech production in the *neutral* control condition, there were significant correlations between all facial segments and the vocal parameters. The most significant ones were between jaw lowering and increases in both pitch and loudness. These results corroborated previous research on the correlation between mouth opening and vocal pitch (Thompson & Russo, 2007), but extended it to include vocal loudness as well. In addition, we observed that increases in pitch were correlated with increases in brow raising, in support of previous findings (Scherer & Ellgring, 2007b; Thompson & Russo, 2007). These multimodal correlations were observed in both the character and emotion conditions, although the correlations for emotions were larger, in keeping with the observation from the PCA analysis that the performances of the emotions were more extreme than were those of the characters. Taken together, these results reveal the prospects of analyzing facial expression in the naturalistic context of speaking, as well as the benefits of carrying out multimodal analyses between facial expression and vocal prosody.

4.5.3 – A dimensional approach to characters and emotions

Our previous study of vocal prosody employed the two-dimensional scheme for classifying literary characters developed by Berry and Brown (2017) to examine the prosodic correlates of character portrayal in the same cohort of actors used here. The results demonstrated significant effects of character assertiveness on all prosodic parameters, but few effects of character cooperativeness on such parameters. The current analysis of facial expression showed very nearly the opposite pattern, with significant monotonic effects of cooperativeness on the expansiveness of three of the four facial segments, but an effect of assertiveness on the one segment that did not show a monotonic trend for cooperativeness, namely the jaw segment. These results reveal an important complementarity between the voice (assertiveness) and face (cooperativeness) in the communication of expressive information, as well as one between the facial effectors that linearly convey cooperativeness (the brow, eyebrow, and lips) and the one that linearly conveys assertiveness (the jaw). As mentioned above, the jaw showed an important cross-modal relationship with the voice via correlations with vocal pitch and loudness. These results are consistent with the idea – based in part on the contrastive appearance between the Duchenne smile and the fake smile – that the upper part of the face is a more honest indicator of felt emotions, whereas the lower face can be more effectively recruited to generate fake expressions (Carroll & Russell, 1997; Ekman et al., 1990, 2002a, 2002b; Gunnery & Hall, 2014).

These results provide further support for our two-dimensional classification of literary characters (Berry & Brown, 2017), as well as for the relevance of assertiveness and cooperativeness as salient personality dimensions by which characters can be meaningfully classified, as based on the Thomas-Kilmann Conflict Mode Instrument (Kilmann & Thomas, 1975, 1977; Thomas, 1992). We extended this notion of dimensionality by organizing the basic emotions included in the study in a dimensional manner in order to examine the character/emotion relationship. When we organized the emotions according to the dimensional scheme of the circumplex, we were able to recreate the circumplex structure in the PCA analysis using dynamic segmental data for the face. In addition, we observed striking parallels between the character dimension of cooperativeness and the emotion dimension of valence in the univariate analyses, as well as a parallel between the character dimension of assertiveness and the emotion dimension of arousal, a relationship that was alluded to but not analyzed in a direct manner in our previous study (Berry & Brown, 2019). These results suggest that cooperativeness and valence collectively comprise a *quality* factor, whereas assertiveness and arousal collectively comprise an *intensity* factor. They also suggest that the face might be the preferred modality for conveying expressive quality, while the voice might be the preferred modality for conveying expressive intensity, implying a complementarity between these two effector systems. These results point to the advantage of looking at emotions and characters in a dimensional manner, as well as their application for analyzing the character/emotion relationship.

The PCA analysis revealed that characters were often located in PC space proximate to particular emotions that would be intuitively associated with them, such as the king with proud, and the recluse with sad. Such results suggest that actors use facial and vocal parameters in a multimodal manner to contrastively depict both characters and emotions. However, the characters as a whole occupied only a subset of the expressive space of the emotions, suggesting that the portrayals of emotion were more extreme from an expressive standpoint than were the portrayals of characters. Another way of thinking about this is that, while characters may indeed have associations with specific emotions, they are not equivalent to these emotions. They have more complexity to them, leading to greater nuance in performance by actors.

4.5.4 – Applications

The present work has important applications to number of areas. These include clinical areas (e.g., behavior therapy, drama therapy, simulated care/training), commercial uses (e.g., performance art, consumer-based advertising, body language monitoring, multimedia, robotics), and entertainment (e.g., storytelling, video games, stage and screen performance; Zhi et al., 2020). An additional application is towards the establishment of a scientifically supported approach to acting methods that is grounded in multimodal expression (Berry & Brown, 2019; Kemp, 2012; Konijn, 2000). Indeed, a segmental view of facial expression allows for a quantification of behaviors that actors can meaningfully incorporate into their performances either implicitly (e.g., improvisation; Halpern et al., 1994; Spolin & Sills, 1999) or with training (e.g., acting education; (Benedetti, 2012; Brestoff, 1995; Mirodan, 2019). Additionally, a scientifically-grounded approach could provide testable psychological benefits in areas like theory-of-mind, empathy, and emotion regulation (Goldstein, 2009; Goldstein & Bloom, 2011). Finally, there is an important application of this work to the current interest in embodied cognition and how people can modulate their emotions and the presentation of the self in everyday circumstances through targeted changes to their body, including their facial expressions (Glenberg, 2010; Kemp, 2012; Niedenthal et al., 2009; Scott et al., 2001; Shapiro, 2019; Winkielman et al., 2015). The dramaturgical perspective in social psychology argues that social behavior is akin to a form of theatre and stagecraft (Goffman, 1959; Shulman, 2017), and that the analysis of social behavior can benefit from a view from acting theory.

4.5.6 – Limitations

While exploratory, the present work has a number of important limitations. A limited number of characters and emotions were used as the functional units of analysis in the study. However, these functional units were performed by a large and diverse group of actors of various trainings, ages, and genders. The ecological validity of the work could be increased by having the actors do their performances in front of an audience. Likewise, the actors could be presented with the characters in advance of the experiment, allowing them to produce more rehearsed and polished interpretations. The character/emotion relationship could be examined in greater detail by creating explicit pairings between characters and emotions, for example by comparing a proud king to an angry king to a sad king, a concept that we have referred to as *ethotypes* of a character (Berry & Brown, 2017). Even though stock characters are thought of as prototypes having relatively fixed traits, the use of different emotion pairings for a given character could highlight the character's *state*-dependent features as well. This would be especially important in looking beyond stock characters toward complex dramatic characters. For example, Romeo is initially a happy-go-lucky romantic (i.e., a lover) who falls in love with a girl at a party, but later becomes an anguished fugitive (i.e., a recluse) when he avenges the death of his best friend by killing a member of the rival group. An actor will externalize very different facial expressions, vocal prosodies, and body gestures when playing the balcony scene with Juliet as when playing the duel scene in which Romeo kills Tybalt and flees his home city.

Previous work on performance using actors has made use of automatic and computationally-driven 2D and 3D feature-extraction methods, allowing for greater data acquisition and analysis than was possible with our methods (Rosenberg & Ekman, 2020; Soyel & Demirel, 2007; Zhang et al., 2015; for surveys on different types of feature extraction see Sandbach et al., 2012; Zhi et al., 2020). The more limited number of markers used in 3D motion capture systems compared to 2D digital mesh overlays is offset by motion capture's higher fidelity in all three dimensions, increased sampling rate, and increased resolution (Qualysis, 2006). Indeed, Livingstone et al., (2015) took advantage of this increased fidelity by carrying out a translation of the 3D reference points to create a six-degree-of-freedom (6DoF) quantitative facial analysis of singers. Their 6DoF analysis included facial-marker movement in the three cardinal planes, as well as yaw, pitch, and roll for the head and neck. This is in contrast to the type of segmental analysis that we carried out, which has one degree of freedom (1DoF) and which Livingstone et al. (2015) employed to examine expansion of the jaw. We argue that a 1DoF segmental analysis of facial expression is readily interpretable in such a way that it can be easily disseminated in applied uses like actor training and behavior therapy.

4.6 – Conclusions

We carried out the first experimental production study of the facial correlates of character portrayal in professional actors. We applied a 3D segment-based approach for measuring facial changes during performance, and observed that such changes were more-reliable indicators of the cooperativeness than the assertiveness of a character, a complementary finding to our previous vocal findings, which showed a stronger relationship of prosody with character assertiveness. Significant correlations were observed between the facial and vocal modalities of expression for both the stock characters and basic emotions, extending previous work on verbal and non-verbal forms of expressive performance. These results not only provide new insight into the nature of acting and performance, but reveal the prospect of studying facial expression in the context of speech and dynamic performance, rather than producing static poses in isolation.

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4.8 – Appendix A

Neutral Script. **“**I walked into the room. A bag is in the room. It sits on the cabinet beside a clock. Digital clocks are common. There are four drawers in the cabinet. I see a rug on the floor. It looks to be expensive.”

4.9 – Declaration of conflicting interests

The Authors declare that there is no conflict of interest.

4.10 – References

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Chapter 5 – Discussion

Matthew Berry

5.1 – Introduction

The fascinating phenomenon of acting has been well documented across the millennia. Numerous acting theorists, teachers, and practitioners have provided various methods for producing a *conceivable* and *compelling* representation of a character, fictional or otherwise. While a small number of attempts have been made by the scientific community to study acting empirically from an actor-centric perspective (Hannah et al., 1994; Neuringer & Willis, 1995; Smith, 1971; Timmons, 1945), acting as a phenomenon has not been broadly investigated (Goldstein, 2015). Critically, psychological studies of acting have, up to this point, omitted the direct and systematic study of what constitutes the gestural production of a character. To produce a conceivable and compelling representation of another individual, an actor has to know in advance, or develop in real time, what the character looks like, sounds like, and acts like. Real-time character production is of particular interest to me, and was therefore explored in this dissertation. As such, this dissertation constitutes the first series of studies set to study acting with regards to the vocal and facial expressions generated by actors during character portrayal.

5.2 – Contributions to the Field

To date, few studies have attempted to study the process of acting empirically. In addition, no scientific studies have, to the best of my knowledge, approached the study of acting from a character-oriented perspective. Those studies that have attempted to quantify the process of acting have approached it from an actor-only or actor-character direction (Hannah et al., 1994; Neuringer & Willis, 1995; Smith, 1971; Timmons, 1945). Such studies have been relatively limited in scope by focusing on student actors, specific plays, or specific characters. Additionally, they have investigated only one specific question (i.e., do actors and/or characters psychologically influence one another?). By consequence, these studies have ignored other questions related to acting and character portrayal. Their findings and conclusions have also been mixed. When investigating how the personalities of an actor and a character interact, Smith (1971) found slight modifications of character personality in the direction of the actor's personality, while Hannah and colleagues (1994) found slight modifications of actor personality in the direction of their character's personality. Timmons (1945) found no effect of character personality on actor personality. This finding was corroborated by Neuringer and Willis (1995). My dissertation diverges from these lines of investigation. First, it increases the investigative scope by conducting analyses at the group level, including multiple actors of differing training levels, and a range of characters. Second, it explores the behavioural aspects of character portrayal in actors through a modeling of the products of acting, namely the characters' gestures.

The data that I presented in this dissertation should be of interest to those who study acting and psychology, since it contributes to an understanding of acting as an embodied behavioural process. While the work is exploratory, I have demonstrated that actors and non-actors share general conceptualizations of basic character-types and that these conceptualizations are consistent enough to establish characters as a new testable "functional unit" for acting studies. My work has been the first to investigate character-types in isolation, independent of emotion or dramatic context. Furthermore, I have shown that actors can reliably physicalize their character-type conceptualizations along similar lines in two modalities, namely the voice and face. Indeed, the work presented here is the first to perform group-level analyses of actors as they portray characters or emotions, doing so across multiple ages and training levels. The results of these analyses have demonstrated that actors can reliably manipulate their vocal and facial expressive-cues in a contrastive manner to differentiate characters based on the characters' underlying personality traits. Finally, the work is the first to use a predictive model – namely, our two-dimensional 3x3 scheme for character assertiveness and cooperativeness – as the basis for hypothesis testing with regards to acting and character portrayal. In essence, my contribution of a predictive model for character portrayal brings a critical component of science into the world of acting, namely hypothesis testing.

In addition to the predictive model, this dissertation contributed to the field by providing a heretofore unused approach to evaluating the process of acting: multimodal gestural analysis. Indeed, this thesis analyzed data in three distinct but complementary ways. The first was a univariate-unimodal analysis of coarse-level vocal and facial gestures during character portrayal. This analysis established the relationships between the respective parameters and the two dimensions of the predictive model. The results of the univariate-unimodal analysis demonstrated dimensionally-predictable, modality-specific gestures and behaviours during character portrayal. Along these lines, a direct comparison between the performative and non-performative versions of the self was conducted. Second, I presented a univariate-multimodal analysis of the voice and face. This analysis established the relationships between select parameters across the two modalities, independent of any dimension-specific predictions. This analysis extended beyond the predictive model and was not necessarily related to performance per se, but rather was indicative of larger behavioural trends. The results of the univariate-multimodal analysis demonstrated predictable, modality-connected behaviours that are exhibited during acting (i.e., character and emotion portrayal) but that may transcend the context. Future studies in this area are needed. Third, I presented a multivariate-multimodal analysis of the voice and face during character and emotion portrayal. This analysis established the shared relationships between the behavioural parameters and the two "functional unit" groups. The multivariate-multimodal analysis illuminated the relationship between characters and emotions within a multidimensional performance-space.

In sum, the data and analyses presented in this dissertation contributed to the quantitative study of acting by providing the inaugural character-oriented study of the products and process of acting. Characters were established as "functional units", and their coarse-level gestures were performed, extracted, and analyzed at the group level in the two modalities of the voice and face. The result is a theoretically predictable, practically meaningful blueprint of character portrayal.

5.3 – Chapter Summary

5.3.1 – Chapter 2

In **Chapter 2**, I created and validated a classification scheme for literary characters that served as a predictable model for the other behavioural experiments in this dissertation. I established a new "functional unit" for the purposes of experimentation, namely that of a stock (or prototypical) character. I carried out a psychometric rating study to evaluate four personality-trait scales and 40 stock characters from across Western literature. I found that only the two personality dimensions of assertiveness and cooperativeness were orthogonal, allowing for the classification of characters along these two dimensions. These results suggest that prototypical characters can be conceptualized in a predictable manner across participants, and that personality traits provide a reliable means of classifying literary characters.

5.3.2 – Chapter 3

In **Chapter 3**, I further validated this character-classification scheme using actors' vocal gestures during character portrayal. Behavioural piloting revealed differences between character conceptualization and character performance, which allowed for a more refined and testable two-dimensional model. I used a novel neutrally-scripted acting paradigm and voice recording technology with 24 professional actors to explore 12 prosodic features of character vocal production related to pitch, loudness, timbre, and duration/timing. I found that actors' vocal productions conformed more to the assertiveness dimension than to the cooperativeness dimension of the character scheme. This supports findings from the vocal emotion literature (Belyk & Brown, 2014; Douglas-Cowie, Campbell, Cowie, & Roach, 2003; Goudbeek & Scherer, 2010; Owren & Bachorowski, 2007; Schröder, 2004) indicating that arousal (similar to assertiveness) is much more reliably encoded than valence (similar to cooperativeness) in vocal prosody, suggesting a potential link between character and emotion that was explored in more depth in **Chapter 4**. These results indicate overall that actors modulate their voice to differentiate between different characters and that the personality of the character is predictive of its performance prosody.

5.3.3 – Chapter 4

In **Chapter 4**, I further validated the two-dimensional character model using actors' facial gestures during character portrayal. In addition, I replicated and extended previous findings on the facial expression of emotion by investigating a dimensional scheme of emotional arousal and valence. I used a novel neutrally-scripted acting paradigm and 3D motion capture technology with 24 professional actors to explore four dynamic facial segments of character and emotion production. The four facial segments were related to the expansion and contraction of the brow, eyebrows, lips, and jaw. This was done across 9 characters, as organized in a 3x3 scheme, and across 9 emotions, as organized in a 2x2 scheme. I found that actors' facial productions conformed more to the cooperativeness dimension than the assertiveness dimension, a finding opposite to the prosody results found in **Chapter 3**. This suggests a multimodal trade-off for acting whereby the voice is more effective at conveying character assertiveness, while the face is more effective at conveying character cooperativeness. The interface between these two sets of results was the jaw, whose expansion (i.e., mouth opening) conveyed character assertiveness for both the voice and the face. Hence, I observed correlations between jaw expansion and vocal pitch and loudness. Furthermore, the work established a dimensional connection between character cooperativeness and emotional valence, and between character assertiveness and emotion arousal. Finally, the principal components analysis (PCA) established a connection between the characters and certain basic emotions that would be intuitively associated with them. The characters were found to be contained within the space of the emotions, suggesting that characters are most nuanced, from an expressive standpoint, than emotions in isolation. These results overall suggest that actors modulate their faces to differentiate between different characters and emotions, and that the personality of the character is predictive of its performer's facial expressivity. They also suggest that the face and the voice may convey reciprocal personality dimensions of characters, with the exception of the jaw/voice connection. Finally, the results point to suggestive connections between characters and emotions that should be explored in future studies.

5.4 – Limitations

I would like to take this opportunity and underscore a series of limitations in the generalizability of this dissertation. I specifically wish to address limitations due to the cultural specificity of the sample and methodology as well as limitations due to complexity reduction within the acting paradigm. I present these limitations in the following sections.

5.4.1 – Western-centrism

First, I wish to address the limitations due to cultural, geographical, and demographic specificity of the rater and actor samples. Indeed, the demographics of the participant raters in **Chapter 2,** as well demographics of the participant actors used in **Chapter 3** and **Chapter 4,** were only collected with regards to gender and age – with the latter sample additionally being screened for native language and acting experience. Indeed, while the data suggests there are no rating/performance differences between genders, the data in the present dissertation are incapable of supporting any cultural or further demographic analyses. However, there may in fact be cultural biases in the overarching methodology leading to the semblance of Western- or Euro-centrism. For example, the characters provided for the rating study were primarily taken from Western literature ("Archetypal Character," 2013; Freedman, 2014; Golden, 2011; Landy, 1996; "List of stock characters," 2012; Propp, 1968; Schmidt, 2001, 2012) and may thus present a Western bias. Furthermore, while no cultural demographic data were acquired, I will note that the training and cultural backgrounds of the sampled actors were primarily Western, with the majority of actors being visibly Caucasian. Recall that the actors were sampled from McMaster University and the local surrounding areas (Berry & Brown, 2019, submitted).

This is not to say that the findings disseminated in this dissertation do not merit discussion or offer important insight into the nature of acting. Rather, the generalizability of these findings beyond a Western context may be limited. For example, Japanese Noh actors or performers from West Java may be unlikely to contextualize and perform characters such as "cynic" or "librarian", since their characters stem from a different cultural history (Benedetti, 2012; Foley, 1995/2002; Meinek, 2011; Suzuki, 1995/2002). Additionally, more ubiquitous characters like "king" and "hero" may be contextualized, but their interpretation and physical embodiment by the actors could be different from what the current findings suggest. It is not my intention to focus solely on European culture, characters, or theatrical history to the exclusion of a wider view of the acting world. The work presented here is a product of my own cultural background and understanding. Moving forward, it is imperative that cross-cultural research be conducted to add context, perspective, and ultimately expand on the findings presented in this dissertation.

5.4.2 – Complexity reduction

Second, I wish to address the limitations due to reducing the complexity of acting as a paradigm. Despite the earlier operationalization of acting being a conceivable and compelling representation of a character, the act of performing a character is highly complex. In almost any given performance, actors are required to a) create a conceivable and compelling complex characterization, b) memorize and recite highly complex and intricate dialogue, c) interpersonally interact with directors, scene partners, co-actors, assistants, stage-hands, trainers, coaches, and more, d) scan the environment visually and acoustically for cues, e) consistently hit temporal cues, f) consistently hit physical cues/location based blocking, and g) anticipate changes in audience feedback and improvise while in character, to name a few. With such a grouping of complex behaviours, a reduction in complexity is required to remove confounds to even begin to systemically explore any one of these aspects of acting individually. This is what was done in the present dissertation. To examine character creation in isolation, actors performed simple monologues of basic characters in solo performances without direction, cues, blocking, or an audience. However, this can lead to limitations in generalizability, specifically in the vein of reductionism – confusing statistical findings/artefacts with the actual biological, psychological, and behavioural realities of acting. This is not to say what is reported in this dissertation does not constitute acting; it does. Rather, what can be considered acting is more complex than the paradigm used here. In other words, the paradigm is a significantly reduced form of acting and performance more generally. Therefore, the results should be generalized with some caution and expanded upon in future psychological and scientific studies of acting.

While the work presented here is the first to attempt to systematically explore the gestural correlates of characters, it is not the first entry under the larger umbrella of the psychology of acting, or indeed the science of acting. Currently, there are important empirical contributions to the literature exploring acting in relation to less behavioural and more abstract, but equally vital, aspects of acting such as: emotions (Konijn, 2000), memory (Noice & Noice, 1996; 1999), empathy, mentalizing, theory-of-mind (Goldstein, 2009; Goldstein & Winner, 2010; Nettle, 2006; Panero, 2019; Panero & Winner, 2020), and embodiment (Carney, Cuddy, & Yap, 2010; Flack, 2006; Flack, Laird, & Cavallaro, 1999; Kemp, 2012; Strack, Martin, & Stepper, 1988). Future work in the strengthening and proliferation of the scientific and psychological study of acting will require integrating the approaches and findings of these areas into a more holistic methodology and theory.

5.5 – Future Directions

I believe that sound science progresses in two distinct but equally important ways: through *evaluation* and through *integration*. Evaluation, through either the direct replication or validation of one's work, assures scientists that their assumptions and foundation of knowledge are correct. Evaluation can be conducted by the original scientist, but it is best served when it is conducted by one's contemporaries. Integration, through the incorporation of insights, theories, and practices from other domains into one's research and vice versa, extends the foundation of knowledge to be greater than the sum of its parts. Good science is synergistic; it builds upon itself while also incorporating insights from adjacent fields. I believe that my research exemplifies the practices of evaluation and integration. The work in my dissertation builds upon itself with each successive experiment, as well as bridges the fields of theatre and psychology with points of entry, like character-types, emotion, and personality. In continuation with this practice, I present the two overarching directions for future research: 1) evaluating the quantitative study of acting, and 2) integrating my findings into a new field: the science of acting.

5.5.1 – Evaluating the quantitative study of acting

I listed two aspects of evaluation above: direct replication and validation. The work of this dissertation constitutes a series of exploratory studies requiring direct replication. Replication in its simplest form would require utilizing the 3x3 predictive model and the characters therein, as I have presented in **Chapter 4.** This would need to be coupled with identical behavioural methods, as outlined in **Chapter 3** and **Chapter 4.** For proper replication, future researchers would also have to analyze a different, yet comparable, group of professional actors that ranges in age, training, and experience. Direct replication would evaluate if the methods and results that I have presented here are generalizable to additional and similar samples, rather than being the subject of random chance observations. Once replication has been conducted and the results are verified, further samples of increasing diversity can be explored. Additional changes to the protocol I established would allow researchers to validate the findings I have presented, rather than directly replicating them.

Validation involves the exploration and refinement of a study's protocol, leading to a greater understanding of the results. Validation also extends our understanding of the original study's findings to new contexts. Validation of my studies could be conducted through, but not be limited to, explorations of the methodology, analysis, participant sample, character sample, and personality measures. For example, a validation of the methodology could be conducted in a two-person dialogue scene, instead of the one-person monologue scene employed here. Such a study could also validate the character sample by having the two actors portray different characters from the 3x3 predictive model who have contrasting goals or personalities (e.g., low-cooperativeness-high-assertiveness & low-cooperativeness-low-assertiveness). A multimodal gestural analysis of this scene could investigate how different combinations of characters (e.g., bully & lover; bully & bully) impact which gestures are used. Perhaps the gestures observed during these contrastive interactions would map onto predictions from the TK Conflict Mode Instrument (Barki & Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992). This type of validation could be done utilizing the characters previously explored behaviourally (see **Chapter 3** and **Chapter 4**). Additionally, this could be done through testing characters collected but not explored (see **Chapter 2**) or through the inclusion of yet additional character-types from different cultures that vary in nature and complexity. For a full understanding of characters and character-types, all three examples should eventually be explored.

The same can be said for the validation of the personality measures. Future research will be needed to provide a more thorough understanding of the dimensions used for character classification, comparing their predictive power directly against other models of personality (i.e., the five factor model of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism, collectively abbreviated as OCEAN; Costa

& McCrae, 1992; Digman, 1990; Meyers, 2010) and emotion (i.e., the Ortony, Clore, & Collins model of emotion, collectively abbreviated as OCC; Ortony et al., 1988). On the one hand, the data presented in this dissertation aligns with established personality theory that the two dimensions of assertiveness and cooperativeness can be seen as adequate for predictability (Abbott, 2008; Barki & Hartwick, 2001; Duane, 1989; Kilmann & Thomas, 1975, 1977; Rahim, 1985; Thomas, 1992). On the other hand, it provides support for a personality- and emotion-dimension relationship. Indeed, it can be seen that the dimensions of assertiveness and cooperativeness relate to emotion dimensions of arousal and valence, respectively, as well as to overarching dimensions of *intensity* and *quality*, as shown in the PCA analysis in **Chapter 4**. There may be additional predictive power through the inclusion of another dimension. One such candidate might be a *dominance/power/control* dimension (Barrett et al., 2019; Scherer et al., 2006; Wundt, 1905). Future research will need to investigate the inclusion of different dimensions, striking a balance between predictability and parsimony. Alternatively, appraisal-based models of emotion can also be investigated for connections with personality and characters (see the OCC model of emotion, Clore & Ortony, 2013; Ortony et al., 1988 or componential appraisal theory, Scherer et al., 2006; Scherer & Ellgring, 2007a, 2007b)

The exploration of the relationship between emotions and characters is yet another direction for future research. My research suggests a new concept: that of an *ethotype* or character variant. At present, I have only explored this concept indirectly by having actors portray characters and emotions separately. A direct exploration of ethotypes could be done by contrastively pairing characters and emotions (e.g., angry-king vs. sad-king; fearful-hero vs. proud-hero) in a similar study to the one described above. This would be a critical step in the quantitative study of acting towards a more detailed and nuanced understanding of character portrayal.

5.5.2 – The science of acting

While the practice of experimental psychology is the systematic and quantitative study of the structure of behaviour and cognition, it does not operate in a vacuum, but can instead provide insights, theories, and practices to other domains. The culmination can be the creation of an entirely new field of investigation in human psychology. The emergence of one such field in relation to acting is evident, and so I offer a series of future directions by which this field can grow. Most, if not all, of the aspects of this new field remain unexplored. For brevity, I will limit this discussion to three avenues of investigation: the character, the actor, and the actor-character relationship.

5.5.2.1 – Understanding the character

Acting is more than just presenting a character's spontaneous emotions. Personalities, characteristics, and gestures are also presented during acting. It is this paradigm shift from emotions to characters that has only just begun to be evaluated. The dedicated study of characters has proven to be tenable, as indicated by the results of my dissertation. Indeed, there are emerging avenues for understanding characters more thoroughly. A next logical step is to extend our concept of characters as "functional units" by evaluating their classification, complexity (e.g., one dimensional vs. fully realized characters), use of actions, emotions, relationships with each other, and their existence more broadly (e.g., cross-media and cross-cultural analyses). I believe that a more detailed understanding of characters, both conceptually and behaviourally, is necessary in establishing this field.

5.5.2.2 – Understanding the actor

Actors as a group require attention within the broader scope of the science of acting. Indeed, acting and science go hand in hand. On the one hand, actors use scientific and psychological findings to create a deeper understanding of their characters and inform their portrayals (Goldstein & Bloom, 2011; Kemp, 2012). On the other hand, actors have been used by scientists to enhance our understanding of a variety of areas, including personality (Burgoyne et al., 1999; Hannah et al., 1994; Nemiro, 1997; Neuringer & Willis, 1995; Panero, 2019; Smith, 1971; Timmons, 1945), emotions and emotion regulation (Carroll & Russell, 1997; Ershadi et al., 2018; Goldstein, 2009; Juslin & Laukka, 2003; Juslin & Scherer, 2005; Murray & Arnott, 1993; Scherer & Ellgring, 2007a, 2007b; Wallbott & Scherer, 1986), deception (Anolli & Ciceri, 1997; Ekman, Friesen, & Scherer, 1976; Villar, Arciulia, & Paterson, 2013), empathy, mentalizing, and theory-of-mind (Goldstein, 2009; Goldstein & Winner, 2010; Nettle, 2006; Panero, 2019; Panero & Winner, 2020), memory (Noice & Noice, 1996; 1999), and embodiment (Carney, Cuddy, & Yap, 2010; Flack, 2006; Flack, Laird, & Cavallaro, 1999; Strack, Martin, & Stepper, 1988).

However, it is not clear at this stage if actors comprise a “special population”, one with enhanced or diminished faculties in these areas. For example, Nettle’s (2006) comparison of actor and non-actor personality scores demonstrated differences along the dimensions of extraversion, openness, agreeableness, and empathizing, indicating that actors as a group may have an inherent personality configuration that is different from the general population. Goldstein (2009) speculated that actor disposition may moderate theory-of-mind, empathy, and emotion-regulation skills. The degree to which acting training moderates faculties in these areas is also an important question (Goldstein, 2009). Further research is required to investigate the relationship between an actor's intrinsic nature, training, and the degree to which these two factors affect their psychological abilities.

An additional psychological ability in the actor that has also yet to be addressed is the manifestation of *the illusion of spontaneity*. This reflects the audience's perceptual illusion of the character's "aliveness" (Weinbren, 2020) or "new ness" in the actor's actions despite constant preparation, repetition, and rehearsal of the same actions. The paradox of *behaviourally-prepared-but-perceptually-fresh* action and how actors overcome it should be given adequate empirical attention.

Finally, it will be important to understand the actor with regards to the intangible concept of personal charisma or the "it factor" (Roach, 2007). Some people have "it" (e.g., actors, professors, politicians), and some people do not have "it". "It" is extremely sought after. "It" is hard to specify: grace, personal charisma, charm, confidence, the ability to command attention, the innate spark, gravitas, stage presence, and so on. To fully understand the actor, scientists will need to develop an empirical grasp on what "it" is. Future research needs to endeavor to quantify charm, charisma, and confidence, and how they relate to aspects of acting and the actor-character relationship.

5.5.2.3 – Understanding the actor-character relationship

Humans are complex and so it stands to reason that the characters they create and embody are complex as well. In addition, the relationship between the actor and the character is a complex one that requires careful attention. What I offer for future investigations is a series of comparisons between the innate/learned aspects of actors and the characters that they portray. For example, a deeper understanding of actor personality and character personality can be sought now that there is evidence that both can be directly measured in a predictable manner. Perhaps certain actors are drawn to roles that are similar to (or divergent from) their innate personalities (i.e., *persona* or *transformative* acting, respectively; Kemp 2012), and adopt roles to showcase their talents in either capacity (see the *self-expressive mode* in States, 1995/2002). In like form, actor training may influence role selection and character-type use, and this in turn may be mediated by factors such as the performance context (e.g., stage or screen), purpose (e.g., audition, personal, or performance), and others.

Future research should explore the nature of character identification by the actor. States (1995/2002) writes that there is the ghost of the actor's self in their performance. No matter how an actor approaches the task of character portrayal, they are always present, and there is always a little bit of themselves in their performances. An actor can only ever blur, but never erase, the boundary between themselves and their character (Burgoyne, 1999). Indeed, recent neuroscientific work may support this claim. In the first neuroimaging study of dramatic role playing, the researchers revealed deactivations in self-related brain regions during acting (suggestive of boundary blurring) and activations in areas indicative of dual-consciousness (suggestive of a lack of overlap or character carry-over; Brown et al., 2019;

Burgoyne, 1999). However, these results are complicated by the observation in this dissertation of an actor's *performance persona.* The *performance persona* indicates that the self may also be considered as a character, complete with its own behavioural properties. Indeed, the self-as-role concept is central to the "dramaturgical" perspective in social psychology, which posits context-dependent roles and scripts for each type of social partner (Goffman, 1959). It is imperative that future behavioural, cognitive, and neuroscientific research investigate character identification and its correlates across a potential spectrum of self, self-roles, and characters of varying complexities.

5.6 – Conclusion

The data that I presented in this dissertation comprise the first experimental analyses of gesturing during character portrayal in actors. While exploratory, the results of the three experiments I conducted demonstrate three salient points: 1) actors and non-actors share general conceptualizations of basic character types, 2) actors reliably physicalize their shared character-conceptualizations along similar lines in the two modalities of the voice and face, and 3) actors reliably manipulate their vocal and facial expressive-cues in a contrastive manner to differentiate characters based on the characters' underlying personality traits. This final point about the *reliability* of character portrayal brings a critical component of science into the world of acting – hypothesis testing – and paves the way for a heretofore unexplored area of psychology to emerge: the scientific study of acting. My work constitutes the first entry point in what I believe will become a long and productive chapter in the exploration of the craft of acting. It is my hope that this dissertation will inspire psychologists to continue multimodal studies of actors, characters, personalities, emotions and more, but also embolden scientists, actors, and acting theorists of all sorts to collaborate and extend our understanding of the fascinating phenomenon we call acting.

5.7 – General References (Chapter 1 and Chapter 5)

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