Do Biometric Analyses and Empathy Training Predict the Development of Empathy?

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Many healthcare education programs recognize the importance of empathy in professional practice and, consequently, include empathy training in their curricula. Unfortunately, the literature has not yet demonstrated that empathy training consistently yields greater levels of empathy. This may partly stem from the fact that empathy is frequently measured using (valid and reliable) self-reported scales. These instruments provide a "snapshot" of a respondent's empathy but provide minimal information about the development of empathy. Applying biometric analyses within the context of empathy training permits collecting additional data that may provide a more developmental evaluation of empathy training. This study empirically examines whether biometric measures are statistically significant predictors of empathy when employed within the context of health-related empathy training. We find that empathy training does not significantly impact self-reported levels of cognitive or affective empathy as measured. However, biometric information collected from individuals who completed empathy training does significantly predict affective (but not cognitive) empathy.

Keywords: cognitive empathy, affective empathy, biometric analyses, information entropy, Tobit regression

INTRODUCTION

Empathy is a fundamental way we comprehend and interact with the world around us (Gallese, 2005). Our ability to understand and relate to others is, in part, a function of the empathetic process. How well we make rapid and accurate inferences about the feelings, goals, attitudes, motivations, beliefs, intentions, and behaviors of other people will determine, to a large extent, what we may contribute to a specific social interaction as well as how others perceive us (Mitchell, 2008). Empathetic understanding is, therefore, an important determinant of how well we communicate with each other and a personal characteristic that can facilitate our ability to persuade other people to accept an idea, feel a particular way, or pursue a certain course of action. Empathy is a means of communication that people use daily to better understand one another and to share their thoughts, feelings, and personal experience (Rizzolatti et al., 2006).

Like many professional academic associations, the American Association of Medical Schools (1998) has long recognized the importance of communication skills, including empathy, in clinical healthcare environments.[1] The quality of the clinician-patient relationship is moderated by the extent of empathetic understanding expressed by the clinician (Hojat et al., 2002). Empathetic understanding has been found to reduce stress and increase job satisfaction among medical service providers, as well as result in more accurate diagnoses and fewer malpractice lawsuits (Hojat et al., 2011; Hojat et al., 2013; Wagaman et al., 2015; Ferreira et al., 2020). Patients also report superior healthcare outcomes, greater conformity with medical provider recommendations, and higher levels of satisfaction when they perceive higher levels of empathetic understanding (Vermeire et al., 2001; Hojat et al., 2010; Wang et al., 2018).

Health profession educators have developed a broad array of empathy-related training programs as a consequence. Even though empathy-related training has become a growing component of healthcare professionals' education, the literature does not unequivocally demonstrate that empathy education results in greater levels of clinician empathy and/or which form(s) of empathy training may be more successful in doing so. Decety (2020) argues that these inconsistent results are a function of vague empathy definitions and situational context. Although many past studies argue empathetic skills can be enhanced through training, those same inquiries often reach such a conclusion despite evidence to the contrary.

The assertion that empathy may be taught effectively often appears to be delivered as a philosophical position rather than a deduction drawn from a compelling body of evidence. For example, Erera (1997) concluded that empathy training improved empathy levels. However, that conclusion was drawn based on statistically significant differences in the within-subjects treatment group, rather through a comparison of the test (i.e., training) and control (i.e., no training) groups. Kataoka et al. (2019) found that physicians who completed a communications skills training program exhibited higher empathy scores. However, those increases in empathy were temporary. Teding van Berkout and Malouf (2016) conducted a meta-analysis of various approaches to empathy training and found little systematic evidence to support the effectiveness of empathy training. The authors also noted that the effectiveness of empathy training depended largely on whether empathy was characterized using self-reported or objective measures.

The Teding van Berkout and Malouf (2016) study raises an interesting topic, which has been insufficiently addressed in the literature. A critical component of evaluating the effectiveness of empathy training focuses on how empathy is measured. Empathetic understanding is an inherently internal personal characteristic. As such, most global empathy assessments rely on subjective, self-reported responses. Objective measures tend to be indirect indicators of empathy (i.e., characterizing individual responses to specific stimuli that, according to the researcher, require an expression of empathy). Both types of measurconcluses exhibit limitations. Subjective measures are subject to framing and other cognitive biases that may vary systematically by individual characteristics or situational context. Objective measures are limited in that they either characterize specific aspects of empathy or characterize overall empathy with measurement error (or both). One possible means to address these limitations is to use both types of measures when assessing the effectiveness of empathy training. More specifically, subjective self-reported measures can be used to capture overall empathy. Objectively collected measures can also be collected throughout the empathy training and used as additional control variables to assess individual-specific differences as respondents complete the training. In doing so, it is possible to evaluate the effectiveness of empathy training and establish empirical associations between objectively and subjectively collected empathy measures.

This study aims to conduct an experiment that allows for the evaluation of empathy training, while incorporating both objective and subjective empathy measures. In doing so, it is also possible to evaluate the relationship between the two types of empathy measures. The remainder of this paper proceeds as follows. In the next section, we use the empathy literature to discuss the multidimensional nature of empathy and how different empathetic elements may influence interpersonal communication. This leads to the development of several hypotheses surrounding the measurement of empathy. The third section describes an empirical methodology that can be used to test those hypotheses. More specifically, we conducted an experiment using an existing empathy training exercise created by a major medical school/hospital. Empathy is measured using a global, self-reported empathy instrument (the Basic Empathy Scale for Adults, or BEA-S) and objective, biometric information collected from respondents during the training. An extension of the difference-in-differences statistical model is developed and subsequently applied to the data to test the study's hypotheses. The fourth section describes the empirical results. In the paper's final section, we summarize our major findings, discuss the study's limitations, and present some suggestions for future research in this area.

LITERATURE REVIEW

Empathy has been defined as the ability to understand and identify with the thoughts and feelings of another human being using auditory and visual cues (Davis, 1983). As such, empathy is a broad umbrella construct often used to describe several related but distinct concepts. For example, this general definition of empathy includes emotional contagion (the automatic feeling and/or similar expression of another person's emotions), emotional concern (feelings for the perceived needs of another person coupled with a desire to help), emotional empathy (an emotional identification with, rather than a blurring of the distinction between, oneself and another person), and cognitive empathy (understanding what another person may be feeling or thinking by consciously adopting their perspective) (Hoffman, 2000).

Previous research has mostly concentrated on a single aspect of empathetic response, or the lack thereof, rather than on how these various empathetic states are related or may be activated in people. As an illustration, early work on emotional contagion proposed that this phenomenon developed in humans as a survival mechanism (Plutchik, 1987). A young child, for example, who vicariously feels happy upon seeing her/his mother's smiling face does so automatically to develop a stronger bond with that parent. Although such a bond may increase the probability of the child's surviving by enhancing empathetic understanding between a mother and child, little enlightenment is provided on the neurological mechanism of emotional contagion or how it may be related to more elaborate empathetic responses.

Mirror neurons identified in the human brain provide a plausible explanation for this most basic form of the emotional contagion-based empathetic response. A mirror neuron is a premotor neuron that fires automatically when an action is observed in another person (Gallese, 2005; Iacoboni et al., 2005). Those are the same neurons that fire whenever a person undertakes the specific actions of him or herself, allowing people to form a congruent mental response or representation (Gallese, 2003). Observation of another person's behavior simply causes the arousal of the same neural mechanism in the observer. However, research has also shown that this particular empathetic link between individuals can correspond to more than automatically experiencing another person's emotions. Gallese (2009) reviewed findings from a series of experiments that suggest people can accurately discern the motivation and behavioral intentions of others from the emotional states of the people they observe. Such empathetic understanding is expressed in a variety of more complex ways than simple mimicry. For example, Lamm et al. (2007) describe a perspective-taking experiment that reflects neurological differences between empathetic concern and emotional empathy. One group of research participants was told of another person's plight and asked to imagine how that person felt. Empathetic concern for the other person was the result. A second group of research participants were asked to imagine how they would feel in the other person's place. Feelings of personal distress or emotional empathy, rather than empathetic concern for the other person's plight, was the discrepant outcome for the same situation except for the framing instructions given to respondents.

Automatic empathetic responses appear to dominate early in life and are largely involuntary. Infant mimicry of parental facial expressions is an early form of emotional sharing believed to be a prerequisite for speech development (Lamm et al., 2008). The discovery of mirror neurons in the human brain also provides an evolutionary basis for explaining more complex cognitive empathetic responses and empathetic caring (Gallese, 2008). More complex human knowledge structures, such as language, appear to be associated with higher-level empathetic processes that build upon basic empathetic activities and suggest that appropriate empathetic responses to other people are learned with age and enculturation (Decety and

Michalska, 2010). Although two people can share emotion without cognition, this preverbal and essentially involuntary form of empathetic arousal does not explain empathic processes like simulation or perspective-taking. At least some thoughtful elaboration and/or evaluation must occur whenever an individual imagines what another person may feel or how he or she will act in a particular situation. The evolution of the human cerebral cortex and the limbic system allows most people to take advantage of knowledge structures based on their experience and an advanced information processing capacity (Decety et al., 2012).

Research on the neurological foundations of empathy provide useful means for integrating a variety of findings on empathy. For example, a lack of emotional empathy is a primary feature of autism spectrum disorder (Gleichgerrcht et al., 2013; Mazza et al., 2014). Shirayama et al. (2022) found that young adults with autism spectrum disorder displayed significantly lower cognitive empathy scores and levels of empathetic concern compared to a control group of otherwise comparable individuals who do not have an autism spectrum disorder diagnosis. However, Rueda et al. (2015) found that, while individuals with autism spectrum conditions (specifically Asperger Syndrome) exhibited lower cognitive empathy scores compared to a control group, and also exhibited emotional recognition deficits, their affective empathy scores were not statistically different from those of the control group. Similarly, Leigh et al. (2013) demonstrated that acute brain lesions on the right side of people's brains impair emotional, empathetic responses — their ability to accurately assess how another person may feel. These findings suggest that developing different empathetic elements relies on at least partially distinct neural networks. The development of these more elaborate mental capabilities does not appear to eliminate or subjugate human instinctive and automatic responses to others. On the contrary, higher order cognitive abilities appear to mediate and augment the more basic empathetic processes and structures we may share (Decety et al., 2012).

Human empathy appears to depend on several distinct brain structures and interrelated processes that regulate our social affiliation (Corradini and Antonietti, 2013; Gonzalez-Liencres et al., 2013). These range from the autonomic nervous system and endocrine systems to the cerebral cortex (Decety, 2011). For example, neuroimaging studies clearly distinguish between empathetic concern and emotional empathy. Empathetic concern employs the hypothalamus, striatum and prefrontal cortex brain structures. Emotional empathy, in contrast, relies more on the amygdala, somatosensory cortex, and insula brain structures (Ashar et al., 2017, Decety 2020). While a full analysis of these studies is beyond the scope of the current analysis, the major conclusion that can be drawn is that empathy is not simply a reflexive response. Instead, it depends upon various emotive and cognitive factors that influence both the accuracy and the internalization of other people's thoughts and feelings. Humans can imagine how other members of their species feel or think and often do so very intentionally.

The findings regarding brain activation mentioned above may partially explain empathy differences based on age and gender. Schwenck et al. (2014) found that age and gender both strongly and significantly influenced cognitive empathy among children ages 7-17. More specifically, emotional recognition and perspective-taking skills were much higher among older and female children. Perhaps differences in brain development, such as the acquisition of cognitive skills, may better explain why differences in cognitive empathy exist.

Interpersonal relationships are mediated by the empathetic knowledge structures people hold about themselves or infer about others (Nakao and Itakura, 2009). That is, a person's self-concept impacts how she or he perceives interpersonal knowledge, what people believe or feel regarding someone else, and influences how that person interacts with other people. This statement is true whether the attributions internalized are detached cognitions or the result of imaginative projection or reflexive response (Coricelli, 2005).

Empathy is a phenomenon that is both "bottom-up" (or automatic), and "top-down" (or cognitive) in nature (Lamm et al., 2007). One response informs and regulates the other. Automatic processes are faster, more emotive, and reflexive, dominating early childhood (Adolphs, 2009). Cognitive processes are slower and more effortful; they often involve learned reflective thinking. Many of our daily social interactions depend upon this empathetic understanding, and the effectiveness of any individual will depend, to a large degree, on his or her ability to accurately assess and predict the feelings, motives, thoughts, and behaviors of other people.

The above literature has several major implications for training to facilitate empathy development. First, empathy's complex and multi-faceted nature makes it challenging to design trainings that are likely to be consistently effective in enhancing overall empathy. To help address this complexity, any assessments of empathy should characterize and assess cognitive empathy separately from those aspects of empathy that are primarily affective. A primary focus should be on those sub-domains of empathy that can be characterized validly and reliably. Moreover, the complex nature of empathy also presents the possibility that stimuli (including, but not limited to empathy training) may have secondary or indirect effects that are associated with overall empathy, without actually impacting an individual's expression of empathy. This further suggests that the outcomes associated with empathy training may be extremely nuanced, and not fully captured in an overall empathy measure. Third, the literature also shows that emotional responses to stimuli (including empathy training) may correlate with more general assessments. Thus, empirical measures that objectively capture an individual's emotional responses may provide information that helps identify changes in empathy. Lastly, changes in empathy are critically dependent on age and gender. Training designed to increase empathy (and research studies attempting to evaluate empathy and empathetic development) should account for these differences.

When considered collectively, these implications suggest four primary hypotheses and several corollary hypotheses, which are stated (in null form) below:

Hypothesis 1: *The provision of a well-designed empathy training does not significantly impact cognitive empathy among similarly-aged adults.*

Corollary 1: *The provision of a well-designed empathy training does not significantly impact the information underlying the characterization of cognitive empathy provided by similarly-aged adults.*

Hypothesis 2: *The provision of a well-designed empathy training does not significantly impact affective empathy among similarly-aged adults.*

Corollary 2: *The provision of a well-designed empathy training does not significantly impact the information underlying the characterization of affective empathy provided by similarly-aged adults.*

Hypothesis 3: *The objectively observed emotional responses of participants during the provision of a well-designed empathy training do not significantly impact cognitive empathy among similarly-aged adults.*

Corollary 3: *The objectively observed emotional responses of participants during the provision of a well-designed empathy training do not significantly impact the information underlying the characterization of cognitive empathy provided by similarly-aged adults.*

Hypothesis 4: *The objectively observed emotional responses of participants during the provision of a well-designed empathy training do not significantly impact affective empathy among similarly-aged adults.*

Corollary 4: *The objectively observed emotional responses of participants during the provision of a well-designed empathy training do not significantly impact the information underlying the characterization of affective empathy provided by similarly-aged adults.*

Hypotheses 1 through 4 flow directly from the literature review. However, the second implication derived from the literature review is difficult to assess in a general context, especially without further specifying the nature of those secondary or indirect effects of stimuli on empathy. Corollaries 1 through 4 specifically evaluate one (narrowly defined) type of indirect effect: the amount of information respondents provide in empathy assessments. Because overall empathy measures are survey based, the utility of these surveys is critically dependent on the quantity of information provided (including, but not limited to, the care and attention accorded to answering survey items) by respondents completing the survey (Dahl and

Osteras, 2010; Friesner et al., 2021; Friesner et al., 2023). While the amount (or quantity) of information is a component of such indirect or secondary effects, we recognize that it is not an exhaustive measure of these effects. Future research is necessary to assess the effects of empathy training on these indirect and secondary effects in a more holistic manner.

METHOD

Experimental Design

The study was approved by the Gonzaga University Institutional Review Board, Protocol 2202BOZMRKT, and the research was conducted during the spring 2022 semester. The population of interest is young adults aged 18-23, currently enrolled in college. Volunteers were recruited from the general student population at Gonzaga University. Each participant scheduled one hour to complete a computer-aided interview. All participants provided verbal informed consent. Upon entering the testing facility, respondents were randomly assigned to one of two groups. The first group, which we refer to as our "control" group was asked to watch a short video with no empathy content (i.e., a "cleansing" video). iMotions software was used to collect biometric information on these respondents as they watched the video (Lewandowska et al., 2022; Warnick et al., 2021). The biometric information was used to identify (with 70% certainty) whether respondents facial micro-expressions expressed one of three states: joy, contempt, and engagement. At the completion of the video, these participants were also asked to complete the Basic Empathy Scale in Adults (BES-A) (Carre, et al., 2013), one of the most common means to characterize an individual's (self-reported) levels of cognitive empathy and affective empathy.

Participants in the second group, which we refer to as our "test" group, watched the same cleansing video as the control group. After watching this video, students watched a second video drawn from a well-known, health-related empathy training exercise (https://www.empathyproject.com/films). iMotions software collected biometric information on these respondents as they watched both videos. As with the control group participants, biometric information was used to identify (with 70% certainty) whether participants consciously or unconsciously expressed one of three states: joy, contempt, and engagement during each video. After both videos, these participants were also asked to complete the Basic Empathy Scale in Adults (BES-A).

Consistent with the study's four hypotheses and four corollaries, the study's empirical methodology operates under the general statistical null hypothesis of no mean/median differences in empathy – whether measured overall or as a construct characterizing the information underlying the formation of empathy - between the test and control groups. The study further assumes a statistical null hypothesis of no relationship between biometric information collected from watching any video and any measure of empathy.

Outcome Variables

The study utilizes four primary outcome variables. The first two outcome variables are the cognitive empathy scale score and affective empathy scale score, as characterized by the Basic Empathy Scale in Adults (BES-A). Two additional measures are also developed to capture the information indirectly conveyed in the BES-A, which are drawn from the information economics literature (Dahl and Osteras, 2010).[2] Specifically, the responses to individual survey items comprising each empathy scale within the BES-A are used to create a (normalized) information entropy index for each empathy scale (Jaynes, 1957, 1982; Shannon, 1948). The normalized entropy index characterizes the underlying "quantity" of information respondents can provide as they complete each BES-A survey item (Friesner et al., 2023).

Using the terminology and notation of Friesner et al. (2021), suppose that the researcher has a valid and reliable survey-based scale comprised of l = 1,...,L items. Each of these L items elicits responses using a response scale with j = 1,…, J options. The survey is administered to i = 1,…,n respondents. Now define a binary variable D_{ijl}, which takes a value of 1 if respondent i selects response item j for survey item l. It follows that $p_{ij} = \frac{\sum_{l=1}^{L} D_{ijl}}{L}$ represents the proportion of survey items for which respondent i selected response option j. We note in passing that the p_{ij}s are (whether by assumption, the nature of the calculations, or both) proper proportions over j and l. That is, $p_{ij} \geq 0$ for every i and j, and $\sum_{j=1}^{J} p_{ij} = 1$. Information entropy is characterized by the following:

$$H_i(p) = -\sum_{j=1}^{J} p_{ij} \log_2(p_{ij}) \quad (1)$$

where $p_{ij} \log_2(p_{ij}) = 0$ when $p_{ij} = 0$ (Golan et al., 1996, p. 8).

The quantity of information is a relative assessment of the observed distribution of responses to a survey item (or collection of items), compared to the distribution that is expected a priori by the researcher (which, in most applications is assumed to be uniformly distributed, reflecting an assumption of "ignorance"). Suppose the observed distribution matches the expected distribution. In that case, the data contains a relatively low quantity of information because the same information could be obtained without collecting the data in the first place. Concomitantly, the larger the difference between these distributions, the higher the quantity of information contained in the data. With more information in the data, it is worthwhile for researchers to apply statistical analysis to characterize trends and analyze inter-relationships across variables in the data. Dahl and Osteras (2010) refer to the latter as exploring the "quality" of information in the data. One challenge with the formulation in (1) is that it is difficult to interpret on an absolute basis. We follow Friesner et al. (2021) and Dahl and Osteras (2010), who divide (1) by its theoretic maximum and convert this proportion into a percentage:

$$\text{Normalized } H_i(p) = \left(1 - \frac{H_i(p)}{\text{Max}(H_i(p))}\right) * 100\% \quad (2)$$

The percentage expressed in (2) depicts the percentage of available information that is captured in the L survey responses across the n respondents.

Within the context of this study, should a statistically significant relationship between one or more information entropy measures (created using the BES-A) exist, that implies that certain respondent characteristics provide a significantly different (whether greater or less) quantity of information than other types of respondents. At some basic level, these respondents approach the BES-A questions fundamentally differently than other types of respondents, regardless of whether their overall BES-A scores differ significantly from other respondents. A primary limitation of the information entropy measure is that it is a general measure of the quantity of information. It merely quantifies, in a relative sense, how much information is contained in the data. When combined with statistical analyses (to be detailed in the following sub-section), it is possible to assess whether specific types of respondents provide more or less information in those responses, regardless of whether overall BES-A scores change. However, information entropy provides no additional information concerning the neurological or sociological factors that lead to those more or less informative responses. As such, our use of information entropy represents only a first (and admittedly incomplete) attempt to test our corollary hypotheses. Future research is necessary to assess such corollary hypotheses using a broader and more detailed set of variables.

Statistical Analysis Methods

The study's general null hypothesis is tested by conducting a two-step statistical methodology. First, mean differences in the outcome variables are assessed using a one-way analysis of variance (ANOVA) and Kruskal-Wallis tests.

Next, to control for the effects of other important factors that may cause differences between the test and control groups, a series of Tobit regression analyses employed a regression specification that mimics a difference-in-differences analysis. The dependent variable is one of the four primary outcome variables within each regression equation. Each Tobit model accounts for the natural censoring of its specific outcome variable (Greene, 2000, pp. 906-912). Regressors include metrics to distinguish between the test and control groups and each of the three states (joy, contempt, and engagement) identified by the iMotions software while respondents watched the cleansing video. For the test group, we also included the same three states experienced by participants while watching the empathy training video. The general form of each regression is as follows:

$$\begin{aligned}\mathrm{Empathy}_i^* &= \alpha + \beta \mathrm{TestGroup}_i + \gamma \mathrm{Female}_i + \sum_{k=1}^{K} \delta_k \,\mathrm{CleansingEmotion}_i^k \\ &+ \rho \mathrm{TestGroup}_i * \mathrm{Female}_i + \textstyle\sum_{k=1}^{K} \omega_k \mathrm{TestGroup} * \mathrm{CleansingEmotion}_i^k \\ &+ \textstyle\sum_{h=1}^{H} \theta_h \mathrm{TestGroup} * \mathrm{Emotion}_i^h + \nu_i \end{aligned} \quad (3)$$

where: $\mathrm{Empathy}_i^*$ is the true, uncensored empathy measure; $\mathrm{CleansingEmotion}_i^k$ represents a series of k = 1,…,K binary variables that yield a value of one if a respondent displayed a specific emotional state in the cleansing video as measured by the iMotions software in the cleansing video; $\mathrm{TestGroup}$ is a binary variable giving a value of 1 to those participants in the test group and 0 otherwise; $\mathrm{Emotion}_i^h$ represents a series of h = 1,…,H binary variables that yield a value of one if a respondent displayed a specific emotional state as measured by the iMotions software while watching the test video and zero otherwise; ν_i is a white noise error term; α, β, γ, the δs, the θs, ρ,and the ω_ts are parameters to be estimated, and all other notation is as defined previously.

As noted earlier, the Tobit model accounts for the censoring of the dependent variable. In this study, we observe a censored version ($\mathrm{Empathy}_i$) of the dependent variable ($\mathrm{Empathy}_i^*$), which has both upper and lower censoring:

$$\mathrm{Empathy}_i = \begin{cases} 0 & \text{if } \mathrm{Empathy}_i^* < 0 \\ \mathrm{Empathy}_i^* & \text{if } 0 \leq \mathrm{Empathy}_i^* \leq 100 \\ 0 & \text{if } \mathrm{Empathy}_i^* > 100 \end{cases} \quad (4)$$

Statistical significance is assessed at the 5% level, with 10% level significance noted for interested readers. The ANOVA and Kruskal-Wallis tests were conducted using IBM Statistics Version 27. The Tobit regressions and all associated hypothesis tests were conducted using SAS Version 9.4.

RESULTS

Table 1 contains the variable names, variable descriptions, and basic descriptive statistics for each variable included in the analysis. The study consists of 51 individuals who provided a full set of information for the analysis, 21 of which were in the control group and 31 of which were randomly assigned to the test group. The mean cognitive empathy scale score for the test (control) group was 37.35 (36.71) with a standard deviation of 2.40 (3.21). Similarly, the mean affective empathy scale score for the test (control) group was 42.00 (40.29) with a standard deviation of 6.04 (7.46). The mean normalized entropy of the cognitive empathy scale score for the test (control) group was 61.58 (55.03) with a standard deviation of 21.78 (14.87). This implies that respondents in both groups extract, at the mean, about 62 percent (55 percent) of the available information in the cognitive empathy scale score. Lastly, the mean normalized entropy of the affective empathy scale score for the test (control) group was 43.72 (38.61) with a standard deviation of 23.44 (15.79). This implies that respondents in both groups extract, at the mean, about 44 percent (39 percent) of the available information in the affective empathy scale score.

Table 2 contains the results of the one-way ANOVA and Kruskal-Wallis tests. No significant differences exist across test and control groups for any of the four outcome variables in all tests.

Table 3 contains the results of the Tobit regressions for the traditional BES-A cognitive empathy and affective empathy scale scores. For the cognitive empathy regression, the overall chi-square test of model significance yields a p-value of 0.20, indicating that the overall model fails to find a significant relationship between the cognitive empathy metric and all of the model's regressors. For the affective empathy scale, the chi-square test's p-value (0.02) indicates that the model is statistically significant. However, the individual t-statistic for the test/control group binary variable is not statistically significant (p-value: 0.59). The results also indicate that participants who expressed engagement in the cleansing video (parameter estimate: -9.76; p-value: < 0.01), as well as those respondents who expressed joy in the empathy training video (parameter estimate: -9.47; p-value: 0.03), both exhibited significantly lower levels of affective empathy than other respondents, holding the other regressors in the model constant.

As depicted in Table 4, results for the regressions using the (normalized) information entropy metrics yield slightly different results. For the regression predicting the (normalized) information entropy index of the cognitive empathy scale, the overall chi-square test of model significance yields a p-value of 0.09, indicating that the overall model fails to find a significant relationship between this information entropy measure and all of the model's regressors. The chi-square test's p-value (0.01) indicates that the model is statistically significant for the information entropy measure based on the affective empathy scale. Moreover, females in the test group exhibited significantly higher levels of information entropy (parameter estimate: 31.36; p-value: 0.01) than other respondents. Test group respondents who expressed engagement in the cleansing video (parameter estimate: 49.59; p-value: 0.02), also exhibited greater levels of information entropy, holding the other specified regressors constant. Lastly, respondents in the test group who exhibited engagement while watching the empathy training video exhibited lower levels of information entropy (parameter estimate: -69.15; p-value: < 0.01), holding the other specified regressors constant.

CONCLUSIONS

Despite a holistic empathy definition and often conflicting empathy training results, medical educators have become proponents of teaching empathy. Communication skills that enhance a medical professional's empathy and patient perceptions of physician empathy are becoming a high priority within healthcare education (Rouf et al, 2009). Empathy is believed to be so important in clinical environments that several medical schools have even begun to investigate the usefulness of admissions tests in assessing the innate empathetic characteristics of prospective healthcare professionals (Patterson et al., 2012; Patterson et al., 2018). This study represents an attempt to conduct an experiment that empirically assesses whether empathy training affects empathy expression, while incorporating objective and subjective empathy measures.

Overall, this study's findings are twofold. First, limited empathy training does not significantly impact self-reported cognitive or affective empathy levels as measured by the BES-A. However, empathy training impacts the quantity of information provided by certain respondents, especially females and those who are engaged in watching the empathy training video. Thus, empathy training better orients or prepares certain groups of participants to express their existing levels of empathy, even if the overall levels of empathy do not change. The groups most likely to be better oriented toward training, particularly females, is consistent with the literature (for example, Schwenck et al., 2014).

The implications of this study are threefold. First, health professions (as well as other professional program) educators should not consider empathy training to automatically result in direct gains in all types of empathy, especially cognitive empathy. However, empathy training may result in gains in certain types of empathy, in this study, affective empathy. Thus, health-related empathy training may be worthwhile but should not be considered as a holistic approach to ensure that health professionals exhibit empathy while providing patient care.

Second, empathy training may impact observed empathy in indirect or secondary ways. This study found evidence suggesting that empathy training impacted the quantity of information respondents provided while completing assessments of affective empathy. That is, the training-oriented respondents provide significantly more informative responses. For professionals who already exhibit adequate levels of affective empathy, the empathy training may serve as a "reminder" or a "refresher" to professionals on the importance of expressing affective empathy.

Third, most empathy assessments rely on respondents' subjective self-assessments. The current study provides evidence suggesting that biometric information may provide unique, more objectively-obtained information to supplement traditional, subjective empathy assessments. However, the current study merely identifies the potential for objective measures to supplement self-reported empathy. Future research must identify the types of biometric measures that most effectively supplement traditional subjective measures, as well as the structure relationship between biometric and subjective (self-assessed) empathy measures.

While the current study provides interesting inferences, the research exhibits several major limitations. As such, the results contained in this study should be viewed with caution. Four limitations are particularly noteworthy. First, the data used in the experimental design are drawn from young adults. The literature clearly shows that empathy is developed and evolves over time. Thus, replications of this study using adolescents, or adults of different ages (middle-aged, elderly, etc.), may generate different results. Second, the study uses well-known empathy training videos as an educational intervention. Other forms of empathy training may yield different results. Such training may specifically lead to gains in other forms of empathy not found in this manuscript (i.e., cognitive empathy) or not studied in the current manuscript (i.e., emotional empathy). Third, the current study evaluated the indirect effects of empathy using entropy-based measures of the quantity of information provided by respondents. This is only one of many possible characterizations of the indirect effects of empathy. Future research that replicates our analysis using other indirect measures would provide a valuable extension of our work. Lastly, the current study uses very limited biometric information – binary variables measuring whether or not study participants exhibited three emotional states (joy, engagement, and contempt). Future research that uses more and more nuanced biometric information in such analysis will likely identify much stronger and more informative links between these more objective indicators of empathy and self-reported empathy assessments.

ENDNOTES

1. While the existence and development of empathy is of critical important to health care professionals, it is not constrained to the health professions. It is also of critical importance to other professional programs, including, but not limited to, the various business disciplines (AACSB International, 2023).
2. These two measures should not be interpreted as exhaustive measures of the underlying informational content contained in empathy assessments. They are simply measures that are commonly used in quantifying informational content. Future research is necessary to replicate the current study using alternative informational constructs.

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APPENDIX

TABLE 1
DESCRIPTIVE STATISTICS

		All Participants [n=52]		***Control Group [n=21]***		***Test Group [n=31]***	
Variable	**Definition**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Dependent Variables							
Cogemp	BES Cognitive Empathy Score	37.10	2.75	36.71	3.21	37.35	2.40
Affemp	BES Affective Empathy Score	41.31	6.63	40.29	7.46	42.00	6.04
Nentcemp	Normalized Entropy - Cogemp	58.94	19.40	55.03	14.87	61.58	21.78
Nentaemp	Normalized Entropy - Affemp	41.65	20.68	38.61	15.79	43.72	23.44
Independent Variables							
TestGroup	Binary variable identifying test group participants	0.60		0.00		1.00	
Female	Binary variable identifying female participants	0.60		0.52		0.65	
CjoyDV	Binary variable identifying participants who displayed joy in the cleansing video	0.46		0.38		0.52	
Ccontempt DV	Binary variable identifying participants who displayed contempt in the cleansing video	0.35		0.33		0.35	
Cengageme ntDV	Binary variable identifying participants who displayed engagement in the cleansing video	0.75		0.57		0.87	
TjoyDV	Binary variable identifying participants who were included in the test group and displayed joy in the empathy video	0.38		0.00		0.65	
Tcontempt DV	Binary variable identifying participants who were included in the test group and displayed contempt in the empathy video	0.23		0.00		0.39	
Tengageme ntDV	Binary variable identifying participants who were included in the test group and displayed engagement in the empathy video	0.50		0.00		0.84	

TABLE 2
MEAN COMPARISONS

	Control Group [n=21]		*Test Group [n=31]*		*F-*		*Kruskal-Wallis*	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Statistic**	**Prob.**	**Statistic**	**Prob.**
Cogemp	36.71	3.21	37.35	2.40	0.68	0.41	1.13	0.29
Affemp	40.29	7.46	42.00	6.04	0.83	0.37	0.44	0.51
Nentcemp	55.03	14.87	61.58	21.78	1.44	0.24	0.81	0.37
Nentaemp	38.61	15.79	43.72	23.44	0.76	0.39	0.24	0.63

TABLE 3
TOBIT REGRESSION ANALYSES FOR EMPATHY SCORES [n=52]

Dependent Variable:		*Cogemp*					*Affemp*			
		Std.	**t-**				**Std.**	**t-**		
Variable	**Estimate**	**Error**	**Statistic**	**Prob.**		**Estimate**	**Error**	**Statistic**	**Prob.**	
Intercept	36.02	0.93	38.85	<0.01	**	40.19	2.08	19.37	<0.01	**
TestGroup	1.61	1.53	1.05	0.29		-1.85	3.42	-0.54	0.59	
Female	2.71	1.25	2.18	0.03	**	5.25	2.79	1.88	0.06	*
CjoyDV	-1.64	1.68	-0.98	0.33		4.59	3.75	1.22	0.22	
CcontemptDV	0.21	1.12	0.19	0.85		3.49	2.51	1.39	0.16	
CengagementDV	-0.31	1.42	-0.22	0.83		-9.76	3.18	-3.07	<0.01	**
TestGroup*Female	-4.16	1.62	-2.57	0.01	**	1.14	3.63	0.32	0.75	
TestGroup*CjoyDV	-0.20	2.00	-0.10	0.92		-9.47	4.48	-2.11	0.03	**
TestGroup*CcontemptDV	0.82	1.48	0.56	0.58		-0.97	3.32	-0.29	0.77	
TestGroup*CengagementDV	-1.27	3.19	-0.40	0.69		9.65	7.14	1.35	0.18	
TjoyDV	-0.04	1.31	-0.03	0.98		-0.71	2.94	-0.24	0.81	
TcontemptDV	-1.09	0.91	-1.19	0.23		2.23	2.04	1.09	0.27	
TengagementDV	3.65	2.73	1.33	0.18		0.99	6.12	0.16	0.87	
Tobit Censoring Term (sigma)	2.33	0.23	10.20	<0.01	**	5.22	0.51	10.20	<0.01	**
Unrestricted Log-Likelihood	-117.86					-159.75				
Restricted Log-Likelihood	-125.80					-171.68				
Chi-Square Statistic	15.89					23.86				
Chi-Square Test Prob.	0.20					0.02	**			

** indicates statistical significance at the 5 percent level; * indicates statistical significance at the 10 percent level

TABLE 4
TOBIT REGRESSION ANALYSES FOR NORMALIZED ENTROPY SCORES [n=52]

Dependent Variable:		***Nentcemp***					***Nentaemp***			
		Std.	**t-**				**Std.**	**t-**		
Variable	**Estimate**	**Error**	**Statistic**	**Prob.**		**Estimate**	**Error**	**Statistic**	**Prob.**	
Intercept	53.41	7.14	7.48	<0.01	**	44.44	6.37	6.98	<0.01	**
TestGroup	14.38	11.78	1.22	0.22		7.81	10.62	0.74	0.46	
Female	-0.64	9.60	-0.07	0.95		-2.53	8.57	-0.30	0.77	
CjoyDV	1.05	12.90	0.08	0.94		8.66	11.51	0.75	0.45	
CcontemptDV	4.11	8.62	0.48	0.63		-1.00	7.69	-0.13	0.90	
CengagementDV	0.34	10.94	0.03	0.98		-13.08	9.76	-1.34	0.18	
TestGroup*Female	6.45	12.49	0.52	0.61		31.36	11.18	2.81	0.01	**
TestGroup*CjoyDV	-0.60	15.48	-0.04	0.97		-19.70	13.76	-1.43	0.15	
TestGroup*CcontemptDV	-3.07	11.47	-0.27	0.79		-2.85	10.19	-0.28	0.78	
TestGroup*CengagementDV	148.74	8.20	18.13	<0.01	**	49.59	21.96	2.26	0.02	**
TjoyDV	15.89	10.20	1.56	0.12		12.19	9.03	1.35	0.18	
TcontemptDV	-20.19	7.11	-2.84	0.00	**	-3.84	6.28	-0.61	0.54	
TengagementDV	-165.31	8.20	-20.15	<0.01	**	-69.15	18.78	-3.68	<0.01	**
Tobit Censoring Term (sigma)	17.97	1.90	9.46	<0.01	**	16.03	1.59	10.05	<0.01	**
Unrestricted Log-Likelihood	-207.40					-215.00				
Restricted Log-Likelihood	-216.84					-228.90				
Chi-Square Statistic [8 degrees of freedom]	18.88					27.80				
Chi-Square Test Prob.	0.09	*				0.01	**			

** indicates statistical significance at the 5 percent level; * indicates statistical significance at the 10 percent level