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HEALTH PSYCHOLOGY | RESEARCH ARTICLE

Eliciting clinical empathy via transmission of patient-specific symptoms of Parkinson's disease

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Abstract: Clinical empathy can have numerous benefits for patients, clinicians, and health-care providers. Traditional empathy training techniques (e.g. storytelling, videos, or disease simulators) are centered on the health condition rather than the individual. This condition-centric approach perpetuates the belief that the disease, rather than the patient, is at the core of the experience. This process can be ineffective in generating the ability to understand and accurately acknowledge the feelings of another. A more effective means of eliciting empathy can be through technology-mediated symptom transference for transmitting an individual patient's actual experience, rather than a simulation, to the user—a process termed "tele-empathy." We developed an investigational digital tele-empathy device for use toward patients with Parkinson's disease (PD), known as SymPulse™. The device plays back muscle tremors using an armband, giving the wearer a replication of the involuntary muscle activity that a patient with PD feels. The purpose of the current study was to determine whether the SymPulse™ device could enhance feelings of empathy in test participants (wearing the device) versus control participants (not wearing the device). A sample of 45 participants (22 test; 23 control) reported their level of empathy via self-report questionnaires. Results revealed significantly higher empathy scale scores for test compared to control participants, demonstrating the

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Adam Palanica holds a PhD in Cognitive Neuroscience Psychology from the University of Waterloo and has utilized his expertise to advance academic research and commercial applications. Presently, he works as a behavioral scientist in the health-care field and helps to bring new insights and methodologies for research with pharmaceutical companies, hospitals, rehabilitation institutes, health-care professionals, caregivers, and patients. He works for Klick Labs, which is a digital medicine and research facility based in Toronto, Canada. The Klick Labs team focuses on creating solutions that engage and educate health-care providers about life-saving treatments and help inform and empower patients to manage their health and play a central role in their own care.

PUBLIC INTEREST STATEMENT

It has been shown that enhanced empathy in caregivers can be an important factor leading to better patient outcomes. However, traditional empathy training methods, such as storytelling and videos, can be ineffective in generating the ability to accurately understand the feelings of individual patients. The goal of the present research is based on the premise that empathy can be cultivated and improved by the use of digital technology. This study explores the effects of personalized transmissions of patient-specific symptoms of Parkinson's disease by analyzing the muscle activity of a patient's tremor and playing back the signal in caregivers through muscle stimulation. This type of health-care technology has the potential to transmit symptom data from individual patients in real-time so that caregivers can physically feel those symptoms. The enhanced empathy generated from the device could foster better perception and judgment of patient symptoms and possibly improve diagnosis and treatment outcomes.

effectiveness of the SymPulse™ for use in tele-empathy. The use of such technology for eliciting tele-empathy may have practical and clinical implications for providing effective training to health-care providers.

Subjects: Biomedical Engineering; Biosensors; Health Psychology; Behavioral Medicine; Allied Health; Health Conditions; Public Health Policy and Practice

Keywords: empathy; tele-empathy; investigational device; health care; Parkinson's disease

1. Introduction

Within the health-care literature, empathy has been defined as the ability to understand and accurately acknowledge the feelings of another, eliciting a more receptive response from the observer (Mercer & Reynolds, 2002; Post et al., 2014; Sinclair et al., 2017). Clinical empathy involves both cognitive and affective components, which include (1) understanding the patient's situation, thoughts, and feelings, (2) verifying its precision with the patient, and (3) responding to the patient in a helpful manner (Jeffrey, 2016; Mercer & Reynolds, 2002; Sinclair et al., 2017). It should also be noted that the term "empathy" is often used interchangeably with "sympathy," yet the latter has been distinctly defined as the emotional response of pity or feeling sorry for another's misfortune (Jeffrey, 2016; Post et al., 2014; Sinclair et al., 2017).

The ability to empathize within health-care settings can have numerous benefits, including better patient–caregiver relationships, which can foster a higher sense of trust and engagement from patients; this, in turn, can result in better reporting of symptoms, enhanced medical education, higher treatment adherence, and increased satisfaction of care (Halpern, 2007; Neumann et al., 2012; Riess, Kelley, Bailey, Dunn, & Phillips, 2012). Additionally, increased empathy from the caregiver or physician can result in fewer instances of depression and burnout, increased well-being, more accurate diagnosis, decreased medical errors, better treatment outcomes, greater patient safety, and fewer malpractice claims (Halpern, 2007; Neumann et al., 2012; Riess et al., 2012; Wilkinson, Whittington, Perry, & Eames, 2017).

Despite all of the demonstrated benefits of experiencing empathy in health care, research indicates that formal empathy teaching in medical education is lacking and that the empathy of medical students is often stunted during medical education (Neumann et al., 2011; Pedersen, 2010; Sulzer, Feinstein, & Wendland, 2016). Additionally, it may be difficult to accurately teach empathy for symptoms and illnesses that have never been experienced. It has been argued that the instruments used to examine empathy may not measure anything meaningful to clinical practice or patient satisfaction (Colliver, Conlee, Verhulst, & Dorsey, 2010; Sulzer et al., 2016). For instance, most empathy training for medical students involves self-assessment and storytelling, which may not be effective in eliciting accurate empathy for patients.

Some devices have been developed to help mimic the symptoms of certain health conditions, including geriatric simulator suits (Realityworks, 2017a), pregnancy profile outfits (Realityworks, 2017b), arthritis simulation gloves (Hall, Nixon, Dias, Graham, & Cook, 2010), and macular degeneration simulation goggles (Zagar & Baggarly, 2010). Although these devices may enhance empathy in the user, they represent non-digitized instruments that cannot be adjusted for various levels of individual patient conditions. That is, they are generic tools which can perpetuate the belief that a particular condition produces the same experience for everyone. Some examples of digitized technology have also been introduced to move one step closer in helping better share the feelings of patients, including the use of virtual reality to simulate migraines (Excedrin®, 2016), as well as a device to simulate the experience of stuttering (Stacha x SXSW, 2017). Again, however, these devices are more akin to a generic simulator than a personalized mechanism to transfer individualized data of patient symptoms. Proper examination and promotion of clinical empathy should inherently involve an interacting component between the caregiver and the individual patient.

Consequently, a technology-mediated symptom transference emulator could transmit a patient's actual experience in real time, through a process known as "tele-empathy" (Ho, Turnbull, & Fossat, 2017). The construct of tele-empathy represents a class of technology used to accurately identity, digitize, and characterize symptoms in a specific patient in order to generate a representative physiological response in a non-patient to elicit empathy for a particular health condition. For example, electromyography (EMG) could be used to identify tremor symptoms in patients with movement disorders and then played back to non-patients using electrical muscle stimulation; spirometry could be used to measure air flow in patients with chronic obstructive pulmonary disease and then played back to non-patients using air flow restriction; patient history and behaviors could be used to measure a range of psychiatric disorders, including obsessive compulsive disorder, schizophrenia, and post-traumatic stress disorder, and then played back to non-patients using augmented and virtual reality. The purpose of tele-empathy is to facilitate a more accurate understanding of what individual patients feel in their daily lives, to allow for better and more personalized treatment options. A tele-empathy system allows the fine-tuned objective signal transference of digitized symptom data of a specific patient, rather than the use of a blanket device that simply emulates generic or subjective symptom information. Tele-empathy has many practical applications in health care, including training and practice for physicians, nurses, physical and occupational therapists, and all other health-care providers, which could help develop better perception and judgment of patient symptoms, possibly prevent the widespread stunting of empathy, and enhance patient quality of care.

A practical application of a tele-empathy system involves Parkinson's disease (PD), which is a long-term degenerative disorder of the central nervous system that mainly affects the motor system (Blumenfeld, 2010). The usual age of onset of PD is between 40 and 70 years, with about 1% of individuals over the age of 65 being affected (Blumenfeld, 2010). PD affects a large number of people worldwide, with prevalence ranging from 41 people per 100,000 over the age of 40 to more than 1,900 people per 100,000 over the age of 80 (Pringsheim, Jette, Frolkis, & Steeves, 2014). It has also been shown that physicians and caregivers often lack empathy when dealing with patients with PD (Pinder, 1992; Pomponi et al., 2016), producing an empathy deficit in health care. Additionally, the muscle tremor symptoms of PD can be digitally transmitted to another person using objective data, thus presenting an effective application of tele-empathy.

In this particular case, a PD tele-empathy system would involve a wireless electromyogram on a patient's arm and a programmable electrical muscle stimulator on a health-care provider's arm, in order to digitally transfer muscle tremor data from the patient to generate involuntary muscle activity in the health-care provider (Ho et al., 2017). This can allow someone to feel the actual involuntary muscle tremors of a patient with PD. As a result, this tele-empathy system may induce a more accurate sense of empathy that would otherwise be impossible through traditional empathy communication of verbal description or storytelling.

We have recently designed and engineered a patent-pending investigational tele-empathy device, known as SymPulse™, which plays back involuntary muscle tremors from PD patients using an arm band. The purpose of the current study was to determine whether the SymPulse™ device could enhance empathy in others to allow them to better understand what PD patients feel daily. In this study, empathy was measured via self-report questionnaires for both trait- and state empathy to examine both dispositional empathy (i.e., how one generally feels on a regular basis) and situational empathy (i.e., how one feels in the moment), respectively (Shen, 2010a).

2. Methods

2.1. Study design

The present study involved a randomized design to compare a group of test participants who wore the SymPulse™ device while performing motor function tasks (e.g., buttoning a shirt and printing out one's name) versus control participants who did not wear the device while performing the same tasks. It was predicted that no statistical differences would be found in *trait* empathy between test and control groups at baseline, before the study manipulation and motor tasks. After the implementation of using the SymPulse™ (test) or not (control), it was predicted that *state* empathy would be significantly higher for the test group than the control group. By measuring trait empathy at baseline and state empathy after study manipulation, it could be ensured that any examined differences in empathetic feelings between study groups could be accounted for by the SymPulse™ device and not by inherent personality traits of the users.

2.2. Participants

A total of 45 participants (22 test; 23 control) completed the study (see Table 1 for demographic characteristics between study groups). The study took place at various science/medical conferences located in Toronto, Canada, and San Diego, United States to recruit conference attendees as participants. All participants were told that the SymPulse™ is an investigational device to simulate muscle tremors in the forearm, giving the wearer a simulation of a resting tremor from a PD patient; they were also told that the research study would involve trying out the SymPulse™ device and answering a few questionnaires. Please note that all participants (i.e., test and control) were given the same information about the device and research study; however, test participants tried the device when performing motor function tasks, whereas control participants tried the device after

Table 1. Demographic characteristics of participants

	Control (n = 23)	Test (n = 22)	p-Value
Age (SD)	48.5 (11.7)	44.1 (12.6)	0.227
Gender			0.026
Male	7 (30.4%)	14 (63.6%)	
Female	16 (69.6%)	8 (36.4%)	
Handedness			0.524
Right-handed	17 (73.9%)	18 (81.8%)	
Left-handed	6 (26.1%)	4 (18.2%)	
Occupational profession			0.297
Entrepreneurs/Business executives	3 (13.0%)	6 (27.3%)	
Physicians	5 (21.7%)	3 (13.6%)	
Occupational/Physical therapists	5 (21.7%)	1 (4.5%)	
Professors/Researchers	2 (8.7%)	4 (18.2%)	
Technologists	4 (17.4%)	1 (4.5%)	
Medical/Pharmaceutical industry specialists	1 (4.3%)	4 (18.2%)	
Financial/Sales experts	2 (8.7%)	2 (9.1%)	
Nurses	1 (4.3%)	1 (4.5%)	
Country of profession			0.396
Canada	13 (56.5%)	10 (45.5%)	
United States	5 (21.7%)	6 (27.3%)	
Brazil	1 (4.3%)	1 (4.5%)	
Israel	2 (8.7%)	0 (0.0%)	
New Zealand	2 (8.7%)	0 (0.0%)	
Belgium	0 (0.0%)	1 (4.5%)	
Czech Republic	0 (0.0%)	1 (4.5%)	
Germany	0 (0.0%)	1 (4.5%)	
Netherlands	0 (0.0%)	1 (4.5%)	
Switzerland	0 (0.0%)	1 (4.5%)	

Note. p-Values represent differences between participants groups.

study completion (see Section 2.5 for more details). All participants signed informed written consent and freely volunteered their time with no compensation. The study received full ethics clearance from Advarra IRB Services (www.advarra.com/services/irb-services/), an independent ethics committee that reviewed the study.

2.3. Apparatus

The SymPulse™ tele-empathy device (Figure 1) was developed by Klick Inc., which is a technology, media, and research company in the health-care sector based in Toronto, Canada.

The device is composed of 8 pairs of 2 electrodes (16 total) that span the circumference of the forearm in order to transmit muscle activity. In the current study, the device was used to provide participants with a prerecorded sample of muscle tremors from a patient with PD; the electrical muscle stimulation from the SymPulse™ came from a single patient, who was a 43-year old male, who had been diagnosed with PD 10 years prior to data collection.

The original muscle tremors from the PD patient were captured via EMG. Although EMG and the SymPulse™ can be used to transmit tele-empathy data in real-time (Figure 2), the primary purpose of the current study was to play back prerecorded muscle tremors to participants, rather than record the original data from PD patients. For more information regarding the development and design of the SymPulse™ device, please see the supplementary material.

2.4. Empathy measures

2.4.1. Trait empathy

was measured with the Healthcare Provider Student Version of the Jefferson Scale of Empathy (JSE-HPS [Fields et al., 2011]), which was based on the original Jefferson Scale of Empathy (JSE [Hojat et al., 2001]) used for physicians and other health professionals. The JSE-HPS version is reworded from the original JSE so that it could be used for anyone in general by measuring feelings of empathy toward health-care providers' actions and behaviors with their patients. The JSE-HPS contains 20 items with response options based on a 7-point Likert scale from 1 = "strongly disagree" to 7 = "strongly agree." Total scale scores range from 20 to 140, with higher scores indicating that the participant has more empathic engagement in patient care (Fields et al., 2011). Previous research has found the scale to have good internal consistency, with α coefficients ranging from 0.75 to 0.89 (Fields et al., 2011; Fjortoft, Van Winkle, & Hojat, 2011; Kiersma, Chen, Yehle, & Plake, 2013; Williams, Brown, Boyle, & Dousek, 2013; Williams et al., 2014). The current study revealed an α coefficient of 0.72.

Figure 1. SymPulse™ tele-empathy device for Parkinson's disease.

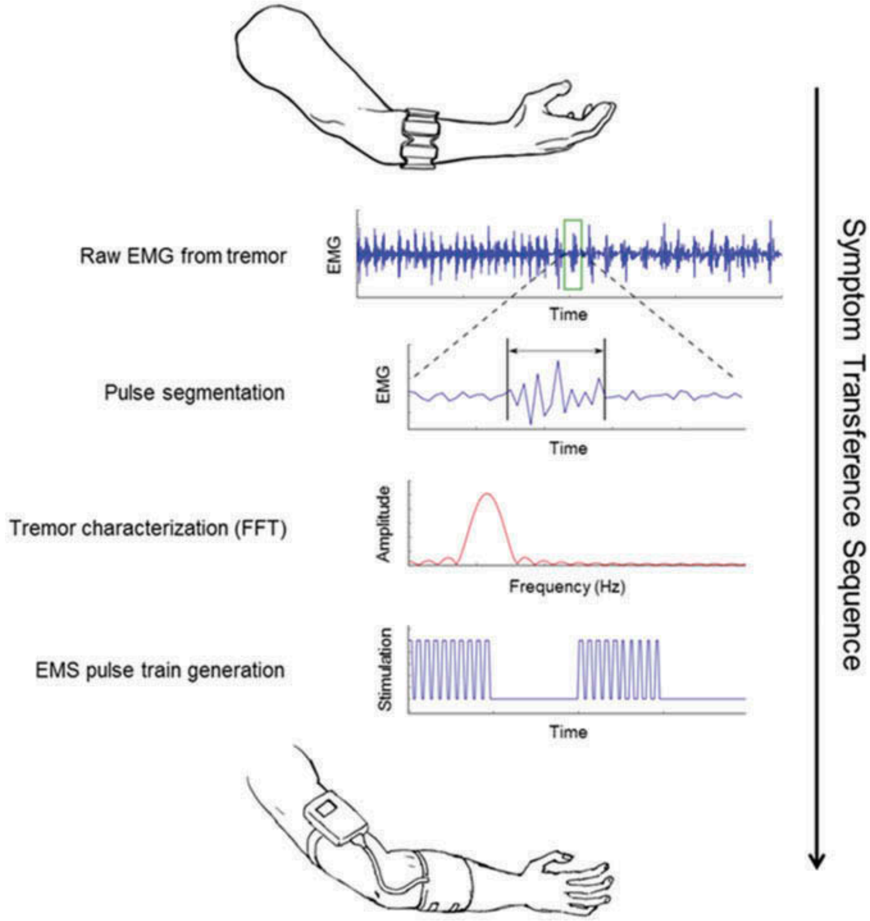

Figure 2. Sequence of the SymPulse™ tele-empathy symptom transference. EMG: Electromyography; EMS: electrical muscle stimulation; FFT: fast Fourier transform.

2.4.2. State empathy

was measured with a modified version of the State Empathy Scale (Shen, 2010a), which is a 12-item questionnaire, measuring affective, cognitive, and associative components of situational empathy on a 5-point Likert scale from 0 = "not at all" to 4 = "completely" (see Appendix A). The modified version of the State Empathy Scale was reworded so that items contained the word "patient" rather than "character" from the original version (Shen, 2010a). Participants were asked to respond to the items while imagining themselves communicating with someone who has PD (even if they have never met anyone with PD). The purpose was to measure empathy specifically toward PD patients. Total scale scores range from 0 to 48, with higher scores indicating that the participant has more of an empathic orientation toward patients in that moment. Previous research has found the original scale to have good internal consistency, with α coefficients ranging from 0.90 to 0.93 (Shen, 2010a, 2010b, 2011, 2015). The current study revealed that the modified version of the scale yielded an α coefficient of 0.91.

2.5. Procedure

Participants were randomly assigned to either the test or control condition, although all participants were explicitly aware of the SymPulse™ device and its purpose (see Section 2.2). However, it should be noted that participants were not aware of the two different study conditions. That is, participants knew the purpose of the SymPulse™ device and that they would eventually be experiencing its effects, but participants were not aware that the goal of the research study was to demonstrate a significant difference in state empathy scores between conditions.

All participants first answered the Healthcare Provider Student Version of the Jefferson Scale of Empathy (Fields et al., 2011) to assess overall trait empathy. Next, *test* group participants were outfitted with the SymPulse™ device on the forearm of their dominant hand and were stimulated with a prerecorded tremor simulation from a PD patient, while being asked to perform specific motor function tasks, including buttoning up two buttons of a standard men's dress shirt, and printing their full name on a sheet of paper. The electrical stimulation from the SymPulse™ lasted as long as it took to complete both tasks, which was approximately 2–3 min in total. *Control* group participants were not given any device or simulation but were still asked to perform the identical motor function tasks as test group participants, replicating a sham control scenario. After the motor function tasks, all participants were asked to answer the modified State Empathy Scale (Shen, 2010a) while hypothetically imagining themselves communicating with someone who has PD. After the completion of the study, all control participants were given a chance to experience the stimulation from the SymPulse™ device.

2.6. Statistical analysis

Comparisons of demographic characteristics between test and control participant groups were analyzed using a chi-squared test. Trait and state empathy scores were each analyzed using planned independent samples (two-tailed) *t*-tests between test and control participant groups. For state empathy, a two-tailed *t*-test at $p < 0.05$ yielded 81% power to detect an effect size of Cohen's $d = 0.86$ between the test ($n = 22$) and control groups ($n = 23$). The Shapiro–Wilk test for normality was not significant for trait and state empathy scales (all $p > 0.1$), indicating that data were normally distributed. Levene's test for equality of variances was not significant for any of the planned *t*-tests (all $p > 0.5$), indicating an assumption of equal variances between test and control groups for the empathy scales. The data were analyzed using IBM SPSS Statistics Version 23.

3. Results

3.1. Demographics

Demographic characteristics for each study group are presented in Table 1. Of the total sample, 40 of the 45 participants (89%) had experience in communicating with someone who was diagnosed with PD, with various levels of relationships to the patient (Table 2). Comparisons of demographic characteristics between test and control participant groups demonstrated no significant differences for all of the variables (all $p > 0.2$), except for gender ($p = 0.026$). These results show a slight bias for more males (vs. females) being present in the test group and the opposite bias for the control group.

3.2. Empathy scores

Scores for *trait empathy*, using the JSE-HPS (Figure 3), revealed no significant difference between test ($M = 114.1$; SD = 11.5) and control ($M = 114.3$; SD = 9.6) participants ($t(43) = 0.067$, $p > 0.90$). By contrast, scores for *state empathy*, using the modified State Empathy Scale (Figure 4), revealed significantly higher scores for test ($M = 36.1$; SD = 8.4) compared to control ($M = 28.9$; SD = 8.7) participants ($t(43) = 2.865$, $p < 0.01$). The difference in state empathy yielded a considerably large effect size of Cohen's $d = 0.86$ (Cohen, 1988).

No differences were found in trait or state empathy scale scores between participants' gender, handedness, or study site within either the test or control condition. Low *N* values across other demographic variables (e.g., occupational professions) within each study condition prevented additional segmentation analyses.

4. Discussion

The findings of the present research supported the main prediction that the SymPulse™ device would elicit a heightened sense of empathy toward patients with PD. Moreover, the effect of the SymPulse™ device was not due to any preexisting personality disposition of empathy since the baseline trait empathy scale yielded no significant differences between study groups. This supports the notion that the SymPulse™ device can elicit an increased ability to understand

Table 2. Frequency of communication and relationship of participants with anyone who has Parkinson's disease

	Control (n = 23)	Test (n = 22)	p-Value
Frequency of communication with patient			0.482
Every day	5 (22.7%)	2 (8.7%)	
Nearly every day	1 (4.5%)	2 (8.7%)	
3 to 4 times a week	1 (4.5%)	0 (0.0%)	
2 times a week	0 (0.0%)	1 (4.3%)	
Once a week	1 (4.5%)	1 (4.3%)	
2–3 times a month	0 (0.0%)	3 (13.0%)	
Once a month	3 (13.6%)	4 (17.4%)	
Once every 2–3 months	1 (4.5%)	1 (4.3%)	
Once every 3–6 months	1 (4.5%)	1 (4.3%)	
Once every 6–12 months	2 (9.1%)	2 (8.7%)	
Less often than once every 12 months	6 (27.3%)	2 (8.7%)	
Never	1 (4.5%)	4 (17.4%)	
Relationship of patient to participant			0.203
Patient of mine being treated	5 (23.8%)	8 (42.1%)	
Friend	4 (19.0%)	3 (15.8%)	
Parent	3 (14.3%)	3 (15.8%)	
Research participant	4 (19.0%)	0 (0.0%)	
Spouse/Partner	1 (4.8%)	3 (15.8%)	
Grandparent	3 (14.3%)	0 (0.0%)	
Cousin	1 (4.8%)	1 (5.3%)	
Aunt	0 (0.0%)	1 (5.3%)	

Note. p-Values represent differences between participants groups.

and acknowledge the thoughts and feelings of individuals diagnosed with PD. Furthermore, this effect occurred despite the fact that the great majority of participants (89%) have previously experienced social interactions with PD patients. This finding suggests that tele-empathy may induce a more accurate sense of clinical empathy compared to traditional empathy communication of storytelling or anecdotal verbal descriptions (Ho et al., 2017). The SymPulse™ also facilitated increased empathy in test participants versus control participants even though *all* participants were given the same information about the SymPulse™ device and its purpose. That is, the a priori understanding of knowing that the SymPulse™ device would simulate the experience of motor tremors from a patient with PD was not enough to increase state empathy in the control condition; only the physical experience of trying the SymPulse™ in the test condition was able to significantly increase the feeling of empathy toward patients with PD. This suggests that simply being psychologically aware of a particular condition may not be enough to heighten empathy toward patients; one must physically experience the symptoms to better understand the patient's personal situation.

The field of tele-empathy is unique because it represents digital technology that can be fine-tuned and adjusted to transmit various levels of objective individual patient conditions. It is not a generic tool that produces the same experience for every user. Further investigation could examine the practical applications of tele-empathy in training and practice for all types of health-care providers to help develop better perception and judgement of patient symptoms and possibly improve diagnosis and treatment outcomes. Tele-empathy devices may also be used as an empathy "booster shot" for all experienced health-care professionals to potentially prevent any stunting or decrease of empathy across one's professional career (Neumann et al., 2011; Pedersen, 2010; Sulzer et al., 2016). Future research could measure the longitudinal impact of the SymPulse™ device on *trait* empathy in health-care providers and assess the

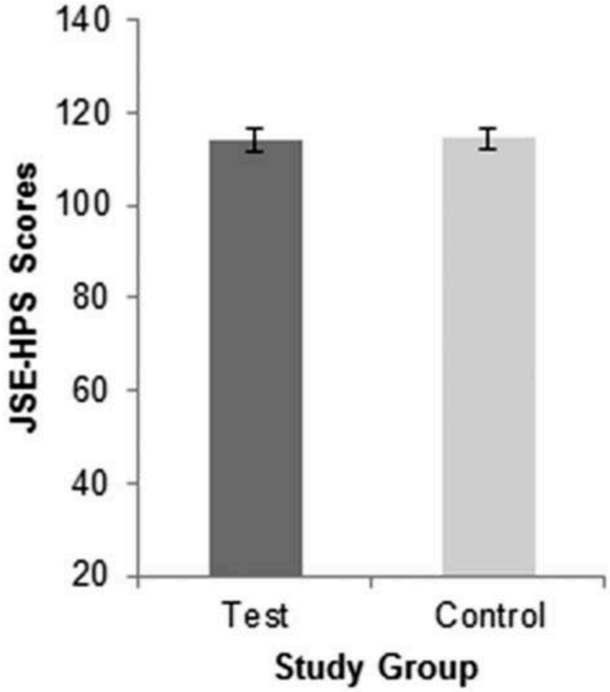

Figure 3. Scores for trait empathy, using the JSE-HPS (Fields et al., 2011), with standard error bars. Total scale scores potentially range from 20 to 140.

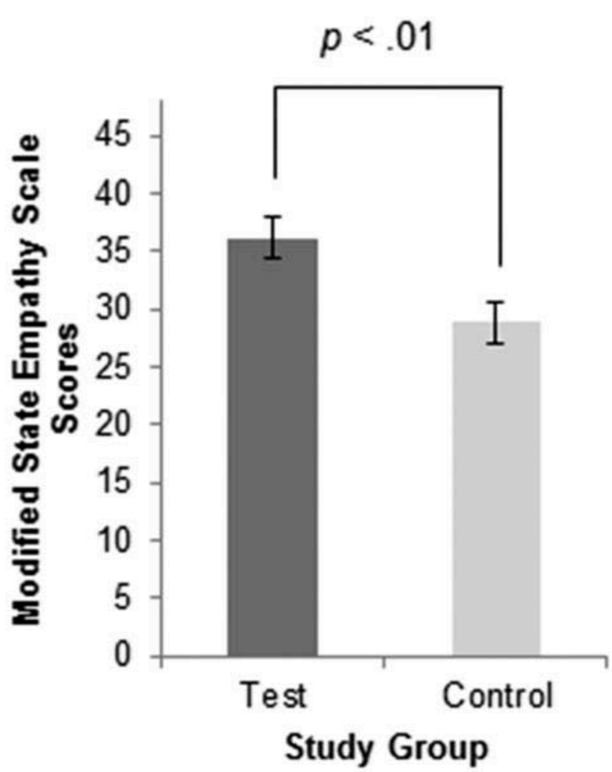

Figure 4. Scores for state empathy, using the modified State Empathy Scale (adapted from Shen, 2010a), with standard error bars. Total scale scores potentially range from 0 to 48.

overall effects on patient care and satisfaction. Tele-empathy may also be able to attenuate the impact of perceived stigmatization found in medical students and physicians for conditions linked to social stigmatizing attitudes and discrimination, such as psychiatric disorders (e.g., schizophrenia) (Serafini et al., 2011). As stigmatization of some disorders is widespread, tele-empathy may at least partially reduce the burden of perceived social stigmatizing attitudes.

Although the present study was the first of its kind to study an investigational tele-empathy device, some limitations should be noted, which may help foster future research. First, the sample of participants used in the current study was not entirely composed of health-care providers (i.e., the primary target audience for any tele-empathy device); this study also contained entrepreneurs, business executives, and financial experts. However, it could be argued that this particular study design supports a more generalizable finding since the participants come from a variety of occupational professions. Second, the demographic characteristics of participants revealed a bias for more males being present in the test group and more females being present in the control group. Previous studies have shown that, if anything, females typically score higher than males on health-care empathy scales (Fields et al., 2011; Fjortoft et al., 2011; Hojat et al., 2001); however, in the current study, *less* females were present in the test condition, but this group still scored higher in empathetic responses than the control group, which had *more* females. Thus, the main conclusions of the present findings were unlikely to be influenced by gender. Lastly, the SymPulse™ device in this study focused on the motor tremors of a PD patient; however, PD also gives rise to many non-motor symptoms, including sensory deficits, cognitive difficulties, sleep problems, dementia, depression, anxiety, and emotional problems (Blumenfeld, 2010). Future research could investigate whether experiencing multiple symptoms through tele-empathy would elicit even greater feelings of empathy compared to experiencing just a single symptom.

In conclusion, tele-empathy technology has the potential to transmit symptom data from individual patients in real time so that physicians can physically feel those symptoms from anywhere in the world, as another form of telemedicine (Ho et al., 2017). This research is encouraging for the use of tele-empathy instruments in clinical practice and suggests that the SymPulse™ device could help enable tele-empathy in caregivers and health-care providers across the globe.

Supplementary Material
Supplemental material for this article can be accessed here 10.1080/23311908.2018.1526459

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Competing interests
Adam Palanica, Anirudh Thommandram, and Yan Fossat are full-time employees of Klick Inc., the sponsor company of the research, which currently owns the technology and has a patent pending for the SymPulse™ device. This research was internally funded and received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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Author Contributions
A.P. executed the study, collected the data, analyzed the results, and contributed to writing the manuscript. A.T. engineered and built the SymPulse™ device and contributed to the writing of the manuscript. Y.F. developed the concept of "tele-empathy," assisted in data collection, and contributed to the writing and editing of the manuscript. All authors contributed to the literature search and have approved the final manuscript.

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Appendix A. Modified State Empathy Scale

Please respond to the following statements while imagining yourself communicating with someone who has Parkinson's disease. Please answer as honest as possible, as there are no right or wrong answers.

	Not at all 0	1	2	3	Completely 4
1. The patient's emotions are genuine					
2. I can experience the same emotions as the patient when dealing with them					
3. I am in a similar emotional state as the patient when dealing with them					
4. I can feel the patient's emotions					
5. I can see the patient's point of view					
6. I recognize the patient's situation					
7. I can understand what the patient is going through with their symptoms					
8. The patient's reactions to their situation are understandable					
9. When dealing with the patient, I am fully absorbed					
10. I can relate to what the patient is going through with their symptoms					
11. I can identify with the situation described by the patient					
12. I can identify with the patient					