

# Changes in Cognitive Control Following a Novel Resilience-Focused Nursing Educational Program: An Exploratory Study

Shannon Dames

Vancouver Island University, shannon.dames@viu.ca

Wendy Young

Royal Roads University, wendy.1young@royalroads.ca

Olave Krigolson

University of Victoria, krigolson@gmail.com

Kelly Zhang

Vancouver Island University, krystal.1014@hotmail.com

Lincoln Stoller

Mind Strength Balance, ls@mindstrengthbalance.com

Robyn Bartle

Vancouver Island University, SENDROBYNSOMETHING@gmail.com

Follow this and additional works at: <https://qane-afi.casn.ca/journal>



Part of the [Adult and Continuing Education Commons](#), [Cognitive Psychology Commons](#), [Curriculum and Instruction Commons](#), [Educational Assessment, Evaluation, and Research Commons](#), [Nursing Commons](#), [Quality Improvement Commons](#), and the [Transpersonal Psychology Commons](#)

## Recommended Citation

Dames, Shannon; Young, Wendy; Krigolson, Olave; Zhang, Kelly; Stoller, Lincoln; and Bartle, Robyn (2022) "Changes in Cognitive Control Following a Novel Resilience-Focused Nursing Educational Program: An Exploratory Study," *Quality Advancement in Nursing Education - Avancées en formation infirmière*: Vol. 8: Iss. 2, Article 6.

DOI: <https://doi.org/10.17483/2368-6669.1330>

This Article is brought to you for free and open access by Quality Advancement in Nursing Education - Avancées en formation infirmière. It has been accepted for inclusion in Quality Advancement in Nursing Education - Avancées en formation infirmière by an authorized editor of Quality Advancement in Nursing Education - Avancées en formation infirmière.

---

## Changes in Cognitive Control Following a Novel Resilience-Focused Nursing Educational Program: An Exploratory Study

### Cover Page Footnote

Thank you to Alex Mitchell for volunteering many hours as a research assistant on this project. | Merci à Alex Mitchell qui a consacré de nombreuses heures de bénévolat en tant qu'assistant de recherche pour ce projet.

## Introduction

Nurse fatigue is a subjective feeling that ranges from tiredness to exhaustion, creating an overall condition that interferes with an individual's physical and cognitive function. It is caused by physiological, psychological, behavioural, and environmental stresses. It may significantly degrade functioning and persist despite periods of rest (Canadian Nurses Association, 2010). It results in dangerously low staffing levels, high levels of absenteeism, workplace violence, mental disorder symptoms arising from an unhealthy work environment, and overtime costs estimated at \$2 billion in 2016 (Hall & Visekruna, 2020).

Innovative educational programs are desperately needed to control nurses' stress, relieve distress, and enhance nurse performance. The general target of this work is to find methods to improve quality of life. Specifically, this requires tools for better control of behaviours, thoughts, and emotions both in oneself and in the workplace. Cognitive control is an important asset for organizational leaders and nurse managers because it relates to nurses' ability to navigate uncertainty (Mushtaq et al., 2011) and navigate stressors (Hoorelbeke et al., 2015), enables a greater ability to think critically through complex situations, and promotes motivation (Yee & Braver, 2018), which is a necessary quality for organizational change agents. In today's uncertain, high-stimulus, and trauma-laden work environments, this developmental asset can promote and empower a creative and meaningful way forward.

## Background

In Canada, health professionals suffer from mental health conditions caused or exacerbated by the toll of high-stimulus and often trauma-laden work environments. Unhealthy providers are more likely to make errors, call in sick, and leave the profession, all of which have an enormous cost in terms of recruitment and training (Bodenheimer & Sinsky, 2014). Even before stressors related to COVID-19, 40%–60% of health care providers were likely to face burnout at some point in their career (Olson et al., 2015; Rabb, 2014). Additionally, 30%–50% of new graduate nurses were leaving the profession within two years, usually because of post-traumatic stress disorder (PTSD), depression, or moral distress (Chandler, 2012; Laschinger et al., 2010; Stelnicki et al., 2020).

A 2019 survey of over 3,200 nurses Canada-wide compared symptom screening results reported by nurses and other public safety personnel (Stelnicki et al., 2020). Approximately one in three nurses screened positive for major depressive disorder (36.4%); one in four for generalized anxiety disorder (26.1%); one in four for PTSD (23.0%), and one in five for panic disorder (20.3%). One in three reported having suicidal ideation (39.9%); one in three reported clinically significant symptoms of burnout (29.3%); one in five reported planning suicide (22.3%); and one in ten reported attempting suicide during their lifetime (12.6%) (Stelnicki et al., 2020). Burnout is defined as experiencing overwork, chronic stress, and interpersonal strain that results in symptoms of emotional exhaustion, cynicism, or depersonalization, and reduced personal accomplishment (Aronsson et al., 2017). Workplace stress is a significant problem and little is known about how best to mitigate stress and promote thriving in nurses at high burnout risk. The Canadian Federation of Nurses Unions has called for the introduction of quality educational programs. It suggests annual assessments of the quality and safety of health care work environments, funding of program development, and provision of new education programs to support the nursing workforce (Hall & Visekruna, 2020).

As seminal researchers of cognitive control, Miller and Cohen (2001) defined it as the ability to intentionally select thoughts, emotions, and behaviours based on surrounding task and social demands, while also being able to suppress less desirable habitual reactions. It is commonly measured through a variety of behavioural tasks, electroencephalogram (EEG), and pupillary response (Compton et al., 2021). In this exploratory study, cognitive control is measured through EEG.

Research on cognitive control and strategies that promote it are needed. This exploratory study, conducted before the outbreak of COVID-19—exploring, proposing, delivering, and examining the impact of a novel educational program—is a landmark study that begins to fill this gap in the literature. The aim of this study was to investigate the effects of an innovative educational program on cognitive control. We were also interested in participants' perceptions of the educational program.

### **A Novel Education Program, Embodied Through a COP Program**

We have assembled a multidisciplinary team led by a doctorally educated nurse and involving leaders in the nursing field from two accredited Canadian universities and Island Health, the local public health authority. We have developed a novel and evidence-informed curriculum aiming to bolster key developmental and resilience assets to promote flourishing among health care providers. A provincial grantor supported the curriculum development process, enabling the team of providers and content experts to research a curriculum framework that links education to practice. After the curriculum was developed, to promote greater integration, it was implemented in a community in which new ways of being and skills could be embodied through relational practice, referred to here as a community of practice (COP). The educational program was provided to a mixed sample of nurses and nursing students and then evaluated using a mixed-method study. The objectives of the evaluation were to (a) assess quantitative changes in students' EEG measurements of cognitive control before and after completing the course and (b) to gather experiences of participating in the course through a focus group.

### **The COP**

The term *COP* was coined by Lave and Wenger (1991). It can be described as a community of people who are like intentioned, and who develop their skillfulness as they interact regularly. The focus of the COP program was developed from a research-informed resilience development framework, emulating an abbreviated version of a COP program referred to as Roots to Thrive (Dames et al., 2022), which aims to promote resilience by working with the concepts of congruence (Rogers, 1959) and a sense of coherence (Antonovsky, 1979), and is further informed by elements of polyvagal theory (Porges, 2011). The methods used to promote these resilience factors include connecting to self and others through the experience of secure attachment, addressing trauma within an environment of unconditional positive regard, regulating the nervous system, co-regulating through relationship, and aligning with one's desires and calling.

### **The Theoretical Framework**

The theoretical framework informs the educational program, study design, data collection methods, and data analysis process, and provides the lens through which the results were interpreted.

The first concept, congruence, describes one's orientation to self and authentic expression in the world. It describes the degree of alignment between the “real” and “ideal” self, a core

requirement that determines one's ability to engage in self-actualizing activities (Rogers, 1959). The curriculum is based on Carl Rogers's (1959) concept of congruence to understand the influence of social belonging, self-esteem needs, and environments of unconditional positive regard. Aligning with Rogers's work, the program focuses on the somatic (tending to the messages of the body) nature of healing and mindfulness of the present moment, within a COP that mirrors unconditional positive regard.

Sense of coherence describes one's objective orientation to the world. Increasing the sense of coherence bolsters one's personal sense of meaning, understanding, and increases confidence in one's resources. It addresses the cognitive components of self-actualization (Cilliers & Coetzee, 2003) and the health consequences related to chronic stress and dissonance arising from unmet needs. Sense of coherence is a descriptor of one's orientation to life, including cognitive control, and serves as a predictive tool for health outcomes.

Co-regulation theories, such as polyvagal theory, describes how social relationships can be a source of connection and security, and where regulation of the nervous system paves the way for more authentic ways of being. When people feel accepted and emotionally safe, it improves their ability to regulate stress. Additionally, as trust is developed among members, the window of tolerance for vulnerability expands, enabling participants to practise their new skills in a supportive relational environment.

### Research Questions

- Does an innovative education program that is embedded in a COP result in cognitive changes?
- What is the perceived value and priorities of this novel educational program to mitigate stress and promote thriving?

### Methods

A novel, 5-week curriculum based on Rogers's concept of congruence, involving 16 hours of personal contact and 4 hours of virtual meetings, was designed to expand awareness, mitigate stress, and enhance sense of purpose. A mixed-methods process (Figure 1) was employed to provide a global understanding of the impact on resilience factors and specifically on cognitive control. Quantitative cognitive abilities were evaluated pre- and post-course by analyzing EEG-based tests of attention, focus, and apperception. Focus groups were convened and their proceedings recorded and linguistically analyzed to evaluate the program's qualitative effects.

### Figure 1

*The Research Process*



## **Sample**

Eighteen participants completed the program, including 3 nursing students and 15 registered nurses. However, only 16 (3 nursing students and 13 registered nurses) completed the pre and post data collection process; therefore the study results are based on data from the sixteen participants who completed the program of research. The COP program developed here is designed for both populations, and the inclusion of both populations in the sample was designed to explore the different needs of and resources available to these populations. Inclusion criteria for the study included (a) working as a nurse or as an active nursing student (third or fourth year), (b) being willing to do the activities assigned between curriculum sessions, (c) being able to give informed consent, (d) having access to a computer for virtual weekly sessions. It was clarified that participation was voluntary and they could exit at any point.

## **Intervention**

Before the intervention began, participants were pretested using EEG assessments of brain performance. They then went through the curriculum (two 8-hour days, 3 virtual sessions, and 1 wrap-up session). Upon completion of the program, participants repeated the pretests and took part in a semi-structured focus group. Ethical approval was obtained from the universities hosting the research study and from the local health authority. The research process adhered to the approved research design, and confidentiality was protected through the use of pseudonyms.

## ***COP Description***

The participants were given an overview of the process that included the fundamental theories and concepts supporting the work. In a virtual session, they were provided with preparatory tips and were given opportunity to ask questions before the 5-week journey. Afterward, participants gathered for two in-person experiential sessions with facilitators, then three 90-minute virtual sessions (and weekly phone calls with a buddy), and a last in-person session (2 hours). Participants were given a manual of the theory behind the work and multiple optional exercises between sessions. The program also had a website, offering supportive resources to promote integration.

The program provided core practices that encouraged developing an ability to pendulate between the inner and outer world, learning to “be” human, and learning to “do” from that place of being. The practices promoted (a) developing expanded awareness, (b) using self-regulation/stress mitigation, (c) connecting heartfully, and (d) aligning with one’s calling.

Each session promoted empathetic connection in the community and aimed to support participants as they navigated the challenges of integrating the work in their daily activities. Participants were randomly assigned a buddy for phone contact. Phone conversations provided support, promoting a greater ability to integrate the concepts and tools. To complete the 5-week curriculum, participants gathered for a focus group debrief without the facilitators, which allowed them to speak freely.

## **Outcome Measures**

Our primary outcome of interest was a change in cognitive control using well-established (Cid-Fernández et al., 2014; Yamasaki et al., 2012) EEG measurements before and after the educational program. Cognitive improvement was specifically determined by an increase in the amplitude of EEG-derived evoked potentials, specifically the N200 and P300 components, also

referred to as N2 and P3. Our secondary outcome of interest was participant feedback on the program, specifically the perceived value and priorities for improvement.

## **Data Collection**

### ***Quantitative Methodology***

Cognitive control was measured by event-related potentials (ERP) extracted from EEG data. To assess changes in brain function caused by the intervention participants performed a standard visual oddball task (Krigolson et al., 2017) using the PEER application (Suva Technologies Inc., Victoria, BC) while EEG data were recorded from a MUSE headband (InterAxon Inc., Toronto, ON).

During the performance of the oddball task, participants saw a series of blue and green circles that appeared for 600 to 800 ms in the centre of a black screen on an iPad (Apple Canada Inc.; see Krigolson et al., 2017 for more detail). The task was conducted in this way: “Prior to the onset of the first circle and in between the presentation of subsequent circles, a [grey] fixation cross was presented for 300 to 500 ms [in the middle of the display]... Participants were not told that the frequency of the blue and green circles differed: [however,] the blue circles appeared less frequently (oddball: 25%) than the green circles (control: 75%) with the sequence order of presented circles [randomized]” (Krigolson et al., 2017, section “Standard Group”). Participants were instructed to tap the screen every time they saw a green circle. Participants completed 4 blocks of 50 trials during the performance of the oddball task.

EEG data were recorded from a MUSE EEG system. The MUSE EEG system has electrodes located analogously to Fpz, AF7, AF8, TP9, and TP10, with electrode Fpz acting as the reference electrode. The PEER application allowed participants to play the oddball task and also recorded the EEG data from the MUSE via Bluetooth. Events (the onset of the circles) were marked to allow a subsequent analysis of event-related brain potentials.

### ***Qualitative Methodology***

The focus group was facilitated by an experienced third-party researcher with no explicit connection to participants. The focus group was guided by Merriam’s (2014) basic qualitative methodology. Accordingly, a script was provided to the focus group facilitator. The facilitator was given the flexibility to go off-script to explore trends that emerged as the interview progressed. The interview was recorded and then transcribed by a research assistant, with no participant names attached to specific interviews. This approach promoted participant-led feedback, enabling space where ideas could flow freely, and encouraged reflection and discourse with the aim of uncovering patterns and meaning. Focus group results were used to better understand the value and impact of the curriculum and guide quality improvement.

## **Data Analysis**

### ***Quantitative Analysis***

To examine differences in brain performance in EEG data, the amplitude and latencies of the N200 and P300 were compared between the pre- and post-tests using paired samples *t* tests. Processing of EEG data from the MUSE device was done in MATLAB 2019a (Brainard, 1997), using custom code generated in the Krigolson Lab (<https://github.com/Neuro-Tools>) and also with EEGLAB (Delorme & Makeig, 2004). ERP signals were extracted from EEG recordings, the average of posterior virtual electrodes at site Tp9 and Tp10 in the 10-20 system, referenced to Fpz.

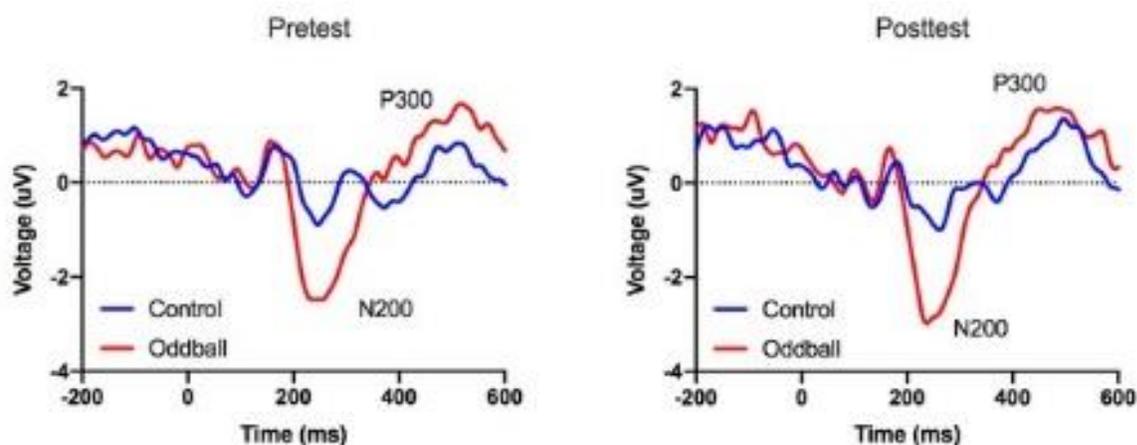
The MUSE device creates these virtual sites by recording across the base of the ear adjacent to the scalp.

The continuous EEG data were first filtered with a dual-pass Butterworth filter with a passband of 0.1 Hz to 30 Hz and with a notch filter at 60 Hz. Data were then segmented from 200 ms preceding stimulus onset to 600 ms after. A baseline correction was then applied to each segment using the mean value in the 200 ms immediately preceding stimulus onset. Artifacts that resulted in a maximum/minimum difference in each segment of more than 75  $\mu$ V were removed, resulting in a data loss of 31%.

Participant average waveforms were obtained by averaging the segmented data. A difference waveform was made by subtracting the control average waveform from the oddball average waveform. The N200 and the P300 were scored as the minimum and maximum values in a 200 ms window centred on the N200 and P300 peaks on the grand average waveforms (and the corresponding individual peak latency; see Figure 2). This procedure was repeated for both the pre- and post-tests EEG data. For all statistical tests, alpha was set to be 0.05.

## Figure 2

### *Electroencephalogram Peak Latency*



## Qualitative Analysis

The research team recorded and transcribed the focus group discussion, identifying themes that spoke to the research questions. To analyze the data, we followed Merriam's (2014) basic qualitative process. The process involved two independent and comparative back-and-forth analyses, documenting meaning that emerged, looking for patterns and themes. Meaning-making for the thematic analysis occurred by clustering the descriptions used by participants and the connections they made between their experiences. Inductive analysis occurred through open coding techniques, followed by deductive analysis. In the summary of findings described below, for some themes, direct quotes are used when they represent the flow of the group conversation. In other cases, paraphrasing the group conversation and highlighting word choices was a more accurate reflection of the collectively developed theme.

## Validity and Trustworthiness

This study involved three institutions. Multiple people were involved in the data collection and analysis process, which enabled researchers to vet results with multiple parties to reduce bias.

For instance, one team collected and analyzed quantitative results; triangulation occurred by having qualitative results analyzed by two independent parties and reviewed by a supervisor. Qualitative results were compared via two separate analysis processes to limit bias and dual-role conflicts, and promote trustworthiness. Findings were interpreted through the lens of the theoretical framework, which is research informed and well established in nursing and psychology.

## Results

### Quantitative Results

There was a significant improvement in cognitive control as measured by an increase in the amplitude of the N200 ERP component (Chan et al., 2020; Lorist et al., 2009). Specifically, our ERP results revealed an increase in the amplitude of the N200 ERP component following the intervention,  $t(12) = 2.14$ ,  $p < .05$  ( $-2.9$  uV [ $-2.4$ - $3.3$ ] versus  $-3.5$ uV [ $-3.1$   $-3.9$ ]; see Figure 2). Larger deflections in N200 amplitudes are indicative of increased cognitive control during information processing, as well as in the development of goal-oriented behaviour (Daltrozzo & Conway, 2014). Our results demonstrated no change in N200 latency, P300 amplitude, and P300 latency by the educational program intervention (all  $p > .05$ ). A lack of change in these measures suggests that the educational intervention impacted the engagement of cognitive control and not the neural processes indexed by the other measures (e.g., N200 latency, attentional allocation: Hogendoorn et al., 2008; P300 amplitude, working memory: Polich, 2007; and P300 latency, sensory processing: McCarthy & Donchin, 1981).

### Qualitative Results

The qualitative results explored the participants' perception of value, reporting on what worked well and what could be improved with the innovative educational program. In this results section, general themes are stated.

#### *Theme 1: Feeling Validated and Supported through Unconditional Positive Regard*

During the program, participants reported feeling genuine connection and unconditional acceptance over the duration of the training. Participants used the group's relational safety to express and tend to their needs:

- “The lack of guilt and shame that you didn't do something is really refreshing.”
- “The unconditional positive self-regard... impacts my life, my family's life, and the people that I interact with... that will continue to impact my life.”
- “To create compassion for the real person that you are... to love the parts of myself that I found unacceptable and accept them.”
- “It's actually something for your personal well-being.”

#### *Theme 2: Varying Interpretations of Spirituality*

Participants resonated with spirituality, but specific belief systems varied. There were mixed feelings about the various belief systems that emerged. For instance, one felt “derailed” by one facilitator's spiritual perspective, noting it felt too “weird.” Another found it was helpful to explore the varying viewpoints, promoting greater curiosity.

### ***Theme 3: Generating Greater Self-Efficacy***

Participants developed a greater sense of self-efficacy and ownership through the creation of an accepting, guilt-free environment:

- “It helped me want to actually participate... coming from a place of actually choosing... internal motivation rather than the external, or forced.”
- “Trying to see the essence of somebody and not necessarily reacting to everything that happens.”
- “Now that I’ve started the ball rolling, I really can’t stop.”
- “I feel like I need to keep going with it in terms of sort of how I design my new self and implications in relationships”
- “I feel like I’m more me, and when I get upset it’s like I can sit there and actually say what’s on my mind... I’m just way more upfront and honest and open.”

### ***Theme 4: Using Non-attachment as a Core Asset to Mitigate Stress***

Cultivating non-attachment improved participants’ ability to navigate stressors. Releasing guilt and self-blame generated greater self-acceptance:

- “I’ve been enjoying detaching from my mom-guilt.”
- “Non-attachment has been really meaningful. I can choose whether or not I’m going to hold on to the moment.”
- “A little self-compassion... rather than just spending the rest of the night raking myself over the coals.”
- “Provided a bit of freedom to forgive myself.”

### ***Theme 5: Creating Balance Between Enough Choice and Too Many Options***

Participants noted that a variety of resources promoted choice, but too many resources felt overwhelming. Some participants enjoyed multiple options; others found that too many options without enough depth left them feeling anxious.

### ***Theme 6: Having Accountability and Support Builds Resilience***

Participants noted that a strong relational practice environment promoted authenticity and resilience:

- “They did a really good job of creating the container.”
- “To be aware and more authentic and just come with that I know.”
- “This is going to be really useful in those teams that have been resilient for so long and that have developed unhealthy patterns.”
- “If everyone was coming in with a feeling of being more authentic, being more grounded, I think it would go a long way.”

### ***Theme 7: Using a Trauma-Informed Approach Was Well Received***

Participants appreciated the sense of safety and support as a means of preparing for moments of stress and suffering:

- “If I was reacting that way I didn't like, ‘oh well that's a trigger,’ I can get it, get how. And so it just was a really great foundation for me to apply the work on top of.”
- “You maybe become a leader without any sort of training on what to do, and then your job is then to check in with all your staff on how they are doing with this trauma... and then they start sharing what happened for them.”

### ***Theme 8: Preferring Support That Is Frequent, Face to Face, and Longer***

The face-to-face interactions helped participants feel connected, with mixed reviews on the virtual sessions (some liked virtual sessions and others didn't). One-to-one phone check-ins with a buddy were reported as helpful. Opinions varied on ideal program length, with most participants suggesting it would have been beneficial if the program spanned 8 to 12 weeks. There was consensus that fitting sessions into the workday could ease transitions and prevent personal conflicts. Checking in with a buddy between sessions, in which the contact felt emotionally safer and less pressured, helped to integrate the material.

### ***Theme 9: Recognizing the Importance of Culture Change and Ongoing Support***

Participants felt employer and faculty support was essential for the creation of an environment that would sustain positive change. They recommended providing the same experience for leaders with a priority on deconstructing “power over” structures, equalizing all members as humans with a shared vision. Many found it challenging to integrate the learnings from the program in their current work environment that felt vulnerable, rushed, and stressed:

- “I was just there and knowing everyone else was on the line, I think it was comforting.”
- “Your own personal well-being, which is just going to have like the ripple effect on your colleagues and your clients.”
- “Focusing on the people before they get into nursing, the nursing students. I still think there's a lot of value to that.”

## **Discussion**

To our knowledge, our exploratory study, conducted before the outbreak of COVID-19, is the first to examine the impact of an innovative and evidence-informed educational nursing program on cognitive control and to examine the perceptions of participants. Our results, that the education framework led to improvements in cognitive control, contributes to the research both theoretically and practically. Theoretically, we were guided, in part, by Antonovsky's (1979) concept of sense of coherence (promoting health despite a hostile environment), which relates to a person's outlook on the world and promotes an ability to move towards health and cope more successfully, despite difficult circumstances. This perspective provides an understanding of the sense of security, resources, and social support provided by a COP. Practically, our study offers further support for the introduction of the evidence-informed education so desperately needed to address the wellness and resilience of nurses and nursing students (Mitchell & Sawatzky, 2021; Spurr et al., 2021). The need for education that serves to mitigate stress and promote resilience in nursing training is clear (Spurr et al., 2021). Working toward solutions, this study suggests that integration of theory and new ways of being may be amplified through a COP.

## Interpretations of the Significant Results

The EEG quantitative results of this exploratory study suggest that the novel educational program that promotes a sense of coherence and congruence (described in the theoretical framework earlier), led to positive cognitive changes. Sense of coherence (Antonovsky, 1979) includes three main components: meaning, understanding, and confidence to manage life; each component is addressed in the curriculum. Therefore, results suggest that when we gain confidence in our inner and outer resources to manage challenges, gain understanding of how to self-regulate the body to mitigate stress, and as a result, gain a sense of control over our lives, we may also improve our cognitive control.

The observed EEG changes with this innovation add to the existing work on EEG changes associated with participation in interventions. EEG has been used for some time now to evaluate different exercise intervention protocols (Gramkow et al., 2020). EEG has also been used as a tool to evaluate neurofeedback training (Peeters et al., 2014), in the Program for the Education and Enrichment of Relational Skills (PEERS: Van Hecke et al., 2015), and in medical education (Anderson et al., 2019). Furthermore, our EEG data are consistent with findings from earlier studies with nurses that used an alternative way, mindfulness, to improve cognitive control (Wong et al., 2018).

## Discussion of Qualitative Results

Viewed through the lens of the theoretical framework, qualitative results of the study led to a greater understanding of the perceptions and priorities of what worked and did not work in the innovative educational program design. The COP provided the container for the educational program to be practised, promoting the sense of meaning and confidence described in Antonovsky's (1979) description of a sense of coherence. It provided a vessel for participants to reorient to life and relationships, as well as to practise embodying the skills they were learning. Results suggest that within a relational environment in which participants felt safe and connected to one another, they could practise showing up authentically and speaking honestly. Aligning with Rogers's (1959) concept of congruence, the mirroring of unconditional positive regard appeared to promote a greater ability for participants to engage in the vulnerability and positive reinforcement necessary to continue showing up authentically over the 5-week program. Sturgeon and Zautra's work (2015) also found that feeling connected to others seems to mitigate pain and suffering, making challenges more tolerable. Staying connected reminded participants that they were not alone, which in addition to directing kindness inwardly is another core characteristic in the development of self-compassion (Neff & Germer, 2018). While there was a desire to continue creating the same safe spaces at their place of work, many did not feel sufficiently safe at work to do so. Finally, aligning with polyvagal theory (Porges, 2011), also described in the theoretical framework earlier, we can retrain neural pathways through social interactions that feel safe. When practising a safe way of being with others in our social circle, we are more apt to integrate this shift in contexts outside the circle if we are being witnessed and received with unconditional positive regard. Promoting and sustaining efforts towards culture change in the workplace and in postsecondary settings requires all participants—including supportive leaders, educators, and employers—to provide greater access to cognitive control development programs in order to reach a cultural tipping point (Steger et al., 2012; Dixon-Woods et al., 2014; West, 2018).

### ***Objectivity as a Quality of Sense of Coherence***

Participants were considered a high-risk group for vicarious trauma, making it important to recognize when trauma presents and to provide regulation tools for management. With regulation, participants can work objectively with trauma, rather than reactively. If unresolved, trauma can impact one's identity and belief systems, leading to cynicism and despair (Pearlman & Mac Ian, 1995). Regulation tools buffered participants from overidentifying with the experience of others, thereby preventing additional vicarious trauma (Grevenstein et al., 2018). Aligning with the literature, cultivating non-attachment or an objective orientation, which is a quality of sense of coherence, reduces psychological distress (Wang et al., 2015) and reduces symptoms related to depression and anxiety (Chao & Chen, 2013). With a sense of wholeness and objectivity (non-attachment), participants felt less emotionally fused and less reactive, and able to let go of conditions outside their control. Integrating ways of being that are more resilient to stress requires supportive organizational structures that strive to minimize contextual stressors, invest in meaningful education mechanisms, and cultivate relational environments in which students and employees feel safe to express their needs and wants (Ruotsalainen Verbeek et al., 2016).

### ***Confidence in New Habits as a Quality of Sense of Coherence***

Participants were encouraged to try a number of practices to promote self-awareness and self-regulation in the program. To successfully cultivate habit development, they were asked to choose only a few that they wanted to take forward into their daily lives. This sentiment aligns with seminal authors who speak to the importance of promoting greater self-efficacy by taking ownership, enabling a greater ability to reach these goals (Zimmerman et al., 1992). Having many options was helpful for some and not for others. Based on a meta-analysis of 50 publications on choice overload, for those less aware of their preferences, having too many options can decrease motivation to make a choice at all. Conversely, those who have well-defined preferences prior to choosing are more likely to enjoy a plethora of options (Scheibehenne et al., 2010).

### ***Amplifying Results With More Time***

In the focus group, the nursing students agreed that more resilience education is imperative to promote confidence and to remediate the toxic components of caregiving cultures as they move into professional practice; but they felt that making the space to tend to their personal work, as encouraged in the course, would hamper their ability to complete required tasks in their school programs. The working nurses also agreed that the combination of the course on top of their regular work schedule did not provide enough time and space to integrate the practices taught to everyday tasks. Essentially, they had little space to BE outside the DOing required in busy work and family lives.

Finally, improvements in cognitive control were consistent with another study using a mindfulness-based stress reduction curriculum (Incagli et al., 2020). This improvement is significant because having the confidence to navigate workplace challenges can prevent such challenges from evolving into chronic stressors. Cognitive control appears to be a less instantaneous solution and more of a launching pad for a way of living that is slowly cultivated, encouraging a self-compassionate way of being (Hoorelbeke et al., 2015).

### **Limitations**

The sample was relatively homogenous. Fifteen of the participants identified as female and one as male. All participants identified as White and were born and raised in Canada. Because of

the sample size, limited geography, and relative homogeneity in gender and ethnicity, this research does not include diverse perspectives and contexts. Thus, there is scope for others to investigate other disciplines, demographics, or contexts of cognitive control programming. The 5-week time period was likely too limited to integrate significant shifts. Most participants suggested a longer time period, extending beyond 5-weeks, potentially resulting in additional benefits.

A limitation of the MUSE headband is that it cannot correct for ocular artifacts because of the low channel count, which impacts the quality of the signal coming from the device. As a result, the data loss can be relatively high. While it is quite clear that the MUSE is capable of measuring evoked responses that reflect the neural processes underlying cognitive control (Krigolson et al., 2017; Krigolson et al., 2021), the data quality of the MUSE signal is not as good as a research-grade system (Radüntz, 2018).

### **Conclusion**

The results support educators and leaders collaboratively developing and implementing evidence-informed innovative educational programs. On entry into the workforce, COPs can cultivate resilience at work and also bolster cognitive control. Given the many ongoing stressors that are endemic to health care work environments, cognitive control is imperative to mitigate stress and to promote a greater ability to thrive. These results suggest that evidence-informed and participant-informed COPs, operating within the limitations of workforce obligations, can improve cognitive control in nurses, provide relief from workplace stress, and potentially transform health care.

As evident in participant feedback, cognitive control is only one part of the equation. Reinforcing relationships of unconditional positive regard promotes authenticity and compassion for self, co-workers, and patients. Such relationships provide nurses with a greater ability to self-regulate, authentically express themselves, and celebrate the same in others. Cultivating work environments that promote the time and space for mindful states of being (instead of overwhelmed states of doing), provides a foundation for healthy work environments. This study supports the introduction of interventions that are designed to improve cognitive control, promoting self-regulation and stress mitigation. There is a need for future research to examine the impact of resilience-focused and evidence-informed COPs on patient care, safety, and costs.

## References

- Anderson, S., Jamnickzy, H., Krigolson, O. E., Coderre, S., & Hecker, K. (2019). Quantifying two-dimensional and three-dimensional stereoscopic learning in anatomy using electroencephalography. *NPJ Science of Learning*, *10*(4). <https://doi.org/10.1038/s41539-019-0050-4>
- Antonovsky, A. (1979). *Health, stress and coping*. Jossey-Bass.
- Aronsson, G., Theorell, T., Grape, T., Hammarström, A., Hogstedt, C., Marteinsdottir, I., Skoog, I., Träskman-Bendz, L., & Hall, C. (2017). A systematic review including meta-analysis of work environment and burnout symptoms. *BMC Public Health*, *17*(1), 264. <https://doi.org/10.1186/s12889-017-4153-7>
- Bodenheimer, T., & Sinsky, C. (2014). From triple to quadruple aim: Care of the patient requires care of the provider. *Annals of Family Medicine*, *12*(6), 573–576. <https://doi.org/10.1370/afm.1713>
- Brainard, D. H. (1997). The psychophysics toolbox. *Spatial Vision Volume*, *10*(4), 433–436. <https://doi.org/10.1163/156856897X00357>
- Canadian Nurses Association. (2010). *Nurse fatigue and patient safety*. [https://cna-aiic.ca/~media/cna/page-content/pdf-en/fatigue\\_safety\\_2010\\_report\\_e.pdf](https://cna-aiic.ca/~media/cna/page-content/pdf-en/fatigue_safety_2010_report_e.pdf)
- Chan, R. W., Alday, P. M., Zou-Williams, L., Lushington, K., Schlesewsky, M., Bornkessel Schlesewsky, I. B., & Immink, M. A. (2020). Focused-attention meditation increases cognitive control during motor sequence performance: Evidence from the N2 cortical evoked potential. *Behavior Brain Research*, *384*(2020), 112536. <https://doi.org/10.1016/j.bbr.2020.112536>
- Chandler, G. E. (2012). Succeeding in the first year of practice: Heed the wisdom of novice nurses. *Journal for Nurses in Staff Development*, *28*(3), 103–107. <https://doi.org/10.1097/NND.0b013e31825514ee>
- Chao, S. H., & Chen, P. (2013). The reliability and validity of the Chinese version of the nonattachment scale: reliability, validity, and its relationship with mental health. *Bulletin of Educational Psychology*, *45*(1), 121–139.
- Cid-Fernández, S., Lindín, M., & Díaz, F. (2014, January. 1). Effects of amnesic mild cognitive impairment on N2 and P3 Go/NoGo ERP Components. *Journal of Alzheimer's Disease*, *38*(2), 295–306. <https://doi.org/10.3233/JAD-130677>
- Cilliers, F., & Coetzee, F. C. (2003). The theoretical–empirical fit between three psychological wellness constructs: Sense of coherence, learned resourcefulness and self-actualization. *South African Journal of Labor Relations*, *27*(1), 4–24. [https://www.researchgate.net/publication/280482583\\_The\\_theoreticalempirical\\_fit\\_between\\_three\\_psychological\\_wellness\\_constructs\\_sense\\_of\\_coherence\\_learned\\_resourcefulness\\_and\\_self-actualisation](https://www.researchgate.net/publication/280482583_The_theoreticalempirical_fit_between_three_psychological_wellness_constructs_sense_of_coherence_learned_resourcefulness_and_self-actualisation).
- Compton, R. J., Gearinger, D., Wild, H., Rette, D., Heaton, E. C., Histon, S., Thiel, P., & Jaskir, M. (2021). Simultaneous EEG and pupillary evidence for post-error arousal during a speeded performance task. *The European Journal of Neuroscience*, *53*(2), 543–555. <https://doi.org/10.1111/ejn.14947>

- Daltrozzo, J., & Conway, C. M. (2014). Neurocognitive mechanisms of statistical sequential learning: What do event-related potentials tell us? *Frontiers in Human Neuroscience*, 8(437). <https://doi.org/10.3389/fnhum.2014.00437>
- Dames, S., Kryskow, P., & Watler, C. (2022). A cohort-based case report: The impact of ketamine-assisted therapy embedded in a community of practice framework for healthcare providers with PTSD and depression. *Frontiers in Psychiatry*, 12, 803279. <https://doi.org/10.3389/fpsy.2021.803279>
- Delorme, A., & Makeig, S. (2004). EEGLAB: an open source toolbox for analysis of single trial EEG dynamics. *Journal of Neuroscience Methods* 134, 9–21. <https://doi.org/10.1016/j.jneumeth.2003.10.009>
- Dixon-Woods, M., Baker, R., Charles, K., Dawson, J., Jerzembek, G., Martin, G., McCarthy, I., McKee, L., Minion, J., Ozieranski, P., Willars, J., Wilkie, P., & West, M. (2014). Culture and behaviour in the English National Health Service: overview of lessons from a large multimethod study. *BMJ quality & safety*, 23(2), 106–115. <https://doi.org/10.1136/bmjqs-2013-001947>
- Gramkow, M. H., Hasselbalch, S. G., Waldemar, G., & Frederiksen, K. S. (2020). Resting state EEG in exercise intervention studies: a systematic review of effects and methods. *Frontiers in Human Neuroscience*, 14(155). <https://doi.org/10.3389/fnhum.2020.00155>
- Grevenstein, D., Aguilar-Raab, C., & Bluemke, M. (2018). Mindful and resilient? Incremental validity of SOC over mindfulness and big five personality factors for quality of life outcomes. *Journal of Happiness Studies*, 19(7), 1883–1902. <https://doi.org/10.1007/s10902-0179901-y>
- Hall, L. M., & Visekruna, S. (2020). *Outlook on nursing: A snapshot from Canadian nurses on work environments pre-Covid-19*. Canadian Federation of Nurses. [https://nursesunions.ca/wpcontent/uploads/2020/12/CFNU\\_outlook\\_ENfinal\\_web.pdf](https://nursesunions.ca/wpcontent/uploads/2020/12/CFNU_outlook_ENfinal_web.pdf)
- Hogendoorn, H., Carlson, T. A., & Verstraten, F. A. (2008). Interpolation and extrapolation on the path of apparent motion. *Vision Research*, 48(7), 872–881. <https://doi.org/10.1016/j.visres.2007.12.019>
- Hoorelbeke, K., Koster, E. H. W., Vanderhasselt, A., Callewaert, S., & Demeyer, I. (2015). The influence of cognitive control training on stress reactivity and rumination in response to a lab stressor and naturalistic stress, *Behaviour Research and Therapy*, 69, 1–10. <https://doi.org/10.1016/j.brat.2015.03.010>
- Incagli, F., Tarantino, V., Crescentini, C., & Vallesi, A. (2020). The effects of 8-week mindfulness-based stress reduction program on cognitive control: an EEG study. *Mindfulness*, 11, 756–770. <https://doi.org/10.1007/s12671-019-01288-3>
- Krigolson, O. E., Hammerstrom, M. R., Abimvola, W., Trska, R., Wright, B. W., Hecker, K. G., & Binsted, G. (2021). Using Muse: Rapid mobile assessment of brain performance. *Frontiers in Neuroscience*, 15, 634147. <https://doi.org/10.3389/fnins.2021.634147>
- Krigolson, O. E., Williams, C. C., Norton, A., Hassall, C. D., & Colino, F. L. (2017). Choosing MUSE: Validation of a low-cost, portable EEG system for ERP research. *Frontiers in Neuroscience*, 109. <https://doi.org/10.3389/fnins.2017.00109>

- Laschinger, H. K. S., Grau, A. L., Finegan, J., & Wilk, P. (2010). New graduate nurses' experiences of bullying and burnout in hospital settings. *Journal of Advanced Nursing*, 66(12), 2732–2742. <https://doi.org/10.1111/j.1365-2648.2010.05420.x>
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- Lorist, M. M., Bezdán, E., ten Caat, M., Span, M. M., Roerdink, J. B. T. M., & Maurits, N. M. (2009). The influence of mental fatigue and motivation on neural network dynamics: An EEG coherence study. *Brain Research*, 1207, 95–106. <https://doi.org/10.1016/j.brainres.2009.03.015>
- McCarthy, G., & Donchin, E. (1981). A metric for thought: A comparison of P300 latency and reaction time. *Science*, 211(4477), 77–80. <https://doi.org/10.1126/SCIENCE.7444452>
- Merriam, S. B. (2014). *Qualitative research: A guide to design and implementation* (3rd ed.). Wiley.
- Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience*, 24, 167–202. <https://doi.org/10.1146/annurev.neuro.24.1.167>
- Mitchell, K., & Sawatzky, B. (2021). Nursing student wellness and resilience in the time of Covid-19. *Notes on Nursing Scholarship Newsletter*. <https://www.casn.ca/wp-content/uploads/2018/07/Notes-on-Nursing-Scholarship-Winter-2021-FNL.pdf>
- Mushtaq, F., Bland, A. R., & Schaefer, A. (2011). Uncertainty and cognitive control. *Frontiers in Psychology*, 2, 249–249. <https://doi.org/10.3389/fpsyg.2011.00249>
- Neff, K., & Germer, C. (2018). *The mindful self-compassion workbook: A proven way to accept yourself, build inner strength, and thrive*. Guildford Press.
- Olson, M. A., Kemper, K. J., & Mahan, J. D. (2015). What factors promote resilience and protect against burnout in first year pediatric and medicine-pediatric residents. *Evidence-Based Complementary and Alternative Medicine*, 20(3), 192–198. <https://doi.org/10.1177/2156587214568894>
- Pearlman, L. A., & Mac Ian, P. S. (1995). Vicarious traumatization: An empirical study of the effects of trauma work on trauma therapists. *Professional Psychology: Research and Practice*, 26(6), 558–565. <https://doi.org/10.1037/0735-7028.26.6.558>
- Peeters, F., Ronner, J., Bodar, L., van Os, J., & Lousberg, R. (2014). Validation of a neurofeedback paradigm: Manipulating frontal EEG alpha-activity and its impact on mood. *International Journal of Psychophysiology*, 93(1), 116–120. <https://doi.org/10.1016/j.ijpsycho.2013.06.010>
- Polich, J. (2007). Updating P300: An integrative theory of P3a and P3b. *Clinical Neurophysiology*, 118(10), 2128–2148. <https://doi.org/10.1016/j.clinph.2007.04.019>
- Porges, S. W. (2011). *The polyvagal theory: Neurophysiological foundations of emotions, attachment, communication, and self-regulation*. Norton.
- Rabb, K. (2014). Mindfulness, self-compassion and empathy, among health care professionals: A review of the literature. *Journal of Health Care Chaplaincy*, 20, 95–108. <https://doi.org/10.1080/08854726.2014.913876>

- Raduntz, T. (2018). Signal quality evaluation of emerging EEG devices. *Frontiers in Physiology*, 9, 98–98. <https://doi.org/10.3389/fphys.2018.00098>
- Rogers, C. (1959). A theory of therapy, personality and interpersonal relationships as developed in the client-centered framework. In S. Koch (Ed.), *Psychology: A study of science. Social Context* (Vol. 3, pp. 184–256). McGraw Hill.
- Ruotsalainen, J. H., Verbeek, J. H., Mariné, A., & Serra, C. (2016). Preventing occupational stress in healthcare workers. *Sao Paulo Medical Journal*, 134. <https://doi.org/10.1590/1516-3180.20161341T1>
- Scheibehenne, B., Greifeneder, R., & Todd, P. (2010). Can there ever be too many options? A meta-analytic review of choice overload. *Journal of Consumer Research*, 37(3), 409–425. <https://doi.org/10.1086/651235>
- Spurr, S., Walker, K., Squires, V., & Redl, N. (2021). Examining nursing students' wellness and resilience: An exploratory study. *Nurse Education in Practice*, 51, 102978. <https://doi.org/10.1016/j.nepr.2021.102978>
- Steger, M. F., Dik, B. J., & Duffy, R. D. (2012). Measuring meaningful work: The work and meaning inventory (WAMI). *Journal of Career Assessment*, 20, 322–337. <https://doi.org/10.1177/1069072711436160>
- Stelnicki, A. M., Carleton, N., & Reichert, C. (2020). *Mental disorder symptoms among nurses in Canada*. Canadian Federation of Nurses Unions. [https://nursesunions.ca/wp-content/uploads/2020/06/OSI-REPORT\\_final.pdf](https://nursesunions.ca/wp-content/uploads/2020/06/OSI-REPORT_final.pdf)
- Sturgeon, J. A., & Zautra, A. J. (2015). Social pain and physical pain: shared paths to resilience. *Pain Management*, 6(1), 63–74. <https://doi.org/10.1007/s11916-010-0095-9>
- Van Hecke, A. V., Stevens, S., Carson, A. M., Karst, J. S., Dolan, B., Schohl, K., McKindles, R. J., Rimmel, R., & Brockman, S. (2015). Measuring the plasticity of social approach: A randomized controlled trial of the effects of the PEERS intervention on EEG asymmetry in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 45(2), 316–335. <https://doi.org/10.1007/s10803-013-1883-y>
- Wang, S., Wong, Y., & Yeh, K. (2015). Relationship harmony, dialectical coping, and nonattachment: Chinese indigenous well-being and mental health. *The Counseling Psychologist*, 44(1), 78–108. <https://doi.org/10.1177/0011000015616463>
- West, M. (2018). *Compassionate leadership for cultures of high quality care*. [https://patientsikkerhed.dk/content/uploads/2018/04/patient18\\_plenum\\_michaelwest.pdf](https://patientsikkerhed.dk/content/uploads/2018/04/patient18_plenum_michaelwest.pdf)
- Wong, K. F., Teng, J., Chee, M. W. L., Doshi, K., & Lim, J. (2018). Positive effects of mindfulness-based training on energy maintenance and the EEG correlates of sustained attention in a cohort of nurses. *Frontiers in Human Neuroscience*, 12, 80–80. <https://doi.org/10.3389/fnhum.2018.00080>
- Yamasaki, T., Goto, Y., Ohyagi, Y., Monji, A., Munetsuna, S., Minohara, M., Minohara, K., Kira, J.-I., Kanba, S., & Tobimatsu, S. (2012). Selective impairment of optic flow perception in amnesic mild cognitive impairment: Evidence from event-related potentials. *Journal of Alzheimer's Disease*, 28(3), 695–708. <https://doi.org/10.3233/JAD-2011>

- Yee, D. M., & Braver, T. S. (2018). Interactions of motivation and cognitive control. *Current Opinion in Behavioral Sciences*, 19, 83–90. <https://doi.org/10.1016/j.cobeha.2017.11.009>
- Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for personal attainment: The role of self-efficacy beliefs, and personal goal setting. *American Educational Research Journal*, 29(3), 663–676. <https://doi.org/10.3102/00028312029003663>