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[Olivia Pastore](#)^{*}, François Jarry , Jammy Zou , Jennifer R. Tomasone , Luc J. Martin , Véronique Pagé , Shane Sweet

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Article

The Effect of Model Similarity on Exercise Self-Efficacy among Adults Recovering from a Stroke: A Mixed-Method Single Case Experimental Research Design

Olivia L. Pastore ^{1,*}, François Jarry ¹, Jammy Zou ¹, Jennifer R. Tomasone ³, Luc J. Martin ³, Véronique Pagé ⁴ and Shane N. Sweet ^{1,2}

¹ Department of Kinesiology Sciences, McGill University, Montreal, Quebec

² Center for Interdisciplinary Research in Rehabilitation of Greater Montreal, Montreal, Quebec

³ School of Kinesiology and Health Studies, Queen's University, Kingston, Ontario

⁴ Viomax, Montreal Quebec

* Correspondence: oliiva.pastore@mail.mcgill.ca

Abstract: We used a mixed-method single-case experimental research design to examine the effect of modelling (peer versus non-peer) on exercise self-efficacy in stroke survivors who participated in a community-based exercise program. Quantitative data were obtained using a ABCA design: (A₁) no model/baseline 1 (3 weeks); (B) peer model (6 weeks); (C) non-peer model (6 weeks); and (A₂) no model/baseline 2 (3 weeks). Four participants completed self-efficacy questionnaires after each weekly session. Qualitative data were obtained using researcher diaries and two semi-structured interviews: after B and A₂. Based on quantitative and qualitative results, participants reported higher exercise self-efficacy in the model conditions, with ratings appearing highest for the non-peer model. This finding could be due to a lack of full integration of the peer model and low feelings of similarity. Modelling in general could help people recovering from a stroke increase their exercise self-efficacy, but non-peer models may not be most advantageous.

Keywords: mixed-method; modelling; peers; single-case design; self-efficacy; stroke

1. Introduction

In Canada, approximately 2% of the population are stroke survivors (Public Health Agency of Canada, 2016) and 88% of people recovering from a stroke have long-lasting motor deficits (Saunders et al., 2008). To help individuals prevent, and recover from a stroke, physical activity and exercise have been recommended (Gordon et al., 2004; Wendel-Vos et al., 2004). However, a large majority of people recovering from stroke are not physically active (Billinger et al., 2014). To help understand how people with physical disabilities can become more active, a meta-review encouraged researchers to move beyond describing barriers/facilitators to physical activity participation and instead focus on testing theory-informed interventions that span both intra- and interpersonal dimensions (Martin Ginis et al., 2016). One example of theory-informed physical activity interventions that have been found to be efficacious within the context of stroke survivors are those based on self-efficacy (Korpershoek et al., 2011).

Self-efficacy represents one's belief in their ability to achieve certain tasks (Bandura, 1977). Moreover, exercise self-efficacy is one's belief in their ability to successfully perform exercise (McAuley, 1993). People recovering from a stroke live with functional impairments that make it more difficult to be physically active, consequently reducing their exercise self-efficacy (Billinger et al., 2014; Korpershoek et al., 2011). According to Bandura (1977), there are four sources of self-efficacy: (A) *past experience*, which is based on previously achieved personal mastery of tasks, (B) *vicarious*

experiences (modelling), which involves observing others' successful completion of a task, (C) *verbal persuasion*, which is the verbal and non-verbal feedback related to the performance of a task, and lastly (D) *affective/physiological responses*, which include the emotional/physical responses affecting the perceptions of personal competency. Followed by past experiences, modelling is the second most effective way to increase an individual's self-efficacy (Ashford et al., 2010). Among older adults, a systematic review examining the effect of 23 behaviour change techniques (BCTs; active ingredients of a behaviour change intervention; Michie et al., 2013) showed that modelling physical activity had medium effects on self-efficacy and physical activity behaviour (Cohen's $d = 0.41$; French et al., 2014). More research is needed to better understand how the sources of self-efficacy, specifically modelling, operate on exercise self-efficacy post-stroke (Jones & Riazi, 2011). In addition, the combination of BCTs in physical activity interventions limits the ability to discern their effects individually. Thus, there is a call for research to experimentally examine BCTs individually (Spring et al., 2020). As such, our study will aim to fill these gaps.

Modelling has been found to be most effective when performed by someone with similar characteristics, such as peers (Schunk, 1995). Peer-led programs have shown potential in promoting healthy behaviours among stroke survivors, but further research is needed to confirm their effectiveness (Warner et al., 2015). A study on peer-led wheelchair training program (including modelling) for manual wheelchair users demonstrated significant improvements in self-efficacy (Best et al., 2016). However, the peer-led wheelchair training program included practical skills training and the control group was not subjected to a non-peer-led program. Thus, more research is required to determine if the peer-led component is solely responsible for the positive outcomes. As such, contrasting the effects of peer vs non-peer models on exercise self-efficacy is necessary, particularly among disability groups.

To assess exercise self-efficacy accurately, distinguishing motivation from capability is essential (Williams & Rhodes, 2016). Including expected motivation in assessments results in *self-efficacy-as-motivation*, reflecting both a person's ability (capability) and willingness (motivation) to engage in a task. To comply with Bandura's (1997) original conceptualization of *self-efficacy-as-capability*, Williams and Rhodes (2016) recommended modifying questionnaire stems to include the phrase "if you wanted to" as a way to parse out motivation from capability. They also recommended including both assessments in a study. Accordingly, we did both to enhance our theoretical and practical understanding of modelling on exercise self-efficacy while testing types of models within a community-based exercise program for stroke survivors.

The purpose of this study was to compare changes in exercise self-efficacy levels among adults recovering from a stroke participating in an 18-week community-based exercise program who were exposed to three conditions in the following order: (A₁) no model (3 weeks); (B) peer model (6 weeks); (C) non-peer model (6 weeks); and (A₂) no model again (3 weeks). In accordance with self-efficacy theory, we anticipated that these adults would have greater exercise self-efficacy (both as-capability and as-motivation) when a peer model was integrated within the program (B) than when there was no model (A₁), and (C) a non-peer model. We also hypothesized that participants would report higher exercise self-efficacy levels with the non-peer model (C) than with no model (A₂) at Baseline 2.

2. Materials and Methods

Research Design & Paradigm

The study was co-constructed with researchers from McGill University (Montreal, Quebec), Queen's University (Kingston, Ontario) and Viomax, an established community partner (Montreal, Quebec). This study was also part of an unpublished master's thesis from one of the co-authors at McGill University (Jarry & Sweet, 2020) and later modified and prepared for publication. Viomax is a fitness center for people with physical disabilities. We selected the beginner/intermediate stroke group exercise course because most participants would be relatively new to exercise. An explanatory sequential mixed-method design was adopted for this study, which involves the primary collection and analyses of quantitative data (Phase 1) followed by collection and analyses of qualitative data

(Phase 2; Shorten & Smith, 2017). Using a mixed-method design allows for the triangulation and completeness of data, which creates a more comprehensive picture of the studied phenomenon (Sparkes, 2015). The quantitative portion of this study involved a single-case experimental design, specifically a concurrent multiple baseline design with an ABCA format (Logan et al., 2008). The ABCA format of the multiple baseline design consisted of a (A₁) no model/Baseline 1 (3 weeks); (B) peer model (6 weeks); (C) non-peer model (6 weeks); and (A₂) no model/Baseline 2 (3 weeks). The qualitative portion involved researcher diaries throughout the duration of the study and two semi-structured interviews with the participants at weeks 9 and 18 of the program. We grounded this study in pragmatism as our philosophical orientation given we are most interested in real world and pragmatic impacts than one type of knowledge/truth (Kaushik & Walsh, 2019).

Participants

Due to the study being conducted in the community setting and our pragmatic viewpoint, we included all participants enrolled in the program, regardless of their past exercise experience. Eligible participants were 18+ years of age, recovering from a stroke, medically cleared to participate in exercise, French/English speaking, and were participating in the Viomax group exercise course for stroke survivors. Participants were excluded if they had a cognitive impairment diagnosed by a medical professional. A total of seven participants were part of the study and provided informed consent; two participants withdrew midway without reasoning, one participant dropped out of the study because they missed too many classes due to an illness/injury. Thus, a total of four participants were exposed to all conditions, which is above the minimum of three participants for level II evidence in single-case designs (Logan et al., 2008).

Procedures

The Viomax beginner/intermediate post-stroke group exercise classes took place once a week in a gymnasium and were led by a kinesiologist. The first 30 minutes included warm-up activities (e.g., performing limb rotations). After a break midway through class, participants were taught new exercises that differed each week. Prior to the start of the classes, a member of the research team explained the study and invited interested participants to sign the consent form. During the first three sessions (Baseline 1, Condition A₁), participants engaged in the course normally, aside from completing the baseline questionnaire after each class. On the fourth session, a peer model was added to the class for the next six sessions (Condition B). The peer model was from the advanced group exercise class and was invited by Viomax. Participants were informed that the peer model was a participant from a more advanced class who volunteered to help demonstrate the exercises until the December break (end of Condition B).

The December break (3 weeks) served as a washout period as the group exercise classes were not being held and the participants were not exposed to a modelling condition. Once the group exercise classes resumed in January, the participants were informed the peer model was no longer able to attend classes but was replaced by a university student from our research team. This student acted as the non-peer model for 6-weeks (Condition C). The university student was matched on the self-disclosed gender of the peer model and did not have a disability. Participants were solely told that the goal of this study was to determine whether the classes could improve their exercise self-efficacy. Following the non-peer model condition, a washout period of 2 weeks was implemented as participants were not exposed to any modelling condition. After the washout, we collected data for three weeks representing Baseline 2 (Condition A₂). Upon completion of data collection, the participants received a short debriefing session to explain the true objective of the study. Participants were compensated \$60 for completing the study. Ethical approval was obtained from the first author's institution was obtained prior to starting the study.

The Peer and Non-Peer Models. The group exercise classes were led by the same Viomax kinesiologist across all conditions of the study. The models were allowed to participate in the activities of the class and interact with the participants. They were instructed to talk about their previous experiences with exercise informally, but to avoid giving feedback on participants' exercise

performance to control for other sources of self-efficacy (i.e., verbal persuasion). The main task of both models was to demonstrate the activities presented by the kinesiologist. Once the activity was modeled, the models also completed the activity prescribed by the kinesiologist. Therefore, the difference between the model conditions was the person who acted as the model. In the peer model condition, the peer model was a white male in his sixties who had a stroke and still lived with post-stroke complications (less balance and strength on one side of the body) although his condition was much less severe than the study participants. He had previously and was still taking part in the advanced post-stroke classes. In the non-peer model condition, the model was a white male Physical and Health Education student in his early twenties who had not previously experienced a stroke.

Phase 1: Quantitative Data

At Baseline 1, participants completed a questionnaire for demographic information, physical activity, and self-efficacy. Within Conditions B and C, participants answered a brief task-specific exercise self-efficacy questionnaire (i.e., self-efficacy-as-capability) and a barrier self-efficacy questionnaire (i.e., self-efficacy-as-motivation) after each class.

Demographic Questionnaire. A demographic questionnaire was given to participants to collect general information (e.g., age, sex, time since the stroke, education).

Leisure Time Physical Activity Questionnaire. Participants completed the Leisure Time Physical Activity Questionnaire for People with Spinal Cord Injury (LTPAQ-SCI; Martin Ginis et al., 2012). This questionnaire assesses participants' self-reported frequency and duration (in minutes) of mild-, moderate-, and vigorous-intensity leisure-time physical activity during the last seven days. The frequency and minutes of mild, moderate, and vigorous physical activity were multiplied to create a total physical activity score, in minutes. The LTPAQ-SCI was validated against an hour-to-hour recall of all daily activities. Although this questionnaire was validated in a sample of adults with SCI, it has been used with other disability groups (Sweet et al., 2021) and the wording applies to a stroke population.

Self-Efficacy. Participants responded to two self-efficacy measures after each class. As per Bandura's recommendations to assess self-efficacy, participants rated their self-efficacy on a 0% to 100% scale (Urdañ & Pajares, 2006). First, self-efficacy-as-capability was measured with a task self-efficacy scale to assess the participants' confidence to do the exercises in the class. Using a graded self-efficacy scale, participants indicated their confidence to do the exercises in the class as shown by the model. They provided their confidence rating on a graded list starting at their confidence to complete 'a quarter' of the exercises to 'all' the exercises (4 items). Importantly, the phrase "if you wanted to" was added to the stem to remove the motivational aspect of self-efficacy and capture self-efficacy-as-capability (Williams & Rhodes, 2016). This questionnaire was pilot tested and modified until participants indicated they understood how to complete the questionnaire. Self-efficacy-as-motivation was assessed with a barrier self-efficacy scale, where participants rated their confidence in exercising when presented with five different barriers: "when physically fatigued", "when exercise is boring", "with minor injuries", "in spite of other time demands", "in spite of family responsibilities" (Dzewaltowski, 1989; Nessen et al., 2015). The sixth barrier, "in spite of your work schedule", was removed as most of the participants were retired. A mean of the four items was calculated for each participant.

Phase 2: Qualitative Methodology

Semi-Structured Interviews. Each participant completed two 30–60-minute semi-structured interviews: (A) after the peer model condition (Condition B; week 9) and (B) after Baseline 2 (Condition A; week 18). Week 9 interviews served as an introduction that established participants' background information, prior exercise experiences, and history with stroke. This interview was also designed to understand the participants' perceptions of the peer model and explore the reasons for changes in self-efficacy. For example, two core questions were asked: "How helpful is it to have someone demonstrate how to do the exercises? Why is it or is it not helpful?" and "What differences, if any, do you find when it is the trainer or peer who demonstrates the exercises?" Similarly, week 18 interviews attempted to

investigate the participants' perceptions of the non-peer model and how they might help contextualize any changes in self-efficacy. In this second interview, the researchers revealed the study's purpose to participants so they could examine the overall impact of the models and their effects on self-efficacy. Two core questions were asked in this interview: "How were things different with the peer model compared to the non-peer model? Who did you connect with most and why?" and "Do you feel like the model had an impact on your confidence in your ability to complete the exercises in the class? How? Which model made you feel more confident and why?"

Researcher Diaries. Observations related to participants' overall enjoyment, exercise performance, and concerns were recorded as diaries for each of the exercise classes. These diaries allowed comparisons to be made between interview responses and a written record of the researcher observations. Researcher observations are recommended for mixed-method research to provide contextual understanding of the results (Sparkes et al., 2015).

Data Analysis

Phase 1: Quantitative Analysis

Graphic/visual analyses were conducted on the data using *Excel* to compare the exercise self-efficacy levels within/between-conditions (Parsonson & Baer, 1986). Means, standard deviations, and medians were then calculated for each condition. A within/between-condition visual analysis (Lane & Gast, 2014) of the graphs was conducted for both types of self-efficacy, separately. For the within-condition analyses, stability, level, and trend analyses were conducted. Two stability/variability metrics were calculated. First, a common rule of thumb for variability is at least three observations with no more than 10% variation (Haegele & Hodge, 2015). Given our scale of 100%, we accepted a 10% variability in score for it to be determined stable. Second, the median was used to calculate a stability envelope, with stability being considered when 80% of the data are within the range that is 25% of the median (Lane & Gast, 2014). Level was determined using three metrics. Following Lane and Gast's (2014) recommendations, a relative level change and an absolute level change were calculated. For relative level change, the scores within a condition were split in half. The median scores of the second half were subtracted from the median scores from the first half to report whether there was any change within the condition. Note that the relative level change was not calculated for the Baseline 1/2 conditions because there were only three values. Absolute level change is the subtraction of the last value from the first value in each condition. The third metric was a mean level line which was added to the figures to illustrate the mean level of the condition. Lastly, a trend line was added to each figure by conducting an ordinary least-squares linear-regression and reporting the unstandardized coefficient (B; Haegele & Hodge, 2015). Trend lines were only calculated for the peer model and non-peer model conditions because there were more than three data points.

For the between-condition analyses, four metrics were used: relative level change, mean level change, effect immediacy, and overlap (Lane & Gast, 2014). Relative level change examined the difference between the median value of the first half of one condition and the second half of another condition. The mean level change between two conditions reported through an effect size (Cohen's *d*) whereby small, medium, and large effects were represented by values of .30, .50, and .80, respectively. To show effect immediacy, the absolute level change examined the last value of one condition with the first value of the next condition. Finally, overlap represented the percentage of data from one phase that falls within the range of data of another phase (Kratochwill et al., 2010). Two metrics were used to assess overlap: percentage of non-overlapping data and percentage of overlapping data (Lane & Gast, 2014). Regarding percentage of non-overlapping data, the highest value of one condition is identified, then the percentage of scores in the next condition that is above that value is calculated. For percentage of overlapping data, the highest score of one condition is used to calculate the percentage of scores from another condition that is the same or lower than that high score.

Phase 2: Qualitative Analysis

Both a deductive and inductive thematic analysis were completed to investigate recurring themes of data (Braun & Clarke, 2006). Familiarization of the transcripts was first performed by translating the interview transcripts from French to English and then re-reading the data (Braun & Clarke, 2006). Next, initial codes for each interview were generated for as many possible themes and data patterns with a particular focus on data extracts related to the four sources of self-efficacy (Bandura, 1977). By doing this, the initial codes contained data patterns relevant to self-efficacy without excluding other important codes; thus, allowing for both a deductive and inductive approach. First, the deductive approach was performed by combining the initial codes from all interviews and further refining the codes by categorizing each code based on its relatedness to one of the four sources of self-efficacy. Since a deductive thematic analysis using self-efficacy as a theoretical foundation was used, the four sources of self-efficacy became the themes which collated all the relevant codes representing a similar set of data. Second, an inductive approach allowed for the generation of themes using codes that were unrelated to self-efficacy but were nevertheless important to gain a better understanding of the data and explain some of the quantitative findings. Each theme was further reviewed and refined to ensure that codes within its respective theme were coherent and clearly distinct from other themes.

Transparency and Openness

We report on any software used to analyze the data. This study's design and its analysis were not pre-registered. We report on how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study, and we follow JARS (Kazak, 2018).

3. Results

Phase 1: Quantitative Results

Participant demographic information is presented in Table 1. The four participants in our study were individuals who returned to complete the beginner/intermediate course at least a second time. A visual analysis of self-efficacy levels of the participants throughout the weeks across all conditions was conducted.

Table 1. Demographic Variables.

| | Age | Gender | Mobility | Years living with stroke | Baseline Leisure Time Physical Activity (mins) |
|-----------|-----|--------|--|--------------------------|--|
| P1 | 69 | Female | Requires cane and personal assistance | 10 | 125 |
| P2 | 83 | Male | Requires wheelchair, cane, and personal assistance | 16 | 240 |
| P3 | 82 | Male | Requires wheelchair | 8 | 240 |
| P4 | 79 | Female | Requires rollator walker | 3 | 180 |

Self-Efficacy-as-Capability

Overall Within-Phase Analysis. For detailed information regarding the variability/stability, level, and trend analyses for each participant, see Table 2. Overall, Participant 1's self-efficacy-as-capability was highly variable but did not change within the conditions (i.e., there were no visually meaningful changes as per level metrics and trend lines). Data were stable for Participant 2 with self-efficacy-as-capability appearing to improve in the non-peer condition. Participants 3 and 4 appeared to increase their self-efficacy-as-capability in both the peer model and non-peer conditions with Participant 3 having variable data in Baseline 1 and Participant 4 having variable data across conditions. In summary, three out of four participants reported an increase in self-efficacy-as-capability within the non-peer model condition while two of the four participants reported an increase within the peer model condition.

Table 2. Within-Phase Analyses Including Variability/Stability, Level, and Trend for Self-Efficacy-as-Capability.

| <i>Self-Efficacy-as-Capability</i> | | | | |
|------------------------------------|-------------|--|---|--|
| Conditions | Participant | Variability/Stability | | Trend Trend line calculated using least-square linear regression. |
| | | ¹ Stability Criteria 1: ≥ 3 data points with $\leq 10\%$ variability ² Stability Criteria 2: 80% of data points are within stability envelope = median \pm 25% | Level ³ Change in absolute level ⁴ Change in relative level | |
| Baseline 1 | P1 | Unstable ¹ Unstable (72.5 \pm -18.13) ² | +32.5 improving ³ | / |
| | P2 | Stable ¹ Stable (65 \pm - 16.25) ² | -10 deteriorating ³ | |
| | P3 | Unstable ¹ Stable (50 \pm - 12.5) ² | +10 improving ³ | |
| | P4 | Unstable ¹ Unstable (65 \pm - 16.25) ² | -17.5 deteriorating ³ | |
| Peer Model Condition | P1 | Stable ¹ Stable (68.75 \pm -17.19) ² | -2.4 deteriorating ³ -0.25 deteriorating ⁴ | Flat regression line (B = -0.03) |
| | P2 | N/A? (69.2 \pm - 17.3) ² | +2.5 improving ³ -0.85 deteriorating ⁴ | Flat regression line (B = -0.01) |
| | P3 | Stable ¹ Stable (72.5 \pm - 18.13) ² | +12.5 improving ³ +9.25 improving ⁴ | Positive regression line (B = 0.18) |
| | P4 | Stable ¹ Stable (68.75 \pm - 17.19) ² | +5 improving ³ +3.7 improving ⁴ | Positive regression line (B = 0.14) |
| Non-Peer Model Condition | P1 | Stable ¹ Stable (72.5 \pm - 18.13) ² | -7.5 deteriorating ³ +8.75 improving ⁴ | Flat regression line (B = -0.06) |
| | P2 | Stable ¹ Stable (73.73 \pm - 18.44) ² | +10 improving ³ +2.5 improving ⁴ | Positive regression line (B = 0.14) |
| | P3 | Stable ¹ Stable (72.5 \pm - 18.13) ² | +15 improving ³ +10 improving ⁴ | Strong Positive regression line (B = 0.36) |
| | P4 | Stable ¹ Stable (67.5 \pm - 16.88) ² | +17.5 improving ³ +8.75 improving ⁴ | Positive regression line (B = 0.24) |
| Baseline 2 | P1 | Not enough data points. | +10 improving ³ | / |
| | P2 | N/A? (67.5 \pm - 16.88) ² | +2.5 improving ³ | |
| | P3 | Stable ¹ Stable (77.5 \pm - 19.38) ² | -5 deteriorating ³ | |
| | P4 | Unstable ¹ Stable (67.5 \pm - 16.88) ² | +5 improving ³ | |

Overall Between-Phase Analysis. For detailed information regarding the relative and mean level change and overlap analyses, see Table 3. For Participant 1, self-efficacy-as-capability was higher at Baseline 1 than the peer model, but had 100% of peer model data overlapping with Baseline 1 values. Participant 2 had higher scores in the non-peer model condition compared to the peer model condition and Baseline 2 with little overlap with the peer model condition. For Participant 3, a large increase in self-efficacy-as-capability was reported between Baseline 1 and the peer model condition with only 17% overlapping data. This increase was retained through the non-peer model condition and even accentuated in Baseline 2. For Participant 4, self-efficacy-as-capability remained similar throughout all conditions. Overall, one participant reported changes in self-efficacy-as-capability for the peer model condition when compared with Baseline 1. Two of four participants reported higher self-efficacy-as-capability in the non-peer condition compared to the peer model condition.

Table 3. Between-Phase Analyses Including Level and Overlap for Self-Efficacy-as-Capability.

| <i>Self-Efficacy-as-Capability</i> | | | | |
|------------------------------------|--------------|--|---|--|
| Conditions | Participants | Level | Mean Level Change | Overlap |
| | | ¹ Relative level change ² Immediacy effect shown by absolute level change | Effect Size – Cohen's d (Small – 0.3; Medium – 0.5; Large – 0.8) | POD = Percent overlapping data PND = Percent non-overlapping data |

| | | | | |
|---------------------------|----|--|-------|--------------------|
| Baseline 1/Peer Model | P1 | -11 deteriorating ¹ -15.1 deteriorating ² | -0.24 | 100% POD 0% PND |
| | P2 | +3.35 improving ¹ +2.5 improving ² | -0.02 | 100% POD 0% PND |
| | P3 | +14.8 improving ¹ +9.6 improving ² | +2.40 | 17% POD 83% PND |
| | P4 | +7.5 improving ¹ +2.5 improving ² | -0.02 | 100% POD 0% PND |
| Peer Model/Non-Peer Model | P1 | -5 deteriorating ¹ +7.5 improving ² | -0.08 | 50% POD 50% PND |
| | P2 | +5 improving ¹ -5 deteriorating ² | 1.38 | 17% POD 83% PND |
| | P3 | -9.05 deteriorating ¹ -12.5 deteriorating ² | -0.15 | 100% POD 0% PND |
| | P4 | -7.45 deteriorating ¹ -12.5 deteriorating ² | 0.39 | 60% POD 40% PND |
| Non-Peer Model/Baseline 2 | P1 | -7.5 deteriorating ¹ -10 deteriorating ² | -0.31 | 100% POD 0% PND |
| | P2 | -7.5 deteriorating ¹ -7.5 deteriorating ² | -1.54 | 100% POD 0% PND |
| | P3 | +3.75 improving ¹ +5 improving ² | 1.21 | 100% POD 0% PND |
| | P4 | -1.25 deteriorating ¹ -15 deteriorating ² | 0 | 67% POD 33% PND |

Self-Efficacy-as-Motivation

Overall Within-Phase Analysis. For detailed information regarding the variability/stability, level, and trend analyses for each participant, see Table 4. Overall, Participant 1 had variable data at Baseline 1 and 2, while some level metrics appeared to change within the peer model condition, but the trend lines did not support a strong slope. Missing data points likely hindered strong trends and may have partially caused high variability. Participant 2 had stable Baselines scores, and experience change in the peer model condition in self-efficacy-as-motivation as per both level change metrics and a strong positive trend. Data were highly variable in the non-peer model condition and the metrics did not support any change. Participant 3 also had stable data at both Baselines and appeared to have increased their self-efficacy-as-motivation only in the non-peer model conditions with large level change metric scores and a positive trend line. Participant 4 had relatively stable data, especially at Baseline 2, and a positive trend accompanied by positive absolute and relative level changes in the non-peer model condition. No important changes appeared within the peer model condition. In summary, two out of four participants reported an increase in self-efficacy-as-motivation within the non-peer model condition. Moreover, one participant had an increase within the peer model condition.

Table 4. Within-Phase Analyses Including Variability/Stability, Level, and Trend for Self-Efficacy-as-Motivation.

| <i>Self-Efficacy-as-Motivation</i> | | | | |
|------------------------------------|-------------|--|--|---|
| Conditions | Participant | Variability/Stability | Level | Trend |
| | | ¹ Stability Criteria I: ≥ 3 data points with $\leq 10\%$ variability ² Stability Criteria II: 80% of data points are within stability envelope = median $\pm 25\%$ | ³ Change in absolute level ⁴ Change in relative level | Trend line calculated using least-square linear regression. |
| Baseline 1 | P1 | Unstable ¹ Unstable (68 \pm 17) ² | -44 deteriorating ³ | / |
| | P2 | Stable ¹ Stable (64 \pm 16) ² | -4 deteriorating ³ | |
| | P3 | Unstable ¹ Unstable (40 \pm 10) ² | 0 change ³ | |
| | P4 | Stable ¹ Stable (64 \pm 16) ² | -2 deteriorating ³ | |

| | | | | |
|--------------------------|----|---|--|---|
| Peer Model Condition | P1 | Stable ¹ Stable (51.5 +/- 12.88) ² | +13 improving ³ +11.5 improving ⁴ | Relatively flat regression line (B = 0.09) |
| | P2 | Stable ¹ Stable (57.5 +/- 14.38) ² | +11.5 improving ³ +9.75 improving ⁴ | Positive regression line (B = 0.24) |
| | P3 | Stable ¹ Stable (62 +/- 15.5) ² | +3 improving ³ +1.5 improving ⁴ | Flat regression line (B = 0.05) |
| | P4 | Stable ¹ Stable (66 +/- 16.5) ² | +1.5 improving ³ +1.5 improving ⁴ | Relatively flat regression line (B = 0.08) |
| Non-Peer Model Condition | P1 | Stable ¹ Stable (63 +/- 15.75) ² | -2 deteriorating ³ +3 improving ⁴ | Flat regression line (B = 0.02) |
| | P2 | Stable ¹ Stable (66 +/- 16.5) ² | -2 deteriorating ³ +10 improving ⁴ | Relatively flat regression line (B = 0.07) |
| | P3 | Stable ¹ Stable (62 +/- 10) ² | +6 improving ³ +10 improving ⁴ | Positive regression line (B = 0.18) |
| | P4 | Stable ¹ Stable (68 +/- 17) ² | +16 improving ³ +10 improving ⁴ | Positive regression line (B = 0.24) |
| Baseline 2 | P1 | Not enough data points. | | -10 deteriorating ³ |
| | P2 | Stable ¹ Stable (66 +/- 16.5) ² | +2 improving ³ | / |
| | P3 | Stable ¹ Stable (64 +/- 16) ² | +2 improving ³ | |
| | P4 | Stable ¹ Stable (68 +/- 17) ² | 0 change | |

Overall Between-Phase Analysis. For detailed information regarding the relative and mean level change and overlap analyses, see Table 5. For Participant 1, the peer model and non-peer model conditions differed the most as most metrics from the level and overlapping analyses tended to show higher response in the non-peer model condition. There was also a decrease in mean level between Baseline 1 and the peer model condition, however with the unstable Baseline 1 data found in the within analysis, this results in inconclusive. Participant 2 had a mean level decrease between Baseline 1 and the peer model condition, followed by an increase in the non-peer model condition. Participant 3 has a large level increase between Baseline 1 and the peer model condition according to all metrics and 100% of the data in the peer model phase being non-overlapping. Data then stabilized in the non-peer model condition and remained around the same level at Baseline 2. Participant 4 had almost no change in mean level throughout all four conditions. Small differences in absolute level change could be noted between the peer model and non-peer model conditions and between the non-peer model condition and Baseline 2. Overall, only one out of four participants had between-level changes in self-efficacy-as-motivation for the peer model condition when compared with Baseline 1. Two out of four participants had higher self-efficacy-as-motivation for the non-peer compared to the peer model.

Table 5. Between-Phase Analyses Including Level and Overlap for Self-Efficacy-as-Motivation.

| <i>Self-Efficacy-as-Motivation</i> | | | | |
|------------------------------------|--------------|--|---|--|
| Conditions | Participants | Level | Mean Level Change | Overlap |
| | | ¹ Relative level change ² Immediacy effect shown by absolute level change | Effect Size – Cohen’s d (Small – 0.3; Medium – 0.5; Large – 0.8) | POD = Percent overlapping data PND = Percent non-overlapping data |
| Baseline 1/Peer Model | P1 | -4 deteriorating ¹ +12 improving ² | -0.37 | 100% POD 0% PND |
| | P2 | -12 deteriorating ¹ -16 deteriorating ² | -1.60 | 100% POD 0% PND |
| | P3 | +26 improving ¹ +22 improving ² | 4.22 | 0% POD 100% PND |
| | P4 | +1 improving ¹ +4 improving ² | 0.26 | 83% POD 17% PND |
| | P1 | +4.5 improving ¹ +9 improving ² | 2.09 | 25% POD 75% PND |

| | | | | |
|---------------------------|----|--|-------|--------------------|
| Peer Model/Non-Peer Model | P2 | +3.25 improving ¹ +6.5 improving ² | 1.69 | 50% POD 50% PND |
| | P3 | -3.5 deteriorating ¹ -7 deteriorating ² | 0 | 100% POD 0% PND |
| | P4 | -4.5 deteriorating ¹ -9.5 deteriorating ² | 0.46 | 67% POD 33% PND |
| Non-Peer Model/Baseline 2 | P1 | -0.75 deteriorating ¹ +7.5 improving ² | 0.45 | 50% POD 50% PND |
| | P2 | -9 deteriorating ¹ +4 improving ² | -0.28 | 100% POD 0% PND |
| | P3 | -4 deteriorating ¹ 0 change | 0.44 | 100% POD 0% PND |
| | P4 | -4 deteriorating ¹ -6 deteriorating ² | 0.15 | 100% POD 0% PND |

Phase 2: Qualitative Results

In alignment with the single-case experimental design, qualitative results are presented per participant. We presented the results over themes within the data highlighted in italics.

Participant 1

Participant 1 mentioned that, having a model (peer and non-peer) was beneficial for their self-efficacy as they *preferred demonstrations* from the model over explanations. These findings are consistent with our quantitative results, as there was an increase in self-efficacy-as-motivation from both the peer and non-peer conditions. Specifically, they said:

It helps that she is a lot more visual because even if she does not understand due to the language barrier, she can see it. If there are words that she does not comprehend, she can know with visual cues the mechanism of how the process works and how to follow through in the activity.

However, the researcher made note in their research diary that it wasn't only the demonstrations, but the *model similarity* and their experience with stroke that seemed to be especially helpful for Participant 1. Moreover, Participant 1 mentioned that seeing someone older and with a stroke being able to competently exercise made them feel they could do it too, likely increasing their self-efficacy-as-capability. The researcher noted:

The two peer [models] were fine, but when she was working with a peer [model], she felt more connected to him." This finding is inconsistent with our quantitative findings, which showed that Participant 1 had no changes in self-efficacy-as-capability and higher levels of self-efficacy-as-motivation with the non-peer.

When shown their own results of self-efficacy from the study, Participant 1 indicated that the lack of changes in self-efficacy-as-capability could be a result of their *past performances* with the organization and exercise program:

Exactly, it's been years, and he's stabilizing himself, coming here and knowing how things will work, helps. You can see the changes and progress in the first years, which is excellent. However, with time, there's usually a plateau in the progress with no big amelioration.

Participant 2

When probing about the peer and non-peer model, Participant 2 mentioned the peer model was *not engaging* when demonstrating the exercises:

We haven't really seen [demonstrations] all that often... the 2-3 times that we did see [peer model] doing it maybe he was too far ... [doing] another activity"... [peer model] is focusing on doing the task, right? But maybe not communicating what we have to do, so maybe that's what's lacking in that part.

This finding aligns with our quantitative findings, which showed that there were no improvements in self-efficacy-as-capability and self-efficacy-as-motivation between Baseline 1 and the peer model condition. However, inconsistent with the quantitative findings, which showed an increase in self-efficacy-as-capability and self-efficacy-as-motivation from the non-peer condition, Participant 2 demonstrated no preference for the non-peer model in the interview. In fact, Participant 2 mentioned that both models played a more “passive role” in the exercise sessions and that the “modelling was not done enough...to be able to give an impact”.

As there were changes in self-efficacy-as-motivation in Participant 2, other sources beyond modelling were identified. Specifically, Participant 2 valued the *social aspect* of the exercise class and felt connected to the group “Well, I think there’s definitely a social component, like cohesiveness and sense of belonging to the group”. Participant 2 also mentioned that “I think on one hand a lot of the exercises are very similar from one class to another ... so one part of the class is pretty routine and straightforward?” This repetitiveness may lead to stable levels of self-efficacy-as-motivation due to *past performance* of the weeks prior.

Participant 3

Participant 3 reported improvements in both self-efficacy-as-capability and self-efficacy-as-motivation from the non-peer and peer condition, as per the quantitative results. These findings align with Participant 3’s interview by mentioning feeling supported with someone helping them, regardless of who it was. However, when asked whether they preferred the peer or non-peer model, the participant discussed liking the non-peer model better and noted not having great chemistry with the peer model. One explanation for this difference is that Participant 3 described that the non-peer model provided them instrumental support by setting up the exercise equipment for them. Participant 3 also thought the non-peer model’s “technique was good” and that the peer model was not properly introduced which could then limit their knowledge on the peer model’s role and usefulness. Lastly, Participant 3 mentioned that they had been participating in these exercise classes for 8 years since their stroke and that “I have 10 years of exercise experience. I used to workout with my son”. Participant 3 therefore had strong *past performances* and mastery experiences with exercise, which could contribute to higher levels of self-efficacy-as-capability and self-efficacy-as-motivation.

Participant 4

From the quantitative data, Participant 4 had no changes in self-efficacy-as-capability or self-efficacy-as-motivation from the peer or non-peer model. Based on the researcher’s diaries, Participant 4 appeared to be unhappy with the *high physical ability of the peer model* and feeling like they were not improving in a similar trajectory as the peer model. Participant 4 added pressure on themselves to perform their exercise at a similar level to the peer model. This high expectation led Participant 4 to question their own competence in doing the exercises.

The peer [model] is better than us as he does his exercises perfectly. However, even though he does a lot of exercises, it does not mean we should be like him. He is too good to be in the same group as us. He makes us feel like we should be like him because he keeps saying that we will see a difference if we do the same type of exercise. But that is not the case, we should not try to become him.

Participant 4 described that they had a lack of instrumental support during the classes, limiting their capability to do the exercises:

I am not able to put skates on me feet and tie myself up, so I always need ask help. Speaking on behalf of our general group, we are all people who are not capable of doing many things by ourselves.

Participant 4 also mentioned the models were not properly introduced in the exercise sessions.

4. Discussion

The purpose of this study was to compare changes in exercise self-efficacy levels among adults recovering from a stroke participating in an 18-week community-based exercise program who were exposed to three conditions in the following order: (A₁) no model (3 weeks); (B) peer model (6 weeks); (C) non-peer model (6 weeks); and (A₂) no model again (3 weeks). Our overall results showed that participants preferred having a model to demonstrate the exercises, with a slight preference for the non-peer model. Overall, our findings from this study will help expand research on modelling and model similarity in populations with stroke or physical disabilities. Our data showed that there were increases in self-efficacy despite the model type and the participants preferred having demonstrations of the exercises as opposed to verbal explanations. There is previous support for the use of modelling in populations with physical disabilities and stroke through peer support studies (Parent & Fortin, 2000; Stenberg et al., 2016; Warner et al., 2015) and from qualitative studies pinpointing modelling as an important component of rehabilitation programs (Dixon et al., 2007). Even though we recruited participants who all had taken the program in the past and had experience with exercise, we still saw increases in self-efficacy either from the within/between-condition analyses. Overall, these findings hint that modelling in this study may be at work because participants had already accumulated past experience (i.e., the strongest source of self-efficacy; Ashford et al., 2010).

Contrary to our expectations, only one participant preferred the *peer* model over the non-peer model in our study. Research suggests that individuals are inspired by the success of seeing a peer successfully accomplish a task (Best et al., 2016; Dixon et al., 2007; Kazdin, 1974). Thus, our findings may hint that *model similarity* (i.e., how similar the model is to the observer) might not be as important for populations with physical disabilities. In fact, the non-peer model seems to have been more effective for enhancing self-efficacy compared to the peer model. It could be that model similarity was not the only factor at play; personal preferences, physical activity background, and more time in the class might have been contributing factors. Further, the non-peer model was a student in physical and health education with a strong physical activity background. They may have demonstrated the activity with more precision or participants may have found him a better leader. In fact, research has found identity leadership can have great influence on group engagement (Stevens et al., 2017), which could impact self-efficacy. All our participants described the non-peer model as more engaging than the peer model, suggesting that leadership and communication style may matter as much or more than model similarity.

As identified in the qualitative results, most participants felt that the peer model was not properly introduced to the exercise class and therefore felt less connected to them. This finding could describe why there was a preference for the non-peer model. For instance, if the model is well-introduced, participants may be more likely to trust them and therefore feel more competent when observing them. Model similarity may therefore only be one of many factors that modulates the effect of modelling on self-efficacy. Overall, the results challenge our hypothesis that the peer model should have a greater impact on self-efficacy than the non-peer model. In this regard, it may be that well-introduced and purposefully engaging peer models could better influence self-efficacy, whereas if not done properly, it could have the opposite effect. If this is not an option, a model that is not meant to appear as a peer could in fact be more effective. Future work may need to examine such questions further while also exploring other factors that may moderate the impact of peer and non-peer models on self-efficacy.

When observing the levels of self-efficacy, self-efficacy-as-capability scores were consistently higher than self-efficacy-as-motivation scores for three out of the four participants. This observation aligns with the self-efficacy measurement arguments put forward by Williams and Rhodes (2016). Specifically, when individuals consider their motivation in their self-efficacy judgements (e.g., overcoming barriers to exercise), they rate their self-efficacy lower. We do acknowledge that the self-efficacy scales assessed different types of self-efficacy (task vs. barrier) which may also impact the scores. However, this result highlights that when measuring self-efficacy, researchers should be

cognizant as to *how* they are assessing it to be able to report whether they are looking to changes to self-efficacy-as-capability or self-efficacy-as motivation.

Both modelling conditions seemed to have increased and/or maintained participants' self-efficacy levels, despite the type. Community organizations such as Viomax could implement models in their program to help increase self-efficacy. From these results, they may opt for a non-peer model; however, a peer model would not necessarily negatively impact one's self-efficacy. Given that this study only provides a first examination on the impact of models and model similarity within a community-based group exercise program for stroke survivors, the community programs could consult with group members on the type of model they would prefer and how to best integrate them into the class. The availability of peer or non-peer volunteers is also a potential benefit for community groups. Several experienced adults with physical disabilities are training in centres such as Viomax, to which volunteers could be identified. Further, undergraduate students and programs in kinesiology, physical education, or other health domains may look for volunteer or internship opportunities to gain or provide valuable real-world experience in an exercise setting. Research findings from this study offers community organizations such as Viomax with preliminary scientific evidence to include modelling in their programs, with no indication that one type of model is more advantageous.

Despite our partner's efforts to recruit new members to their program and introduce new exercises every class, the beginner level course comprised past participants. This may have influenced higher self-efficacy levels from the onset. Although we attempted to manipulate self-efficacy (and BCT) to answer recent calls in the literature (Spring et al., 2020), attempting to do such experimentation in real-world setting is challenging. Given our research was conducted in an existing community-based program, we opted to lose some internal validity for gains in external/ecological validity. As such, we did not interfere with how the program ran or remind participants to attend the sessions. In working with the community, researchers need to relinquish control and work with the community to identify how they can meet their needs (Melton et al., 2022). In our case, a researcher was present at every session to assist with data collection and, after encountering a missed session by a model, a researcher took on the responsibility to remind the models to attend the session. Given we still had some results in a real-world setting, models may be an effective method to increase self-efficacy.

With the challenges of experimentation in real-world settings, we suggest that researchers use varying methodologies and document their implementation (e.g., researcher diaries). If it was not for our qualitative work, we would not have known that the models were not introduced well, which helped partially explain our results. Another suggestion for researchers working in community-based settings is to have meetings early on with community representatives about different methodologies and designs that can be used (Jagosh et al., 2015). Not only should there be discussions around efficacy, but also feasibility in that specific setting. Lastly and most importantly, we suggest that researchers establish constant communication with their community partner to ensure quick adaptations when needed (Agans et al., 2020). As we learned, our study protocol needed to be adjusted a few times due to unpredictable circumstances.

Limitations and Future Research

A limitation of this study was that the peer model condition was presented to all participants before the non-peer model condition. As such, it is difficult to make conclusions as to whether the non-peer model condition further increased self-efficacy in some participants or if the higher self-efficacy levels were attributable to the peer model condition. We had originally planned to run the study with both orders (ABCA and ACBA) in two different weekly classes, but the lack of participants limited us to one class and design. Future research should attempt to expose the modelling manipulation in different orders to be able to make stronger conclusions.

Finally, we had a high attrition rate with three of seven participants dropping out of the program for the Winter sessions (two participants) and one participant who dropped out of the study because they missed too many sessions due to injury/illness. High attrition rates are typical in research with

people with physical disabilities and in real world research (Dorstyn, et al., 2011; Kosma et al., 2005). As a result, researchers and community organization need to continue to work together to identify strategies to maximize participant engagement that is specific to that local context with the goal of minimizing attrition.

5. Conclusions

Three of the four participants showed increased self-efficacy in at least one condition, with two participants demonstrating improvement in the non-peer model condition, suggesting its potential effectiveness. However, the findings were not consistent across all participants, and the qualitative data suggested that model similarity might be modulated by subjective components like the participants' perception of the models. Nonetheless, the results indicate that modelling, in general, may benefit stroke survivors in increasing their self-efficacy.

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