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Training in influencing skills from neuro-linguistic programming (modelled from hypnosis and family therapy), in combination with innovative maths pedagogy, raises maths attainment in adult numeracy learners

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Abstract

Case study research suggests that NLP influencing strategies benefit teacher effectiveness. Maths pedagogy involving higher-order questioning, challenge, problem solving and collaborative working may be a way of improving attainment in adult numeracy learning, however, such strategies may be less effective if the relationship between teacher and learner does not reflect sensitivity to attitudes, beliefs and emotions (areas in which advocates of NLP claim effectiveness). The present study investigated these claims and the combined effect of such approaches using a pre- and post-treatment test design with 173 adult numeracy learners. Teachers were randomly allocated to three conditions, these were: (1) teachers given no training (control condition); (2) teachers trained in innovative maths pedagogy (including more frequent higher-order questioning, challenge, problem solving and collaborative learning); and (3) teachers trained in both NLP and the innovative maths pedagogy. NLP training included suggestion using language patterns modelled from hypnosis, body language modelled from family therapy and spatial anchoring for emotional state management. A significant within-subject mean difference in maths test scores for the innovative maths pedagogy group (MD = 10.97, t(66) = 7.292, p< .0005, η^2=.446) was nearly twice that of the control (MD = 5.67, t(42) = 3.099, p = .003, η^2 = .186). Although an attainment gap between pre- and post- treatment scores for the innovative treatment group alone (without NLP) appeared to close over time post hoc between-group contrasts indicated differences between pre- and post-treatment means were not statistically significant (p = .404 and p = .689, respectively). However, with the addition of NLP training, post hoc contrasts showed mean maths attainment had significantly improved compared to the control (p = .040) with mean difference, pre- and post-treatment attainment, increased to over three times that of the control (MD = 18.35, t(62) = 9.552, p< .0005, η^2 = .595). CfBT Education Trust carried out this research with funding from the Learning and Skills Improvement Service.

Key words: NLP, mathematics, teaching, learning, adult numeracy.

Introduction

Neuro-linguistic programming (NLP) publications frequently claim to have modelled the subjective experience of highly able people (particularly in relation to communication skills) in a way that enables the transfer of effectiveness both within and across disciplines (see Tosey and Mathison (2009) for an academic appraisal of the field and its development). The earliest NLP publications originated when Richard Bandler and John Grinder (the co-founders of NLP) were a student and associate professor of linguistics at the University of Santa Cruz in California in the mid-1970s. Their early books document the use of the NLP process of modelling with hypnotherapists and family therapists such as Milton Erickson and Virginia Satir (Bandler and Grinder, 1975a; b; 1979; Bandler, Grinder and Satir, 1976; Grinder and Bandler, 1976). These contain the first publication of their ideas about language (verbal and non-verbal), NLP approaches to the investigation of subjective experience and the internal mental processes which people are capable of perceiving. The first book to discuss teachers and classroom practice with NLP appeared in 1982 (Harper, 1982), although an earlier publication looked at the development of self-esteem with children and teenagers (Anderson, 1981). Robert Dilts then produced a book which contained a specific chapter on NLP in Education (Dilts, 1983) originally written in 1981. Also in that year, Sidney Jacobson published the first of three extensive volumes on NLP and education (Jacobson, 1983; 1986a; b). Over the next 20 years, there have been over 20 more publications (see Carey et al. 2009 for a detailed review). Drawing on the evidence in relation to communication skills and teaching (for example, Muijs and Reynolds, 2005) NLP skills have, in recent years, been increasingly associated with the teacher effectiveness (Churches and West-Burnham ,2008; 2009; Carey et al., 2009; 2011; Vieira and Gaspar, 2012).

From an academic perspective, there has been an increasing interest in research into NLP in recent years with calls for academic commentary to become more evidence based (Tosey and Mathison, 2009) rather than speculative and theoretical. In education, there has been a significant growth in the publication of research evidence on NLP, and in 2010, CfBT Education Trust published the first systematic literature review (Carey et al., 2010). This reviewed the content of 111 references including studies that contain research evidence. The authors identified 52 papers that claimed to contain confirmatory research evidence from 27 qualitative, 7 mixed-method and 18 quantitative education related studies. The review identified six quantitative studies that claim disconfirmatory evidence. None of the disconfirmatory studies was specifically in the area of adult numeracy learning, or classroom based mathematics teaching in general. There were no large-scale classroom based randomised controlled trials. Prior to the carrying out of the present research, a further search of the same databases used by Carey and colleagues in 2009 was undertaken. Between 2009 and 2011 an additional 10 education related papers referencing NLP were published (el Gany et al., 2010; Carey et al., 2011; Jones, J, 2010; Kudliskis, 2009; Mohsin, 2009; Ran, 2009; Salmas-Villarreal, 2010; Saunders, 2009; Sibley, 2009; Slater et al., 2009; Tosey and Mathison, 2010). None of these contained evidence about the effectiveness of NLP in adult numeracy, or mathematics teaching specifically, however, two studies (Pishghadam et al., 2011a; b) report statistically significant positive correlations between teacher success in English language teaching and NLP.

With the exception of the NLP Spelling Strategy (Malloy, 1989; Malloy, 1995), most of the evidence in support of using NLP in education suggests benefits in relation to areas like effective communication, engagement, questioning and classroom climate rather than specific classroom pedagogy. In a perspectives paper on the potential of NLP in education Churches and West-Burnham (2008), for example, associate the potential benefits of NLP in teaching with ideas about emotional climate and the importance of this for effective learning.

Of particular relevance to this study are the 24 teacher-led action research case studies published by Carey and colleagues (2009; 2011). The peer reviewed journal paper (Carey et al., 2011) notes the potential benefits of teachers learning language patterns modelled from hypnosis, body language and emotional state management techniques but acknowledges the limitations of evidence provided by small scale teacher-led action research. Specifically, Carey and colleague (2011), recommend a large-scale randomised controlled trial to explore the potential of such techniques. The present study aims to build on that recommendation.

Three recent papers illustrate the need for more research into adult numeracy and effective pedagogy (McLeod and Straw, 2010; NIACE, 2010; NRDC, 2010). In terms of progress, adult numeracy still lags behind progress in literacy in England (NIACE, 2010). Some of the contributing factors to this are clear from a recent extensive literature review by the National Research and Development Centre for Adult Literacy and Numeracy (NRDC, 2010). This endorsed earlier findings that suggest adult numeracy teaching is both under-researched and generally lacking a strong theoretical basis (Coben, 2003). The CfBT Education Trust literature review into Adult Basic Skills also illustrates that there is only a limited research base currently in this area compared to other areas of adult learning, particular in relation to pedagogy (McLeod and Straw, 2010). The NRDC review looked at academic literature, practitioner-focused publications, government reports and large-scale representative surveys. The review noted the importance of areas such as students' self-perceptions of their numeracy difficulties (DfES, 2003) and that the gap between assessed and perceived skills is even greater in numeracy than it is for literacy (Bynner and Parson, 2006). In relation to the climate that teachers create in their classrooms, teachers who are effective are able to motivate learners to persist (Lopez et al., 2007; Swain et al., 2005) and deal with the high levels of anxiety and fear that is felt by many adult numeracy learners (Sewell, 1981; Meader, 2000). These anxieties often originate from early childhood and can be traumatic and long-lasting (Coben and Thumpston, 1996). Anxiety may also weaken memory, logical thinking and the ability to work methodically (Ashcraft, 2002). The nature of the relationship between the learner and teacher itself may therefore have a significant impact with effective teachers being sensitive to the attitudes, beliefs and emotions of their learners (Cohen, 2005) and by extension it could be argued that adult numeracy teachers need the skills to deal with these areas effectively. In terms of pedagogy, research evidence suggests that engagement and making maths meaningful is important (Salford, 2000; Baker, 2005) as is the teaching of abstract concepts not just basic numeracy (Swain et al., 2005). Salford, for example, drawing on Piaget argues for a constructivist approach in which learners should be allowed to work out the general rules of mathematics from exploratory situations (Salford, 2000). 'Bad' practice is seen as involving the application of procedures without understanding (Swain, 2005). High levels of effective questioning, collaboration and engagement in which learners are challenged to think for themselves may therefore be more effective (see Swain and Swan, 2007). In addition, the need to focus on the development of effective models for mathematics teaching rather than merely the identification and recruitment of the most mathematically talented is becoming increasingly clear across all education phases (Burghes and Robinson, 2009).

Principles for more innovative and effective adult numeracy teaching have been defined by the National Centre for Excellence in the Teaching of Mathematics (NCETM, 2008). These build on earlier research by Swain and Swan (2007). These principles include the need to build on existing knowledge more effectively, expose learner misconceptions, increase the amount of higher-order questioning, more appropriate use of whole class, individual and small group work, encouraging reasoning rather than simplistic answering, the use of richer collaborative tasks and the need to make mathematics relate to the real world. The report also emphasised the appropriate use of technology, confronting difficulties rather than avoiding them, greater use of mathematical language and the need to ensure that learners

understand how they have learned things as well as what they have learned. This said there has not been any controlled research to test these claims.

It would appear, from a review of the literature, that achieving effective adult numeracy pedagogy might require the inclusion of training that supports teachers to develop more effective communication skills (in order to deal with issues of learners' anxiety, fear and motivation) as well as the types of effective pedagogy described above. In such a context, communication skills usually found in therapeutic contexts might be useful. Formal clinical hypnosis is an increasingly established field (see Oakley and Halligan, 2009, for a review of the cognitive neuroscience evidence), however, it has also been demonstrated that hypnotic-suggestive communication can have an effect outside of formal hypnosis in contexts such as advertising (Kaplan, 2007). The best predictor of a person's hypnotic suggestibility is individual responsiveness to the same suggestions outside of hypnosis (Braffman and Kirsch, 1999). Furthermore, an emerging consensus in the field of hypnosis (Kirsch et al., 2011) acknowledges that: all suggestions experienced following induction can be experienced without it; that hypnotic inductions only slightly increase suggestibility; and that waking and hypnotic suggestibility are highly correlated. In relation to NLP one recent study also suggested evidence for a relationship between some NLP techniques and hypnotizability. Research by Kirenskaya and colleagues (2011) showed a decrease in negative emotional intensity for both high and low hypnotizables but with autonomic activity (heart rate, skin conduction span) decline observed in high hypnotizables only. Image vividness and emotional intensity were also significantly higher in the high hypnotizability subjects. Whether NLP represents a sub-school of hypnosis, a set of techniques, or a field of study in itself remains a live debate (see Tosey and Mathison, 2009). This study has sought to integrate two domains: NLP influencing strategies; and innovative maths pedagogy including approaches such as higher levels of collaborative learning, challenge, engagement and higher-order questioning - both of which claim benefits, assess their combined effectiveness and the extent to which the NLP training might enhance effective pedagogy. Therefore, this research sought to contribute to both the debate about the usefulness of NLP in education and the effectiveness of NLP in general.

The present study consisted of a research design with three between-subject conditions and a within-subject pre- and post-treatment maths attainment test. The three conditions were: (1) teachers given no training (control condition); (2) teachers trained in innovative maths pedagogy (involving higher amounts of higher-order questioning, challenge, problem solving and collaborative learning); (3) teachers trained in NLP influencing skills in addition to the innovative math pedagogy training in Condition (2). Each adult learner participant group took the same maths attainment test pre- and post-treatment. A review of the literature and subject matter content of NLP training suggested that NLP communication skills were unlikely to improve maths attainment in themselves if the quality of pedagogy being used was in question (because NLP communication skills are essentially content-free). Rather there was more likely to be a measurable effect if a baseline of good pedagogy was established and known to be in place. The study's design therefore allowed for the testing of two hypotheses:

Hypothesis (a) - adult learners whose teachers are trained in innovative maths pedagogy attain higher maths results than adult learners whose teachers have had no training

Hypothesis (b) - training in NLP influencing skills enhances the maths attainment of adult learners whose teachers have trained in innovative maths pedagogy

Method

Participants

Prior to participant recruitment *a priori* power analysis was carried out using G*Power 3.1.2 (Faul et al., 2007; 2009) in order to estimate a minimum sample size for the study. No prior studies were available on which to base an effect size estimate. An effect size of 0.1, $\alpha = 0.05$, $\beta\text{-}1 = 0.95$ (repeated measures, within-between interaction) was used in the calculation. Results indicated a recommended sample size of >207. Anticipating substantial levels of participant attrition, because of the transient nature of adult numeracy classes, the recruitment approach aimed for a target number of 300-350. Recruitment was via e-mail and presentations at networking events and targeted the teachers of adult numeracy learners across the southeast of England. Initially, 37 Further Education sector teachers expressed interest in participating in the study, 24 teachers eventually took part with 278 adult learners completing the initial baseline testing. Offender learning was not eligible because of data sharing issues. As anticipated, there were substantial levels of participant attrition during the study. In addition (to reduce the risk of ceiling effects), the decision was taken to remove learners who scored more than 95% in the initial pre-treatment maths test. Six learners whose scores were above this cut-off point were withdrawn from the participant group following the baseline test. In total, 173 adult learners between the ages of 16 and 70 ($M = 30.94$, $SD = 13.12$) completed the study, 71 males and 102 females. The following number of participants completed the post-treatment maths test: no training, n = 43; training in innovative maths pedagogy, n = 67; training in NLP and innovative maths pedagogy, n = 63 (see Table 1).

Table 1

Adult learner participants who completed the research study

Condition	Number of participants	Age	Age range	SD	Males	Females
No training	43	37.79	16-68	13.44	11	32
Innovative maths pedagogy	67	27.09	16-71	12.37	18	49
NLP and innovative maths pedagogy	63	23.44	16-51	10.61	41	22
Total	173	30.94	16-70	13.12	71	102

As an incentive, teachers whose classes completed the research could attend a post-research conference and additional training. There were no incentives for the adult learners. All participants received treatment that was in accordance with standard ethical research guidelines. Dr Paul Tosey, University of Surrey, was consulted about the ethical application of NLP within the research design. The Skills for Life Development Centre, University of Sussex Innovation Centre monitored and controlled all data security, entry and analysis.

Materials

All adult learner participants received the same pencil and paper single level maths test that they completed pre- and post-treatment. Participants also completed a demographic questionnaire (e.g. age, gender). The maths test was from the Department for Education

and Skills ReadWritePlus Skills for Life Diagnostic tools in Numeracy Testing. The test covered curriculum areas as specified in the Skills for Life Adult Core Curriculum for Numeracy: Entry 1, 2, 3 and Levels 1 to 3 (DfES, 2001). In addition, participants completed an attitude to maths learning questionnaire, repeated pre- and post- treatment. A further research paper (currently in draft) will discuss the results from this.

Procedure

Prior to the administration of the pre-treatment test and demographic questionnaire the teachers were randomly allocated to one of the three conditions described above, whilst controlling for a number of background factors to ensure a similar distribution in each condition. The controlled variables were teacher qualification level, number of years in teaching, spread of experience in teaching Skills for Life Numeracy, Functional Maths and Key Skills - Application of Number. No teachers from the same organisation/location completed the same condition to avoid the risk of 'content sharing' in relation to the training received and 'contamination' between participant groups.

One criticism of NLP is that it is a form of 'cargo cult' psychology (Roderique-Davies, 2009). The implication being that any effects are perceptual (or placebo) and exist only in the minds of converts – although no research has tested this hypothesis yet. In response to this criticism, the present study implemented a number of additional controls. All the adult learners were kept 'blind' to the purpose of the study and to the content that their teachers had, or had not, been trained in – the teachers simply adapted their practice without making any explicit references to anything that they had learned. In relation to the teachers, the no training group remained 'blind' to the content that the other teacher groups had been trained in and the innovative maths pedagogy alone group remained unaware of the content of the training given to the NLP and innovative maths group. Furthermore, the NLP trained teachers did not know that they were to receive training in NLP until they arrived on the first day of the NLP training programme. All other participants remained unaware that NLP was part of the research design. No teachers whose learners completed the study had received any previous training in NLP.

The adult learners gave consent before completing the pre-treatment maths test, attitudes questionnaire and demographic questionnaire. Teachers conducted the pre- and post-treatment maths attainment tests in their own classrooms in Further Education, sixth form colleges, work-based learning providers and adult and community learning providers. There was no time limit for the test. Learners could take as much time as they needed to attempt (in one session within one lesson) as many questions as possible before handing in the test paper. Pre-treatment tests took place in the middle to end of the autumn term and post-treatment tests at the end of the spring term/beginning of the summer term, although exact control of this variable was difficult because of the nature of adult numeracy learning and differences in weekly contact time and term dates. Where there was variation this was similar within each condition. Teachers themselves received instructions to avoid reading the maths test and simply to invigilate the test on the two occasions, collect it in and post it immediately to the project administrator.

The three conditions were as follows:

(1) No training

Adult learners in this group completed the maths attainment test at the beginning of the allocated time-period and again at the end, their teachers received no training (from the project) between the two testing points.

(2) Training in innovative math pedagogy (involving higher amounts of higher-order questioning, challenge, problem solving and collaborative learning)

Adult learners in this group completed the maths attainment test at the beginning of the allocated time-period, their teachers then received 2 days of training in innovative maths pedagogy. The principles of effective adult numeracy teaching, as defined in the National Centre for Excellence in the Teaching of Mathematics 2008 report (NCETM, 2008), and which define a more innovative approach to pedagogy in adult learning, formed the basis for the curriculum, with a particular emphasis on higher-order questioning:

- Building on existing knowledge
- Exposing misconceptions
- Using higher-order questioning
- Appropriate whole class, individual and small group work
- Encouraging reasoning rather than answer getting
- Using rich collaborative tasks
- Creating connection between topics, both within mathematics and to the real world
- Using technology appropriately
- Confronting difficulties rather than avoiding them
- Developing mathematical language
- Understand what has been learned and how

The training the teachers received also built on ideas and approaches from the Maths4Life project (see Carpentieri et al. (2010), for a summary). Teachers in Condition (2) were encouraged to use the online adult numeracy resources available at the Learning and Skills Improvement Service Excellence Gateway throughout the research period. Participants also received non-NLP related mentoring support to help them to embed the training that they had received. This mentoring was carried out by the same mentors who mentored group 3 (see below) all of whom were trained to NLP Diploma level but in the case of group 2 were briefed to avoid using any NLP related techniques. At the end of the allocated time-period, the adult learners completed the same single level maths test again.

(3) NLP and innovative maths pedagogy group

Adult learners in this group completed the maths attainment test at the beginning of the allocated time-period, their teachers then received the same innovative math pedagogy training as Condition (2) above. The teachers also received a further 4 days of training in NLP. The NLP training curriculum consisted of:

- Learning to use influential language patterns modelled from hypnosis (the Milton model (Grinder and Bandler, 1975b; 1981)) in order to formulate positive suggestions in relation to attainment, motivation and behaviour (Churches and Terry, 2007). Specifically, the teachers were taught how to create positive presuppositions and suggestions and how to use: cause and effect and complex equivalence patterns, chained modal operators, double binds, embedded commands, linkage language, pacing and leading, universal quantifiers, yes set and yes tags.
- Learning to understand the effects of Satir category body language (Blamer, Placater, Leveller, Computer, Confuser) and apply appropriate categories in a

congruent way (Bandler and Grinder, 1976; Bandler, Grinder and Satir, 1976) whilst communicating in the classroom (Churches and Terry, 2007). This component of the training included foundation training in the development of sensory acuity and the use matching and mirroring to build rapport (Bandler and Grinder, 1979)

- Learning to use anchoring to support emotional state management (Bandler and Grinder, 1979) whilst teaching using spatial anchoring (Churches and Terry, 2007)

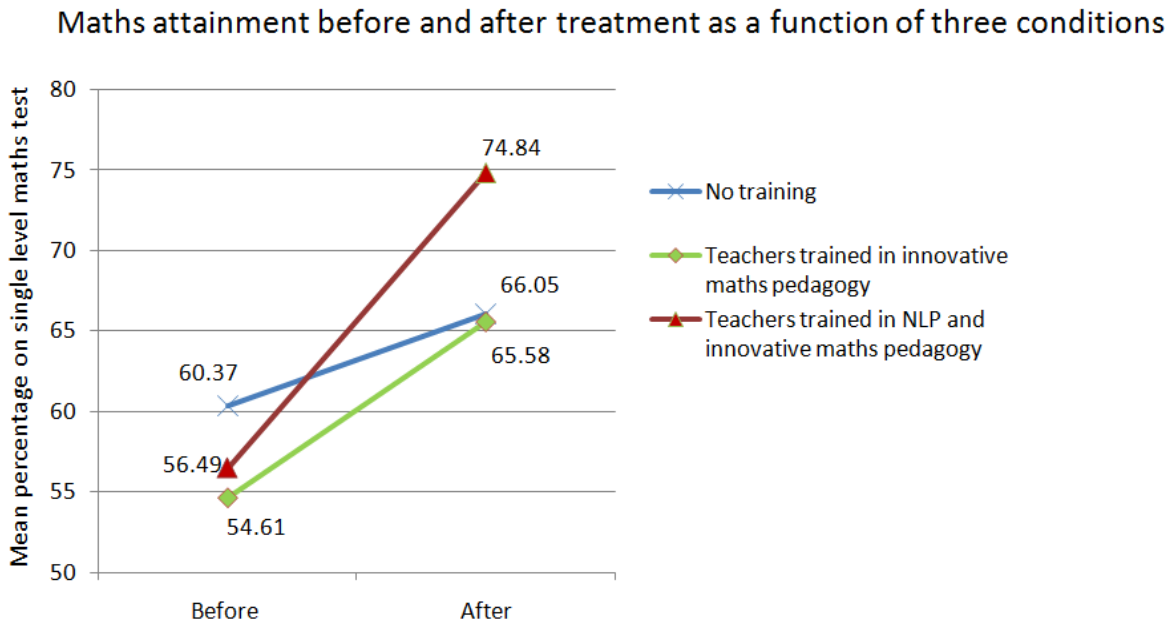
Details of the training protocol are available from nlpresearch@surrey.ac.uk. At the end of the allocated time-period, the adult learners completed the same single level maths test again.

Teachers in Condition (3) received additional NLP reading material (Churches and Terry, 2007; Terry and Churches, 2008) and the Teaching Influence cards used in previous NLP classroom case study research (Carey et al., 2010; 2011). They also received mentoring support from mentors trained to INLPTA NLP Diploma Level (INLPTA, 2005) to help them to embed the training they had received.

Results

Descriptive statistics show that the mean for the single level maths test improved from 60.37 to 66.05 in the no training group; from 54.61 to 65.58 for innovative math pedagogy group; and from 56.49 to 74.84 for the NLP and innovative maths group (see Figure 1 below).

Figure 1



To address hypotheses (a) and (b) paired-samples t-tests compared pre- and post-treatment adult learner maths attainment in the three conditions: no training, training of teachers in innovative maths pedagogy; training of teachers in NLP influencing strategies. Further analysis used a 3 x 2 analysis of variance with post hoc comparisons. Preliminary assumption testing used SPSS Explore. In relation to carrying out the paired-samples t-tests, pre- and post-treatment maths test within-subject data was satisfactory in relation to assumption of normality and the presence outliers. The final analysis applied post hoc tests suitable for use with unequal samples sizes. In relation to the assumptions required for the

analysis of variance and between-subject post hoc comparisons, the pre-treatment data violated the assumption of homogeneity of variance, therefore the data was analysed using the Games-Howell multiple comparisons test. Post-treatment data was satisfactory in relation to all assumptions and was assessed using Dunnett's t.

Paired-samples t-tests showed that the improvement in maths attainment in Figure 1 was statistically significant for all three of the participant groups: no training, $t(42) = 3.099$, $p = .003$ (2-tailed); training in innovative maths pedagogy, $t(66) = 7.292$, $p < .0005$ (2-tailed); training in NLP and innovative maths pedagogy, $t(62) = 9.552$, $p < .0005$ (2-tailed). Partial eta squared values for all three conditions indicated they could be interpreted as having had a large effect (Cohen, 1998): control (no training), $\eta^2 = .186$; training in innovative maths pedagogy, $\eta^2 = .446$; training in innovative maths pedagogy and NLP, $\eta^2 = .595$. The largest statistically significant improvement in maths attainment was for the participant group whose teachers trained in both NLP influencing skills and innovative maths pedagogy. Specifically, the NLP and innovative maths pedagogy group had the highest mean increase of the three participant groups (*MD* = 18.35; *SE* = 1.92) with an increase in maths attainment that was nearly three times that of the control condition (*MD* = 5.67; *SE* = 1.83) and one and a half times that of the innovative maths pedagogy alone group (*MD* = 10.97; *SE* = 1.50). As can be observed in the data above, and in Table 2 below, innovative maths pegagogy alone also improved attainment with a mean difference score that was nearly twice that of the control condition.

Table 2

Paired differences for the three conditions

	Mean Difference	Standard Deviation	Standard Error	95% Confidence Interval of the Mean Difference	
				Lower bound	Upper bound
Control group difference between pre- and post-maths test scores	5.67	12.01	1.83	1.98	9.37
Innovative maths pedagogy difference between pre- and post-maths test scores	10.97	12.31	1.50	7.97	13.97
NLP and innovative maths pedagogy difference between pre- and post- maths test scores	18.35	15.25	1.92	14.51	22.19

However, scrutiny of the confidence intervals for pre- and post-treatment means themselves (Figure 2 and Table 3 below) suggest the increase for the no treatment group would not generalise 95% of the time to the population because the post-test score for this group (66.05) lies within the 95% confidence interval for the pre-test mean (lower bound = 53.49, upper bound = 67.25). This is also the case for the innovative maths pedagogy alone results. By contrast, the confidence interval data from the NLP and innovative maths pedagogy groups indicates that the statistical model presented by the data is likely to represent true values for the population from which the samples were drawn.

Figure 2

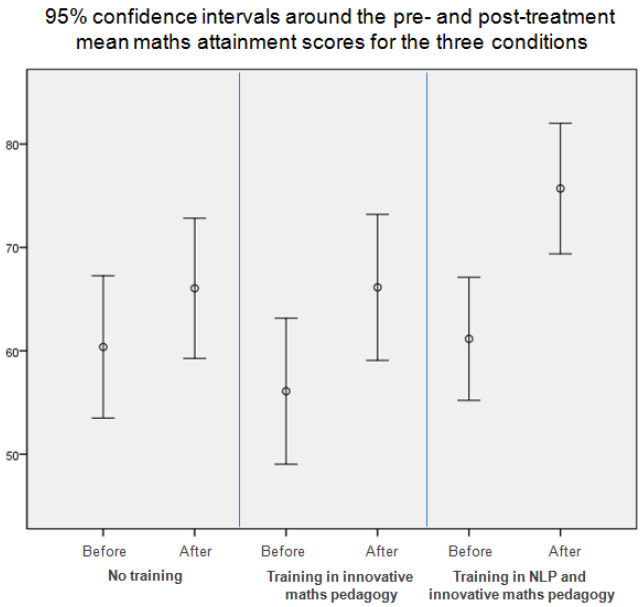


Table 3

Mean scores for the three condition pre- and post- tests with confidence intervals

	Maths attainment mean score	Standard Deviation	Standard Error	Minimum	Maximum	95% Confidence Interval	
						Lower bound	Upper bound
Pre- control condition	60.37	22.35	3.41	18	95	53.49	67.25
Post- control condition	66.05	22.02	3.36	16	98	59.27	72.82
Pre- innovative maths pedagogy training	54.61	23.54	3.50	10	94	49.03	63.16
Post- innovative maths pedagogy training	65.58	23.83	3.50	20	99	59.08	73.12
Pre- NLP and innovative maths pedagogy training	56.49	21.47	3.02	6	95	54.65	66.84
Post- NLP and innovative maths training	74.84	20.26	3.49	21	99	67.68	81.72

A 3 x 2 analysis of variance with repeated measures explored the trend seen in Figure 1, above. The dependent variable was maths attainment. The first factor was the condition (no training; innovative maths pedagogy; NLP and innovative maths pedagogy). The second factor was the timing of the maths test (before or after treatment). Both the main effect of level and timing ($F(1,170) = 126.37$, $p < .0005$) and the level x timing interaction were significant ($F(2,170) = 12.02$, $p < .0005$). In order to explore the meaning of the data post hoc analysis used a series of contrasts comparing the pre- and post-treatment interaction with the three conditions. The first set of contrasts explored the differences

between the levels for the pre-treatment maths tests. Because sample sizes for the pre-treatment tests were unequal and Levine's Test of Equality of Error Variance was significant the Games-Howell multiple comparisons procedure was used. All of the contrasts between the levels were not significant (control-innovative maths, p = .404; control-NLP and innovative maths, p = .647; innovative maths alone-NLP and innovative maths, p = .883). A further series of three contrasts explored the three post-treatment maths attainment scores after the treatment phase of the research used Dunnett's t because Levine's Test was not significant for this data. This test also allowed for the treatment of one condition as a control (the no training group) and for the comparison of other conditions against it. The contrast between the control condition and the NLP and innovative maths condition was significant (*MD* = 8.80, *SE* = 4.38, p = .040). As expected, from what can been seen in Figure 1 the contrast between the control condition and the innovative maths condition was not significant (p = .689). A final contrast with innovative maths pedagogy defined as the control, indicated a statistically significant difference between the NLP and innovative maths and innovative maths alone conditions (*MD* = 9.26, *SE* = 3.88, p = .017).

A final test determined levels of significance in relation to individual participant improvement between pre- and post-treatment maths attainment (improvement was defined as 'post-treatment test score' minus the 'pre-treatment score' for each individual participant). As expected from the 3 x 2 analysis of variance the one-way analysis of variance produced the same significant main effect (F(2,170) = 12.02, p< .0005). Post hoc contrasts (Dunnett's t) indicated a statistically significant difference between the NLP and innovative maths condition and the control (*MD* = 12.67, *SE* = 2.65, p<.0005) and between the innovative maths pedagogy and the control (*MD* = 5.30, *SE* = 2.62, p = .039). A further contrast with innovative maths pedagogy defined as the control showed a significant difference between this condition and the NLP and innovative maths group's level of improvement (*MD* = 7.38, *SE* = 2.35, p = .002).

Discussion

The current research intended to examine the extent to which innovative maths pedagogy (involving higher amounts of higher-order questioning, challenge, problem solving and collaborative learning) could improve adult numeracy attainment and whether training in NLP influencing skills could further enhance any improvements. A review of the literature showed that there had been no large-scale quantitative research studies in relation to either of these areas. For the purpose of this research, we wrote a formal NLP research training protocol. Future research could use this to standardise the pre-research training of teachers.

The data clearly indicated that NLP training in additional to innovative maths pedagogy significantly enhanced attainment compared to both the control and innovative maths pedagogy condition. However, the extent to which innovative maths pedagogy alone contributed to improved maths scores was ambiguous.

Hypothesis (a) - adult learners whose teachers are trained in innovative maths pedagogy attain higher maths results than adult learners whose teachers have had no training

Interpretation of the data for the innovative maths alone condition is ambiguous and depends of the emphasis placed on each of the tests used. On the one hand, although training in innovative maths pedagogy alone appeared to have closed a small attainment gap between the pre-treatment maths attainment of the control condition (M = 60.37) and the innovative maths pedagogy group (M = 54.61), the between-subject post hoc tests for both the pre- and post-treatment maths attainment scores were not significant. Therefore, this difference could have occurred by chance. Confidence intervals around the means further

challenge assertions about the closing of an attainment gap. An interpretation based solely on this data would result in an acceptance of the null hypothesis. However, there was also a statistically significant within-subject mean difference for the innovative maths pedagogy condition, nearly twice that of the control group. Again, interpretation of this result depends on the emphasis placed on different statistical data, in this case confidence intervals versus statistically significant within-subject effects. Finally, assessment of levels of improvement in innovative maths attainment, compared to the control, found a statistically significant result when the data was analysed from this perspective. Taking these things into consideration another interpretation could be a partial but not conclusive confirmation of hypothesis (a). Further, bearing in mind that participant attrition reduced the sample size for the control this will have affected the statistical significance of the difference between the pre-treatment innovative maths condition and the control and therefore the significance of any closing of attainment gap between the initially lower attaining innovative maths group. Taking this into account, and the two possible interpretations of the data, we have favoured the second interpretation in our conclusions.

Hypothesis (b) - training in NLP influencing skills enhances the maths attainment of adult learners whose teachers have trained in innovative maths pedagogy

The statistically significant results for the paired-sample t-tests, and the post hoc comparisons, confirm that teachers trained in NLP influencing strategies, in addition to innovative math pedagogy, improved maths attainment. This was the case in relation to mean difference between the pre- and post-treatment scores and in relation to the difference in final test score between the three conditions, a clear confirmation of hypothesis (b). Confidence intervals further reinforce an unambiguous interpretation.

Possible methodological limitations and suggestions for future research

Because NLP was not trained as a separate condition it is unclear as to the extent to which the improvements in maths attainment were completely due to the NLP training or the result of the combination of NLP and innovative math pedagogy. This said, it seems unlikely that training in content-free communication skills would improve an area of the curriculum like mathematics that has very clear subject and pedagogic requirements without a degree of good practice also being in place. Furthermore, the study did not seek to test whether NLP influencing skills would also improve maths attainment where teaching methods were more traditional. A second limitation is that the level of participant attrition reduced the number of participants in the control condition to below that of the other two participant groups and may have affected the results. Specifically, the lack of statistically significant evidence (in post hoc tests) that innovative maths pedagogy alone closed, what in terms of the descriptive statistics appeared to be a gap in attainment between the control and this group, could be the result of this lower sample size for the control condition. Thirdly, the teachers in the NLP and innovative maths group may have been more motivated to maintain the implementation of strategies during the research period between mentoring visits because they received more training days overall. Finally, the NLP training contained a number of components that some claim need integration for NLP to be successful as a communication strategy (see Churches and West-Burnham, 2009). This combination of strategies makes it impossible to assess the individual contribution of any of the distinct components. One further issue may have affected the difference between the control condition and the maths alone group as many of the maths pedagogy strategies that were included in the training have been gradually being implemented across the sector generally, making it difficult to assess the extent to which already existing skills may have confounded differences.

A larger study might be able to produce clearer results in relation to innovative maths pedagogy's contribution to improvements in maths attainment. There is also a need to explore the effectiveness of individual NLP components, compared to the combined effectiveness of techniques. Finally, future research might explore whether NLP can improve attainment irrespective of teaching method or could look at whether NLP had an equal effect on other maths teaching methods.

Conclusions

Overall, training teachers in content-free NLP influencing strategies modelled from hypnosis and family therapy appeared to improve maths attainment for adult learners where there was a baseline of innovative maths pedagogy involving higher amounts of active learning and group work in place. It was not possible to determine conclusively the effectiveness of the particular maths pedagogy used in the study, although there was partial evidence that it had a beneficial effect on its own. Based on our experience in this research, NLP training has the potential to improve attainment if used as an enhancement to the development of pedagogy and subject knowledge but not we would argue instead of such programmes. Ultimately, from a classroom perspective, the success of any content-free influencing strategy is most likely to depend on the quality of the content communicated (e.g. quality of subject knowledge (so important in mathematics teaching (see for example, Burghes, 2011)) and appropriateness of learning activities etc. However, this present study suggests that without effective communication good subject knowledge may not be enough. From a broader perspective, and in relation to the evidence from adult numeracy research, the evidence from this study supports earlier research that shows that engagement and a teacher's ability to create positive classroom climate is at least as important as pedagogy (see Muijs and Reynolds (2005) for a discussion of the importance of classroom climate, generally). What this present study suggests, for the first time, is that some of the interpersonal and intrapersonal skills associated with creating the right conditions for effective adult numeracy may be able to be modelled, codified and transferred to and between teachers. In relation to criticisms of NLP generally (Heap, 1998; Heap 2008; Roderique-Davies, 2009) we believe that the effect sizes in this study can be interpreted as preliminary evidence that some NLP techniques, when applied to specific contexts, are more than 'cargo cult' psychology (Roderique-Davies, 2009). A conclusion reinforced by recent statistical research that has yielded confirmatory evidence of the positive effects of NLP in the fields of radiology (reducing the need for anaesthesia in claustrophobia patients undergoing MRI) (Bigley et al., 2010), psychotherapy (Stipancic, 2010) and in relation to high verses low hypnotizables (Kirenskaya, 2011). However, we accept that some of the criticisms aimed at the theoretical foundations of NLP, could be valid and agree with writers who suggest a reappraisal of some of the theoretical explanations in the NLP literature (see for discussions, Carey et al., 2009; Tosey and Mathison, 2010).

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References

Anderson, J. (1981) *Thinking, changing, rearranging: improving self-esteem in young people*, Portland, Oregon: Metamorphous Press.

Ashcraft, M.H. (2002) Maths anxiety: personal, educational and cognitive consequences, Current Directions in Psychological Science, 11: 5: 181-185.

Baker, D. (2005) 'Numeracy and funds of knowledge', *Reflect* 3:16–17.

Bandler, R. and Grinder, J. (1975a) *The structure of magic: a book about language and therapy*, vol.1, Palo Alto: Science and Behaviour Books.

Bandler, R. and Grinder, J. (1975b) *Patterns of the hypnotic techniques of Milton Erickson*, M.D. vol. 1, California: Meta Publications.

Bandler, R. and Grinder, J. (1979) *Frogs into princes*, Moab, Utah: Real People Press.

Bandler, R., Grinder, J. and Satir, V. (1976) *Changing with families: A book about further education for being human*, Palo Alto: Science and Behavior Books.

Bigley, J., Griffiths, P.D., Prydderch, A., Romanowski, A.J., Miles, L., Lidiard, H. and Hoggard, N. (2010) Neurolinguistic programming used to reduce the need for anaesthesia in claustrophobic patients undergoing MRI, *The British Journal of Radiology*, 83: 113–117.

Braffman, W. and Kirsch, I. (1999) Imaginative suggestibility and hypnotisability:an empirical analysis, *Journal of Personal and Social Psychology* 77: 578–587.

Burghes, D. (2011) *International comparative study in mathematics teacher training: enhancing the training of teachers of mathematics*, Reading: CfBT Education Trust.

Burghes, D. and Robinson, D. (2009) *Lesson study: enhancing mathematics teaching and learning*, Reading: CfBT Education Trust.

Bynner, J. and Parsons, S. (2006) *New light on literacy and numeracy*, London: National Research and Development Centre for Adult Literacy and Numeracy, Institute of Education.

Carey, J., Churches, R., Hutchinson, G., Jones, J. and Tosey, P. (2009) (foreword by John West-Burnham) Neuro-linguistic programming and learning: teacher case studies on the impact of NLP in education, Reading: CfBT Education Trust.

Carey, J., Churches, R., Hutchinson, G., Jones, J., Tosey, P., and West-Burnham, J. (2011) Report on preliminary case study evidence that supports the effectiveness of NLP in primary and secondary school classrooms, in P. Tosey (ed), *Current research in NLP, vol 2: proceedings of the second international NLP research conference*, *University of Cardiff, 3rd July 2010,* South Mimms, Hertfordshire: ANLP International CIC, 6-20.

Carpentier, J.D., Litster, J. and Frumkin, L. (2010) *Adult numeracy: a review of the literature*, London: National Research and Development Centre for Adult Literacy and Numeracy, Institute of Education.

Coben, D. (2003) *Adult numeracy: review of research and related literature*, London: National Research and Development Centre for Adult Literacy and Numeracy, Institute of Education.

Coben, D. (2005) *Adult Numeracy: shifting the focus: A Report and Recommendations on Adult Numeracy in Scotland.* Learning Connections: Communities Scotland.

Coben, D. and G. Thumpston (1996) 'Common sense, good sense and invisible mathematics.' PDME III Proceedings: Numeracy, Gender, Class, Race, Proceedings of the Third International Conference of Political Dimensions of Mathematics Education (PDME) III, Bergen, Norway, July 24–27 1995. T. Kjærgård, A. Kvamme and N. Lindén. Landås, Norway, Caspar**:** 284–298.

Churches, R. and Terry, R. (2007) *NLP for teachers: how to be a highly effective teacher*, Camarthen: Crown House.

Churches, R. and West-Burnham, J. (2008) *Leading learning through relationships,* Reading: CfBT Education Trust.

Churches, R. and West-Burnham, J. (2009) Leading learning through relationships: the implications of Neuro-Linguistic Programming for personalisation and the Children's Agenda in England, in P. Tosey, (ed.), *Current research in NLP, vol 1: proceedings of the first international NLP research conference, University of Surrey, 5 July 2008*, South Mimms, Hertfordshire: ANLP International CIC, pp.126–136.

Cohen, J. (1988) *Statistical power analysis for the behavioural sciences,* Hillsdale, New Jersey: Erlbaum.

DfES (2001) ReadWritePlus Skills for Life Diagnostic tools in Numeracy testing, available www.rwp.excellencegateway.org.uk/Diagnostic%20Assessment, accessed 20th July 2012.

DfES (2003) *The Skills for Life survey. A national needs and impact survey of literacy, numeracy and ICT skills.* London, Department for Education and Skills.

Dilts, R.B. (1983) Application of NLP in education (1981), in R. Dilts, *Applications of Neuro-Linguistic Programming*. Cupertino, California: Meta Publications, pp. 1–39.

el Gany, M.A.A, Belal, M.A, and Azim, N.R.M.A. (2010) Development of Psychological and Mental Abilities for the Elite of Junior Players through the Application of A Mentoring Program, International Journal of Information Studies, 2: 2: 97-113.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007) G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods,* 39: 175-191.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009) Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41: 1149-1160.

Grinder, J. and Bandler, R. (1976) *The structure of magic II: a book about communication and change,* Palo Alto: Science and Behavior Books.

Grinder, J. and Bandler, R. (1981) *Tranceformations: Neuro-Linguistic Programming and the structure of hypnosis*, Moab, Utah: Real People Press.

Harper, L. (1982) *Classroom magic – effective teaching made easy*, Troy, Michigan: Twiggs Communication. Revised and republished as Lloyd, L. (1989) *Classroom magic: amazing technology for teachers and homeschoolers*, Portland, Oregon: Metamorphous Press.

Heap, M. (1988) Neurolinguistic Programming – an interim verdict, in M. Heap (ed), *Hypnosis: current clinical, experimental and forensic practices*, London: Croom Helm, pp. 268–280.

Heap, M. (2008) The validity of some early claims of neuro-linguistic programming, *Skeptical Intelligencer*, 11: 6–13.

INLPTA (2005) *Standards: Diploma*, International NLP Trainers Association. http://www.inlpta.com/, Accessed July 1st 2008.

Jacobson, S. (1983) *Meta-Cation: prescriptions for some ailing education processes*, Cupertino, California: Meta Publications.

Jacobson, S. (1986a) *Meta-Cation, volume II: new improved formulas for thinking about thinking*, Cupertino, California: Meta Publications.

Jacobson, S. (1986b) *Meta-Cation, volume III: powerful applications for strong relief*, Cupertino, California: Meta Publications.

Jones, J. (2010) Leadership lessons from the Fast Track programme for teachers in England, *Educational Management Administration and Leadership*, 38: 2: 149-163.

Kaplan, O. (2007) The effect of the hypnotic-suggestive communication level of advertisements on their effectiveness, *Contemporary Hypnosis*, 24: 2: 53-63.

Kirenskaya, A.V., Novototsky-Vlasov, V.Y., Chistayakov, A.N. and Zvonikov, V.M. (2011) The relationship between hypnotizability, internal imagery, and efficiency of neurolinguistic programming, *International Journal of Clinical and Experimental Hypnosis*, 59:2:224-41.

Kirsch, I., Cardeña, E., Derbyshire, S., Dienes, Z., Heap. M., Kallio, S., Mazzoni, G., Naish, P., Oakley, P., Potter, C. and Walters, V. (2011) Definitions of Hypnosis and Hypnotizability and their Relation to Suggestion and Suggesitibility: A Consensus Statement. Contemporary Hypnosis 28:107-115.

Kudliskis, V., Burden, R. (2009) Applying 'what works' in psychology to enhancing examination success in schools: the potential contribution of NLP, Thinking skills and creativity, 4: 3: 170-177.

Lopez, D., Litster, J., Vorhaus, J. and Salter, E. (2007) *Stick with it! Motivating Skills for Life learners to persist, progress and achieve, NRDC Report to the Quality Improvement Agency,* Coventry: Quality Improvement Agency.

MacLeod, S. And Straw, S. (2010) Adult basic skills, Reading: CfBT Education Trust.

Malloy, T.E. (1989) Principles for teaching cognitive strategies, University of Utah, available at www.kattmodel.se.

Malloy, T.E. (1995) Empirical evaluation of the effectiveness of a visual spelling strategy, in K.H. Schick (ed), *Rechtschreibterapie*, Paderborn, Junfermann Verlag.

Meader, P. (2000) 'The effects of continuing goal-settling on persistence in a math classroom.', *Focus on Basics 4.*

Mohsin, Z.I. (2010) Incorporation of NLP strategies into TEFL, Najran Univerisity, Saudi Arabia, Proceedings of the Moroccan Association of Teachers of English, 29th Annual Conference, March 2010.

Muijs, D. and Reynolds, D. (2005, 2nd Edition) *Effective teaching, evidence and practice*, London: Sage.

NCETM (2008) *Mathematics matters*, Sheffield: National Centre for Excellence in the Teaching of Mathematics.

NIACE (2001) Numeracy counts, NIACE Committee of Inquiry on Adult Numeracy Learning, London: National Institute of Adult Continuing Education.

Oakley, D.A. and Halligan, P.W. (2009) Hypnotic suggestion and cognitive neuroscience, *Trend in Cognitive Sciences,* 13: 6: 264-270.

Pishghadam, R., Shapoori M. and Shayesteh, S. (2011a) NLP and its relationship with teacher success, gender, teaching experience and degree: A Comparative Study, *World Journal of English Language*, 1: 2: 2-8.

Pishghadam, R., Shayesteh, S and Shapoori M. (2011b) Validation of an NLP Scale and its Relationship with Teacher Success in High Schools, *Journal of Language Teaching and Research*, 2: 4: 909-917.

Ran, X. (2009) The use of Neuro-linguistic programming (NLP) technique in the classroom, *Journal of Liupanshui Teachers College*, http://en.cnki.com.cn/Journal_en/H-H000-LPSS-2009-05.htm , accessed June 2011.

Roderique-Davies, G. (2009) Neuro-linguistic programming: cargo cult psychology? *Journal of applied research in higher education*, 1: 2: 57–63.

Safford, K. (2000) 'Making Peace in the Math Wars', *Focus on Basics,* 4.B.

Salmas-Villarreal, R. (2010) Work in progress – on tutoring and advising engineering students using NLP, 40th ASEE/IEE Frontiers in Education Conference, October 27-30, Washington DC.

Saunders, D.E. (2009) A psycho-educational programme for cricket players using neuro-linguistic programming, Doctoral dissertation (Sports Psychology), University of Stellenbosch.

Sewell, B. (1981) *Use of mathematics by adults in daily life*. Leicester: Advisory Council for Adult and Continuing Education (ACACE).

Sibley, K.J. (2009) The NLP communication model applied to the engineering classroom, Nova Scotia Agricultural College.

Slater, R., Brotherton, A., Lyons, C. and Whittaker, K. (2010) Using Emotional Intelligence and NLP Training to Promote and Sustain Relationships within KTPs, *Smart Innovation Systems and Technologies*, 5: 3: 189-196.

Stipancic, M., Renner, W., Schutz, P. and Dond, R. (2010) Effects of neuro-linguistic psychotherapy on psychological difficulties and perceived quality of life, *Counselling and Psychotherapy Research,* 10: 1: 39-49.

Swain, J. (2005) What is good practice in adult numeracy teaching?, *Reflect*, 2: 10–12.

Swain, J., Baker, E., Holder, D., Newmarch, B. and Coben, D. (2005) *Beyond the daily application: making numeracy teaching meaningful to adult learners.* London: National Research and Development Centre for Adult Literacy and Numeracy, Institute of Education.

Swain, J. and Swan, M. (2007) *Thinking Through Mathematics: Research Report*, London: National Research and Development Centre for Adult Literacy and Numeracy, Institute of Education.

Terry and Churches (2009) *The NLP tookit: activities and strategies for teachers, trainers and school leaders*, Camarthen: Crown House.

Tosey, P. and Mathison, J. (2009) Neuro-Linguistic Programming: a critical appreciation for managers and developers, Basingstoke, Hants: Palgrave.

Tosey, P. and Mathison, J. (2010) Neuro-linguistic programming in education and teaching, *Innovations in Education and Teaching International*, 47: 3: 317-326.

Vieira, C.R. and Gaspar, M.F. (2012) Plenatitude: teacher education for effectiveness and well-being with neuro-linguistic programming, 4th Association for Teacher Education in Europe Winter Conference, Coimbra, 4th September.

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