(一) 以下是一則摘要，

問題 1. 請將此摘要翻譯成中文(20%)

問題 2. 請將此摘要下一個中文與一個英文的標題(10%)

問題 3. 請畫圖說明此研究的實驗設計(10%)

SUMMARY: Exercise may affect osteopenic women at risk of falls and fractures. A workstation approach to exercise was evaluated in a randomised study of 98 women. The intervention group improved in measures of balance, strength and bone density. This study supports a preventative exercise approach that aims to reduce risk factors for fractures and falls, in women already at risk, through balance training and weight-bearing activity. INTRODUCTION: The objective of this study was to determine the effects of a workstation balance training and weight-bearing exercise program on balance, strength and bone mineral density (BMD) in osteopenic women. A single-blinded randomised controlled trial (RCT) was undertaken for 20 weeks with measurements at baseline and completion. **MATERIALS AND METHODS:** Ninety-eight (98) community-dwelling osteopenic women aged 41-78 years were recruited through the North Brisbane electoral roll. Subjects were randomised via computer-generated random numbers lists into either a control (receiving no intervention), or exercise group (two one-hour exercise sessions per week for 20 weeks with a trained physiotherapist). Assessments at baseline and post-intervention included balance testing (five measures), strength testing (quadriceps, hip adductors / abductors / external rotators and trunk extensors), and DXA scans (proximal femur and lumbar spine). Baseline assessment showed no significant differences between groups for all demographics and measures except for subjects taking osteoporosis medication. The percentage differences between pre- and post-intervention measurements were examined for group effect by ANOVA using an intention-to-treat protocol. **RESULTS:** Ninety-eight women (mean age 62.01 years, SD 8.9 years) enrolled in the study. The mean number of classes attended for the 42 participants in the exercise group who completed the program was 28.2 of a possible 40 classes (71%). At the completion of the trial the intervention group showed markedly significant better performances in balance (unilateral and bilateral stance sway measures, lateral reach, timed up and go and step test) ($p < 0.05$) with strong positive training effects reflecting improvements of between 10% to 71%. Similarly there were gains in strength of the hip muscles (abductors, adductors, and external rotators), quadriceps and trunk extensors with training effects between 9% and 23%. **CONCLUSIONS:** Specific workstation exercises can significantly improve balance and strength in osteopenic women. This type of training may also positively influence bone density although further study is required with intervention over a longer period. A preventative exercise program may reduce the risk of falls and fractures in osteopenic women already at risk (摘錄自 Osteoporos Int. 2008 Jul;19(7):1077-86. Epub 2008 Jan 11.)

見背面

(二) 承上題，請根據附表說明實驗結果(10%)。

Table 3 Mean values (sds) and within subject percentage change for the balance and strength measures at pre- and post- intervention assessments

	Exercisers (n = 50)			Controls (n = 48)			% Change difference** training effect	P-values
	Pre-test	Post-test	% change*	Pre-test	Post-test	% change*		
BALANCE								
Lateral reach left (cms)	16.09(3.66)	19.97(4.74)	27.37	15.67(4.49)	16.25(4.16)	8.49	18.88	.002[b]
Lateral reach right (cms)	16.87(3.20)	20.99(4.49)	28.44	16.60(3.97)	16.84(4.64)	3.64	24.8	.000[a]
Step test left (no. of steps)	16.84(3.28)	20.49(3.42)	24.3	16.96(3.44)	17.69(3.37)	5.02	19.28	.000[a]
Step test right (no. of steps)	16.98(3.41)	20.63(3.64)	24.66	17.48(3.72)	17.73(3.56)	2.11	22.55	.000[a]
Timed up and go (s)	6.76(1.18)	5.97(.84)	−10.37	6.92(1.44)	7.02(1.49)	1.82	12.19	.000[a]
Bilateral stance (deg/s sway)								
Eyes open	.23(.10)	.22(.08)	5.63	.19(.08)	.21(.08)	23.96	18.33	.076[T]
Eyes closed	.32(.15)	.29(.11)	−5.11	.27(.13)	.29(.14)	18.09	23.2	.011[c]
Foam eyes open	.72(.23)	.64(.19)	−9.39	.58(.21)	.62(.26)	10.99	20.38	.000[a]
Foam eyes closed	2.14(.89)	1.96(.69)	−3.04	2.26(1.19)	2.24(.98)	6.86	9.9	.112
Unilateral stance left (deg/s sway)								
Eyes open	1.89(2.51)	1.33(1.95)	−16.74	3.12(4.03)	2.84(3.53)	12.03	28.77	.018[c]
Unilateral stance right (deg/s sway)								
eyes open	1.93(2.25)	1.23(1.74)	−17.97	2.44(3.31)	2.52(3.44)	53.31	71.28	.013[c]
STRENGTH (KG)								
Hip abductors right	13.56(3.82)	15.26(4.09)	16.21	14.26(5.48)	14.03(4.38)	4.09	12.12	.001[a]
Hip abductors left	13.82(3.62)	15.47(3.68)	16.05	14.48(6.19)	13.58(4.34)	−2.05	18.1	.019[c]
Hip adductors right	11.73(3.39)	13.08(3.78)	16.49	12.37(4.66)	12.01(3.85)	.95	15.54	.013[c]
Hip adductors left	11.39(3.35)	12.88(3.77)	18.29	12.46(4.71)	12.27(4.59)	3.29	15.00	.013[c]
Hip external rotators right	7.93(2.89)	8.88(2.61)	18.78	9.68(2.96)	9.05(3.01)	−4.69	23.47	.037[c]
Hip external rotators left	8.08(2.98)	8.85(2.52)	15.85	9.40(2.99)	8.68(2.95)	−4.78	20.63	.080[T]
Trunk extensors	10.97(4.22)	10.89(3.82)	5.63	11.44(4.59)	9.11(3.44)	−14.98	20.61	.152
Quadriceps right	18.85(6.63)	20.52(6.07)	17.27	19.60(6.71)	19.88(7.39)	8.23	9.04	.003[b]
Quadriceps left	18.26(6.32)	19.97(6.23)	17.66	19.42(6.22)	19.78(7.13)	7.97	9.69	.004[b]

Increases in strength, distance reached and number of steps taken and decreases in sway or time indicate improvement
*Mean percentage change expressed as [(post-test score − pre-test score) / pre-test score] × 100
**Mean percentage change in exercise group minus mean percentage change in control group = net benefit of intervention or% difference between groups
[a] Significantly different from control group at $p<0.001$ [b] Significantly different from control group at $p<0.01$[c] Significantly different from control group at $p<0.05$ [T] Trend approaching significance ($p<.10$)

(摘錄自 Osteoporos Int. 2008 Jul;19(7):1077-86. Epub 2008 Jan 11.)

(三) 請閱讀下面的文章並回答問題 (摘錄自 Neurobiol Aging. 2012 Jan;33(1):200.e1-10.)

問題 1: 請問何謂 uncontrolled manifold (UCM) approach? (20%) 另配合圖解說明 (10%)

問題 2: 請問此研究之目的為何? (10%)

問題 3: 請幫此文章下一個中文與一個英文的標題(10%)

Normal adult aging has been hypothesized to lower individuals' ability to adapt their behavior to environmental and task requirements ([Newell et al., 2006] and [Vaillancourt and Newell, 2002]), possibly caused by changes in system "complexity", such as a reduction of the number of independent components, their coupling strength, or both (Lipsitz, 2004). In a similar vein and inspired by cybernetics, Thaler (2002) proposed that age-related changes in sensorimotor performance may be due to a reduction in the system's variety of perceptual states and available responses. Most of the empirical evidence for this general theoretical position stems from nonlinear time series analyses of "system output", such as physiological measures (Lipsitz and Goldberger, 1992), postural sway (Thurner et al., 2002), or step patterns (Hausdorff et al., 1997), addressing the temporal structure of variability ("dynamical degrees of freedom"). In contrast, potential age-related changes in the functional organization of variability across multiple biomechanical degrees of freedom have found only limited attention.

接次頁

Adult aging affects motor performance at different levels, ranging from physiological mechanisms to coordinative skills (Spirduso et al., 2005). Studies on rapid goal-directed arm movements found older adults to show slower and more variable arm movements than younger adults ([Darling et al., 1989], [Yan et al., 1998] and [Yan et al., 2000]) and higher levels of muscle coactivation (Seidler-Dobrin et al., 1998). Moreover, age-related impairments in movement smoothness and end-point accuracy are generally more pronounced for movements requiring shoulder-elbow coordination than for single-joint actions (Seidler et al., 2002), suggesting a selective deficit in multijoint coordination among the elderly.

Motor synergies, defined as task-specific organization of movement variability across the effector system (Latash et al., 2007), may play an important role for the efficiency of motor control processes and their adaptation to environmental and organismic constraints ([Latash and Anson, 2006] and [Latash, 2008]), such as senescence-related skeletal, muscular, and neuronal changes. Here, we investigate adult age-related differences in motor synergies in a manual pointing task, using the uncontrolled manifold (UCM) approach ([Latash et al., 2007], [Latash, 2008] and [Scholz and Schöner, 1999]).

According to the UCM hypothesis (Scholz and Schöner, 1999), variability in motor tasks involving abundant degrees of freedom (DOF) is structured in a way that takes advantage of motor equivalence, that is, of the fact that a variety of configurations of elemental variables (e.g., joint angles) can lead to the same motor output in a task variable (e.g., the position of an end effector). It is hypothesized that stabilization of a task variable by the central nervous system is achieved by selectively constraining variability along dimensions affecting that task variable while allowing for variability along "goal-equivalent" dimensions. A task variable is said to be synergistically controlled when higher amounts of goal-equivalent variability (GEV, exploiting motor abundance) are present compared with nongoal-equivalent variability (NGEV, affecting the task variable).

If this condition is met, then the strength of the synergy can be quantified by a synergy index, for instance as the relative proportion of GEV (Latash et al., 2007). Thus, higher synergy indexes indicate more flexible exploitation of motor abundance. It has to be noted that this definition of motor synergy differs from the terminology often used in clinical research and by some movement scientists (e.g., diPietro et al., 2007), where it usually refers to a relatively invariant temporal coupling among system components. In contrast, the operationalization of motor synergies used here emphasizes both the accuracy and flexibility aspect of motor coordination, by analyzing motor-equivalent stabilization of a task variable (Latash et al., 2007). Note that this is a functional rather than a data-driven definition, in the sense that a synergy is always defined with respect to a specific task variable.

Previous studies using the UCM approach have found age-related differences in the structure of variability in multifinger force production ([Olafsdottir et al., 2007], [Shim et al., 2004] and [Shinohara et al., 2004]), with weaker synergies in older compared with younger adults. Latash (2008) argued that constraining the use of motor abundance (leading to lower synergy indexes) may be an adaptive strategy to cope with age-related decline in sensorimotor processing and increasing neuromuscular noise (Enoka et al., 2003). This view is partly compatible with results from simulation studies in a stochastic optimal control framework (Todorov and Jordan, 2002), in which motor behavior is modeled based on the assumption that biological controllers minimize variation in elemental variables mainly along dimensions that affect the task outcome ("minimal intervention

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principle"). These simulation results indicated that constraining motor abundance may be adaptive in a system with increased sensory noise or higher movement correction costs.

Pointing movements lend themselves well to a UCM analysis, due to the clearly defined goal and the motor abundance of the task, and have been studied in detail using the UCM method (e.g., [Reisman and Scholz, 2003], [Tseng et al., 2002] and [Tseng et al., 2003]). However, to our knowledge, age group differences in motor synergies in pointing attributable to normal aging have not yet been investigated. As pointing is part of our everyday movement repertoire, little or no age-related differences are expected in terms of basic performance measures, such as end point accuracy, at least under self-paced (nonspeeded) conditions. In contrast, based on previous empirical and theoretical results discussed above, we hypothesized that older adults would differ from younger adults regarding the strength of motor synergies.

Constraining abundant degrees of freedom (reducing GEV) may be particularly adaptive for immediate repetitions of the very same action (e.g., pointing to a single target), where little variation is introduced externally by the task. According to this reasoning, the use of motor abundance should be lower in uniform and predictable target schedules, compared with mixed or unpredictable ones, and uniform schedules should enhance existing age differences.

The present study examines potential adult age differences in the structure of variability in manual pointing, using the UCM approach (Scholz and Schöner, 1999). Postural variability was decomposed with respect to finger tip position control. Based on the preceding considerations, we predicted that older adults would show reduced relative amounts of GEV (and lower synergy indexes) than younger adults. To assess sequence effects, 2 targets were used, which had to be pointed at according to 3 different target schedules: blocked, alternating, and random. Our goal was to explore influences of target schedule on the structure of movement variability and potential interactions with adult age, hypothesizing that age-differences would be most pronounced in the blocked condition.