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ORIGINAL PAPER

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Questioning the stability of sense of coherence

The impact of socio-economic status and working conditions in the Canadian population

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Abstract *Background* Much debate exists about the stability of the sense of coherence measure. This study examined changes in sense of coherence (SOC), and the variables associated with these changes, over a 4-year period, in a representative sample of the Canadian labour force (n = 6,790). *Methods* Two methods were used to assess change in SOC: (1) Change outside of that which could be considered as indistinguishable from measurement error, and (2) Change of more than 10 %, which was originally proposed by Antonovksy, the scales designer. *Results* Over the study period, 35.4 % of the population reported changes in SOC outside the range we consider possible due to measurement error, with 58 % reporting change greater than 10 %. Unskilled occupations were associated with declines in SOC, with household income demonstrating a curvilinear relationship with decline in SOC in the female population only. None of the variables used predicted increases in SOC. *Conclusions* Given the degree of change in SOC, and the representativeness of the study sample, we suggest that SOC has a large state component. Given this lack of stability, we recommend caution if using the SOC to represent a stable global orientation within a causal context.

Key words sense of coherence – socio-economic position – reliability of change – stability – gender

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Abbreviations

SOC	Sense of Coherence
T-RT	Test-Retest
SEM	Standard Error of Measurement
MDC	Minimum Detectable Change

Introduction

The psychological resource sense of coherence (SOC) was developed by Antonovksy and is defined as: "*A global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement*" (Antonovsky 1987).

The SOC measure has been used in a wide variety of studies (Berg and Hallberg 1999; Kivimaki et al. 1998; Skirka 2000; Nesbitt and Heidrich 2000; Lewis 1996; Anderzen and Arnetz 1999; Bengtsson-Tops and Hansson 2001; Suominen et al. 2001; Nilsson et al. 2000; Mehlum 1998; van Selm and Dittmann-Kohli 1998; Gilbar 1998; Carstens and Spangenberg 1997) and while there have been positive associations reported between high SOC and the number of positive health outcomes, as well as low SOC and a variety of negative health outcomes, debate still continues regarding the purported stability of this measure (Schnyder et al. 2000; Karlsson et al. 2000; Feldt et al. 2000; Feldt et al. 2000; Antonovsky 1996; Antonovsky 1998).

Given these associations between SOC and health, the Canadian National Population Health Survey provides a unique opportunity to investigate the temporal stability of the SOC measure in a large population sample using a reliability of change index (Jacobson et al. 1984). Based on previous research, we could expect that declines in SOC are associated with an increased risk of a variety of poor health outcomes.

Antonovksy has postulated that a person's SOC should be fully developed by age 30 (Antonovsky 1987). After this point, change may occur; however, this change would be no greater than 10 %, and would return to a stable level once the cause of the change had dissipated (Karlsson et al. 2000).

Research has shown that both the working environment and social hierarchy can affect relatively stable personality traits. Kohn and colleagues (1990) have reported that an individual's ability to be self-directed in their work can affect personality development, particularly in relation to self-depreciation and self-confidence. The degree to which employees can determine what they do and how they do it will play a large effect on shaping elements of their personality (Kohn et al. 1990).

Specifically in relation to SOC, Feldt and colleagues (2000) report that employees in the Finnish labour force who perceived their working conditions as worsening also reported reductions in SOC scores. Similarly, employees who perceived their organizational climate as good with high levels of job security report higher SOC scores than those who did not (Feldt et al. 2000).

To date, the research investigating the stability of SOC has either used test-retest (T-RT) correlations (it is unsure the type of correlation used in each study; some state they are interclass correlations, and others do not report type used) (Feldt et al. 2000; Gana and Garnier 2001; Sagy and Antonovsky 1990; Radmacher and Sheridan 1989; Schnyder et al. 2000; Antonovsky 1993), or the 10 % fluctuation proposed by Antonovksy (Karlsson et al. 2000). T-RT correlations have varied between a low of 0.52, for Israeli retirees over a 1-year period (Sagy et al. 1990), to a high of 0.91, for US college students over a 2-week period (Radmacher et al. 1989). These lower T-RT correlations over longer time periods question the stability of SOC, especially compared to the five NEO-PI personality traits, which have T-RT correlations of between 0.63 and 0.83 over time periods of between 3 and 6 years [Neuroticism (T-RT = 0.83, over 6 years), Extraversion (T-RT = 0.82, over 6 years), Openness (T-RT = 0.83, over 6 years), Agreeableness (T-RT = 0.63, over 3 years), Conscientiousness (T-RT = 0.79, over 3 years] (Costa and McCrae 1994). However, to date, research on the stability of the SOC construct has utilised small population samples, in convenient settings. Canada's National Population Health Survey offers the opportunity to examine the stability of the SOC construct over a long period of time, within a rigorous sampling framework.

The need to define the point at which the observed change can be interpreted as distinct from change due to random day-to-day variability in an instrument has been addressed in several bodies of literature. The T-RT correlation alone is limited as it fails to define the specific score threshold where change is no longer due to error in the SOC instrument, but is true change in an individual's SOC. One of the most common methods to identify "real" change, i. e. change that is distinguishable from measurement error, is the reliability of change index which was introduced to psychotherapy by Jacobson (1984) and refers to change divided by standard error of measurement (SEM) for a given scale. This measure provides a Z score for the change score in an individual over time. Others have corrected this original formula by adding a factor of square root of two, to add additional error due to sampling from two distributions (the test and the retest) (Jacobson et al. 1999; Jacobson and Traux 1991; Stratford et al. 1996; Stratford et al. 1999; Bland and Altman 1986; Ottenbacher et al. 1988; Ravaud et al. 1999).

Others (Stratford et al. 1996; Sadler et al. 1992; Bland et al. 1986) have set an agreed upon $Z\alpha$ level (e. g. 1.96 for an alpha of 0.05) and then solved the equation to get the related change score. This change score then represents the amount of change above which one could be 95 % confident that the observed change was not due to measurement error. Therefore, change greater than the bounds of measurement error can be considered real or true change.

In the absence of a direct estimate of the SEM, a robust approximation can be made using standard deviation and reliability coefficients. As shown by Stratford (1996) and McHorney (1995) this formula is:

$$\sigma_x \sqrt{(1 - r_{xx})} \quad (1)$$

where r_{xx} is the T-RT reliability coefficient, and σ_x is the standard deviation in the sample. Using these parameters (Z score, SEM), we can estimate the amount of change that would need to be exceeded before we could be confident that the observed change in an individual's score is a real or true change rather than day-to-day variability. Stratford [1996, 1999] has coined the term "minimal detectable change" or MDC for this threshold. We have suggested adding a suffix of the level of confidence being considered, in our application 95 %, so MDC_{95} (Beaton et al. 2001).

$$MDC_{95} = Z\alpha \times \sqrt{2} \times SEM = 1.96 \times \sqrt{2} \times (\sigma_x \sqrt{(1 - r_{xx})}) \quad (2)$$

Where r_{xx} = T-RT reliability coefficient

σ_x = standard deviation in the sample at time 1.

$\sqrt{2}$ = error correction for sampling from two distributions (McHorney et al. 1995; Jacobson et al. 1991)

This defines the amount of change needed before one could be 95 % confident that the change between two scores was a real change, and not just change due to day-to-day variability in scores (i. e. measurement error).

The MDC_{95} has been applied in a variety of fields, most often to aid in the interpretation of reliability coefficients at an individual level by translating the coefficient back into units of change on the scale (Jacobson et al. 1999; McHorney et al. 1995; Ravaud et al. 1999; Sadler et al. 1992; Stratford et al. 1999; Jacobson et al. 1999; McHorney et al. 1995; Ravaud et al. 1999; Sadler et al. 1992; Stratford et al. 1999). When looking for change in our application, we are reversing the interpretation by saying that, in a stable trait, one would expect to see differences between SOC scores in 1994 and 1998 to lie within $\pm MDC_{95}$, 95 % of the time. Therefore, if SOC is a stable trait of an individual, no more than 5 % of the sample should be found to vary outside of the bounds of measurement error which we have defined at MDC_{95}.

Using the methods described above, we can classify meaningful change in SOC over the 4-year period of this study, and separately compare those at risk of poor health through declines in SOC, and those more likely to have positive health outcomes through increases in SOC, to the population with stable SOC scores.

The present study has two main objectives. Firstly, we will investigate stability of SOC between 1994 and 1998 in a representative sample of the Canadian labour force. Secondly, given the previously reported associations between work variables and change in personality traits (Kohn et al. 1990) and SOC (Feldt et al. 2000), we will investigate predictors of change outside the measurement error in the SOC scale, in both a negative and positive direction, in particular the effect of occupational position, household income and the working conditions decision latitude and job security.

Subjects and methods

This study used data from the Canadian National Population Health Survey (NPHS) from 1994 to 1998. The NPHS employs a stratified multi-stage sampling design to collect a large sample of respondents representative of the Canadian population. In the period 1994–95, the NPHS reached 19,600 households across Canada, collecting general information for all household members, and a more detailed health interview was conducted with one household member selected at random. The overall response rate in the period 1994–95 was 88.7 % and the selected person response rate was 92.5 %.

The longitudinal sample of the NPHS comprises 14,619 randomly selected individuals who have completed at least the general component of the 1994–95 questionnaire. A total of 13,945 (95.4 %) of these respondents again responded to the 1998–99 survey.

For the purpose of this analysis, the longitudinal study population was reduced to those aged 18–64 who were labour-force participants in 1994 (N = 7,390). Of this sample, 600 respondents did not have valid SOC scores in either 1994 or 1998, leaving a study sample of 6,790 (91.9 %).

Dependent variable

Sense of coherence

Both the 1994 and 1998 NPHS used the abbreviated measure of sense of coherence (SOC-13), consisting of thirteen questions, rated between 1 and 7 on a Likert-type scale (see Appendix I).

Five of the 13 items are reversed-scored, and the sum of all items provides a score ranging from 13 to 91. Higher scores indicate a stronger level of SOC. The Cronbach alpha for the SOC measure in the NPHS data has been reported at 0.83 (Hood et al. 1996), within an acceptable range for internal consistency (Wolff and Ratner 1999). The SOC-13 has been validated across different white-collar occupations (age, gender and work) and shown to reflect accurately each of the three interrelated first order factors: 1) comprehensibility – that the challenges people face from the external environment are structured, predictable and explicable; 2) meaningfulness – that these challenges are worthy of investment and engagement; and 3) manageability – that the individual has the resources available to meet the demands imposed by these challenges (Antonovsky 1998).

Change in sense of coherence

The guidelines for estimating the minimum detectable change ideally require a T-RT correlation over a small time period where we could be confident that no-one would have actually changed in the level of SOC. Ideally, this measure should be obtained from the same population sample as was being studied, or at least a similar population. As we did not have this measure on our population, we were forced to search the literature for T-RT correlations over very small periods of time. Given the ambiguity over the stability of SOC, it is likely that T-RT correlations over longer periods are open to the influence of actual changes in people's SOC level and, therefore, unsuitable to estimate the change attributable only to error in the instrument.

Our review of the literature on SOC provided a T-RT correlation of 0.91 over a 2-week period in 307 US college students (68 % female) (Radmacher et al. 1989), a T-RT correlation of 0.92 in 171 undergraduate students over a 1-week period, and 0.93 in a group of 37 social service employees over a period of 7–30 days (Frenz and Carey 1993). Taken together these estimates provide an average T-RT correlation of 0.91. There was also a T-RT correlation of 0.65 over a 3-week period for 32 French university students (62 % female) (Gana et al. 2001). The SOC scale in this study was modified slightly due to translation problems. Hence, we discounted this result from our estimate. It should be noted that including or excluding this estimate makes no difference to the estimate of the reliability of change index when rounded to the nearest whole number.

Given that SOC primarily develops prior to age 30 (Antonovsky 1987), it is conceivable that real changes in SOC level may have occurred in people within these samples who were under the age of 30 years, making this estimate representative of both measurement error as well as true change in SOC. However, given the relatively short time period between first and second tests in both studies, we have confidence that, at present, this is the best conservative estimate of the change in SOC scores attributable only to measurement error in the instrument.

Using the r_{xx} of 0.91 (Radmacher et al. 1989; Frenz et al. 1993) and the standard deviation in the 1994 SOC scores in our population sample, a change in SOC of 10.22 points, between 1994 and 1998, was considered to represent the smallest change outside the range of measurement variability in SOC, at a 95 % confidence level. The population was then grouped into those people with increased SOC (change $\geq$ 10.22), those who decreased in SOC (change $\geq$ –10.22) and those with change in SOC which is indistinguishable from measurement error (referred to as stable) (change $\leq \pm$ 10.22).

Independent variables

Position in occupational hierarchy

Occupational position was categorized using the Pineo classification system (Pineo et al. 1977). The 16 Pineo categories were collapsed into five occupational groups in line with previous research (Borg and Kristensen 2000; Wilkins and Beaudet 1998; Schrijvers et al. 1998). These were: (i) self-employed professionals, employed professionals, high-level management, semi-professionals and technicians; (ii) middle management, supervisors and forepersons; (iii) skilled manual and non-manual, and farmers; (iv) semi-skilled manual and non-manual; (v) unskilled manual and non-manual, and farm labourers.

Psychosocial characteristics of the work

Environment

The working environment was evaluated using an abbreviated form of the job content questionnaire (JCQ) (Karasek and Theorell 1990). Respondents were required to answer each question based on a 5-point Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). The items used in this study were: (1) skill discretion (three questions, range 0–12); (2) decision authority (two questions; range 0–8); and (3) job security (one question; range 0–4).

Skill discretion, as defined by Karasek and Theorell (1990) relates to the worker's ability to choose the skills they use to complete tasks at work. Decision authority refers to the ability of the worker to make decisions in relation to themselves. Karasek and Theorell recommend combining both skill discretion and decision authority measures to give one measure of decision latitude (range 0–20). Lower scores reflect greater decision latitude. This score was then divided into quartiles. Statistics Canada has reported an internal consistency measure of a = 0.61 for decision latitude in the NPHS (Wilkins et al. 1998).

Household income

We had a 5-level measure of household income. The categories are as follows: (1) lowest income level – less than $10,000 (1–4 people); less than $15,000 (5 or more people); (2) second level – $10,000–$14,999 (1–2 people); $10,000–$19,999 (3–4 people); $15,000–$29,999 (5 or more people); (3) third level – $15,000–$29,999 (1–2 people); $20,000–$39,999 (3–4 people); $30,000–$59,999 (5 or more people); (4) fourth level – $30,000–$59,999 (1–2 people); $40,000–$79,999 (3–4 people); $60,000–$79,999 (5 or more people); (5) highest income level – $60,000 or more (1–2 people); $80,000 or more (3 or more people).

Sociodemographic covariates

Each analysis was adjusted for age and marital status. As differences have been reported between males and females in relation to both SOC (Kivimaki et al. 2000) and the effect of work (Vermeulen and Mustard 2000; McDonough and Walters 2001). Each logistic analysis was stratified by gender.

Analysis

The original sample for the descriptive analysis of SOC levels in 1994 and 1998 totaled 6,790. Using an analysis of variance, we examined the cross-sectional associations between five occupational position levels, quartiles of decision latitude and quintiles of job security and household income with mean level of SOC in 1994.

The analysis of stability in SOC used both a sample of only those people aged 30 and above, as above this age SOC is thought to be most stable (n = 4,872), and the full population sample (n = 6,790). As there was virtually no difference in percentage of change between the two groups, only data on the full sample will be reported in this paper.

The stability of SOC was measured using both the estimate of the minimum detectable change and Antonovsky's estimate of 10 % fluctuation. From this analysis three groups were formed: (1) those who increased in SOC, (2) those who decreased in SOC, (3) those who remained stable.

To assess variables associated with change in SOC level in both a positive and negative direction, compared to no change, we utilized a logistic framework. There were two main reasons for opting for a logistic framework as opposed to a linear analysis. Firstly, an important aspect of the present study is to disentangle meaningful change from change due to measurement error. We have defined a level of change we feel is above the measurement error in the SOC instrument, and seek to investigate what factors are associated with change above this level, as opposed to smaller changes below this level. The logistic regression enables us to do this, whereas a linear regression would not. Secondly, the variables associated with declines in SOC may not be the same variables associated with increases in SOC. The logistic regression enables us to differentiate between positive and negative changes in sense of coherence, thus separately identifying the correlates of negative health outcomes from the correlates of positive health outcomes. Again, a linear regression would not enable us to do this.

Our analysis examined the association between occupational position, household income, decision latitude and job security, separately on decline and increase in SOC, compared to the population who did not change. Each model was adjusted for age, 1994 level of SOC and marital status. For the analysis on decrease in SOC we removed people who increased in SOC over the 4-year period and those whose 1994 SOC score was within the minimum detectable change estimate and the lowest possible SOC score, given that they would be unable to decrease in SOC over the 4-year period (n = 1,747, 37 % female), leaving a sample size of 5,043. Similarly, observations that decreased in SOC level, or those within the top range of SOC scores (n = 2,059, 32 % female) were removed from the analysis of predictors of increase in SOC.

The adjustment for level of SOC in 1994 was necessary to: (1) control the floor effect constraining score declines on groups at the bottom, and ceiling effects constraining score increases on groups at the top; and (2) control for the decreased likelihood of people with higher levels of SOC to report changes in SOC, as they buffer life stress more effectively, and generally experience less instability, than individuals with low SOC.

To account for the complex sampling techniques used in the NPHS, all variance estimates were adjusted using bootstrap adjustment techniques in accordance with Statistics Canada data usage guidelines. All analysis was conducted using SAS version 8.0 (The SAS Institute 2000).

Results

Table 1 describes the distribution of male and female population groups across levels of each of the independent variables. There were no differences in the distribution of males and females across each of the five levels of the occupational hierarchy. However, there were differences in the distribution of males and females in measures of household income, decision latitude and job security, with a greater percentage of females in lower

Table 1 Weighted distribution of males and females across levels of independent variables in 1994

	Males	Females	p-value for chi-square
Occupational Position	(n = 3,324)	(n = 2,767)	
I – professionals and semi-professionals	21.2	27.0	
II – supervisors/management	15.9	10.7	
III – skilled	20.8	15.7	
IV – semi-skilled	21.6	26.5	
V – unskilled	20.4	20.0	0.538
Household income	(n = 3,524)	(n = 2,984)	
Highest quintile	21.9	19.4	
4th quintile	42.2	41.6	
3rd quintile	23.9	26.6	
2nd quintile	8.5	8.2	
Lowest quintile	3.5	4.2	0.006
Decision latitude	(n = 3,060)	(n = 2,589)	
1st quartile (high)	36.1	26.4	
2nd quartile	25.7	22.4	
3rd quartile	15.3	19.3	
4th quartile (low)	23.0	31.9	< 0.001
Job security	(n = 3,060)	(n = 2,589)	
High	24.1	20.7	
Above average	43.9	45.5	
Average	11.6	12.1	
Below average	15.5	14.4	
Low	5.0	7.3	0.005

Note: people aged 18–64 in 1994 who reported their main activity in the last 12 months was working for pay or profit or their reason for not working as a labour force dispute, or partial paid or unpaid leave. Cochran-Mantel-Haenszel test is for difference between males and females in trend of variable levels across rows

household income groups and in jobs with lower decision latitude and job security.

Table 2 describes the relationship between mean levels of SOC in 1994 and occupational position, household income and selected psychosocial work stress variables in the entire working population aged 18–64 (n = 6,790). In 1994, people in semi-skilled and unskilled occupational positions reported lower mean SOC scores compared to those classified as professionals or semi-professionals. Similarly, participants from each level of lower household income reported lower mean SOC levels, as did those with lower decision latitude and job security in 1994.

Table 3 reports the T-RT correlations for SOC and its three first-level factors between 1994 and 1998 in both the population sample aged less than 30 and those over 30. The T-RT correlations for SOC in both samples appear lower than T-RT correlations previously reported for NEO-PI personality traits (Costa et al. 1994).

Table 4 reports the amount of significant change in the SOC measure, utilizing the two techniques described in our methods. Using our 95 % confidence estimate of the minimum detectable change (MDC_{95}), 35.4 % of the population reported a change between 1994 and 1998.

Table 2 Mean scores for SOC for levels of independent variables in 1994 (n = 6,790)

	Mean SOC 1994	95 % CI	p-value
Occupational position			
I – professionals and semi-professionals	60.4	59.8–61.1	
II – supervisors/management	60.8	59.8–61.7	0.593
III – skilled	59.5	58.8–60.3	0.076
IV – semi-skilled	57.1	56.1–58.0	< 0.001
V – unskilled	56.6	55.6–57.5	< 0.001
Household Income			
Highest quintile	60.0	59.2–60.8	
4th quintile	58.7	58.2–59.3	0.009
3rd quintile	57.9	57.1–58.7	< 0.001
2nd quintile	55.6	54.0–57.2	< 0.001
Lowest quintile	55.1	52.1–57.2	< 0.001
Decision latitude			
1st quartile (high)	61.6	60.9–62.2	
2nd quartile	59.3	58.6–60.1	< 0.001
3rd quartile	57.5	56.7–58.4	< 0.001
4th quartile (low)	56.0	55.1–56.9	< 0.001
Job security			
High	61.6	60.9–62.3	
Above average	59.6	59.0–60.2	< 0.001
Average	57.4	56.2–58.5	< 0.001
Below average	55.0	53.8–56.2	< 0.001
Low	55.4	53.5–57.4	< 0.001

Note: population is people aged 18–64 in 1994 who reported their main activity in the last 12 months was working for pay or profit or their reason for not working as a labour force dispute, or partial paid or unpaid leave. The p-value tests the difference in one group from the first group. N = 6,091: 371 males and 328 females were removed from the occupational position analysis due to missing values. N = 6,508: 171 males and 111 females were removed from the household income analysis due to missing values. N = 5,649: 635 males and 506 females were removed from the decision latitude and job security analyses due to missing values

Table 3 Test-retest correlations for SOC between 1994 and 1998 (n = 6,790)

Factor	Sample n	Age	Interval	T-RT
NPHS 1994–1998				
Sense of coherence	1,904 (53 % male)	18–30	4 years	0.42
Manageability				0.32
Meaningfulness				0.39
Comprehensibility				0.35
NPHS 1994–1998				
Sense of Coherence	4,886 (55 % male)	30–64	4 years	0.45
Manageability				0.38
Meaningfulness				0.39
Comprehensibility				0.38

Note: Population is people aged 18–64 in 1994 who reported their main activity in the last 12 months was working for pay or profit or their reason for not working as a labour force dispute, or partial paid or unpaid leave

Using Antonovsky's prediction that 10 % would be the largest fluctuation in SOC level, 58 % of the population reported change.

Table 4 Change in SOC between 1994 and 1998 using both reliability of change index (± 10.22 points) and a movement of more than 10 % (n = 6,790)

	Increased SOC (%)	Decreased SOC (%)	Stable SOC (%)
MDC_{95} limit	25.4	10.1	64.6
Antonovsky's 10% rule of thumb	39.7	18.3	42.0

Note: population is people aged 18–64 in 1994 who reported their main activity in the last 12 months was working for pay or profit or their reason for not working as a labour force dispute, or partial paid or unpaid leave

Table 5 reports the association between occupational position, household income level, decision latitude and job security and the likelihood of decreasing in SOC, compared to not changing, over the 4-year period using the minimum detectable change estimate. Both males and females in unskilled occupational positions had an increased risk for declines in SOC, relative to males and females in professional and semi-professional occupational positions. In the female population, there was a curvilinear relationship between risk of decline and household income, with the second and third levels of household income reporting increased risk of decline in SOC compared to the highest (fifth) income level. The working conditions decision latitude and job security were not associated with decline in SOC in either the male or female population.

Table 6 reports the association between occupational position, household income level, decision latitude and job security and increases in SOC, compared to the population who did not change. Unlike the previous table, neither occupational position nor household income level was associated with increase in SOC level over the 4-year period of this study. Similarly to in Table 5, neither decision latitude nor job security was related to increase in SOC.

Discussion

The objectives of this study were to investigate the stability of SOC over a 4-year period and also to investigate the effect of occupational position, household income and two psychosocial work measures on this change.

Based on these results, it appears that the SOC mea-

Table 5 Odds ratios for decline in SOC, vs. no change, between 1994 and 1998 in the Canadian working population using MDC_{95} estimate

	Males (n = 2.587)		Females (n = 2.456)	
Variable	OR	95% (CI)	OR	95% (CI)
Occupational position				
I – professionals and semi-professionals	1.00		1.00	
II – supervisors/management	1.02	0.54–1.92	1.45	0.76–2.77
III – skilled	1.40	0.81–2.41	1.62	0.93–2.80
IV – semi-skilled	1.27	0.59–2.34	2.41	1.35–4.33
V – unskilled	2.00	1.10–3.64	2.45	1.44–4.19
Household income				
Highest quintile	1.00		1.00	
4th quintile	1.21	0.79–1.86	1.47	0.88–2.46
3rd quintile	1.27	0.82–1.97	2.00	1.15–3.46
2nd quintile	1.24	0.60–2.60	2.40	1.12–5.12
Lowest quintile	2.04	0.85–4.87	1.95	0.89–4.27
Decision latitude				
1st quartile (high)	1.00		1.00	
2nd quartile	1.16	0.75–1.80	1.28	0.77–2.14
3rd quartile	0.93	0.55–1.54	1.42	0.79–2.56
4th quartile (low)	1.32	0.82–2.12	1.53	0.86–2.71
Job Security				
High	1.00		1.00	
Above average	0.85	0.56–1.28	1.05	0.64–1.71
Average	1.41	0.82–2.42	0.73	0.35–1.53
Below average	1.65	0.91–2.97	0.93	0.33–1.18
Low	1.49	0.65–3.39	0.85	0.28–2.58

Note: the population sample does not include those people who increased in SOC, or who were within 10.22 points of the bottom of the scale; 244 males and 240 females were removed from the occupational position analysis due to missing values for occupation; 100 males and 78 females were removed from the household income analysis due to missing values for household income; 387 males and 374 females were removed from the decision latitude and job security analyses due to missing values

Table 6 Odds ratio for increase in SOC, vs. no change, between 1994 and 1998 in the Canadian working population using MDC_{95} estimate

	Males (n = 2,297)		Females (n = 2,434)	
Variable	OR	95% (CI)	OR	95% (CI)
Occupational Position				
I – professionals and semi-professionals	1.00		1.00	
II – supervisors/management	1.18	0.72–1.92	0.71	0.43–1.17
III – skilled	1.18	0.77–1.81	1.13	0.77–1.65
IV – semi-skilled	1.24	0.80–1.92	1.28	0.88–1.86
V – unskilled	1.22	0.82–1.82	1.06	0.73–1.53
Household income				
Highest quintile	1.00		1.00	
4th quintile	0.93	0.64–1.37	1.18	0.82–1.72
3rd quintile	1.07	0.71–1.62	1.24	0.81–1.90
2nd quintile	0.92	0.53–1.59	1.19	0.69–2.05
Lowest quintile	0.89	0.37–2.14	0.76	0.41–1.39
Decision latitude				
1st quartile (high)	1.00		1.00	
2nd quartile	1.21	0.85–1.72	1.87	1.26–2.77
3rd quartile	0.97	0.65–1.47	1.34	0.89–2.03
4th quartile (low)	1.18	0.76–1.83	1.39	0.92–2.08
Job security				
High	1.00		1.00	
Above average	0.62	0.43–0.89	1.02	0.73–1.41
Average	0.80	0.46–1.40	1.21	0.76–1.92
Below average	0.59	0.37–0.94	1.02	0.67–1.56
Low	0.61	0.32–1.15	0.76	0.43–1.34

Note: the population does not include those people who decreased in SOC, or who were within 10.22 points of the top of the scale; 250 males and 264 females were removed from the occupational position analysis due to missing values; 83 males and 73 females were removed from the household income analysis due to missing values; 399 males and 400 females were removed from decision latitude and job security analyses due to missing values

sure may not be as stable as was originally proposed by Antonovsky. Using a conservative limit of change, accounting for possible measurement error in the SOC instrument, 35.4% of our population sample had a change in level of SOC between 1994 and 1998. This proportion increased to 57% using a 10% limit of change.

Similarly, T-RT correlations for the SOC appear to be lower than previously reported T-RT correlations for the five major personality traits (Costa et al. 1994). It should be noted that higher T-RT correlations have been reported for the SOC over both 1-year ($r = 0.63$, $n = 219$, study response rate from original sample = 34%) (Feldt et al. 2000) and 3-year periods ($r = 0.64$, $n = 577$, response rate = 74%) (Kivimaki et al. 2000). However, the differences between these results and ours could be due to the much smaller sample sizes and lower response rates in these studies, possibly increasing the selection bias and decreasing the representativeness of these studies' samples.

Taking into consideration the representativeness of our sample, together with level of change outside or measurement error and the T-RT correlations, we would suggest that the SOC has a strong state component, and appears to be less enduring in its character compared to other measures of personality. Future research should verify the degree of measurement error in the SOC instrument, what level of change can be termed true change, and what factors, both inside and outside the workplace, may contribute to these changes.

The results from the logistic analyses demonstrate that unskilled occupational position was associated with declines in level of SOC in both the male and female population groups. The analysis investigating increases in SOC found that none of our independent variables were associated with the increases in SOC. If SOC change was only related to low initial levels of SOC, we would expect that people in unskilled occupational positions or with low household income would change in both a positive and negative direction, as these groups had lower levels of SOC in 1994. From our results, it appears that unskilled occupations and low household income have an independent effect on decline in SOC.

The above results, however, should be interpreted recognizing the following methodological limitations. Firstly, this is an initial attempt to identify what level of change in SOC is above and beyond the measurement error in the instrument. While we have made an educated approximation towards this goal, this measure needs to be verified in future studies, with shorter intervals between measures in a variety of population groups. Secondly, the job-related measures utilized in the NPHS are abbreviated from their original form and

this reduces their reliability, especially for job security which was only measured by one question (Wilkins and Beaudet 1998).

The variables of decision latitude and job insecurity were not predictive of change in SOC. It is likely that the effect of these conditions would have been greater had these variables been re-measured in 1998 as a previous finding reports that SOC declines as job stress increases (Feldt et al. 2000). This is particularly relevant given the high levels of job security reported in our sample in 1994, coupled with reports of decreasing job security in Canada, associated with movements to more "flexible" employment arrangements within workplaces (McDonough 2000; Burke and Shields 1999). Future research should involve a further examination on both the prevalence of job security and its effect on levels of SOC, and other health-related variables, with respect to gender differences.

The limited effect of the job characteristics elucidates that an individual's occupational position is also a marker for other conditions existing outside the workplace, such as life circumstances, which impact on level of SOC. This is especially relevant to the female population as lower levels of household income, a measure of material circumstances, were also associated with declines in SOC. Therefore, it is not the impact of job conditions that are deleterious to levels of SOC in lower occupational groups, but it is more than likely that other factors existing outside the workplace are directly resulting in changes in SOC levels in these groups.

In addition, the observed changes in SOC may occur via possible overlap between SOC and other constructs such as negative affectivity and depression, with some researchers noting that SOC items are similar to items in mood and depression scales (Korotov 1994; Larsson and Kallenberg 1999). Since mood is also affected by adverse events, and is variable over time, the extent to which SOC reflects mood would in turn influence its level of stability.

Conclusion

The results of this study question both the stability of the SOC construct and how changes within the workplace between 1994 and 1998 may affect certain occupational groups. We suggest that more research is required in two main areas. There needs to be validation of the stability in the SOC scale and, first of all, accepted and valid ways to measure this. Our results demonstrate that the stability of an individual's SOC may be open to the influence of position in the occupational hierarchy in particular, even after the age of 30. More research is required to define both what can be considered to be change in the SOC measure, and what factors in the external environment bring about this change. Our results are not conclusive in relation to the possible effect of the working environment of an individual in changing supposedly stable traits. However, we did find evidence that level in the occupational hierarchy is related to negative changes in SOC as is household income in the female population.

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Appendix I

Sense of coherence in the NPHS

Sense of coherence was measured using the following 13 questions, scored on a 7-point Likert scale.

1. How often do you have a feeling that you don't really care about what goes on around you? (1 = very seldom or never, 7 = very often)
2. How often in the past were you surprised by the behaviour of people whom you thought you knew well? (1 = never happened, 7 = always happened)
3. How often have people you counted on disappointed you? (1 = never happened, 7 = always happened)
4. How often do you have the feeling you're being treated unfairly? (1 = very often, 7 = very seldom or never)
5. How often do you have the feeling you are in an unfamiliar situation and don't know what to do? (1 = very often, 7 = very seldom or never)
6. How often do you have very mixed up feelings and ideas? (1 = very often, 7 = very seldom or never)
7. How often do you have feelings inside that you would rather not feel? (1 = very often, 7 = very seldom or never)
8. Many people – even those with a strong character – sometimes feel like sad sacks (losers) in certain situations. How often have you felt this way in the past? (1 = very seldom or never, 7 = very often)
9. How often do you have the feeling that there's little meaning in the things you do in your daily life? (1 = very often, 7 = very seldom or never)
10. How often do you have feelings that you're not sure you can keep under control? (1 = very often, 7 = very seldom or never)
11. Until now your life has had no clear goals or purpose or has had very clear goals and purpose? (1 = no clear goals and purpose, 7 = very clear goals and purpose)
12. When something happens, you generally find that you overestimate or underestimate its importance or you see things in the right proportion? (1 = overestimate or underestimate its importance, 7 = see things in the right proportion)
13. Is doing the things you do every day a source of great pleasure and satisfaction or a source of pain

and boredom? (1 = a great sense of pleasure and satisfaction, 7 = a source of pain and boredom)

Five of the 13 questions are reversed-scored giving a total score ranging from 13 to 91. The higher the score indicated the greater sense of coherence.

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