

## Does personality affect the risk of developing musculoskeletal discomfort?

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Personality theory suggests that individuals can react differently to the same situation. The primary objective of this research was to study employees' personality preferences as they related to manual materials handling jobs. The hypothesis tested was that those whose work preferences did not match the nature of their job requirements would report more psychosocial, physiological or psychological stress and strain compared with those whose personality preferences did match their jobs. A total of 133 employees from two distribution centres completed the Myers-Briggs Type Indicator and other inventories pertaining to their work environments. The results showed that, when employees' personalities were better matched with the nature of their work environment, they generally reported less anxiety and physical discomfort and more job satisfaction and social support than those having a mismatch. This relationship was more prominent in the less physically demanding jobs, suggesting an interaction between physical workload factors and psychosocial influences. This research suggests that integrating knowledge of one's personality preferences with the physical and psychosocial demands of a job may increase one's understanding of the causes of musculoskeletal discomfort in industrial workplaces and aid ergonomists in designing jobs to better match individuals' capabilities, limitations and work preferences.

*Keywords:* Personality; Musculoskeletal discomfort; Myers-Briggs Type Indicator

### 1. Introduction

Efforts continue on various fronts to reduce the incidence rates of musculoskeletal disorders (MSDs) and for good reason. MSDs are reported to be the most frequent chronic condition causing long-term disability; Badley *et al.* 1994 and Yelin *et al.* 1999 reported that 90% of disabled older workers had MSDs. Further, Lawrence *et al.* (1998) estimated that, by 2020, 18.4% of the US population (nearly 60 million individuals) will suffer from one or more chronic MSDs. In 1995, direct treatment of MSDs in the US cost ~ \$88 billion, with all associated expenses totaling nearly \$215 billion (Praemer *et al.* 1999).

Factors contributing to MSDs have been more difficult to determine, with researchers divided as to whether physical workplace factors or psychosocial influences play more of a role in injury causation. Regarding biomechanical factors,

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clear relationships have been shown to exist between back disorders and factors including: manual materials handling (MMH); load moment; frequent bending and twisting; heavy physical work; and whole-body vibration (National Research Council and Institute of Medicine 2001). This same source found that work-related risk factors for upper extremity disorders include task repetition, amount of applied force and vibration.

It is less clear how to define psychosocial factors. They typically involve the social work environment, a job's organizational aspects and the content of the job tasks performed (Sauter *et al.* 1990), as well as the environment outside of work and traits of the individual (Bernard 1997). However they are defined, psychosocial factors appear to include the behavioural and psychological elements of the job (Carayon and Lim 1999).

Regardless, the literature suggesting a relationship between psychosocial factors and MSDs is substantial. Bongers *et al.* (1993) concluded that several psychosocial factors were associated with back, neck and shoulder pain, including: monotonous work; time pressures; high work load; low control or autonomy; poor social support of colleagues; worry, tension, anxiety and nervousness; and high perceived work stress.

There is not yet a clear understanding of how physical workplace and psychosocial factors together contribute to the development of MSDs, since neither group alone can explain all the variability in MSD reporting (Davis *et al.* 2000). However, it has been established that these factors do, in fact, interact to affect MSD risk (National Research Council and Institute of Medicine 2001), which is the likelihood that one will develop a soft-tissue strain or sprain due to cumulative trauma.

To help better understand this interaction, it may be important to determine if individuals react differently when exposed to the same psychosocial factors and, further, if they view their work environments as either preferable or stressful. Personality theory may aid in this understanding, since it dictates preferences for many life situations, including work. Noted theorist Allport (1937) defined personality as, '... the dynamic organization within the individual of those psychophysical systems that determine his unique adjustments to his environment'. This reflects the idea that personality is a system, integrating both the physical and mental aspects of an individual, and that people are active in adapting to their surroundings. Furthermore, Jung (1923) proposed that human behaviour was not random but was instead predictable, that one's preferences emerge early in life and that these preferences form the basis for attractions to and aversions from people, tasks, events, etc., throughout life.

Personality theory has been used extensively in occupational (though primarily white-collar) settings. The focus of many studies has been on how well individuals' personality preferences coincide or conflict with their job's requirements. An example of a 'match' would involve extraverts (who prefer being actively involved in projects) working in a busy environment that requires considerable interaction with others. A person with a preference for performing practical, routine tasks (such as at an assembly line) could be considered 'mismatched' with their environment if it requires dealing with abstractions or 'the big picture'. Several studies have focused where individuals' personality preferences were less matched with the nature of their jobs, higher rates of turnover (Myers and Myers 1980) and job dissatisfaction (Smart *et al.* 1986, Smith 1988, Karras 1990, Holland 1996) were

found. Mismatches also have been shown to create communication problems, inefficiency and, to a lesser degree, health concerns (Shelton 1996). Thus, there appears to be a link between the job environment and an individual's reactions to it, depending on one's personality preferences.

White-collar jobs are less likely to produce MSDs than in industrial MMH jobs, as is reflected in national injury trends. Unfortunately, studies focusing on personality preferences in these more physically demanding environments have received little attention.

A void in the literature is an understanding of how personality preferences affect the interaction of workplace physical and psychosocial factors, in terms of their impact on MSD injury risk, within more repetitive, physically demanding jobs. Integrating all of these elements may enable one to better associate psychosocial influences with physiological outcomes such as MSDs. Thus, the following hypotheses were generated: (1) For those performing physically demanding work, employees' views of their job's psychosocial stressors and physiological/psychological strains will be related to their personality preferences; and (2) Those whose personality preferences (e.g. introversion or feeling types) are not matched with the requirements of their work (e.g. extraverted or thinking environments) will exhibit signs of increased MSD discomfort compared with those whose personality preferences better match their jobs.

## **2. Methods**

### **2.1. Overview**

This study sought to determine if integrating information about employees' personality preferences, their work environments and the job's physical and psychosocial demands could help to better understand the causes of musculoskeletal discomfort. Questionnaires related to these issues were administered to employees working in jobs with varying physical requirements. Responses from individuals whose personalities matched their work environments were compared with those whose responses did not match, to determine if differences existed that may suggest an increase in psychosocial stress and risk of developing MSDs.

### **2.2. Companies and jobs**

Several companies were contacted that had similar production processes. Work in warehouse distribution centres was chosen, since many employees performed the same job in the same environment and facilities of this type often have historically high MSD rates. Because the physical nature of the work could moderate the outcome variables, two different types of warehouses were selected. In the first, a grocery warehouse (Company A), entire cases of food items (e.g. dry boxed and canned goods, dairy and produce items, frozen foods and meats) were repetitively hand-selected and prepared for shipping. In the second, an apparel distribution centre (Company B), bulk quantities of lightweight flat apparel (e.g. shirts, pants, socks) were repetitively separated and sorted for shipment.

### 2.3. Employees

A total of 133 employees volunteered for this study; all performed the same job within their company. Less than a dozen individuals approached declined to participate. Of the total sample of respondents, 100 (75.2%) were employed in Company A and 33 (24.8%) worked in Company B. Subjects averaged 3 years in their current job (ranging from 2 months to 22 years of experience). The average time they reported doing MMH work (e.g. lifting, pushing, pulling) was 7 years, indicating that they were accustomed to performing physical labour. The amount of time employees spent weekly on their jobs, the years working for their company and their experience performing MMH did not differ significantly between companies, suggesting that their experience levels would not confound the results. Only employees with a mastery of English participated, as there was a considerable amount of reading required.

### 2.4. Variables

The variables studied are summarized in table 1. The independent measures described the individuals and their work environments. These factors included: employee personality type; the employees' perceived assessment of the type of environment in which their work was performed; physical and work organizational aspects of the job; and personal factors. The groups of observational measures were recorded using various questionnaires (described in the following section) and were a function of these independent measures. They included perceived psychosocial stressors (work-related conditions or exposures), individuals' responses to these job stressors and mediating factors. Admittedly, this list of observational measures is considerable. However, all of these variables were included here, since it was the objective of this research to serve as a starting point from which to further study the relationships between personality preferences and physically demanding jobs on a more-specific group of variables, given the outcome of this research.

Table 1. The independent and observational variables collected.

Independent measures	Observational measures
Myers-Briggs type indicator® (MBTI)	Psychosocial stressors
Salter environmental type assessment (SETA)	Job/task demands
Physical factors: Types of objects handled, weight	Mental demands, control (perceived, task, decision, physical environment, and resource) quantitative workload, variability in workload
Work organizational factors: Repetition rate, rotation scheme, break schedules, pacing issues	Organizational factors
Personal factors: Age, gender, anthropometry, work experience, smoking habits	Role conflict, role ambiguity, job future ambiguity
	Physiological/psychological strains
	Anxiety, job satisfaction, discomfort (neck, shoulder, elbow/forearm, hand/wrist, finger, upper back, low back, thigh/knee, lower leg and ankle/feet)
	Mediating factors
	Supervisor support, co-worker support, family/friends support

## 2.5. Apparatus

Several assessment inventories were used, to assess personality type, evaluate the work environment, record reactions to and responses from the organizational work environment and measure anxiety. Each of these inventories is described below.

**2.5.1. Myers-Briggs type indicator (MBTI).** The MBTI form M (Consulting Psychologists Press, Inc. 1998) is a self-reporting inventory of individuals' basic preferences towards life. It categorizes personality across four independent, dichotomous scales. The MBTI has long been applied to work settings and was selected for use here because its descriptions are geared more towards occupational preferences than are other personality assessments. For example, the Minnesota Multiphasic Personality Inventory (MMPI-2, Butcher *et al.* 1989) is used primarily for clinical diagnoses. Descriptions of each preference of the MBTI, along with work-related traits (Myers and Myers 1980, Kummerow *et al.* 1997) are found in Appendix A. This appendix lists work methods that individuals with those preferences may find either more or less suitable and suggests that what is an ideal work situation to one person (e.g. task variety, learning new skills, interaction with others) may be undesirable to another.

The MBTI is widely used across settings (Bayne 1995) and Carlson (1985) located over 700 publications whose authors selected this inventory for their research. Although the MBTI is often administered in applied settings where research findings are not always published, Willis (1984) found the MBTI to be referenced in a wide variety of peer-reviewed business, education, medicine, psychology and science journals.

As with any personality assessment, the score reliability of the MBTI has faced scrutiny. However, it has been validated by a number of researchers (e.g. Johnson 1992, Myers *et al.* 1998b). Alpha coefficients from a large sample of males and females were reported to be 0.91 for the E-I and T-F scales and 0.92 for the S-N and J-P scales (Myers *et al.* 1998a). Although use of the MBTI is not accepted for all applications (Druckman and Bjork 1991), Capraro and Capraro (2002) conducted a reliability generalization analysis, by reviewing data from over 200 recent research articles that used the MBTI. They found that, overall, the MBTI produced acceptable score reliabilities across these studies. Further, these reliability scores were dependent on characteristics of the sample and on the conditions under which the inventory was used.

The MBTI consists of 93 forced-choice questions and word pairs. Users were asked to either choose an answer that most closely described their feelings or actions or to select one word in each pair that best appealed to them. The MBTI is written at the 7th-grade reading level and took 15–25 min to complete.

**2.5.2. Salter environmental type assessment (SETA).** The SETA (Salter 2000) determines the 'personality' of an environment in a way similar to the MBTI's method for typing individuals, which was the main advantage for its use in this research. The outcome is a four-letter designation with the same categorical scales as the MBTI. Work environment types are described in Appendix B. Using the SETA (Form A), individuals selected a word from each of 100 word pairs (e.g. corporation/family, planned/spontaneous, noisy/hushed) that they believed best reflected

their environment. The SETA is used to assess environments from both an individual view and collectively (derived from several persons who work within that environment). It is currently undergoing validation (Salter 2002, Salter and Irvin 2003, Salter *et al.* 2004), although reliability estimates have been reported to be comparable to the MBTI and to the Work Environment Scale (Salter 2000).

**2.5.3. NIOSH generic job stress questionnaire (GJSQ).** Portions of the GJSQ (Hurrell and McLaney 1988, National Institute for Occupational Safety and Health 1997) related to psychosocial stress were also given to employees. These sections were adapted from scales with known and acceptable levels of reliability and validity. Jenkins *et al.* (1985) opined that no psychometric inventory is free from some type of methodological concern. However, because the GJSQ is modular in form (Hurrell *et al.* 1998), allowing for only the relevant scales needed be used and because many of these scales involved the possible relationship between workplace factors and personality preferences described previously, this questionnaire was selected for use. These included: control measures (perceived, task, decision, physical environment and resource); workload measures (quantity and variance); role conflict and role ambiguity; mental demands; social support (from supervisors, co-workers and family); job future ambiguity; and job satisfaction. These variables were integrated into the observational measures listed in table 1.

**2.5.4. State-trait anxiety inventory (STAI).** The STAI, Form Y (Spielberger *et al.* 1970) is a widely accepted tool and has demonstrated levels of validity, reliability and correlations comparable with other anxiety measures (Spielberger 1983). It was used here to assess one's anxiety trait (long-term differences in response to events that produce anxiety) rather than their state (a more transient fluctuation in anxiety intensity or frequency), since the former would better determine potential enduring relationships to the work environment or one's personality profile. Higher values correspond to greater levels of anxiety. The STAI included 20 questions with multiple-choice answers.

**2.5.5. Other assessments.** Data were also collected on employees' personal information and work histories, levels of body discomfort and perceived ratings of physical exertion (Borg 1990). If discomfort was reported, it was rated for 10 different body parts on an ordinal scale, from 1 (low) to 7 (high).

## **2.6. Data collection procedure**

Data gathering was identical in both companies. Volunteers came to a meeting area and briefly informed of the study's purpose. To ensure truthful and complete responses, it was emphasized to employees that they were not being graded, there were no right or wrong answers and all responses were anonymous. The inventories' formats were described and any questions were answered. Employees then completed all forms, which took less than 1 h. Separately, a review was made of the companies' five-to-six most-recent years of employee injury and illness data, which is mandated by the US Occupational Safety and Health Administration (OSHA). This was conducted to determine the type and number of musculoskeletal disorders (e.g. strains of the neck, shoulder, back and upper or lower extremities) that were incurred by

subjects. Finally, work requirements (e.g. weights of items lifted, material handling frequencies) were recorded during job-site observations.

### **2.7. Statistical analysis**

All inventories were scored according to their written instructions. Data were analysed using SAS (Version 6, SAS Institute Inc., Cary, NC) and Statistica (Release 4.5 1993). Descriptive statistics were computed for the observational measures, across all subjects combined and within each company. This was done to assess general responses among these employees. Chi-square goodness-of-fit tests were used on the personality and workplace environment data, to determine their distributions and statistical significance. Analysis of covariance techniques were used on the observational measures, to test the study's hypotheses and to control for the potential influence of age, gender and job experience. Post-hoc comparisons of means used the Tukey honest significant difference test. In all statistical analyses, results were evaluated at the  $\alpha=0.05$  level.

## **3. Results**

### **3.1. Companies and jobs**

Of the jobs studied, those in Company A had the highest physical demands. Grocery case weights (taken from inventory logs) averaged 7.3 kg; 38% of the items weighed 4.5 kg or less, but 6% weighed 18.1 kg or more. This job's MSD strain/sprain rate was 21.6 incidence per 100 full-time employees/year. In comparison, lighter-weight objects were handled in Company B. Here, full boxes typically did not exceed 6.8 kg and employees lifted these boxes infrequently. They mostly handled individual apparel items, which weighed 0.5–1.8 kg and averaged 1.1 kg. The MSD incidence rate for this job was 6.8 strains/sprains per 100 full-time employees/year.

All jobs studied here could be considered highly repetitive. The work standard in Company A required employees to handle at least 187.5 grocery items hourly, while employees in Company B processed at least 235 clothing items per hour. (As a comparison, Marras *et al.* (1993) found the average lifting frequency of over 400 repetitive MMH jobs to be nearly 170 lifts per hour.) However, the frequency of lifting heavier objects was much higher in Company A, as employees handled only full cases of food goods. Company B employees mostly handled individual apparel items.

### **3.2. Work environments**

To date, the published literature on SETA types does not include information on physically demanding work environments. Thus, it was assumed that employees were equally likely to view their work environments as either of the dichotomous types on each of the four scales.

Table 2 presents results from the aggregate SETA data. Employees in both companies overwhelmingly viewed their environments as extraverted and sensing and Company A employees also typed their workplaces as thinking and judging in percentages larger than expected. More Company B employees viewed their work environments as feeling and judging, but these percentages were not statistically

Table 2. Distribution of SETA types, collapsed across the four dichotomous preferences, for the two companies in which employees were surveyed. Data from chi-squared goodness-of-fit tests are also presented; all tests were computed using 1° of freedom.

SETA type	Company A			Company B		
	#	Pct	$\pi^2$	#	Pct	$\pi^2$
Extraverted (E)	68	70.1	15.68 ( $p < 0.001$ )	27	81.8	13.36 ( $p < 0.001$ )
Introverted (I)	29	29.9		6	18.2	
Sensing (S)	80	82.5	40.92 ( $p < 0.001$ )	31	93.9	25.48 ( $p < 0.001$ )
Intuitive (N)	17	17.5		2	6.1	
Thinking (T)	66	68	12.63 ( $p < 0.001$ )	15	45.5	0.27 ( $p > 0.05$ )
Feeling (F)	31	32		18	54.5	
Judging (J)	70	72.2	19.06 ( $p < 0.001$ )	21	63.6	2.45 ( $p > 0.05$ )
Perceiving (P)	27	27.8		12	36.4	

Table 3. Distribution of MBTI types, collapsed across the four dichotomous preferences, for all data and the two companies in which employees were surveyed. Data from chi-squared goodness-of-fit tests are also presented; all tests were computed using 1° of freedom.

MBTI type	All Subjects			Company A		Company B	
	#	Pct	$\pi^2$	#	Pct	#	Pct
Extraversion (E)	68	51.1	0.18 ( $p > 0.05$ )	57	57	11	33.3
Introversion (I)	65	48.9		43	43	22	66.7
Sensing (S)	87	65.4	4.23 ( $p < 0.05$ )	61	61	26	78.8
Intuition (N)	46	34.6		39	39	7	21.2
Thinking (T)	65	48.9	4.16 ( $p < 0.05$ )	60	60	5	15.2
Feeling (F)	68	51.1		40	40	28	84.8
Judging (J)	77	57.9	0.77 ( $p > 0.05$ )	53	53	24	72.2
Perceiving (P)	56	42.1		47	47	9	27.3

greater than chance. However, the written instructions for the SETA indicate that the designation of an environmental type be based on the majority opinion when aggregate measures are used. Thus, Company A was found to have an extraverted, sensing, thinking and judging environment and Company B's was extraverted, sensing, feeling and judging.

### 3.3. Employee personalities

All MBTI preferences were well represented in this sample. The distribution of MBTI scores for the four dichotomous preferences is shown in table 3. The ratios of extraverts/introverts and judges/perceivers in this sample were no different than that found in a nationally representative sample (Myers *et al.* 1998b), though more intuitors and thinkers were found in this sample than would be expected, given national population norms.

There was no significant association between employees' self-reported MBTI types and their individual SETA assessments for the extraversion/introversion, sensing/intuition or thinking/feeling scales. That is, extraverts did not assess their



Table 4. Significant differences in the observational measures across the two companies in which data were collected. Boldface values indicate the significantly higher mean. Analysis of covariance techniques were used to control for the possible effects of age, gender and job experience among the observational measures.

Variable	<i>p</i> -value	Means	
		Company A ( <i>n</i> = 100)	Company B ( <i>n</i> = 33)
<b>Stressors</b>			
Physical env. control	0.003	1.69	<b>2.26</b>
Resource control	0.0156	2.54	<b>3.21</b>
Quantitative workload	0.0363	<b>3.62</b>	3.27
<b>Strains</b>			
Perceived exertion	0.0347	<b>14.74</b>	11.65
Job satisfaction	0.0242	2.36	<b>2.61</b>

work environment as extraverted any more than did introverts, sensors did not believe their environments to be more sensing than did intuitors, etc. In the judging/perceiving scale, however, perceivers in Company B more often viewed their work environment as judging than did judgers. Judgers, in contrast, were evenly divided in their assessment that the work place was either judging or perceiving. With this one exception, these findings indicate that the MBTI and SETA inventories measured preferences independently.

### 3.4. *Company comparisons*

Employees' views of their work environments were compared between companies, since they differed organizationally and in their physical demands. Significant results are presented in table 4. Employees in Company B reported higher mean levels of physical environment control, resource control and job satisfaction and lower mean quantitative workload and physical exertion values than did employees in Company A. The lower workload and exertion values for Company B are likely due to the reduced physical demands of the job. The higher control and job satisfaction scores found in Company B may be due to the job's physical demands, the structure of the work or the nature of the working environment.

### 3.5. *Differences between those matched and those mismatched with their work environment*

The hypotheses of this research stated that employees' personality preferences would be related to their views of the work's psychosocial stressors and physiological strains; also, those whose preferences do not match the nature of their work environment would have indications of higher MSD risk than those with a better fit. Results from the MBTI and the SETA scores allowed for a direct test of these hypotheses. Thus, Company A employees were compared regarding whether or not their personality preferences matched an extraverted, sensing, thinking or judging environment. Likewise, responses from Company B employees were compared between those whose personalities matched or mismatched an extraverted, sensing, feeling or judging workplace.

Employees' responses on several observational measures differed significantly between personality preference groups and companies (table 5). These differences were found across numerous psychosocial stressor, strain and mediating factors. Of particular note:

- Nearly all of the significant outcomes were as hypothesized. That is, those whose preferences were matched with their work environments had mean scores significantly different and in the direction expected, compared with those with personality–work environment mismatches. For example, introverts were considered mismatched with their (extraverted) work environments and they reported higher mean anxiety levels than did their extraverted co-workers. Similarly, intuitors in Company B were mismatched with their sensing environment and they reported significantly higher mean levels of role conflict and role ambiguity than did the sensors working in this company.
- Over three-quarters of the significant differences were found within Company B, the less physically demanding workplace.
- Half of the differences found occurred within the extraversion/introversion preference.
- Common to both companies (each of which were typed as extraverted) was that anxiety and job future ambiguity scores were higher for introverts than for extraverts.
- Significant body discomfort differences occurred only within Company B and only for those personality groups mismatched with their work.
- A higher job satisfaction score was in the direction hypothesized and found only in the sensing/intuition preference for Company A.
- There were no significant differences found in either the thinking/feeling or judging/perceiving scores of Company A employees.
- Some observational measures were not linked to personality differences in any of the analyses performed. These included perceived exertion, mental demands of the job, workload variability and support of family and friends. This result suggests that not all psychosocial factors have a link to personality differences between employees. In addition, there were no significant differences in the rate of injury reports between personality groups. This may be due to the small sample (only 21% of Company A employees) reporting any type of strain or sprain in the preceding 6 years. Further, none of the Company B employees who volunteered for this study reported having experienced a MSD in the previous 5 years.

#### 4. Discussion

This research has provided preliminary evidence that some aspects of one's personality relate to perceptions of and reactions to the industrial work environment and that this relationship is further affected by workload. Thus, the results presented here at least partially support the hypotheses that were proposed. This is an area that previously has received little attention, particularly for physically demanding jobs. Many researchers have stated that the interactions of workplace biomechanical and psychosocial factors and their potential for producing injury to the musculoskeletal system are complex. As previous research has shown (Bongers *et al.* 1993), these factors can independently contribute to MSD risk and they may co-vary in some

Table 5. Statistically significant differences in the observational measures between employees having opposing personality preferences, by company. The variables listed in the first column represent those in which there was a statistically significant difference between MBTI types, within each company, at the  $\alpha = 0.05$  level. Analysis of covariance techniques were used to control for the possible effects of age, gender and job experience among the observational measures.

	Company A SETA: Extraverted, Sensing, Thinking, Judging				Company B SETA: Extraverted, Sensing, Feeling, Judging			
	<i>M</i>		<i>SD</i>		<i>M</i>		<i>SD</i>	
	Extraverted	Introverted	Extraverted	Introverted	Extraverted	Introverted	Extraverted	Introverted
• Quantitative workload	3.71	0.44	3.47	0.59				
• Job future ambiguity	2.55	0.66	2.88	0.95	2.23	0.97	3.25	0.8
• Anxiety	36.94	6.58	41.33	8.09	35.5	7.81	41.57	7.79
• Neck discomfort					1.83	1.33	3.5	1.69
• Shoulder discomfort					1.6	1.34	3.57	1.27
• Supervisor support					4.37	0.6	3.57	0.91
• Co-worker support					4.35	0.46	3.88	0.62
	Sensing		Intuition		Sensing		Intuition	
• Role conflict					25.5	9.55	30	8.29
• Role ambiguity					12.88	3.81	17.71	6.1
• Elbow/forearm discomfort					1.88	1.36	4	0
• Job satisfaction	2.43	0.46	2.25	0.53				
	Thinking		Feeling		Thinking		Feeling	
• Resource control					4.2	0.57	3.04	1.09
• Thigh/knee discomfort					5.33	1.15	2.56	1.67
• Job satisfaction					2.15	0.22	2.7	0.46
	Judging		Perceiving		Judging		Perceiving	
• Decision control					2.25	0.89	1.68	0.6
• Supervisor support					4.04	0.83	3.38	0.9

manner to produce cumulative trauma. The results presented here suggest that these relationships further interact with individuals' personalities.

There were relatively few differences in how the employees studied here viewed their work environments (table 4). In addition, each of the four dichotomous personality preferences of the MBTI was well represented (table 3), suggesting that a valid sample of individuals was recruited.

Personality impacted the responses of several factors when employees' own preferences ran counter to the nature of their work environments (table 5). Further, this relationship was impacted by the job's level of physical workload. Psychosocial factors appeared to have a greater impact in the environment requiring lower physical demands (Company B), where a higher number of significant differences in the observational variables were found between personality types. Responses from employees doing more physically intense work (Company A) appeared to have over-ridden the effects of personality. This is noteworthy since the number of subjects in the Company B sample (33) was considerably less than in Company A (100). From a statistical perspective, fewer significant differences would have been expected if personality had no effect on subjects' responses.

A few studies have identified a link between psychosocial influences, individual factors (such as personality) and biomechanical outcomes. Wærsted *et al.* (1991) found that trapezius muscle activity increased significantly during more-complex mental tasks and that there were no changes in upper-body postures that could have accounted for these differences. Ekberg *et al.*'s (1995) research showed that mental stress had only a small impact on trapezius muscle activity. However, this finding was not consistent across subjects, suggesting that some individuals may be more prone to general increases in muscle tension. Finally, Marras *et al.* (2000) studied lumbar spine loading under stress-free and psychosocially stressful conditions. Among their findings was that subjects generated spinal loads differently in response to the same environmental stressors, an outcome that could be explained, in part, by their personality types. They theorized that individuals internalized stress in different ways, resulting in various methods of trunk muscle co-activation patterns and higher spinal loads. Collectively, these results reinforce the theorized interdependent nature of risk factors believed responsible for musculoskeletal discomfort.

This research was intended to serve as a starting point from which to further explore the relationship between personality and industrial work. It was not the intent of this study to establish definitive proof of a link between personality, views of the industrial environment and musculoskeletal discomfort. Instead, the goal of the research was to determine *if* personality traits could describe differences in stressor and strain responses for those in the industrial work environment, as it has been done so often with white-collar jobs and whether there is justification for future study.

As these results found, some aspects of personality are more occupationally related than others. This is evidenced by the traits listed in Appendix A and the results presented in table 5. That is, the extraversion/introversion personality preference appeared to best differentiate responses to the range of observational measures (table 1) studied here. This is especially true for more physically intensive work. Further, research into personality influences of lower-demand environments may benefit from studying all four personality traits. Lastly, the only variables that were significant for both companies were anxiety and job future ambiguity, as

introverts working in these extraverted environments produced significantly higher responses on these measures. Thus, the information presented in this paper can serve to assist future research efforts related to the integration of personality and physically intense work, by guiding the study of more-specific personality traits or particular psychosocial parameters, rather than the large number of variables included here.

Most importantly, these results imply that multi-factorial approaches are needed to better understand MSD causation. Leading ergonomists, physicians and epidemiologists have echoed this view (National Research Council and Institute of Medicine 2001). In their review of hundreds of research studies, these experts determined that a variety of factors must be considered to understand injury mechanisms. They concluded that, 'Because workplace disorders and individual risk and outcomes are inextricably bound, musculoskeletal disorders should be approached in the context of the whole person rather than focusing on body regions in isolation'. Thus, it is becoming increasingly apparent that studies viewing the entire work system (the interaction of physical and psychosocial workplace issues, as well as individual factors) will most likely derive the root causes of MSDs.

#### **4.1. Implications for ergonomists**

There are several ways in which information about one's personality can be used to improve the work environment. In ergonomics, differences in one's physical attributes (e.g. strength, anthropometry) are not considered detriments but reasons to design work so that most individuals can perform a job effectively. Perhaps this same view should be taken with more intangible qualities, such as personality. However, selecting employees for specific jobs based on their personality types is a misuse of the MBTI (Coe 1992), just as fitting people to jobs runs counter to ergonomics principles.

Another approach for improving human-workplace interaction is through job designs that allow a range of individual preferences to be used. The sensing/intuition trait provides a good example. Sensors prefer to work more steadily; thus, they may be more likely to enjoy the routine of repetitive actions typically required along an assembly line. However, intuitors prefer the option for slack time within periods of increased energy (Myers and Myers 1980, Kummerow *et al.* 1997) and, thus, may be more bothered by this type of manufacturing style. Knowledge of one's personality preferences suggests that work processes should be considered where the method for meeting a production goal is left to the discretion of the individual. For instance, in cell manufacturing, small teams of employees make entire products. This contrasts with typical assembly line operations, where many employees each contribute to a small portion of the final product. The cell manufacturing approach may be better suited for both sensors (who can work at their preferred, steady pace) and intuitors (who would be more able to vary their work speed and output, as desired).

#### **4.2. Limitations**

It is important to note that no perfect instrument exists by which to assess either one's personality or the type of environment in which one works. Every such inventory has its strengths and weaknesses. The MBTI is one of many personality

assessment tools and the SETA is one of but a few questionnaires available to similarly evaluate work environments. These two particular measures were used in this study because they are more occupationally based than other (more-clinical) inventories that exist, which made them appealing in this study. Also, these inventories have the ability to assess individual preferences and work environment types at a specific point in time, which was compared to subjects' views on several psychosocial factors, also at that time.

To derive a more robust understanding of the relationship between individuals' personalities and their work environments, an ideal sample would have included environments that were diametrically opposed in their assessed types on a variety of scales. However, it was not possible from these results to determine if opposing trends would have been observed (e.g. introverts reporting higher anxiety in extraverted environments versus extraverts having higher anxiety in introverted environments). The nature of the work makes it unlikely that industrial environments would be typed as either introverted or intuitive.

Another issue to be mentioned is the large number of statistical tests that were made across the observational factors and personality preference groups. In a controlled experimental design, the results would need to be corrected for these multiple comparisons. However, because this was an exploratory study, a decision was made not to correct for multiple tests. The authors believe that it was a greater benefit to highlight all variables that were considered as possibly related to the effects of personality and physical workload, so that future researchers can better focus on the variables to study in their research.

Finally, the cross-sectional design used in this study does not allow for a cause-and-effect relationship to be implied between a personality-workplace mismatch and discomfort to one's musculoskeletal system. The statistically significant associations reported here are instead to be used as a basis for developing more-comprehensive research studies.

## **5. Conclusions**

The following inferences can be drawn from this research. First, personality theory can be applied in manual materials handling environments to better understand individuals' behaviours, as it has traditionally been used in service-sector occupations. Secondly, the complex interaction between workplace and psychosocial factors in determining the injury risk of physically demanding jobs may be further moderated by personality type, regarding the perceptions of and reactions to stressors and strains of the job. Thirdly, a mismatch between one's personality and the nature of their work environment appears to be related to increased strain responses. Fourthly, these results suggest that an initial understanding can be gained regarding how personality type may assist the ergonomist in designing work environments to account for an individual's capabilities, limitations and preferences on both physical and non-physical levels. Finally, this research can be used to design future studies, as it is clear that more research is needed to understand the relationships between a job's physical demands, the psychosocial influences of the workplace and one's personality in determining how musculoskeletal discomfort develops.

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Appendix A: Descriptions and occupationally related traits of the eight MBTI personality preferences.

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MBTI personality types

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*Extraversion (E)* is a preference for active involvement and quick action. Extraverts:

- Like variety, action;
- Are impatient with long, slow jobs; and
- Like to have people around.

*Sensing (S)* reflects a preference for dealing with physical reality and facts. Sensors:

- Like established ways of doing things;
- Enjoy using current skills rather than learning new ones;
- Work more steadily;
- Are patient with routine details; and
- Are good at precision work.

*Thinking (T)* is a preference for making decisions based on logic. Thinkers:

- Are uncomfortable dealing with people's feelings;
- Like putting things into a logical order;
- Are sometimes impersonal; and
- Can reprimand and fire people when necessary.

*Judging (J)* is a preference to lead an orderly, planned life. Judgers:

- Like to keep and follow a plan of work;
- Prefer to settle and finish things; and
- Dislike interruptions, even for more urgent matters.

*Introversion (I)* is a preference for inner reflection of thoughts and ideas. Introverts:

- Like quiet and periods of uninterrupted work;
- Are content working alone; and
- Have some problems communicating.

*Intuition (N)* is a preference for deriving meaning from personal insight. Intuitors:

- Dislike doing the same thing repeatedly;
- Enjoy learning new skills than using them;
- Work in bursts of energy, with slack periods in-between; and
- Dislike taking time with precision.

*Feeling (F)* is a preference for decision-making based on personal values. Feelers:

- Are people-oriented and aware of others' feelings;
- Enjoy pleasing people;
- Like harmony; and
- Need praise.

*Perceiving (P)* is a preference to lead a more spontaneous, flexible life. Perceivers:

- Adapt well to changing situations;
  - May have trouble making decisions;
  - Want to know all about a new job; and
  - Are curious about new work situations.
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## Appendix B: Traits of the eight environmental types (Salter 2000).

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SETA environmental types	
Extraverted (E)	<ul style="list-style-type: none"><li>● Filled with noticeable energy and an assortment of components;</li><li>● Busy and loud, bright décor;</li><li>● Many ways for employees interaction;</li><li>● Demands total psychological and physical involvement; and</li><li>● Tangible and clear compensation.</li></ul>
Sensing (S)	<ul style="list-style-type: none"><li>● Focus is on individual elements of the environment;</li><li>● Elements are practical and immediately applied; and</li><li>● ‘Hands-on’ settings.</li></ul>
Thinking (T)	<ul style="list-style-type: none"><li>● Demands logic, objective appraisal and impartiality; and</li><li>● Inter-personal relationships are devalued.</li></ul>
Judging (J)	<ul style="list-style-type: none"><li>● Operations and organization are orderly and planned;</li><li>● Goals and objectives clearly defined; and</li><li>● Changes not often made.</li></ul>
Introverted (I)	<ul style="list-style-type: none"><li>● Stimulation regulated by employees;</li><li>● Surroundings quiet and respectful of employees’ needs;</li><li>● Interactions private and intimate; and</li><li>● Disruptive behaviour is not tolerated.</li></ul>
Intuitive (N)	<ul style="list-style-type: none"><li>● Attention demanded of employees;</li><li>● Requires focus on associations between elements;</li><li>● Looks at ‘the big picture’; and</li><li>● Often requires creativity in favour of innovation.</li></ul>
Feeling (F)	<ul style="list-style-type: none"><li>● Harmony is preferred, as is faith and personal beliefs; and</li><li>● Thought of as ‘people places’.</li></ul>
Perceiving (P)	<ul style="list-style-type: none"><li>● Spontaneity, openness is accepted and expected;</li><li>● Identifying information more important than maintaining its order; and</li><li>● An environment in transition.</li></ul>

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