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EFFECTS OF CONTROL AND FLEXIBILITY IN WORKPLACE DESIGN ON EMPLOYEE'S JOB SATISFACTION, GROUP COHESIVENESS AND PERCEIVED PERFORMANCE

By

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ABSTRACT

EFFECTS OF CONTROL AND FLEXIBILITY IN WORKPLACE DESIGN ON EMPLOYEE'S JOB SATISFACTION, GROUP COHESIVENESS AND PERCEIVED PERFORMANCE

By

So Young Lee

In today's changing workplace, the importance of the role of the physical environment in supporting organizational goals and changing needs is increasingly acknowledged. However, many workplace designs have not yet successfully supported these changing needs, and the balance in working alone and working with others is often neglected. At the individual level, control over the physical environment is expected to help employees to cope with change, experience a more stable environment, mitigate the negative effects of distraction and disturbance from the environment, and thus to have higher job satisfaction and performance. On the other hand, at the interpersonal or group level, a flexible use of the workplace is expected to enable employees to have more instant interactions, to do effective collaborative work both in their proximal and broader work areas, and thus to have higher group cohesiveness and higher performance.

In this study, four hundred and nine questionnaires were collected from employees of three manufacturing corporations in Michigan. Approximately 28% of respondents were intensively engaged in engineering while others (24%) intensively worked for marketing/sales or finance/accounting.

The results indicate that control over the physical environmental features of the workplace positively influenced job satisfaction. However, the influence was less than the influence that control over work had on job satisfaction. With respect to physical

dimensions, being able to control social contacts was the important predictor of job satisfaction, along with personalization, and determination of organization and appearance of the workplace. It was found that control played a mediating role in reducing the negative effects of distraction on performance. According to individual work styles, those who valued a quiet workplace had a negative effect from distraction on performance, but those who were less concerned with quietness, the effect of distraction on performance was positive. The findings also supported the hypothesis that flexibility is positively related to task group cohesiveness but not to social group cohesiveness. General flexibility and convertibility were significant predictors of task group cohesiveness. No significant relationship was found between openness and group cohesiveness. In order to measure the physical environmental aspects, as well as control and flexibility, from the user's perspective, the study investigated the gaps between what employees perceive and what they expect from their workplace. Based on linear projection, there was no substantial difference between gap measures and perception measures to explain work environment satisfaction and job satisfaction. Scatter plots revealed different patterns between the two measures.

The present study found control and flexibility in the workplace to be important. Some practical implications were suggested emphasizing that control and flexibility allow limited resources to be used in ways that permit individuals to work effectively within a changing work environment. Finally, this dissertation gives suggestions for future studies including the use of diverse methodological approaches and unexplored areas.

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CHAPTER I INTRODUCTION

The workplace is expected to continue changing rapidly. Information technology and Internet use for information sharing enormously affect work activities and workplaces (Challenger, 2000). A majority of today's office workers are knowledge workers, managerial, professional, and technical; a shift from clerical tasks (U.S. Workers by Occupation by U.S. Bureau of the Census; Robertson,1999) and, in large organizations, a collaborative work style is most prevalent with only a small percentage of people working in isolation (Barber, 2001). Such new trends impact people's attitudes toward work and the nature of work. The trend is toward a more diverse workforce on many levels, a breakdown of boundaries, a weakening of hierarchy, simplification, the passionate pursuit of leisure and personal freedom and control (Barber, 2001). As organizational environments have changed rapidly, it is more necessary than ever before that the workplace support the changing needs of organizations, employees and work processes simultaneously and provide an environmental setting in which employees work effectively and efficiently. Spreckelmeyer (1993) raised the question of how office design can be effective in reducing worker stress and environmental instability in response to a high degree of change.

The importance of the role of the physical environment in supporting organizational goals and changing needs is increasingly acknowledged. Although many researchers investigated the consequence of workplace changes or the relationships among physical environmental features and work behaviors, a relatively small amount of research has been conducted to deal with interrelationships between the broad range of

variables (O'Neill,1994; Donald, 1994). Pinpointing this problem, Pugsley and Haynes (2002) addressed how little had been done in office design to reflect changing dynamics.

In spite of expectations that open office design enhances communication and work efficiency, and reduces operating costs (Zalensny & Farace, 1987), traditional open offices present problems such as distractions, a lack of privacy and high noise levels (Brooks & Kaplan, 1972; Hedge, 1982; Sundstrom, Town, Brown, Forman, & McGee, 1982), decreased performance (Oldham & Brass, 1979) and lower satisfaction (Spreckelmeyer, 1993; Brennan, Chugh & Kline, 2002). At the individual level, workstations and immediate work areas are too often uncontrolled and disturbed to be effective workplaces. Traditional office approaches fail to fulfill the needs for individuals to work undisturbed and the needs for instant interactions among groups. Although open office space is considered to be a flexible accommodation, once office layout had been prepared, the office studied remained relatively static for several years and failed to be used in flexible ways at either the personal or the organizational level (Hedge, 1982). In changing workplaces, people often neglect the balance between working alone and working with others (Brenner & Cornell, 1994; Olson, 2002). Robertson (2000) addressed that one of the greatest dilemmas was the conflict between placing people in their own workplace and enhancing communication through the implementation of team coincidently.

Therefore, in response to these problems and the new changing needs of organizations, some workplace strategies have been introduced. According to Spreckelmeyer (1993), one strategy is to increase the quality of the ambient features to compensate the worker for the increased level of disruption and to let office occupants

have a higher degree of self-determination and personal control in response to change. Other specific alternative workplace options, such as dispersed work sites, flexible work hours and locations, adaptable space and furniture, team focus, unassigned or shared resources, and integrated resources were also introduced (Austin, Bain, Heath, Ratekin, Reilly, Richert, & Ross, 2001). In a general context, these strategies are to provide more control for employees and more flexibility in their work environments.

Increased control over the proximal environment provides more stable work environment for the individuals to cope with negative sources such as distractions and frequent environmental changes. Control is an essential feature of homeostasis (Fisher, 1989), and "Mankind has a characteristic tendency toward self-governance or self-determination" (Angyal, 1949). Perceived control predicts important aspects of motivational, cognitive and emotional functioning (Skinner, Chapman, & Baltes, 1988; Lee, Ashford, & Bobko, 1990). The consequences of low control include withdrawal (Abramson, Seligman, & Teasdale, 1978), decreased performance (Bazerman, 1982), stress, reactance, depression (Greenberger, Strasser, Cummings, & Dunham, 1989), absenteeism, and intentions of turnover (Spector, 1986). Higher control has been shown to increase employee satisfaction, which is more important as demographic makeup changes in labor populations (Challenger, 2000). Moleski and Lang (1982) emphasized the importance of user's needs. They stated that to be responsive to organizational changes, user needs research and corporate space planning must be redefined to recognize the importance of "freedom of choice" in determining the behavioral patterns and involvement in the planning and research process by individuals and work groups. Froggatt (2001) proposed that organizations take advantage of giving individuals control

over their workplaces, enumerating individual differences in working patterns within changing workplaces. The idea that individual control leads to beneficial behavioral outcomes and enhances the quality of life, often leads to recommendations of individual controls for lighting, temperature and ventilation (Veitch & Newsham, 2000).

At the individual level, control over the physical environment is expected to help employees to come up with changes, feel more stable in their environment, better mitigate the negative effects such as distraction and disturbance from the environment, and thus lead to better job satisfaction and higher performance.

On the other hand, at the group level, flexible workplaces need to facilitate individual work and collaborative work simultaneously. In the changing workplace, a new type of flexible environment is needed to support a plethora of working preferences (Pugsley & Haynes, 2002). The concept of flexibility has been emphasized more recently for the following reasons. First, providing workspaces with the flexibility to adapt to change is the most critical factor in supporting new work processes and technology (GSA, 1998). Frequent changes of organizational structure and equipment updates require a more flexible physical environmental structure. Second, a flexible work environment can easily accommodate various changing activities and works. Third, in order to keep up with rapid external changes, organizations have increasingly turned to some version of work teams such as cross-functional teams and self-managing work groups (DeMatteo, Eby, & Sundstrom, 1998). Flexible office design allows employees to shift from working as individuals to working as teams or vice versa. To support organizational objectives and attain business success, workplaces need to be versatile for both individual and teamwork requests. Spaces that enable employees to have more instant communications have been

emphasized (Becker, 1990). Another benefit of flexible design may be reducing the cost of moves. The average churn rate[1] is 44% (IFMA Benchmarks III Report, 1997), not only because a company changes rapidly or its organization moves frequently, but also because space cannot support the changing needs of a company. According to the characteristics of the organization, it might be hard to reduce the churn rate, however, the cost of churn can be reduced (Thatcher, 1995), since flexibility is considered to be a solution for changing demands. Once a physical environment is built, if it is not flexible, the rigid structure may lead to increased cost for renovation or reinstallation to incorporate the organization's changes. As it has been considered that facilities are the largest expenses after pay-roll (Cotts, 1998), the cost of the physical environment that is not flexible to be renovated or modified may be bigger than commonly expected.

In summary, at the interpersonal and group level, a flexible use of space is expected to enable employees to have more instant interactions, promote collaborative work both in their proximal and broad work areas, and thus lead to better group outcomes such as improved group cohesiveness and higher performance. Therefore, if employees possess a high control over their proximal work environment and high flexibility in their workspace use, it is expected that they will not only work more effectively as individuals but will also have more informal and instant interactions in their group work, and thus, a better balance between individual and group work with less concern over distractions or disruptions.

Though the concept of control has been explored intensively in the areas of job design and psychology, and flexibility within the workspace has been strategically

[1] The total number of employee work space moves made in the last year divided by the total number of office employees in the facility multiplied by 100.

emphasized in workplace design, there is yet a paucity of research done regarding control and flexibility.

A general review shows inconsistent research findings on the effects of the physical environment on individual and group work outcomes. This may be due to the difficulty Sundstrom (1986) indicated in proving the effects of the physical environmental features, especially on group and organizational outcomes. There is a lack of conceptualization or measurement of the work environment when measuring the effects of the physical environment on people at work (Carlopio, 1996). According to Marans and Spreckelmeyer (1982), evaluation studies in office design have failed to specify the criteria used to determine the degree to which an environment is successful, or to provide carefully developed conceptual links between the physical environmental attributes and various levels of worker responses to those attributes. Even if criteria are specified, valid and reliable measures are rarely used. In a large amount of empirical research on the effects of the physical environments on workers, physical aspects were limited to ambient features. Few of the instruments measuring the effects of physical environmental features have been used over time or used repeatedly to verify their validity and reliability. In summary, only a few studies deal with the broader dimensions of the physical environmental features (Hedge, 1982; Sundstrom, Town, Brown, Forman, & McGee, 1982; Zalesny & Farace, 1987; Carlopio, 1996; Brennan, Chugh, & Kline, 2002) and the common structure of these features was not fully established.

Under these circumstances, the concept of control over the physical environment and the flexible use of space have hardly been explored and empirical studies rarely have been conducted. Although control and flexibility are strategically emphasized, from the

view of a practical space planner or a facility manager, the concepts of control and flexibility are relatively abstract and lack specifics. In some research, control over physical environmental features has been dealt with as a part of the antecedents of the concept of control including aspects such as control over work activities, work schedule autonomy or decision making (MacLaney & Hurrell, 1988; Greenberger et al.,1989; Sargent & Terry,1998; Ganster, 1989). Becker (1991) emphasized the importance of control in the workplace and specified that research needs to be done inquiring into the types of environmental control preferred by employees and types of involvement in the planning and design in the workplace. Based on a literature review, the results of studying the effects of control are inconsistent.

Therefore, it is necessary to conduct studies to examine whether physical conditions can provide opportunities or possibilities for users to be able to decide various physical work environment options or to use the physical work environment in various ways and to use their physical environment in flexible ways under their control. To understand the impacts of control and flexibility, those concepts should be examined with other aspects of the physical environment that might play roles in mitigating the relationships. Too often, empirical studies deal with separated concepts or simple relationships between the physical elements instead of viewing these as integrated and interrelated relationships.

Although a large amount of research relies on perception, empirical research related to physical environmental aspects lacks of methods to reflect the employee's perspective. There may be large gaps between employees who use the space and a planner who makes decisions or designs the space. For the right decision in workplace

design and management, the concepts of control, flexibility and antecedents of physical aspects should be reviewed from the perspective of the users.

Importance of Study

There are both practical and theoretical reasons for conducting this study. On a theoretical level, this study investigated interrelationships among variables and attributes of the physical workplace environment such as control over physical environmental features and flexible use of workspace and work outcomes, which have not been extensively explored before. Consequently, exploring the interrelationships of the physical environment with employee behavior will lead to an understanding of the dynamic nature of the workplace and provide a structure of analysis for the physical work environment. This will contribute to the establishment of a more reliable approach for such studies.

Moreover, results of confirmatory factor analysis of the measurement can reveal a factor structure and relationships among physical environmental features, and other organizational environmental features. The testing of results adds theoretical knowledge in workplace research by understanding the multiple relationships. With analysis and classification from previous studies, this study can add a different and unique dimension of the physical environmental characteristics on employee satisfaction and work outcome.

This study is important in the development of a model showing a relationship between the physical office environment and behaviors and relationships leading to work outcomes. Such a model can lead to more predictive work habits and enable future

studies to explain more definitive relationships between the physical environment features, work patterns, and profitable outcomes.

From a practical perspective, the results of research in this area will provide a facility manager or planner with a better understanding of employee behavior and the requirements leading to better implementation of the management process, human resources and space utilization. Improved workspace can directly and indirectly influence an employee's job satisfaction, productivity, and well-being. User satisfaction is recognized as an important factor in the success of a certain firm or an organization and is regarded as one of the indicators of performance since higher satisfaction improves morale and reduces voluntary turnover[2]. This study will contribute to reducing gaps between the facility manager and users, and the designer and manager, by identifying desirable features employees want to have from the work environment. Research results will provide evidence of how innovative work patterns and physical work environment solutions can be implemented so that a facility manager can utilize research results to be proactive in strategic planning in order to cope with changing needs in the workplace.

Research Objectives

The overall purpose of this study is to examine the effects of control over the physical environment by individuals, and to examine the effects of flexibility on individual and group work outcomes in the workplace. In order to reach this goal, several more specific objectives were developed to guide the research.

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[2] A study using meta analysis found an inverse relationship between job satisfaction and voluntary turnover intention being consistent with previous research (Dole & Schroeder, 2001).

1) To develop conceptual structures of control, flexibility, and other factors including distraction, work space adequacy and openness in the physical work environment and to test the causal relationships in the proposed constructs (factor structure and indicators) of models for the effects of control and flexibility.
2) To investigate the effects of individual control both on the perception of negative physical environmental features such as distractions and on positive work outcomes such as job satisfaction and individual performance.
3) To examine the impact of a flexible workplace on group cohesiveness.
4) To identify interrelationships of factors of physical environmental aspects that affect work outcomes such as employee's job satisfaction, task group cohesiveness, and perceived performance.
5) To test the proposed models possessing predictive power in showing the relationships between physical workplace characteristics and work outcomes.
6) To investigate the gap between employee's perceptions and expectations toward control over the physical work environment, flexibility, and other physical environmental features in the workplace.

Research Questions

The key questions for the research project are:

1) Does individual control over the physical workplace affect on job satisfaction and perceived performance? Does control play a role in mediating negative effects of distractions from the work environment? Is there a difference due to degree of control or individual work styles?

2) Does flexibility in the physical environment influence task group cohesiveness and social group cohesiveness? With flexibility, are openness and accessibility associated with group cohesiveness?

3) What kinds of multiple effects or relationships among the factors that affect work outcomes do exist? Is the proposed model acceptable?

4) What discrepancies exist between employee perceptions and expectations toward the workplace in terms of control over the physical environments, flexibility, and work space adequacy? Which aspects do employees feel should be improved? Is the gap measure more appropriate for explaining satisfaction with the workplace or job satisfaction than simple perception measure?

Based on these research objectives, a literature review was undertaken and is presented in chapter II. Following the review of literature, the conceptual framework and hypothesis are discussed in chapter III.

CHAPTER II LITERATURE REVIEW

This chapter brings together previous research findings relevant to the research objectives and variables, and includes a discussion of how physical environmental factors affect user satisfaction, group work and performance in the workplace, focusing on the interactive nature between built environments and human behaviors. Concepts of control in human behaviors, antecedents of control over physical environments and multi-faceted aspects of flexibility are also reviewed.

Level of Analysis and Classification in the Workplace

Existing research shows a lack of structure in analyzing the physical work environmental dimensions in the workplace. This may be due to the broad dimensions of the physical elements, their overlapping and interdependent nature, or the nature of difficulty in verifying physical environmental effects with organizational characteristics. This leads to a paucity of reliable and replicable measurement in workplace design. Table 1 summarizes the proposed analysis structure of work environment dimensions including physical environmental dimensions by several researchers. According to the purpose of the research, the dimensions vary. Carlopio (1996) examined the dimensions in relation to work environment satisfaction. Evans, Johansson, and Carrere (1994) examined the characteristics that affect health and well-being. Hartkopf and Loftness (1985) developed a list of performance qualities in office environments for improving satisfaction and productivity. Crouch and Nimran (1989) investigated inhibitory and facilitative features of office environments from sixty five managers and presented results

Table 1. Proposed Work Environment Classifications

Sources	Work environment dimensions
Carlopio (1996)	***Environmental design***: lighting, adequacy lighting, air quality, walk surfaces, work atmosphere, types of facilities, cleanliness
	Facilities: restrooms, recreation, eating size, eating cleanliness, eating pleasantness
	Work organization: schedule, work amount, activity/movement pace, flexibility, work system design, time to complete work, information quality, information move and store
	Equipment and tools: number of tools/machines, efficiency of tools, effectiveness of tools, effectiveness of machines, efficiency of machines
	Health and safety: accident avoidance, accident reporting, accident investigation, safety precautions, hazard warnings, hazard control, handle hazardous materials safety training received, safety training available, safety training of others, fire prevention system
Evans, Johansson, & Carrere (1994)	***<Physical>***
	Ambient: air quality, chemical hazards, noise, temperature, vibration
	Layout and arrangement of space: enclosure (openness), proximity to others, traffic patterns, boundaries, proxemics
	Architectural design: lighting, color, modifiability of space furniture, legibility, natural elements, meeting place
	Ergonomic factors: equipment design, safety hazard, machine pacing, physical load, physical restraint, automation, computerized work
	<Psychological>
	Structural: occupation status, labor market
	Interpersonal: social relationships, leadership style, discrimination
	Organizational: role conflict and ambiguity, clarity of norms/rules, monitoring/evaluation, shift work, wage structure, over time, part time/full time, opportunities for advancement, hierarchical structure
	Task parameters: mental workload, decision latitude (control), monotony, possibility to learn new things, fractionation, interruption, technological dependence, social interaction requirements

Continued.

Sources	Work environment dimensions
Hartkopf & Loftness (1985)	***Functional /spatial quality***
	Individual space layout quality: usable space, layout efficiency, access, ergonomics, flexibility, occupancy controls
	Aggregated space layout quality: proximities, access, compartmentalization, flexibilities/growth
	Building siting: layout quality: access, public interface/image, indoor and outdoor relationships
	Quality of convenience and services: sanitary, fire safety, security, electrical, information technology
	Thermal quality: air temperature, humidity, air speed, occupancy factors
	Air quality: fresh air, air distribution. restriction of mass pollution
	Acoustic quality: sound source, sound path, occupancy factors
	Visual quality: ambient light levels, task light levels, contrast and brightness ratios
	Building integrity: quality of mechanical/ structural properties, quality of physical / chemical properties, and visible properties
Crouch & Nimran (1989)	***Social interactions***: vertical support, horizontal support, quality of relationship, accessibility
	Physical & ambient conditions: lighting, space, atmospheric conditions, visual outlook
	Utilities: equipment, technology, photocopier, etc
	Information & communication
	Workplace experiences: privacy, distraction
Hedge (1982)	***Physical factors***:
	Ambient environment; temperature, ventilation, lighting, electrostatic
	Office layout, office furnishing, disturbances/distractions
	Psycho-social factors: Health, privacy, social environment, proprietary attitudes

with the categories presented in Table 1. Hedge (1982) developed a classification to investigate employee reactions to open plan office environments and employee attitudes.

The scope of this research is intermediate work environments for individuals and groups. Control and flexibility in workplace design mainly covers physical work environmental characteristics and psychological aspects of employees.

Interestingly, Sundstrom (1986) proposed varying levels of analysis with psychological or physiological processes and outcomes (see Table 2). He showed a relationship of the physical environmental elements and outcomes.

Table 2. Levels of Analysis, Facets of the Environment, Process, and Outcomes

Level of Analysis	Facets of Physical Environment	Key Processes	Outcomes
Individual Workers	Ambient conditions Temperature Air quality Lighting Music Work Stations Color Equipment Chair Floor space Supporting Environment Hallways, Restrooms Work areas, etc	Adaptation Arousal Overload Stress Fatigue Attitudes	Satisfaction Performance
Interpersonal Relationships	Work spaces Differentiation Room layout Seating arrangements Furniture Building layout Inter-work-space proximity Enclosure of workspaces Gathering places	Self-identity Status Regulation of immediacy Self-presentation Choices in communication Regulations of interaction	Adequacy of communication Group formation Group cohesion
Organizations	Buildings Separation of work units Differentiation of work units	Congruence of organizational structure and physical environment	Organizational effectiveness

Source: Sundstrom, E. (1986). *Work Places*, Cambridge University Press, p8.

At the individual level, work outcomes are job satisfaction and performance, while at the interpersonal or group level, work outcomes are better communication, group formation and group cohesion. In this study, control is related to the individual level and proximal individual environment. Flexibility is related to a broader work environment including the individual workspace regarding interpersonal relationships.

Roles of Control in Job Satisfaction and Performance

In psychology, control is one of the most thoroughly explored and cited concepts (Baum & Singer, 1980). Yet, the term 'control' is not uniformly defined in the literature. Fisher (1990) defined control as mastery over the environment and said "individuals with control can act to change or reverse situations which are disliked." Perceived control by employees has been heavily studied in job design and participatory decision making (Spector, 1986). The concept of locus of control[3] is different from that of perceived control. Locus of control is the individual's expectancy that some individuals attribute the cause and the control of an event, to be within their power or outside of their abilities (Roberts, Lapidus, & Chonko, 1997).

Some research showed a positive association between high work control and job satisfaction, work performance and psychological well-being (Sargent & Terry, 1998; Greenberger, Strasser, Cummings, & Dunham, 1989; MacLaney & Hurrell, 1988). Spector (1986) conducted meta-analysis relating perceived control variables to employee

[3] Rotter (1966) conceptualized locus of control as to be a relatively stable propensity to locate causality for outcomes either in oneself or in the external environment (Greenberger et al, 1989). For further review, see page 32 of Greenberger and his colleagues' paper (1989).

outcome variables. From the results of the reviewed studies, Spector (1989) found that high levels of perceived control were positively related to a high level of motivation, performance, job satisfaction, involvement, and commitment. And employees who perceive a high level of control at work were absent less, had fewer intentions of quitting, and were less likely to quit. Bachman, Smith and Slesinger (1966) investigated the relationship among control, performance and satisfaction and measured control over an office as the "general amount of influence over the way the office is run." The finding showed that control was associated with satisfaction but not with performance.

While the importance of control has been recognized for well being, motivation, satisfaction, and performance, few studies have investigated the concept of control in terms of physical environment aspects. Investigating the effects of work control on job satisfaction, McLaney and Hurrell (1988) included physical aspects as a major component of control. They used multidimensional measures of work control to assess its influence on task outcomes. The construct of control consisted of task control, decision control, control over the physical environment, and resource control. They found that control over the physical environment and resource control accounted for a variance in job satisfaction regardless of the type of job demands, however, decision control did not.

In control over the physical aspects, Allen and Greenberger (1980) mentioned "In the case of the built environment, an individual can experience an increase in the sense of control by altering, modifying or transforming it in some manner." Through personalization of the individual workplace, altering the exterior or interior of a building or even drastic acts of destruction, people gained control (Allen & Greenberger, 1980).

People with a greater degree of control over their immediate environment were more satisfied than those having a diminished amount of control (Marans & Spreckelmeyer, 1982). Roelofsen (2003) indicated that if users could exercise greater control over the indoor working environment including temperature, ventilation, and lighting, they had higher self reported productivity and improvement in involvement in their works and morale.

Paciuk (1989) investigated the role of personal control in the thermal environment. She measured the following key variables: 1) two descriptors of objective environmental properties, the thermal factors and potential control made available by the situational context, 2) a behavioral measure of instrumental control, 3) a measure of degree of perceived control, 4) a measure of perceived thermal sensation, and 5) three outcome measures, thermal comfort, acceptability and satisfaction with the thermal environment. Perceptions of thermal control were measured with 11 items such as " I have complete control of thermal conditions at my workspace," "I am able to set thermal conditions at my workspace according to my wishes," and "It is hard to know how and when to make use of the different available alternatives for the regulation of thermal condition at my workspace." Exercised control consisted of three modes, adjustment, adaptation and self-removal. Exercised control was measured by the frequency of actions such as setting controls for the central HVAC system, opening/closing windows, opening/closing ventilation vanes, adding/removing items of clothing or complaining to the building's manager. There was negative association between the perceived control and the exercised control –adaptive behaviors (The path coefficient between them was -.2, while path coefficients between the exercised control-manipulative behavior and

perceived control was not calculated). Perceptions of control were found to moderate the effects of other environmental and behavioral variables as well as to have a strong influence in shaping thermal control and satisfaction, while exercised control was found to wield certain negative effects on satisfaction. Considering the fact that the operational definition of 'exercised control' was the relative frequency with which workers engaged in several types of thermally-related behaviors to regain thermal comfort when needed, it appears that the more uncomfortable with the thermal environment employees were in their workstation, the more frequently they engaged in thermal related behaviors. Exercised control measured the degree of uncomfortable thermal environment rather than control in the experimental setting.

O'Neill (1994) found that adjustability as the concept of control was positively associated with work outcomes such as communication, environmental satisfaction and perceived performance based on correlation analysis and path analysis. In his research, adjustability was related to level of environmental control. Adjustability was measured the degree to which the work space supports organization of work materials, ease of adjustment of storage and display features, and ease of rearranging furnishing. The items were "How frequently do you adjust the position of storage units," "How satisfied are you with how well your work space lets you organize your materials," and "How satisfied are you with the ease of rearranging the furniture in your workspace."

Veitch and Gifford (1996) investigated the effects of perceived control over lighting on performance with an experimental design using undergraduate student subjects. They measured lighting control, environmental control and session control respectively with such items as, "I had some control over the lighting in this study,"

"Being able to control my environment makes me feel better," and " I had some control over during this session." Subjects with the choice reported more perceived control, however, contrary to the researcher's expectations, subjects with more perceived control performed more poorly and more slowly than subjects not given a choice. Consistent with this, Veitch and Newsham (2000) found that there were no short-term benefits of the perceived control over lighting. They explained it might result from too high quality of environmental conditions. In experimental design, in order to gain control, subjects might transfer efforts from doing their given tasks to gaining control, resulting in lower performance. However, in reality, through experience from controlling environmental conditions under repetitive daily activities, employees might put less effort into gaining control and increase performance by adjusting the lighting according to tasks and needs. Results should be viewed with caution since, in some cases, providing too much control can overwhelm people (Barnes, 1981). Especially in highly demanding jobs, additional choices concerning the physical environment could contribute to overload (Wineman, 1982). Nevertheless, a large amount of research shows negative outcomes associated with a perceived decrease in control (Greenberger, Strasser, Cummings, & Dunham, 1989).

McCarrey et al. (1974) found that people in open offices perceived themselves to have inadequate control over input to and from the environment. They reported a lack of general privacy, a lack of personal privacy and a lack of confidentiality of communications. Lower satisfaction in open offices is due to employee's perceived lack of control over input to and from the environment (McCarrey, Peterson, Edwards, & Von Kulmiz, 1974).

In general, control over the physical environment is related to job satisfaction, though some differences in findings exist due to differences in measures of perceived control (Lee, Ashford, & Bobko, 1990). Measurements are inconsistent since many authors are developing or adapting instruments for their particular purposes (Spector, 1986). Therefore, for the physical aspects of control, it is necessary to develop the construct of control in the workplace.

For another important aspect, personal control apparently plays a moderator role to help people cope with stress and negative environmental stimuli. Likewise, control over the physical environment is expected to moderate the effects of negative environmental sources such as distractions and disturbances on employee's job satisfaction and performance. Gatchel (1980) supposed that if residents in nursing homes had some sense of control, it would alleviate some of negative reactions and lead to a better adjustment. Similarly, Langer and Saegert (1977) investigated the aversive effects generated by a high density condition - shopping at a crowded supermarket. Providing cognitive control significantly ameliorated the aversiveness of the crowded condition. Yet in spite of studies finding that individual differences may moderate the effects of the physical environmental features, such as the way desks and other equipment are arranged in the work area (Greenberger et al, 1989), little empirical research has dealt with the moderating role of personal control over the physical environment.

Interestingly, there are other moderate variables playing roles in the effects of control as a moderator of stressors. Lee, Ashford, and Bobko (1990) found that the effects of control on job satisfaction and performance were different to specific types of people. They proposed "When perceived control is low, people with high levels of Type

A behavior may be distracted from concentrating on their performance tasks as they divert effort toward strategies to regain control." In a Carlopio and Gardner study (1992), avoidance of distraction, interruption, and noise became more important for employees whose jobs were more complex and afforded them more control over social contacts. Paciuk (1989) proposed that factors influencing control are both personal and situational since personal differences might increase/decrease vulnerability to negative stimuli (stressor), and situational factors such as organizational support/constraints are associated with a certain stressors.

Therefore, the following contention is proposed. When control over the physical environment is low, people are likely to be distracted from concentrating on their work, thus the consequence is lower performance. The consequences of low control may be greater for employees who are used to working in quiet areas than for those who care lass about noises, or for employees whose jobs are more complex than for those whose jobs are simpler.

In the present research, control over the physical workplace can be defined as an individual choice to change the workplace based on individual or interpersonal needs. In the working environment, negative work environmental aspects come from various sources. Control over the physical workplace is expected to provide a more stable environment for the immediate individual work area under a changing environment, as well as to mitigate or moderate the effects of negative stimuli on job satisfaction, performance or other employee's reactions, such as an inclination to work alone, to work in enclosed areas, or to avoid meeting people.

Effects of Negative Ambient Features on Work Outcomes

Related to control, ambient features appeared to cause major stress sources and complaints for employees in work place environments. Severely uncomfortable environments can result in a loss of control and helplessness (Gactel, 1980). Sundstrom explained this mechanism as follows. "If the environment contains enough distractions, it may create overload by occupying more of a person's capacity than can be spared from the task while still maintaining effective performance." Consequences of negative ambient quality are loss of control, lack of privacy, disturbance and distraction. In obverse, control over the physical environment is expected to relieve the negative effects of disturbance, distraction, etc.

Open offices are popularly incorporated by organizations to increase communication; however, there are more distractions in open plan offices than in conventional private closed offices (Brookes & Kaplan, 1972; Canter, 1972; Hedge, 1982). In general, studies of the ambient features in office environments including noise, lighting, temperature, and existence of windows suggest that such elements of the physical environment influence employee attitudes, behaviors, satisfaction and performance (Crouch & Nimran, 1989; Veitch & Gifford, 1996; Larsen, Adams, Deal, Kweon & Tyler, 1998).

Among the ambient features, noise is the major source of distraction for employees needing to concentrate or talk on the telephone (Marans & Spreckelmeyer, 1982). It was found that noise was related to distraction and openness (Sundstrom, Burt, & Kamp, 1980). As an ambient stressor, noise comes from telephone ringing, people talking, ventilation systems, and office equipment (Sundstrom, Town, Rice, Osbourn &

Brill, 1994). Kjellberg et al. (1996) investigated annoyance, distraction and symptoms by various noise sources upon office workers, industry workers and laboratory workers. They found that distraction was most strongly related to the degree of self-control of noise and noise predictability, and annoyance was significantly related to the sound level. Telephone signals and conversation were large indicators of distraction. Ferguson and Weisman (1986) investigated the effects of distraction on satisfaction with the workplace. They measured distraction with eight items such as "concentration frequently distracted," "frequently annoyed by noise," "workplace usually quiet," "noise level too high," and "ability to concentrate" (standardized coefficient alpha was .94). They found that distraction was negatively related to satisfaction with the workplace but not with job satisfaction based on path analysis.

Other distraction sources may include flicker form fluorescent lights, uncomfortable temperature, or poorly designed seating (Sundstrom, 1986). Sundstrom et al. (1994) investigated the effects of noise on environmental satisfaction, job satisfaction and performance before and after the renovation. They identified disturbance by office noise with time to be related to environmental satisfaction and job satisfaction in the work environment. However, contrary to this expectation, performance ratings were not related to any source of noise. Sundstrom (1986) supposed that responses to noise not only rely on its physical properties such as degree of loudness, but also on an individual's sense of control. Through experimental design, it was found that noise influenced performance (Banbury & Berry, 1998). In the research, four test conditions (speech, office noise with speech, office noise without speech and quiet) were assigned. And

performance was measured by accuracy and mean time to complete the tasks for two office related tasks, speech memory for prose and mental arithmetic

Yet other studies found that open office noise can be stressful (Evans & Johnson, 2000) and that open plan offices may have high levels of distraction and disturbance and low privacy levels (Hedge, 1982). If considered in isolation, each ambient feature may not have predictable effects on performance; however, repeated distraction from a collection of physical environmental features may be negatively associated with performance.

With an increase of knowledge workers, distraction might be more important for knowledge workers and their work performance. Aronsson (1989) found that new technology was associated with an increase in intensity demands such as attention, mental effort, and concentration.

Although some research has found significant effects of noise, distraction or disturbance on dependent measures of job satisfaction and performance (Sundstrom et al, 1994; Stone & Irvine, 1994, Banbury & Berry, 1998), other studies have failed to confirm a direct relationship between them (Ferguson & Weisman, 1986).

Relationships between Flexibility and Interpersonal /Group work

In the present study, it is assumed that if people have a higher degree of flexibility and freedom to choose or change their workplace according to differing needs, they will communicate better, leading to a higher degree of group cohesion. Although in much of the literature the importance of flexible space involves support for changing organizational structures, facilitation of instant team communication, and coping with a

variety of work patterns (Berndt, 2000); there is little evidence that shows a relationship between flexible (or rigid) use of workspace and relevant group outcomes such as work effectiveness, group cohesiveness, and performance. Even the meaning of the term 'flexibility' has many facets and is frequently interpreted differently in contemporary discussions of the faltering economy and changes in the labor market. In particular, it could be defined as labor market flexibility, freedom of employers to reduce wages (Casey, Keep, & Mayhwe, 1999), and flexibility in timing and location, etc. Flexibility is considered as "a common to all solution" (Olson, 2002) or as balancing often conflicting individual requests and group requests within the same workplace. In general, flexibility in space design covers three aspects; expansibility, convertibility and versatility (Pena, 1987).

However, this study focuses on the flexible use of furniture and work areas. Flexibility in the workplace can be defined as the capacity to use, adjust and rearrange in various ways to accommodate frequent shifts from individual work to collaborative work, and vice versa. Flexible use of space is expected to facilitate instant communication among work groups. This assumption is based on optimal spacing: sociopetal spaces that bring people together and sociofugal spaces that separate people (Osmond, 1957; Bell, Fisher, Baum & Greene, 1990). If individual workstations are flexible enough to accommodate shifts from sociofugal arrangement to sociopetal arrangement, it might be easier for workers to have more interactions.

Another physical aspect that appeared as a factor affecting group activities or outcome in the literature is the openness (enclosure) or accessibility of employees in open offices that create a more cohesive social environment (Hedge, 1982). Removing high

partitions or walls increases openness and allows for the flexible arrangement of furniture, but it does not always ensure the flexible use of spaces, instant meetings and interactions.

A relatively small amount research has been conducted to investigate the effects of the physical environment on interpersonal or group works. As the emphasis on teamwork grows, organizational performance can be related not only to individuals but also to teams and groups (DeMatteo, Eby, & Sundstrom, 1998). As one example of this shift in dependent measures to group level phenomena, physical enclosures for team work areas may be associated with group cohesiveness (Sundstrom, 1986).

Zahn (1991) examined the effects of physical proximity on exposure and communication and found that the physical distance between offices reflected a chain of command and status distance, and was associated with reduced face-to-face communication.

Brennan et al. (2002) investigated the effects of physical environmental changes on team member relations. Team member relation was defined by the relationship with other members of the team such as " I really feel I am part of my team," "My team members approach me when needed," and " It is easy to ask advice from anyone here". According to Brennan and his colleagues, employees who shifted from traditional offices to open offices experienced a number of disturbances and distractions instead of better communication, resulting in decreased team relations. Similarly, insufficient privacy in office interferes with the development of close interpersonal relationship (Oldham & Rochford, 1983). Evans and his colleagues (1994) inferred the reason that workers in overload environments develop social withdrawal is that they feel unable to hold confidential conversation, or that direct feedback from supervisors was restrained.

Group cohesiveness is one of the indicators of successful group work or team work. The definition of group cohesiveness is the perception of togetherness or sharing within the organizational setting, including the willingness of members to provide material aids (Koys & DeCotis, 1991). Dimensions that are associated with group cohesion are group sprit, morale, social support, communication/cooperation within the team, the extent of work load sharing, and participation in decision making and goal interdependence (Carless & DePaola, 2000). Task cohesion is the extent of "motivation toward achieving the organization's goals and objectives"(Widmeyer, Brawley, & Carron, 1985, p17). Social cohesiveness refers to "motivation to develop and maintain social relationships within the group" (Carless & DePaola, 2000). Task cohesion is more closely related to work performance than interpersonal cohesion (Mullen & Copper, 1994; Carless & DePaola, 2000). Carless and DePaola (2000) found that task cohesion was moderately related to job satisfaction and supervisor ratings of team performance, and strongly related to team member ratings of team effectiveness, and found that individuals don't distinguish between individual- and group- level task cohesion. Chang and Bordia (2001) found that task cohesion was the predictor of self-rated performance in longitudinal design but social cohesion was not the antecedent of performance.

Satisfaction with the Physical Environment and Job satisfaction

In the workplace, it is expected that employees who possess higher satisfaction with the physical environment are likely to have better work outcomes. Carlopio (1996) found that employee's satisfaction with their work environment is related to their job satisfaction and indirectly related to organizational commitment and turnover intention.

Thus, primary focuses in the following are 'what kind of aspects contribute to physical work satisfaction', and 'what relationships exist among these aspects including control and flexibility.'

Another set of attributes that may be directly related to work effectiveness, job satisfaction and performance in the workplace setting is workspace adequacy. Workspace adequacy referred to adequacy of the workspace in terms of equipment, size, lighting, temperature, equipment, and proximity to service area and co-workers (Zalesny & Farace, 1987).

For workspace adequacy, the composite view is more suitable than the factor view since the items are physical environmental components. "The composite view assumes that facets are components of the composite construct while the factor view assumes that facets are manifestations of latent constructs (Law & Wong, 1999)." It is necessary to examine whether the composite or the factor view is suitable for workspace adequacy.

In general, previous research found consistently that satisfaction with the physical environment was positively related to job satisfaction. Investigators have demonstrated that the physical environmental quality affects job perception, attitudes, and job satisfaction (Zalesny, Farace, & Hawkins, 1985; Sundstrom, 1994). Ferguson and Weisman (1986) also found that satisfaction with the workplace was positively related to job satisfaction.

Gaps between Perception and Expectations Toward A Physical Milieu

A majority of physical attributes and variables were measured based on perception. This part of the literature review focuses on the importance of perception and expectation in measuring physical environmental features and on methodological approaches in relevant areas. Because control and flexibility are relatively less studied, there is a lack of information about how much control and flexibility employees have compared to how much they think they should have.

Many environmental satisfaction studies aim to find out the importance of various properties or components in defining the degree of environmental satisfaction/ dissatisfaction or to specify more complex relationships between people and the environment. For instance, attitudes and socio-demographic variables influence evaluative hierarchies of environmental aspects, thus contribute to the relationship between the persons and the environment (Bonnes & Secchiaroli, 1995).

The approach in the majority of research conducted to investigate satisfaction with the physical environment is based on perception by directly asking a question such as "all things considered, how satisfied are you with your primary workplace? " without asking opinions or expectations toward workplaces (Marans & Spreckelmeyer, 1981; Marans & Yan, 1989; Lantrip, 1993; Spreckelmeyer, 1993, Sundstrom, Towm, Rice, Osborn, & Brill, 1994). Unless people indicate severely low satisfaction levels, it is hard to provide specific managerial direction from satisfaction results. For instance, in the Pugsley and Hyanes' study (2002), satisfaction with storage is below the mean of office design (68%) and satisfaction of flat screen PC monitors is much higher than the mean level of ICT (61%). How should a viewer interpret this? Does the higher satisfaction

level mean no action is required or should more flat screen monitors be provided because people are satisfied with the type of monitor? In Carlopio and Gardner's study (1992), satisfaction with the work environment in general, satisfaction with the work site, and satisfaction with health and safety were respectively 3.72, 3.47, and 3.65(" 1 very dissatisfied to 5 very satisfied). It is hard to get specific direction from these results. Frequently satisfaction results may be interpreted with the researcher's perspective rather than reflect the actual user's perspective. It would be more helpful to show the gaps of the present features and future features expected from the user's perspective.

Environmental evaluation is redefined as a function of the 'congruence' people perceive between their own needs and aims and the opportunities offered by the environment rather than as a response directly attributed to the objective properties of the latter (Bonnes & Secchiaroli, 1995).

In a similar context, researcher has investigated incongruence between what environment is and what environment should be to fulfill the required function of people's needs. Szigeti and Davis (2002) developed a building evaluation form[4], which incorporates customer satisfaction needs, and customer functional needs. "Functionality" is defined according to the levels of functionality and service of a facility from stakeholders' views. Serviceability is rated according to the levels of capability. By comparing supply aspects (serviceability) with demand aspects (required functionality), people can easily assess the building performance or capability and specify which aspects should be improved. It provides specific managerial application information in such a way that shortfall aspects need to be changed to save later cost.

[4] ASTM standards on Whole Building Functionality and Serviceability

Brackertz and Kenley (2003) developed a facilities management tool to measure service performance in government facilities. In this tool, people can score on a Likert-type scale for functional requirement (1:not needed to 5:essential) and actual performance (1: doesn't meet, to 5: exceeds). In this study, the functional requirement and the actual performance scales were independent and the gap approach was not used.

Performance of the physical environment has been defined by confirmation between the needs of users and a current diagnosis of the environment. Lantrip (1993) measured perceived differences between what is needed by an inhabitant and what is provided by the environment regarding the effects of constraints on human movement on productivity in an office environment. In Lantrip's study (1993), various methods such as video records, questionnaires, and analysis of floor plans were employed to measure actual spatial characteristics, environmental characteristics and worker characteristics.

However, in these approaches above mentioned, subjects who evaluated the present environmental quality and those who decided future required environment quality are different. There is a lack of perspective that users are 'customers' of a built environment. Thereby, a large of amount of research deals with perception but leaves out the expectations of users.

In marketing research, satisfaction is related to confirmation or disconfirmation of expectation (Smith & Houston, 1982; Parasuraman, Zeithaml, & Berry,1988). Parasuraman et al. (1985) developed 'SERVQUAL' to measure customer's appraisal with expectation together toward service quality. Interesting propositions among major propositions are "The quality that a consumer perceives in a service is a function of the magnitude and direction of the gap between expected service and perceived service" and

"Consumers typically rely on experience properties when evaluating service quality." Against some proposition from which SERVQUAL was developed, Cronin and Taylor (1992) named 'SERVPERF,' performance based simple measures of service quality without expectation aspects. If people have the highest or maximum level of expectation toward every aspect, it may be worthless to ask how much they expect. In Cronin and Taylor's (1992) results, simple performance measurement appeared superior in terms of explaining variation with less effort. In the service area, people can compare several service providers, then they might expect the highest ratings for each desirable aspect. Still the findings raise some questions. If consumers have built a relationship with a certain type of service provider and have built up expectations over time, the results might be different. Especially for the physical environment, people, the users of the space, have had cumulative experiences over longer periods. Although quality in other workplace environments might be the norm, the other environment cannot be substituted into the workplace of people who daily use and reside in their present employment environment. For instance, employees in offices have experiences and expectations based on their residency experiences in the physical environment. Other office environments can be their norm but employees rarely expect implausible features toward their work environment. However, this inquiry has been rarely explored in research related to the physical environmental features. Thus, it is valuable to investigate the gaps between perceived environmental features and expected environmental features by occupants.

This approach can tell whether cumulated experiences in an environmental setting affect expectations and appraisal of the environment. Measuring the gaps is

especially useful in managerial application. People can easily define which aspects are under expectation level and should be improved. Therefore, in order to measure the satisfaction of employees toward their workplace, it is useful to measure their expectations collectively.

CHAPTER III CONCEPTUAL FRAMEWORK & HYPOTHESES

This chapter proposes conceptual frameworks of this study regarding control and flexibility in workplace design and the interactive nature of physical environmental features. The conceptual frameworks are founded on the perspective of the Transactional theory and rest on the Lens theory, Stress and eclectic model.

Person-Environment Transactions-Environmental Probabilism Theory

The aim of transactional perspective is to re-compose the dichotomy between the person and the environment and suggest dynamic interaction and interdependence. As an environment influences a person, there is a simultaneous reciprocity of influence of the person on the environment (Bonnes & Secchiaroli, 1995). The transactional perspective (Ittelson, 1973; Stokols & Altman, 1987) to person-environmental relationships is to free from both perspectives, 'objectivist; environmental determinism' and 'subjectivist; environmental possibilism.' On the one hand, 'environmental determinism' assumes that the environment determines behavior absolutely, on the other hand, 'environmental possibilism' ascribes such a large role to individual choice that it is hard to make predictions regarding environmental influence in behavior (Bell, Fisher, Baum & Greene, 1990). Environmental probabilism (Porteus, 1977) assumes that while an organism may choose a variety of responses in any environmental situation, there are probabilities associated with specific instances of design and behavior. Environmental probabilism incorporates transactional perspective.

As office environments are integrated systems of people, activities, organizational and personal relationships and technology that take place in dynamic settings rather than static settings (Goodrich, 1982), the proposed models for this study have incorporated a perspective based on the environmental probabilism theory. The probabilistic model of behavior is a compromise. According to Sprout (1965), the probabilistic approach is appropriate for the problem of relating environmental factors to psychological behavior. Perceived physical environmental features affect states including values, preferences, attitudes, etc., and actions including choices, decisions, etc. The proposed models of the present study include both physical environmental characteristics and individual control aspects that illustrate an transactional interrelationship between the physical environment and the behaviors of users, rather than focusing on only absolute environmental effects on behaviors or on only a willingness to change the physical environments.

Brunswik's Lens Theory

This research adopted the Brunswik's lens model theory (1956), especially in the perception process. Brunswik's approach was applied to Stewart's (1987) study to develop an observer-based assessment of visual air quality. "Each of the stimuli emanating from the environment might be assigned a weight or probability based upon its usefulness in supporting accurate perception... Not only do certain environmental stimuli differ in their objective usefulness (ecological validity), but individuals may weight them more or less appropriately (cue utilization) because of past experience, personality or other differences.... Subsequent analysis may reveal that certain

individuals share similar weighting profiles or policies, a valuable insight that might have been overlooked by traditional average techniques (Bell et al., 1990, p32)".

There are some difficulties in dealing with physical environmental features as objective variables separated from human perception, not only because each element serves multiple functions but also because people appreciate the same objective features in different ways due to their perspectives, attitudes or norms.

Sundstrom (1986) stated that beyond the individual level of analysis, there is difficulty in proving direct relationships between the physical elements and group outcomes, and the discussion focuses on social, psychological and organizational processes and the ways in which they incorporate the environment rather than on the environment itself.

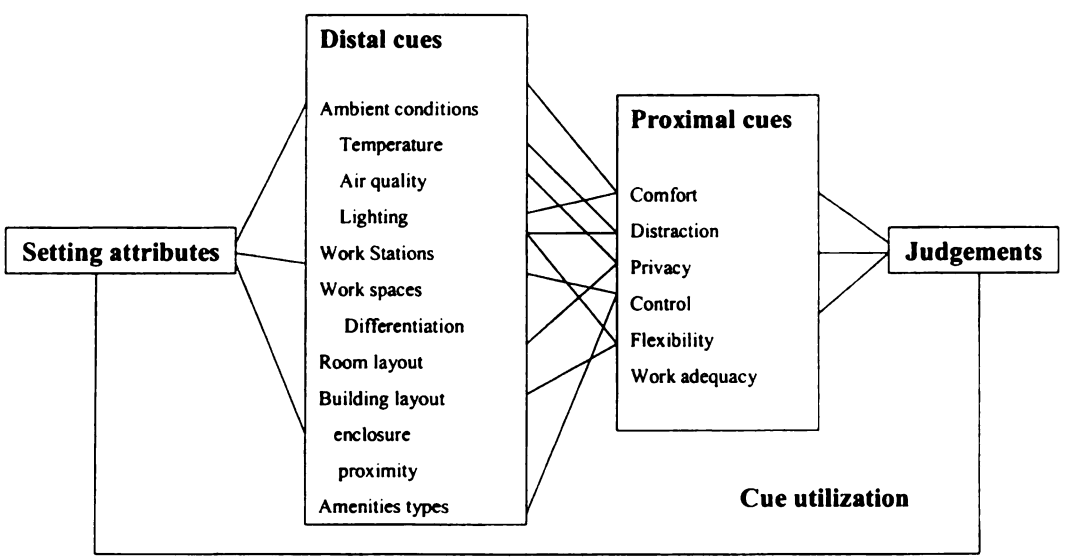
Marans and Spreckelmeyer (1982) hypothesized a model in which environmental and worker characteristics act jointly to affect inhabitants' perceptions of environmental quality. This theory can be applied to explain the importance of subjective attributes in workplace design and individual differences in weighting these attributes. Previous research has shown that users' subjective evaluations of the amount of space are a more reliable predictor of environmental satisfaction than the actual workspace floor area (Brill, Margulis & Konar, 1984; Marans & Yan 1989; Spreckelmeyer; 1993).

Research findings proved that perceptions of physical environmental conditions are strongly associated with objective physical environmental conditions. Block and Stokes (1989) found that how private participants thought their environments to be and the manipulated privacy condition are significantly correlated ($r=.74$, $p<.01$).

The importance of a study to investigate perception lies in the relationship between people's perceptions and other objective attributes. As an individual's perception or assessment of an environmental attribute is related to, but distinct from, the objective attribute, Marans and Spreckelmeyer (1982) conclude that the primary purpose of evaluating research is to explore such connections between specific environmental attributes and people's perceptions of them.

Therefore, this study investigates antecedents of latent factors of control and flexibility regarding the physical environmental features based on employee perceptions.

Figure 1. Brunswik's Lens Model



(Adapted from Bell, Fisher, Baum & Greene, 1990, p 32)

The Stress-Behavior Model and Moderating Process

Moderate or mediate models describe interactive relations, such as physical and psychological factors using two or more physical factors, or two or more psychological factors, which are altered by the presence of a second work environmental factor. Moderator is independent (i.e. slight or no correlation) from the predictor variables while

mediator is interdependent (e.g. correlated) in relation to the predictor and the mediator (Evans & Lepore, 1997). With the exogenous work factor, the antecedents can be either physical or psychological variables, and the mediating variables can be either physical or psychosocial work environments (Evans, Johansson, & Carrere, 1994). The role of control as moderator or mediator will be explored in this study. Evans and Lepore (1997) categorized four typical types of moderator functions: 1) the environment affects behavior in opposite ways for different levels of the moderator (crossover interaction), 2) the relationship between the environment and behavior is stronger (amplification effect) at one level of the moderator than at another level, 3) the relationship between the environment and behavior is weaker (attenuation effect) at one level of the moderator than at another level, and 4) the environment only has an effect in the presence of the moderator.

As a mediator, control plays a role in reducing the effects of environmental constraints. The effects of negative stimuli from the environment on human behavior are more emphasized in the Constraint model than in the Eclectic model by Bell and his colleagues (1990).

According to the behavior constraint model of environmental stimulation, excessive or undesirable environmental stimulation leads to arousal or a strain on the information-processing capacity (Proshansky, Ittelson, & Rivlin,1970; Rodin & Baum,1978). "Constraint" means something about the environment is limiting or interfering with things we wish to do. The model consists of three basic steps: perceived loss of control, reactance and learned helplessness. If people are exposed to unwanted stimuli and they perceive themselves as losing control over time, the ultimate

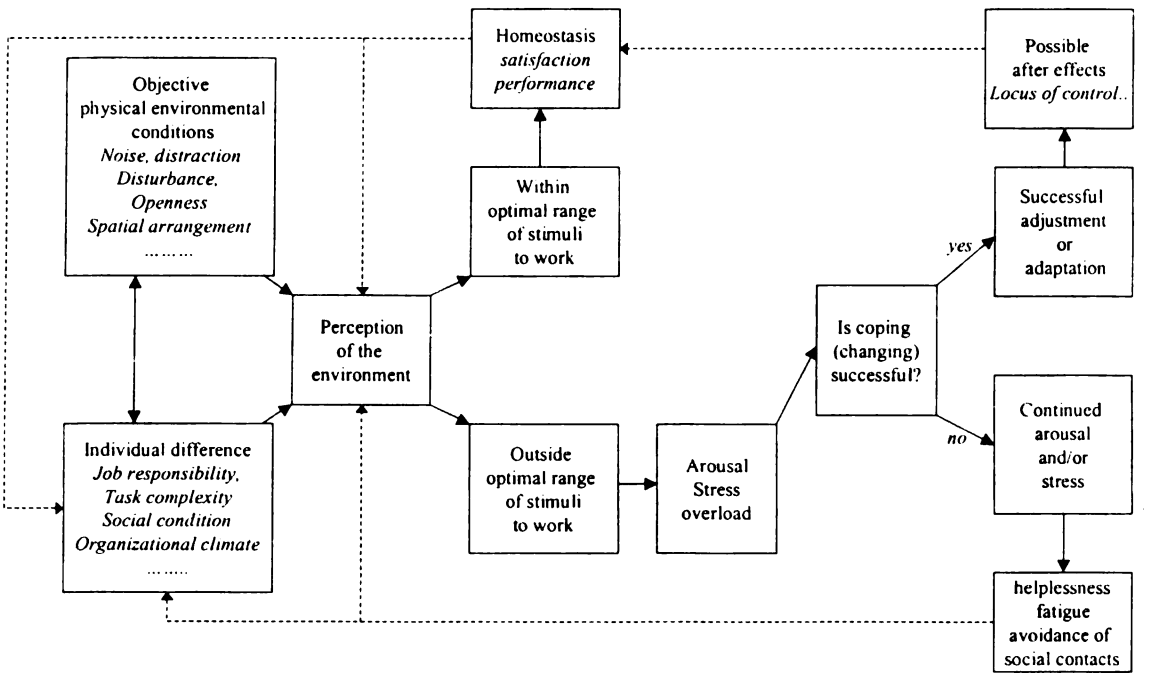
consequence of loss of control is learned helplessness (Bell et al., 1990). Behavior constraint models focus more on the side in which people's efforts to gain control over the constraints fail. But more complicated interrelationships are often present.

Stress can be defined in several dimensions. Roberts and colleagues (1997) explained stress in terms of a person-environment interaction. If a poor Person-Environment fit exists, this results in a strain, when environmental features surpass the individual capabilities, or the environment fails to provide the necessary resources to allow for successful performance of a required task. For instance, stress would rise, if a workplace that is too noisy, visually distracting, and open to frequent interruptions goes beyond the individual's capabilities to deal with the situation; or if a workplace that is poorly equipped, under illuminated, fixed, or unable to change its physical environmental features keeps the individual from performing effectively. In similar context, Paciuk (1989) defined environmental stress as disfunction between human needs and the resources and constraints afforded by the environment. She stated that when individual goals and expectation are frustrated by environmental conditions, stress may be a consequence if goals cannot be readjusted or sufficient resources allocated.

Bell et al. (1990) proposed an eclectic scheme of environmental-behavior relationships (see Figure 2). Their model is developed from several theories including constraint and stress theory, adaptation level theory to integrate the various mediating concepts that have been applied to environment-behavior relationships. Lantrip (1993) summarized that the essential point of the model is that people behaviors are ruled by the desire to satisfy needs rather than any direct influence of the environment in which their desire may be momentary, periodic or long term goals.

As applied to the work environment, this model explains how people perceive their workplace, how they deal with environmental stress or constraints, and how they lead to satisfaction and desirable performance. Homeostasis status may be very short or be relatively stable. The important thing is that the workplace condition needs to provide options or means so that employees easily cope with stressors and inhibitors of doing work by adjusting, modifying or changing their environmental conditions.

Figure 2. Eclectic Model of Environmental Stress in the Workplace



(Adapted from Bell, Fisher, Baum & Greene, 1990, p123)

In this study, perceived loss of control depends on either/ both the degree of control the individual possesses or perceives to have or/and the degree of unwanted environmental stimuli, for example, distraction. If people have a high degree of control over their environment, their reactance efforts will more likely be successful. However,

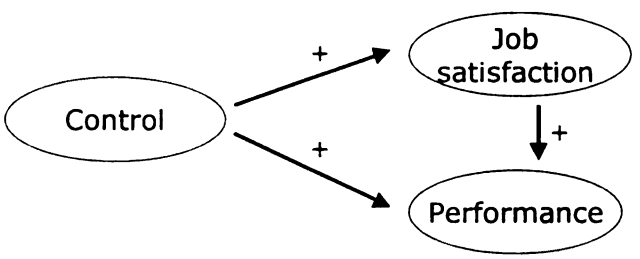
if they have a low degree of control over their physical environment and experience a high level of distraction, they are more likely to feel helpless.

Based on the theoretical background and literature review, conceptual frameworks and hypotheses for this research are proposed.

Models of Control in the Workplace

The direct effects of control in the workplace on employee's job satisfaction and performance are shown in Figure 3.

Figure 3. Effects of Control on Job satisfaction and Performance



Based on this conceptual framework, the following hypotheses are proposed.

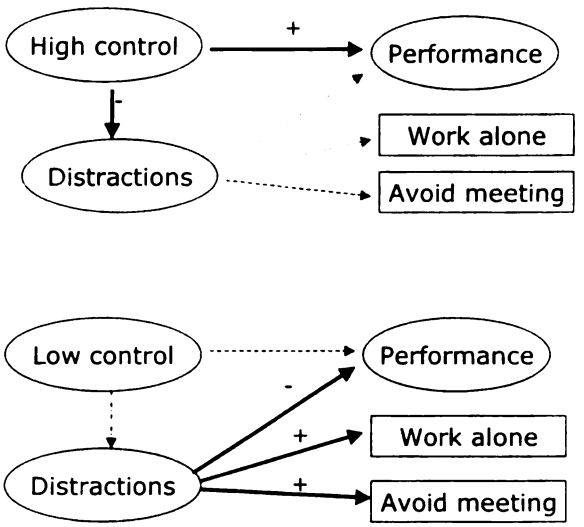
H1a: Control over the physical work environment is positively related to job satisfaction.

H1b: Control over the physical work environment is positively related to perceived performance.

The moderating effects of control on work outcomes and its intervening influence over the relationship between negative environmental sources and work outcomes are proposed in the conceptual framework shown in Figure 4. If employees possess a high degree of control, the negative effects of distraction on performance, retreat or social

withdrawal will be less significant. However, if employees possess a low degree of control, the negative effects of distraction on performance, retreat, or social withdrawal will be substantial. The consequence of negative physical environmental features such as over-crowdedness is social withdrawal (Oldham & Fried, 1987). If employees experience distractions with a low degree of control, it is expected that they would be more likely to avoid meeting people or will want to work alone. In the proposed model, according to the level of control, the path relationships are expected to be different. Based on the proposed model, hypotheses are proposed.

Figure 4. Model of Control, Distraction and Performance



H2: Control over the physical environment and work is negatively related to distractions.

H3a: Perceived distraction levels in the workplace are negatively related to perceived employee performance.

H3b: Perceived distraction levels in the workplace are positively related to an employee's inclination to work alone.

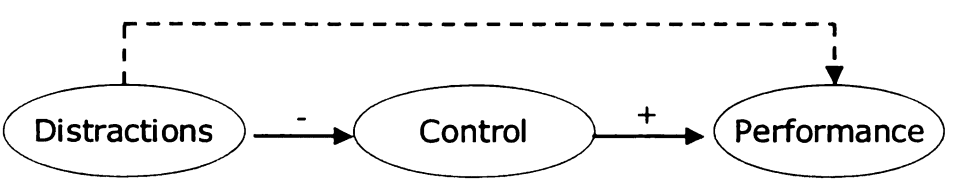
H3c: Perceived distraction levels in the workplace are positively related to an employee's inclination to avoid meeting people in the workplace.

H3d: An employee's inclination to avoid meeting people in the workplace is positively related to an employee's inclination to work alone.

H4: There is a difference in terms of effects of distraction on performance between the high control group and the low control group.

To further examine the mediating role of control, the following path model is tested. In a causal relationship among X (independent variable), Y_1(mediating variable), and Y_2 (dependent variable), if a researcher constrains the path coefficient for $X \rightarrow Y_2$ to zero and overall fit of this constrained model is not appreciably worse than one with $X \rightarrow Y_2$ as free parameter, then the hypothesis on mediated relation is supported (Kline, 1998, p132). It was found that noise was not negatively associated with performance (Sundstrom et al, 1994). And this might be due to the mediating role of some other variables in workplace. The effects of distraction on performance might be mediated by control (see Figure 5). Based on this assumption, the following hypothesis is proposed. Two comparable path models are to be tested.

Figure 5. Mediating Role of Control



H5a: Control plays a mediating role in the relation of distraction to performance.

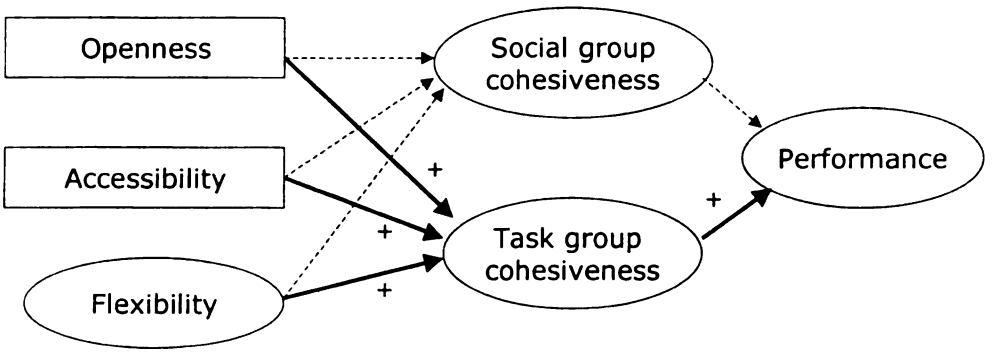
Block and Stokes (1989) proposed that the distinct personality of individuals may affect satisfaction with one's workplace. They hypothesized that introverts would be more satisfied in a private closed setting than extroverts. The hypothesis was not supported. Self-rated sensitivity to noise was found to be significantly related to distraction (Kjellberg, Landstrom, Tesarz, Söderberg, & Akerlund, 1996). Similarly, in this study, according to employee work styles, there might be a difference in reaction toward quietness/noise, or distraction. Therefore, it was hypothesized that there is a difference in the path model according to solo work style.

H5b: According to the individual work style, there is a difference in the relationship between distraction, control, and performance.

Models of Flexibility in Workplace Design

Flexible use of space and furniture arrangement enables employees to accommodate multiple activities including impromptu meetings, and to rearrange or adjust their workplaces. This flexibility is expected to increase interactions and result in better communication and higher task group cohesiveness. The degree of openness or enclosure is expected to affect the opportunity for interactions and communications. The degree of accessibility is expected to increase communication. Since social group cohesiveness is a measure of social relationships among colleagues outside of the workplace, it is expected to have no relationship with flexible physical workplace features. The relationships between the physical environmental characteristics and group cohesiveness (task cohesiveness and social cohesiveness) are described in the conceptual framework in Figure 6.

Figure 6. Effects of Flexibility on Group Cohesiveness



Based on assumptions from the conceptual framework, the following hypotheses are proposed.

H6a: Flexibility in workspace use is positively related to task group cohesiveness.

H6b: The degree of openness in the workplace is positively related to task group cohesiveness.

H6c: The degree of accessibility in the workplace is positively related to task group cohesiveness.

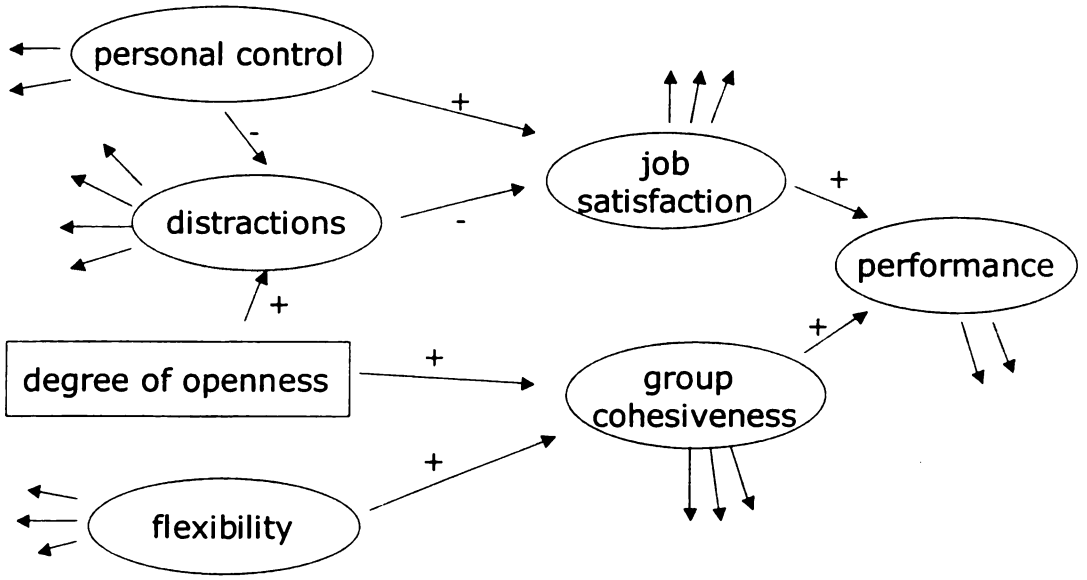
H7a: Flexibility in workspace use is not related to social group cohesiveness.

H7b: The degree of openness in the workplace is not related to social group cohesiveness.

H7c: The degree of accessibility in the workplace is not related to social group cohesiveness.

The interactive process between physical environmental features and employee's work outcomes in a workplace setting is proposed in the following figure.

Figure 7. Model of Effects of Control and Flexibility in the Workplace



Although openness is believed to increase interaction, it was also found that openness and accessibility were positively associated with disturbances (Hedge 1982; Brennan, Chugh & Kline, 2002). Each path will be tested based on the whole model. Additional hypotheses are the following.

H8a: Degree of openness is positively related to distraction.

H8b: Distraction is negatively related to job satisfaction.

H8c: Job satisfaction is positively related to perceived performance.

H8d: Task group cohesiveness is positively related to perceived performance.

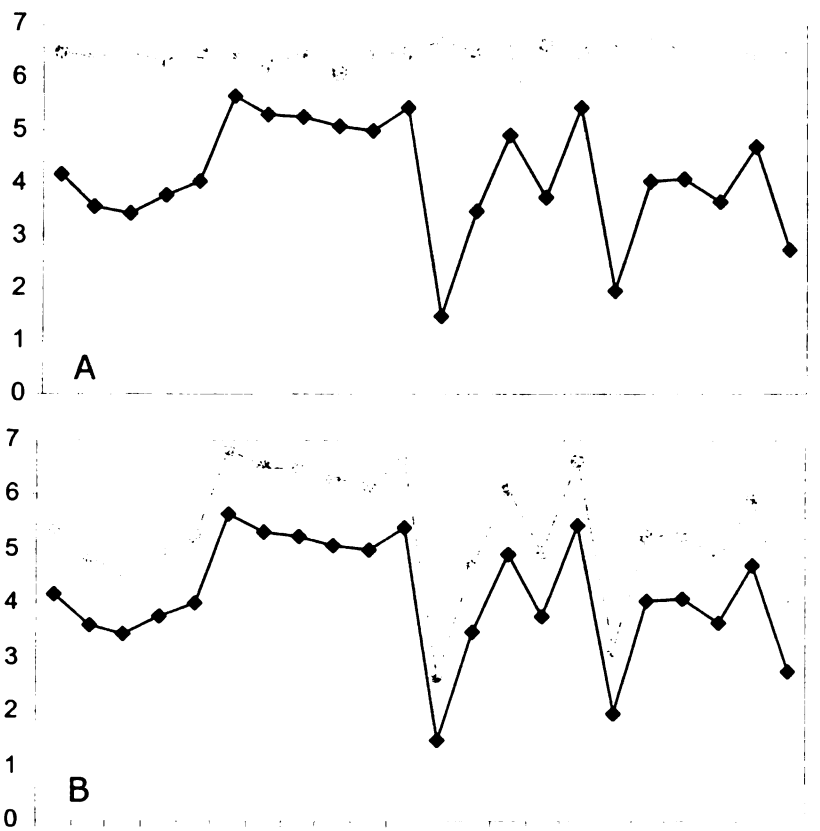
Gaps between Perceptions and Expectations

Satisfaction with the physical work environment might consist of several features such as control, flexibility, and work space adequacy. If satisfaction means confirmation or disconfirmation of user's expectations, the gap between the perceived physical

environmental features and the expected physical environmental features, it is more appropriate to measure satisfaction than just the perception level.

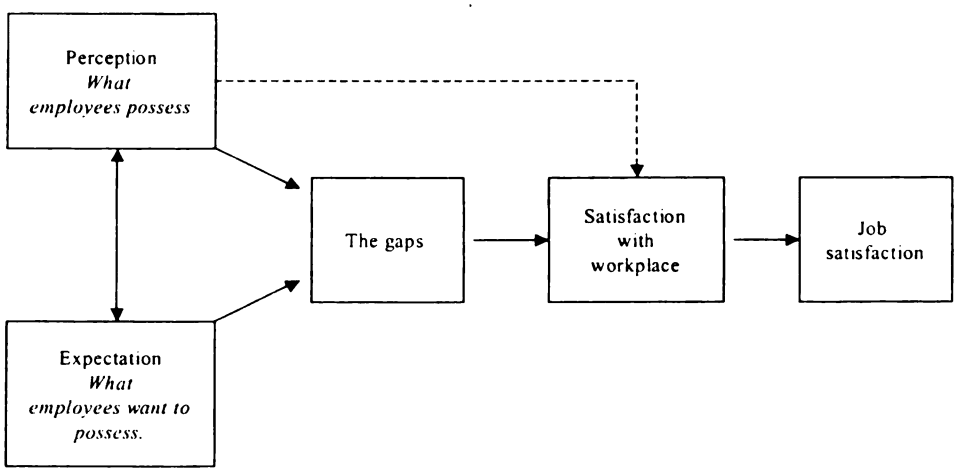
If people have a maximum level of expectation across the variables (fictitious case A, see Figure 8), it is of no use to ask their expectations with perception levels according to physical environmental features because the gaps reflect the perception variations. If people have consistent gap between what they perceive and what they think they should have (fictitious case B, see Figure 8), it is also useless to measure their expectations since the gaps are consistent with physical environmental features. The assumption of this study is that people possess various expectation levels toward physical environmental features since they have cumulative experience in the physical environment.

Figure 8. Gap Patterns between Perceptions and Expectations



Therefore, this study proposes that people have different expectation levels according to variables based on their experiences in the workplace. The gaps are expected to be better indicators of work environment satisfaction. A conceptual diagram is shown in Figure 9.

Figure 9. Relationship between Perception and Expectation in Satisfaction



Based on these assumptions, the following hypotheses are proposed.

H9a: Gap measures between the perceived environmental features and the expected environmental features are stronger predictors in explaining environment satisfaction and job satisfaction than perception based measures.

H9b: Satisfaction with the physical environment is positively related to job satisfaction.

CHAPTER IV METHODS

This section presents the research design, sample selection and data collection followed by instrument development procedure. Techniques for data analysis for testing hypothesis and for estimating the proposed models are also discussed. In order to carry out the objectives of this research most effectively, questionnaires were used in natural workplace settings with cross-sectional design.

Sample

The employee population used in this study was limited to office workers in headquarter facilities or office settings. The industry type is manufacturing and manufacturing related. Manufacturing organizations were selected since as products become more sophisticated and competition demands variety, frequent changes occur in effective distribution systems that deliver physical products, service and knowledge. Therefore, knowledge teams are necessary in product design and process design even in the service industry (Lee, Amundsen, Nelson & Tuttle, 1997). By limiting the workplaces to headquarter and general office settings, the differences in activities and demands on employees were reduced. All companies participating in this study are located in Michigan, U.S.A.

In order to get background information regarding the physical conditions, the researcher contacted a site administrator or a facility manager and visited facilities. Information on the physical aspects of the office buildings such as the built year of the building, the size of the facility, the history of renovation, the distribution method of HVAC systems, and workstation specifications were collected.

According to company size, workplace strategies appeared different. Smaller, and start up firms seek minimal renovation, open-plan designs, aesthetics of flexibility, and diversity in the workplace portfolio (Becker, 2002). The criteria are not clear in judging company size as small or large. Small companies are expected to have different and unique qualities and it would be difficult to get an appropriate number of subjects for this study from small companies. Therefore, the subjects in this study are in companies with 150 or more office employees.

Instrumentation

A structured questionnaire[5] was developed. It included questions that were adapted or directly used from the existing questionnaires developed by other researchers cited in this study. Some items were developed and added based on the literature review because there is a lack of empirical research that has determined factor structure of the detailed physical work environment (Carlopio, 1996). Questionnaires were pre-tested with small groups of people to ensure that participants would clearly understand the questions. In order to measure expectation, the measurement items were re-worded from the measurement of perception.

Work environmental characteristics and job characteristics were also included. Work environmental characteristics included workspace type, a measure of the degree of openness, completely open or more typically a full partition, and the degree of shared space for teamwork or other common shared uses, and workspace adequacy. Workspace types included private closed (four walls to ceiling; door), individual open and high (>54

[5] In reviewing previous studies related to physical aspects of office environment, there are few cases to report discriminant or convergent validity of questionnaire items and factors.

inch) panels/cubicle, individual open and low (<54 inch) panels/cubicle, and completely open (no partitions). In previous studies, openness was sometimes seen as related to the presence or absence of visual and/or acoustic barriers within a space, as well as a more subjective sense of enclosure (Marans & Spreckelmeyer, 1982). Openness was defined to be the overall openness or the ratio of total square footage of the office to the total length of its interior walls and partition (Oldham & Rochford, 1983; Brennan et al, 2002), or was measured by the number of workers within the room (Canter, 1972). In this study, openness refers to how much people perceive their workplaces to be open. Workspace type (workspace surrounded by walls or high partitions, or workspace surrounded by lower or no partition) was also classified. Additionally, workspace adequacy was measured. Workspace adequacy included features such as adequacy of size aspects of workstations and adequacy of storage areas, and quality of tools and equipment. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree").

Job characteristics consisted of the degree of individual or teamwork and the degree of complexity of the employee's job. The degree of complexity of employee's job is expected to be an intervening variable in relationships between control and distraction and between distraction and performance. Complexity of the job was measured in several studies (Sundstrom, Town, Brown, Forman, & McGee, 1982; Block & Stokes, 1989).

Measurements of propensity related to 'retreat' were developed for this study to measure reactions or negative effects of distraction and the effects of loss of control. Retreat refers to either the degree to which employees want to work alone or work in an

enclosed area, or the degree to which employees want to avoid meeting colleagues. Items were measured on a five-point Likert-type scale ("1=never to 5=always").

For other major variables, operational definitions follow:

1) **Control** refers to the degree to which employees perceive the amount of control they have over their environmental characteristics. Control factors consist of control over the physical environment and control in the work schedule, work tasks, the amount of timing, etc. Control over the physical environment deals with determination of one's own workstation organization, personalization, social contact, temperature, and lighting. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree").
2) **Distraction** refers to the degree to which the employee feels distracted, disturbed or irritated by negative and unwanted sources within the workplace environment. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree").
3) **Flexibility** refers to the degree of flexible use of the workplace. It includes convertibility (being flexible enough to adjust, rearrange or reorganize), versatility (multiple functions or multi purpose), general flexibility and movable systems. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree").
4) **Job satisfaction** is the degree to which respondents are satisfied with their jobs. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree").

5) **Group cohesiveness** refers to the degree to which employees share organizational goals or tasks (task group cohesiveness), or how well social relationship among colleagues (social group cohesiveness) are developed and maintained. Items were measured on a seven-point Likert-type scale ("1 strongly disagree to 7 strongly agree"). Group cohesiveness was measured by eight variables developed by Carless & DePaola (2000).

6) **Performance** is the degree to which respondents felt they performed their work well including quality, quantity and creativity aspects. Items were measured on a five-point Likert-type scale ("1=never to 5=always"). The dimensions of worker performance were drawn from Oldham's (1988) study.

As the purpose is not to compare the mean of the variable but to use variance to see the relationships, different scales were employed for this study. Using different scales might contribute to decrease of the multicollinearity among factors. Table 3 is provided to show variables of latent factors and sources.

Data Collection

A requesting cooperation letter and follow-up call, or a requesting cooperation e-mail, was sent to a human resource manager or a facility manager in each headquarter or general office division of several organizations in the selected type of industries. A list of organizations was developed from the employer list of the Lansing Chamber of Commerce, the local stock interest listings in the Lansing State Journal, a list from the Troy the Chamber of Commerce, and the IFMA (International Facility Management Association) Michigan directory.

Table 3. Work Environmental Dimensions and Attributes

Dimensions	Attributes
Job characteristics	When I'm at the office, I work alone rather than in workgroups or teams.
	My job requires a lot of cooperative work with others.
	My work is simple and demands little concentration.
	My work requires deep thoughts and concentration.
Retreat	I would like to work alone.
	I often avoid meeting people in my workplace.
Workplace characteristics	I share common work areas with others
	My workplace has been moved within my office.
	My workplace has been moved between offices.
	My workplace is open enough to see my colleagues working.
	I am able to be easily accessed from my colleague's workstation.
Workspace adequacy (Zalesny & Farace, 1987)	My workstation is large.
	I have ample storage in my work area.
	The quality of my equipment is more than sufficient to work effectively.
Control (Ganster, 1989; Brennan et al, 2002)	I am able to personalize my workspace.
	I am able to control temperature or airflow in my office.
	I am able to determine the organization/appearance of my work area.
	I am able to control the lighting level in my workstation.
	I am able to control the social contact with others around me.
	I am able to determine the scheduling and duration of rest breaks.
	I am able to control the amount and timing of contact with other people including co-workers or clients.
	I am able to choose among available methods to complete my tasks.
	I am able to determine the order in which tasks are completed.
Distractions (Sundstrom et al., 1982; Hedge, 1982; Brennan et al, 2002)	My workplace provides an undisturbed environment so that I can concentrate on my work.
	I am easily distracted from my work.
	My work environment is quiet (R).
	I am able to have quiet and undisturbed time alone (R).
	My work area has many visual distractions.

Continued

Dimensions	Attributes
Flexibility	My furniture is flexible enough to adjust, rearrange, or reorganize my workspace.
	I have informal and impromptu meeting in my private workstation*.
	My furniture is fixed system (R).
	My workplace serves multi-purpose functions for informal and instant meeting.
	In general, my workspace is flexible.
Job satisfaction	If I had it to do over, I would choose to work here again.
	Generally speaking, I am very satisfied with my work.
	I would consider taking another job.
	I would recommend my job to a friend who was qualified and looking for work.
Task group cohesiveness (Carless, & DePaola, 2000))	My colleagues are united in trying to reach its goals for performance.
	My colleagues have conflicting aspirations for the group work performance (R).
	My work group does not give me enough opportunities to improve my personal performance (R).
	I am unhappy with my group's level of commitment to the task (R).
	I communicate effectively with my colleagues within the office.
Social group cohesiveness (Carless, & DePaola, 2000)	My colleagues would like to spend time together outside of work hours.
	My colleagues would rather go out on their own than get together (R).
	My colleagues do not stick together outside of work time (R).
Performance (Oldham, 1988)	My work is of high quality.
	I make mistakes or errors(R)*.
	I can accomplish a great deal each day
	I do a large amount of work each day.
	My work outcome is creative

* The variable was excluded later based on the reliability test results.

Through web search, approximate size and industry type were checked. During the initial contact, it was determined if a company wanted to participate in the study, and

if the organization was appropriate for the research by asking the number of office employees.

If the company declined to participate, it was deleted from the list of possible research subjects. If the organization agreed to participate and the workplace characteristics fit the research purpose, the researcher and a site administrator[6] decided on the number of participants, and set up administrative dates for distributing questionnaires.

Three companies that fit the profile agreed to participate in the study. According to available resources, some organizations wanted to do web surveys using their own company's web site to get higher response. If a company wanted to do a web survey, an e-mail linking a web survey site was distributed to randomly selected employees. If a company wanted to do a written paper survey, questionnaires were distributed to each employee allowing each to return the questionnaire to a designated internal mail address or mail box. Employees were given three weeks to return their responses. Employee participation was voluntary. Participants were told that the study was designed to examine their perceptions and expectations of their physical workplace and to assess the degree to which they agree or disagree with the questionnaire statements (see Appendix A). They were also told that their responses would be anonymous and confidential.

Data Analysis

Basic descriptive statistics were conducted using SPSS. Multivariate analysis was conducted using SPSS 11.5 and LISREL 8.54. To find the direct effects of control, regression analysis was conducted. In order to examine the multiple relationships simultaneously, Structural Equation Modeling (SEM) was conducted. Statistical

[6] According to organization, a site administrator is a human resource manager or a facility manager.

techniques including multivariate data analysis techniques, except for SEM, can examine only a single relationship at a time (Hair, Anderson, Tatham, & Black, 1998). Only a few studies (Ferguson & Weisman, 1986; Lantrip, 1993; Carlopio, 1998; Brennan, Chugh, & Kline, 2002) examine multiple relationships regarding the physical environmental features simultaneously using SEM. Underlying the problems in research related to office environments, Donald (1994) discussed how the emphasis on quantitative research has led to an imbalance with little insight or in-depth understanding of meaning and experience as felt by those using it. In practice, the research has presented a great number of variables independently rather than attempting to develop holistic models (Donald, 1994). All too often, a large amount of research is faced with a set of interrelated questions that have managerial and theoretical importance.

To overcome this limitation, it is necessary to incorporate quantitative studies that can deal with multiple relationships. SEM can provide a straightforward method of dealing with multiple relationships simultaneously while providing statistical efficiency, assess the relationships comprehensively, and provide a transition from exploratory to confirmatory analysis (Hair et al., 1998). Therefore, it will provide for the more comprehensive relationships regarding the impact of the general features of the physical workplace environments, including the effects of control and flexibility.

LISREL (Jöreskog & Sörbom, 1989, 1996) is a SEM software program with EQS (Bentler, 1995) and AMOS (Arbuckle, 1997). The Lisrel model has two parts: the measurement model and structural equation model. The measurement model specifies how latent variables or hypothetical constructs depend on, or are indicated by, the observed variables, and describes the measurement properties (reliabilities and validities)

of the observed variables. The relationships among the observed variables, as defined by sample data, are represented by a covariance coefficient (or it can be computed using correlation coefficients with standard deviations). The structural model specifies the causal relationships among the latent variables, describes the causal effects, and describes the amount of variances that remains unexplained by the model (Jöreskog & Sörbom, 1996).

According to Hair et al. (1998), SEM is particularly useful when one dependent variable becomes an independent variable in subsequent dependent relationships. The transition from exploratory to confirmatory analysis corresponds to greater efforts in all field of study toward developing a more systematic and holistic view of problems.

Therefore, confirmatory factor analysis will be conducted to test the constructs. Using Structural Equation Model, the proposed models and hypotheses are also tested.

Before evaluating the structural or measurement model, the researcher must evaluate the overall fit of the model to ensure that the model represents the entire set of causal relationships well (Hair et al., 1998).

According to Bagozzi and Yi (1988), preliminary fit criteria are 1) absence of negative error variances, 2) absence of error variances not significantly different from zero, 3) absence of correlation greater than one, 4) absence of correlation too close to one, 5) absence of factor loading too small (e.g. < about.5) or too large (e.g. >.95), and 6) absence of very large standard errors. Overall model fit is the achievement of the following; 1) nonsignificant χ^2 (e.g., χ^2 with p-value ≥.5), 2) adequate statistical power of - χ^2 test, 3) satisfactory goodness of fit index, 4) low root mean square residuals, 5)

linear Q-plot of normalized residuals with a slope greater than one, 6) satisfactory critical N, and 7) satisfactory ratio of sample size to number of free parameters (i.e., ratio ≥5:1).

To measure the goodness of fit of a model, several indices are used. The criteria for the goodness of fit are slightly different from one to the other.

A chi-square (χ^2) is a likelihood ratio statistic for testing a hypothesized model against the alternative that the covariance matrix is unconstrained. χ^2 -measure is sensitive to sample size. χ^2 /*df* is a good indicator of fit with large samples. A frequent suggestion is that χ^2 /*df*, the ratio be less than 3 (Kline, 1998), or the range 2-3 is an "adequate" fit (Wheaton, Muhten, Alwin & Summers, 1977). The smaller, the better it is. When using the χ^2 -measure in comparative model fitting, a large difference (drop) in χ^2 -measure, compared to the difference in degrees of freedom, indicates that the changes made in the model represent a real improvement (Jöreskog & Sörbom, 1996).

Goodness-of-fit measures the correspondence of the actual or observed input (covariance or correlation) matrix with that predicted from the proposed model. Values of index theoretically range from 0 (poor fit) to 1 (perfect fit). If goodness of fit index (GFI) is .9, it is considered an "acceptable" fit (McDonald & Ho, 2002).

Another widely used index is RMSEA (root mean square error of approximation). Research reporting the results with RMSEA rely on a RMSEA of less than .05 corresponding to a "good" fit and a RMSEA of less than .08 corresponding to an "acceptable" fit (McDonald & Ho, 2002).

In summary, goodness of fit measures concerns the assessment of the overall fit of the model to the data. However, a researcher should be cautious going from model specification to data, analysis, respecification and interpretation. Good fit indices alone

do not always mean that the model is proved. Kline (1998) recommended that such a complex statistical procedure as SEM use must be guided by reason, and that researchers must be careful not to modify only for the sake of improving fit.

CHAPTER V RESULTS

This chapter reports the results of the statistical analysis and hypotheses testing and discusses these findings. The first part describes demographic characteristics, job activities of participants and facilities characteristics. The following part presents the results of hypotheses testing and model testing with discussions.

Demographic Characteristics

A total of 409 questionnaires were collected: 203 from organization 'A', 158 from organization 'B', and 48 from organization 'C'. For Corporation 'A', a web survey was conducted in response to a request by the site administrative team because the organization has previously had a low response rate to paper surveys. The response rate to the web survey was 18.4 %. For Corporation 'B' and 'C', paper surveys were conducted with response rates of 37.6 % and 40% respectively. After deleting cases that had missing variables, 384 responses were analyzed for this study.

The demographic characteristics of the sample are shown in Table 4.

Table 4. Summary of Sample Characteristics

Characteristics		%
Gender	Male	62.5
	Female	37.5
Age	Under 25	4.0
	25-34	24.8
	35-44	35.2
	45-54	28.6
	55-65	7.4
Education	High school	10.6
	College degree	53.6
	Master's degree	32.9
	Higher degree than master's	2.9

Sixty-five percent of the respondents were male. The age group of 35-44 was the largest. Most respondents (89.4 %) possessed a college degree or higher. Compared to U.S. Census Bureau statistics (2001), the educational level of the sample was much higher and the majority age group was similar (35-54). However, in such a large corporate environment, the education level may be in normal range.

Work Activities

The job responsibilities of respondents are shown in Table 5. Twenty-eight percent of the respondents were extensively involved in engineering ("1" no involvement to "7" extensive involvement). Marketing or sales was the second largest category (12.8 %) in which respondents were extensively engaged. Managers were involved in more than three types of job responsibilities, e.g., human resources, finance, engineering, strategic planning. Other responsibilities are related to legal, project management, clerical support, and other functions.

Table 5. Summary of Job Responsibilities

	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	Total (%)
Marketing/sales	63.4	8.9	4.7	2.4	5.5	2.4	12.8	100
Engineering	46.3	6.1	2.9	3.1	7.9	6.0	27.7	100
Operations	56.2	5.8	8.9	10.0	9.7	5.2	4.2	100
Human resources	67.7	11.6	6.6	6.6	2.6	2.1	2.9	100
Finance/accounting	57.1	8.6	12.6	6.8	1.6	2.6	10.7	100
Purchasing	67.0	11.8	9.9	6.5	2.4	2.1	0.3	100
Research/development	52.5	10.8	10.2	7.6	6.6	6.0	6.3	100
Strategic planning	50.1	7.6	7.3	9.4	8.2	8.4	8.9	100
Other	.4	71.7	0.4	0.7	0.7	1.9	23.4	100

1: No involvement
7: Extensive involvement

The characteristics of work activities are presented in Table 6. More than half of the respondents replied that they worked in teams (58.4%). Fifty-two percent of respondents indicated that their jobs required a lot of cooperative work. Coincidently, a majority of them indicated that they often worked alone rather than in groups or teams. These results indicate the necessity of balancing working alone and working in groups in their workplace. Most of the respondents were engaged in more complex activities, which required concentration. Forty-one percent of respondents never or rarely shared common work areas. Sixty percent of participants did teleconferencing sometimes or more frequently.

Table 6. Summary of Characteristics of Work Activities.

	Never (%)	Rarely (%)	Sometimes (%)	Often (%)	Always (%)	Total (%)
When I'm at office, I work alone rather than work in group or team.	.5	4.4	35.9	51.0	8.1	100
My job requires a lot of cooperative works	.5	3.4	24.0	51.3	1.0	100
My work requires deep thoughts and concentration.	.1	3.1	23.4	54.4	18.0	100
My work is simple and demands little concentration.	37.0	47.9	10.4	3.6	1.0	100
I share common work areas with others.	13.5	27.6	27.3	17.2	14.3	100
I do teleconferencing.	20.8	19.0	27.6	29.2	3.4	100

Facilities Characteristics

The researcher visited each facility to collect general facility information. With demographic information, facility characteristics are important to understand physical

environmental characteristics where employees work. The size of the facilities indicated in Table 7 only the office workplace, not the manufacturing facilities of the corporations studied.

Table 7. Summary of Facilities Characteristics

	'A'	'B'	'C'
Business	Auto and auto parts	Chemical products	Textile products
Built year	1925	Building 1: 1982 Building 2: 1974	1953 (owned)
Location	Urban	Rural	Urban
Hours of operation	6 a.m.-6 p.m.	7 a.m.-6 p.m.	8 a.m.-5 p.m.
Size of facility Gross sq.ft. (GSF) Rentable sq.ft. (RSF) Usable sq.ft (USF).	GSF: 598,000 RSF: 471,500 USF: 439,500	Building 1: GSF: 136,835 RSF: 125,044 USF: 97,384 Building 2: GSF: 119,808 RSF: 109,970 USF: 88,944	GSF: 28,171
Number of employees	1,176 (designed to have 2460)	Building 1: 220 Building 2: 323	170 (1200 trainees)
History of renovation	New furniture systems (1990)	Building 1 new carpet and some furniture	Office, bathroom, public areas (1983-1986)
HVAC system	Central (steam)	Central	Central
Lighting	General Task lighting	General (direct) Task lighting	General (direct) Task lighting

The building of Corporation 'A' is a one story building built in 1925. The original building was expanded, while maintaining the original façade and entrance hall. The whole area was designed for 2,460 occupants but 1,176 employees occupied it when this study was conducted. One building of Corporation 'B' consisted on three stories; its basement was connected to that of the second building and other buildings in the complex.

The 'Building 2' of Corporation 'B' had four stories. Corporation 'B' has been updating office furniture. The office furniture and arrangement were slightly different by floor. Corporation 'C' was housed in a one story building, connected to its manufacturing areas. Other small office buildings were scattered around the building. Different from the other two buildings, private closed offices and open offices were provided together.

The average space per occupant (gross square footage per occupant) was 243, 112, 51, and 165 respectively for each building. For headquarters or offices, the means of gross square footage per occupant were 399 and 456 based on the IFMA benchmarking report (IFMA, 1997). Thus, all buildings in this study had high utilization rates. None of buildings provided local unit controls for heating and ventilation.

To investigate differences in office type by job type, cross-tabulation analysis was conducted. As presented in Table 8, an open office with high partitions was the dominant type (74%) of the various office types investigated in this study. In comparison, according to the IFMA benchmark report, the ratio of open plan to private office is 1.7:1 (IFMA, 1997).

In this study, based on cross tab analysis, office type was differentiated by job categories (χ^2=23.368, df=9, P=.005). Depending on the organization, obviously different office types were provided according to job type. For Corporation 'A', there was no difference (χ^2=3.274, df=6, P=.774). Regardless of job type, an open office with high partitions was the dominant workplace in the organization (83.3%). For Corporation 'B', there was a significant difference in office type by job category (χ^2=21.4, df=9, P=.011). Clerical employees had open offices without high partitions while employees in other categories reside in open offices with high partitions. Organization 'C' showed no

difference in office type with respect to job type (χ^2=9.715, df=9, P=.374). Organization 'C' had fewer participants, which may have contributed to the non-significant result.

Table 8. Office Type Arrangement by Job Type

		Clerical/ Support	Engineer/ Professional	Manager	Other	Row (%) Total (%)
Private closed	N	4	10	8	2	24
	row (%)	16.7	41.7	33.3	8.3	100.0
	column (%)	8.0	4.5	8.8	12.5	6.4
Open individual high	N	27	174	68	10	279
	row (%)	9.7	62.4	24.4	3.6	100.0
	column (%)	54.0	79.1	74.7	62.5	74.0
Open individual low	N	14	33	12	4	63
	row (%)	22.2	52.4	19.0	6.3	100.0
	column (%)	28.0	15.0	13.2	25.0	16.7
Open	N	5	3	3	0	11
	row (%)	45.5	27.3	27.3	0	100.0
	column (%)	10.0	1.4	3.3	0	2.9
		50	220	91	16	377
	Column(%)	13.3	58.4	24.1	4.2	100.0
	Total(%)	100.0	100.0	100.0	100.0	100.0

As horizontal organizational structure becomes popular, workplace design has reflected this trend by having few differences in office type and design regardless of job type. In this study, it was to difficult to determine if various job types and their corresponding workplaces followed this trend. However, according to functions and job requirements, different strategies for workplace type are generally required.

Effects of Control on Job Satisfaction and Perceived Performance

The contribution of independent variables of control to the dependent variable of job satisfaction was examined using linear regression analysis in order to test the proposed hypothesis.

H1a: Control over the physical work environment is positively related to job satisfaction.

Nine variables, including control over works and control over physical environmental features were entered. The standardized and unstandardized regression coefficients are presented in Table 9.

Table 9. Regression Analysis of Effects of Control on Job Satisfaction

Independent variables	B	β	T	P	R^2
Constant	2.021				
Personalization	.085	.111	2.086	.038*	
Temperature/airflow control	.017	.014	.292	.770	
Organization/appearance control	.080	.120	2.275	.023*	
Lighting control	-.044	-.074	-.1535	.126	.207
Social contact	.124	.184	3.404	.001**	.187[a]
Scheduling and duration	.051	.080	1.604	.110	
Control contacts	-.034	-.046	-.859	.391	
Choice among available methods	.148	.180	3.452	.001**	
Determine order	.121	.135	2.702	.007**	

* $p<.05$, ** $P<.01$ [a] = adjusted R^2

The model was significant at the .01 level, [F (363 , 9)=10.501, p=.000], rejecting the null hypothesis. Five of the nine independent variables were significant at the .05 level of probability. Thus, hypothesis H1a was supported. The squared multiple correlation (R^2) was .207 with an adjusted R^2 = .187. The linear combination of nine variables accounted for 20% of the variance in the overall job satisfaction. Consistent with previous findings, work control was a predictor of job satisfaction. Control features with respect to work activities were stronger predictors of job satisfaction than control over physical environment features. For physical features, personalization and determination of organization and appearance of the workplace were predictors of job

satisfaction. 'Being able to control social contact (place oriented)' was a predictor of job satisfaction while 'being able to control over the amount and timing of contact (work oriented)' was not. Among variables of work control, choice among available methods was the most important predictor.

There was no evidence of serious multicollinearity. All VIF (Variance Inflation Factor) were below 2, which was much lower than 10, and tolerance values were above .7, which was much higher than .10 (Cohen, Cohen, West, & Aiken, 2003, p423).

The assumptions of linear regression analysis were examined. Linearity was examined through partial regression plots. Scatter plots of the residuals against each measured independent variable and against the predicted values indicated no systematic relationship. The assumption regarding the residuals in the regression model was also examined. The normality of the residuals of the dependent variable was assessed. The normal probability plot (Figure B1 in Appendix B) showed that the distributed points clustered around the straight line. The Kolmogorov-Smirnov test indicated the residuals were not significantly different from normal ($z=1.014$, $p=.255$).

By plotting the independent variables and the standardized residuals of the dependent variable, independence of the error was examined. Violation will be identified by a consistent pattern in the residuals (Hair, Anderson, Tatham, & Black, 1998, p175). No specific pattern or clustering was found in the scatter plots with exception of the temperature control variable.

Presence of unequal variance (heteroscedasticity) is one of the most common assumption violations (Hair et al., 1998, p174). To detect this problem, a simple method is to a construct a set of scatterplots, plotting residuals against each of the independent

variables and the predicted values (Cohen et al., 2003, p130). Distribution values in each scatter plot were equally distributed above and below the regression line across the values of an independent variable (See Figure B2 in Appendix B). A few outliers did not suggest any evidence of a substantial departure from linearity or homoscedasticity. Thus, no significant violation in the linear regression assumptions was found.

H1b: Control over the physical work environment is positively related to perceived performance.

To test the hypothesis H1b, the effect of the control variables on perceived performance were examined using regression analysis. The same independent control variables were used to examine to explain perceived performance. The results of the regression analysis are shown in Table 10.

Table 10. Regression Analysis of Effects of Control on Perceived Performance

Independent variables	B	β	T	P	R^2
Constant	3.582		26.056	.000	
Personalization	-.013	-.044	-.760	.448	
Temperature/airflow control	.034	.074	1.386	.166	
Organization/appearance control	.004	.017	.286	.775	
Lighting control	.003	.015	.284	.776	.045
Social contact	.007	.026	.440	.660	.021[a]
Scheduling and duration	-.015	-.061	-1.116	.265	
Control contacts	.006	.020	.344	.731	
Choice among available methods	.030	.095	1.657	.098	
Determine order	.048	.140	2.560	.011*	

* $p<.05$ [a] = adjusted R^2

The squared multiple correlation (R^2) was .045, with an adjusted $R^2 = .021$. The linear combination of the nine variables accounted for only .045 proportion of the

variance in the overall perceived performance. The F was not statistically significant at the .05 probability level, [F(365, 9)=1.907, P=.050]. All T-values regarding the effects of control over the physical environment were not significant. The determination of order of work variable was the only variable accountable for the perceived performance. For every one rating scale unit that determination of order of work increases, the perceived performance is predicted to change .140 rating scale units.

The significant value of the Kolmogorov-Smirnov test indicated the residuals were not significantly different from normal (z=.598, p=.867). No evidence of serious multicollinearity was found. Therefore, the regression results allowed rejection of the hypothesis H1b.

Reliability Tests and Confirmatory Factor Analysis

Reliability test results are presented in Table 11. For each latent factor, Cronbach's alpha coefficients are presented in parentheses. All of the alpha coefficients were above .60, which is the minimal acceptable level according to Hair et al. (1998, p 88). Because the control factor contained more items compared to the other factors, the reliability of the construct might be relatively weak. Missing data were deleted using listwise deletion methods.

The validity of the measures was assessed by conducting confirmatory factor analysis (CFA). Items with low construct loadings or low reliability were deleted from the model. The covariance matrix for the analysis is presented in Appendix C. The results indicated a marginal level based on Maximum Likelihood estimation (chi-square=674.82, df=432, RMSEA=.04, GFI=.89). Factor loading of each individual indicator with its respective construct was significant at the .01 level ($p<0.01$).

Table 11. Reliability and Confirmatory Factor Analysis

Constructs and measurement items [a]	Loading [b]		Error	
	SE	T-values	SE	T-values
Control (.6456)				
Personalization	.51	8.85	.74	11.75
Organization/appearance control	46	8.01	.78	12.10
Social contact	.48	8.37	.77	12.04
Scheduling and duration	.24	4.04	.94	13.11
Control amount and timing of contacts	.40	6.90	.84	12.52
Choice among available methods	.49	8.52	.76	12.01
Determine order	.27	4.62	.93	13.01
Flexibility (. 6440)				
Convertibility	.66	12.06	.56	9.81
Versatility	.41	7.16	.83	12.55
General flexibility	.82	14.88	.32	5.25
Movable systems	.25	4.10	.94	13.02
Distractions (.7137)				
Undisturbed workplace (R)	.72	13.96	.48	9.41
Easily distracted	.42	7.43	.82	12.58
Quietness (R)	.71	13.62	.50	9.73
Quiet and undisturbed time alone (R)	.72	13.85	.48	9.51
Visual distraction	.32	5.55	.90	12.93
Task group cohesiveness (.7515)				
United in trying to reach goals	.74	14.51	.46	9.54
Conflicting aspiration (R)	.59	11.46	.65	12.24
Do not give me opportunities (R)	.72	13.78	.49	9.58
Unhappy with my group commitment (R)	.66	13.15	.57	11.71
Communicate effectively	.48	8.69	.77	12.46
Social group cohesiveness (.7326)				
Spend time together	.55	9.83	.70	11.73
Go out with their own (R)	.75	13.71	.44	7.91
Do not stick together (R)	.80	14.66	.37	6.32
Job satisfaction (.7666)				
Generally satisfied	.82	17.35	.33	8.57
Consider taking another job (R)	.49	9.03	.76	12.40
Recommend job to a friend	.73	14.62	.46	9.87
Choose to work here again	.70	13.96	.51	10.63
Performance (.6188)				
Quality	.43	6.86	.81	11.75
Large amount	.61	9.78	.63	9.18
Accomplishment	.61	9.70	.63	9.13
Creativity	.53	8.51	.72	10.57

[a]: Cronbach alphas are in parentheses. [b]: All loadings are significant at $p<0.01$.
SE: Standardized estimates

The modification index recommended cross loading, thus it failed to achieve good discriminant validity. One of the indicators of task group cohesiveness, "My colleagues have conflicting aspirations for the group work performance (R)" was recommended to load on performance.

Interactive Model of Control, Distraction, and Performance

To examine the moderating and mediating effects of control in the relationship between distraction and performance, the proposed models were tested using Structural Equation Modeling. Since the whole confirmatory factor analysis (CFA) result was just at a marginal level, CFA was conducted again for the sub-measurement model only, prior to testing the path model. The covariance matrix for these analyses are presented in Appendix C. Overall, since all fit indices were in the acceptable range, the measurement model showed a good fit (χ^2=200.69, df=97, χ^2/df=2.06, GFI=.94, RMSEA=.054). As presented in Table 12, all factor loadings were significant at the .01 level and there was no negative value in errors and disturbances. Since factor loadings are all significant and there is no significant violation of the construct, the constructs were used to examine the path models.

Thus, the proposed model was used to evaluate the following hypotheses, explaining the effect of control on distraction and performance.

H2 : Control over the physical environment and work is negatively related to distractions.

H3a: Perceived distraction levels in the workplace are negatively related to perceived employee performance.

H3b: Perceived distraction levels in the workplace are positively related to an employee's inclination to work alone.

H3c: Perceived distraction levels in the workplace are positively related to an employee's inclination to avoid meeting people in the workplace.

H3d: An employee's inclination to avoid meeting people in the workplace is positively related to an employee's inclination to work alone.

Table 12. Parameter Estimates for Confirmatory Factor Analysis for Control Models

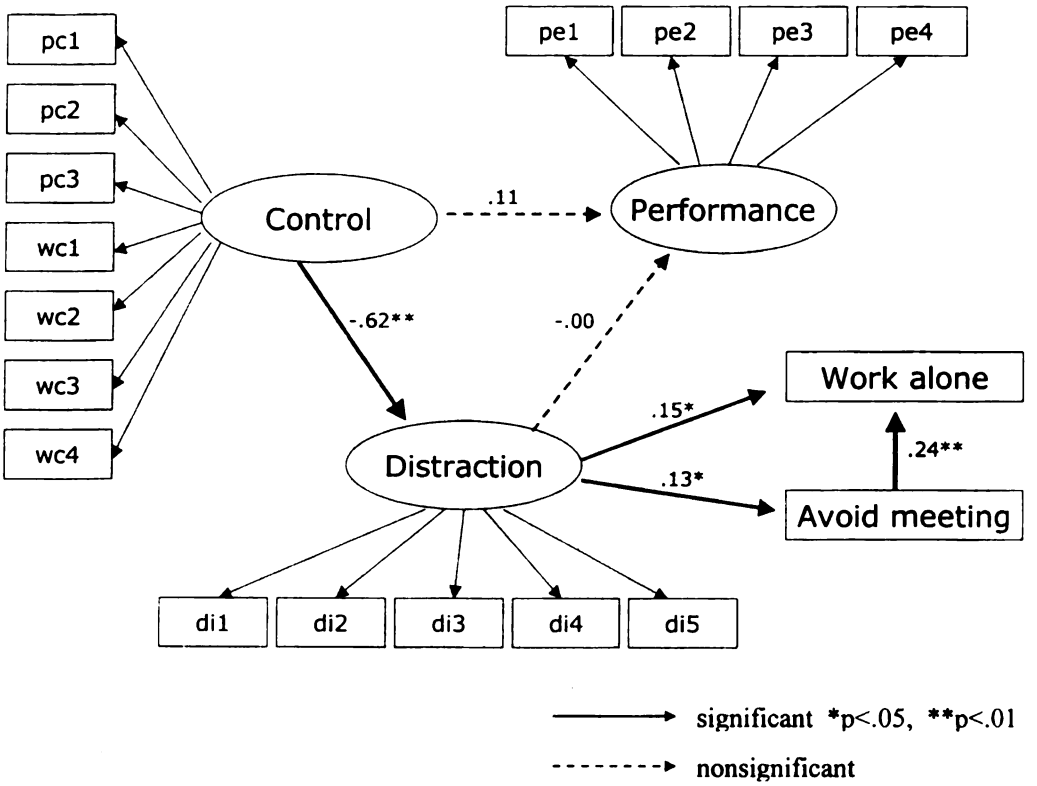
Parameters	Estimates	T-value	Errors	Estimates	T-value
LX (1,1)	.31	4.68	TD 1	.90	12.67
LX (2,1)	.48	7.18	TD 2	.77	10.61
LX (3,1)	.77	9.32	TD 3	.41	3.68
LX (4,1)	.47	7.12	TD 4	.78	11.06
LX (5,2)	.38	6.32	TD 5	.86	12.67
LX (6,2)	.34	5.72	TD 6	.88	12.84
LX (7,2)	.65	11.36	TD 7	.58	9.39
LX (8,2)	.27	4.54	TD 8	.92	13.17
LX (9,2)	.62	10.78	TD 9	.62	10.06
LX (10,2)	.38	6.46	TD 10	.85	12.65
LX (11,2)	.21	3.38	TD 11	.96	13.36
LX (12,3)	.72	14.36	TD 12	.48	9.78
LX (13,3)	.42	7.65	TD 13	.82	12.88
LX (14,3)	.70	13.78	TD 14	.51	10.27
LX (15,3)	.74	14.66	TD 15	.46	9.49
LX (16,3)	.35	6.28	TD 16	.88	13.14

The estimates are standardized.
LX (1,1)-LX (4,1): Performance variables: quality, quantity, accomplishment, and quality
LX (5,2)-LX (11,2): Control variables
LX (12,3)-LX (16,3): Distraction variables

In the initial analysis, the result indicated an acceptable fit (χ^2=304.33, df=131, GFI=.92, RMSEA=.060). As the errors and disturbances (theta-delta and theta epsilon) were freely estimated, the model fit improved. The results are presented in Figure 10 and Table 13. The results of SEM analysis, using Maximum Likelihood estimation, indicated that the proposed model adequately fit (χ^2=198.36, df=124, GFI=.94, RMSEA=.040). Standard residuals varied from 5.01 to –5.01 (median, 0).

As expected and as shown in Figure 10, a negative effect of control on distraction was found, as expected [GA (4,1)=-.62, p<.01] . Therefore, hypothesis H2 was confirmed.

Figure 10. Model of Control, Distraction and Performance



The results of the T values indicated that control had no positive effect on perceived performance [GA (3,1)=.11, nonsignificant] , a result consistent with the regression analysis results. Thus, hypothesis H3a was not supported.

On the other hand, hypothesis H3b was supported. Distraction was positively related to employee's inclination to avoid meeting people in the workplace [BE (1,4)=.15, p<.01].

In addition, distraction appeared to positively influence employee's inclination to work alone, as expected [BE (2,4)=.13, p<.05], and which confirmed hypothesis H3c. Finally, the results of the T-values indicated that employee's inclination to avoid meeting

people in the workplace is positively related to their inclination to work alone [BE (1,2)=.24, p<.01]. Thus, hypothesis H3d was supported.

Table 13. Results for Structural Equation Model.

Measurement					
	T-values	Estimates		T-values	Estimates
LX (1,1)	7.59	.56	TD 1	8.61	.69
LX (2,1)	6.42	.42	TD 2	11.62	.82
LX (3,1)	11.73	.73	TD 3	6.36	.46
LX (4,1)	6.05	.37	TD 4	12.49	.86
LX (5,1)	10.46	.59	TD 5	10.79	.65
LX (6,1)	6.91	.38	TD 6	13.03	.85
LX (7,1)	3.89	.22	TD 7	13.44	.95
LY (1,1)	-	1.00	TE 1	0	0
LY (2,2)	-	1.00	TE 2	0	0
LY (3,3)	-	.43	TE 3	11.74	.81
LY (4,3)	5.05	.60	TE 4	8.81	.64
LY (5,3)	5.51	.61	TE 5	8.61	.63
LY (6,3)	5.18	.49	TE 6	11.01	.76
LY (7,4)	-	.73	TE 7	9.60	.47
LY (8,4)	6.41	.37	TE 8	13.05	.86
LY (9,4)	11.27	.70	TE 9	10.22	.51
LY (10,4)	11.57	.73	TE 10	9.61	.47
LY (11,4)	5.82	.34	TE 11	13.14	.88
Path					
			TD (3,1)	-3.33	-.21
GA (4,1)	-8.97	-.62	TD (1,2)	2.60	.15
GA (3,1)	1.04	.11	TD (2,3)	-2.94	-.15
BE (1,4)	2.57	.15	TD (1,5)	-2.81	-.14
BE (2,4)	2.19	.13	TD (3,4)	-3.64	-.18
BE (3,4)	-.02	-.00	TD (7,6)	4.20	.21
BE (1,2)	4.80	.24	TE (5,8)	-4.15	-.19

The estimates are standardized.
LX (1,1)-LX (7,1): Control variables
LY (1,1): Work alone, LY(2,2): Avoid meeting people
LY (3,3)-LX (6,3): Performance variables: quality, quantity, accomplishment, and quality
LY (7,4)-LY (11,4): Distraction variables

H4: <u>There is a difference in terms of effects of distraction on performance between the high control group and the low control group.</u>

It was assumed that the causality in the relationship between distraction and performance might be different according to the level of control. If people possess a high degree of control, the control might be strong enough to suppress the effects of distraction on performance, propensity to work alone or propensity to avoid meeting people. Conversely, people possessing low degrees of control, the effects of control would not be significant, but distraction would significantly affect performance, inclination to work alone or propensity to avoid meeting people.

Therefore, the model was tested according to different levels of control. Factor scores were used to determine control levels because factor scores are unbiased estimates of the factor (Jöreskog, Sörbom, duToit, & duToit, 2000, p156). The factor scores were computed using PRELIS. A median split of factor scores of control was performed to classify a low control group and a high control group. Assuming that there is no difference in path, equality constraints were given in six paths. These constraints were released one by one. The results of chi-square difference tests are summarized in Table 14.

Table 14. Chi-square Difference Test for Low and High Degree of Control Groups

Model Equality released	$\Delta\chi^2$ (df=1)
1st EQ BE (1,2)=BE (1,2)	6.58 (p<.01)
2nd EQ GA (1,3)= GA (1,3)	.05 (non significant)

The models showed different patterns indicating differences in the relationship by control level. The high control group showed a stronger positive relationship between the inclination to avoid meeting people and the inclination to working alone (2.27) compared to a smaller relationship (.01) in the lower control group. However, the role differing

control levels was not clear. Between the two groups, the path between distraction and performance was equally constrained. After release of the equality, the fit did not improve significantly. Thus, there was no difference in terms of the effects of distraction on performance between the high control and low control groups. Thus, hypothesis H4 was not confirmed. Although the moderating effect of control was feasible, the roles of control in mediating and the moderating process still remain questionable. Environment and behavior relations are not always as straightforward, but often demonstrate multi-causal and non-recursive association between the variables (Evans & Lepore, 1997). Since control and distraction are interdependent, the multiple relationships among control, distraction and performance were further examined.

Mediating Effect of Control

To examine the mediating role of control in the relationship between distraction and performance, a path model and its alternative model were tested.

H5a: Control plays a mediating role in the relation of distraction to performance.

The first model (see Figure 11) examined both the direct effects of distraction on performance and the indirect effects of distraction on performance mediated by control.

In the alternative model (see Figure 12), the path coefficient for distraction→ performance was set to zero assuming that the effects of distraction on performance is mediated entirely by control without the direct effect of distraction on performance. All parameters and errors for both models are presented in Table 15.

Figure 11. Mediating Effect of Control Model A

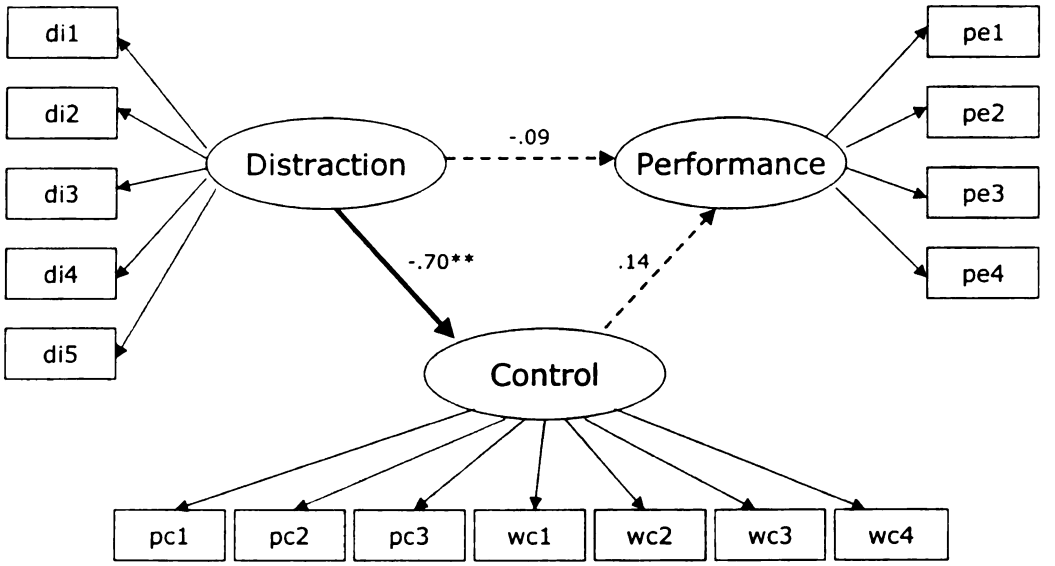


Figure 12. Mediating Effect of Control Model B

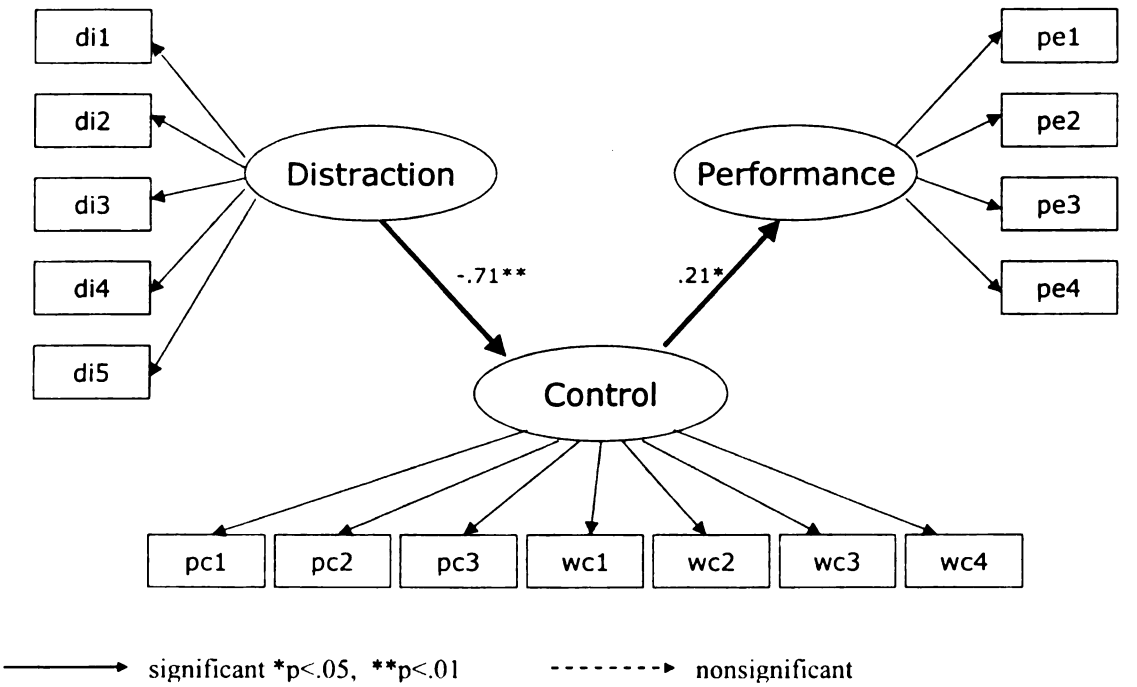


Table 15. Results of SEM for Comparison for the Models A and B

Parameter	Model A	Model B
GA (1,1)	-.72 (-.09)	-
GA (2,1)	-5.21 (-.70)	-5.22 (-.71)
BE (1,1)	.98 (.14)	2.23 (.21)
LX (1,1)	14.38 (.72)	14.42 (.73)
LX (2,1)	7.66 (.42)	7.60 (.42)
LX (3,1)	13.77 (.70)	13.76 (.70)
LX (4,1)	14.66 (.74)	14.66 (.74)
LX (5,1)	6.28 (.35)	6.28 (.35)
LY (1,1)	- (.31)	- (.32)
LY (2,1)	4.74 (.48)	4.79 (.50)
LY (3,1)	3.88 (.77)	3.97 (.74)
LY (4,1)	4.19 (.47)	4.23 (.48)
LY (5,2)	- (.34)	- (.34)
LY (6,2)	4.73 (.31)	4.74 (.31)
LY (7,2)	5.22 (.67)	5.23 (.67)
LY (8,2)	3.53 (.27)	3.52 (.27)
LY (9,2)	5.17 (.63)	5.18 (.63)
LY (10,2)	4.52 (.34)	4.53 (.34)
LY (11,2)	2.99 (.20)	3.02 (.20)
TD 1	9.77 (.48)	9.72 (.47)
TD 2	12.88 (.82)	12.90 (.82)
TD 3	10.29 (.51)	10.30 (.51)
TD 4	9.50 (.46)	9.50 (.46)
TD 5	13.14 (.88)	13.14 (.88)
TE 1	12.67 (.90)	12.54 (.90)
TE 2	10.60 (.76)	10.38 (.75)
TE 3	3.66 (.41)	4.30 (.45)
TE 4	11.07 (.78)	10.87 (.77)
TE 5	12.85 (.88)	12.85 (.88)
TE 6	12.98 (.90)	12.98 (.90)
TE 7	8.87 (.55)	8.95 (.56)
TE 8	13.19 (.93)	13.20 (.93)
TE 9	9.80 (.61)	9.86 (.61)
TE 10	12.87 (.88)	12.87 (.88)
TE 11	13.38 (.96)	13.38 (.96)
TE (1,2)	3.13 (.17)	2.93 (.16)
TE (6,5)	5.51 (.28)	5.51 (.28)
TE (5,10)	3.00 (.15)	2.99 (.15)
TE (6,10)	3.22 (.16)	3.21 (.16)
TE (11,10)	4.27 (.21)	4.26 (.21)
TE (5,11)	2.33 (.11)	2.32 (.11)
χ^2	185.76	186.01
DF	95	96
GFI	.94	.94
RMSEA	.051	.050

Standardized estimates are in parentheses.

The overall fit of the constrained model was not appreciably worse than model A. As presented in Table 15, little difference between the two models was evident. Model fit and parameter estimates from both models were adequate (χ^2 /df < 3, GFI >.9, RMSEA<.1). There was no significant difference in $\triangle\chi^2$ (df=1)=.40. Thus, as hypothesis H5a suggested, a mediated relation was supported.

Interestingly, by deleting the negative direct effect of distraction on performance in the second model, the effect of control on performance appeared significant. This result indicated the interrelated nature of the physical environmental features in the workplace.

H5b: <u>According to the individual work style, there is a difference in the relationship between distraction, control, and performance</u>.

It was assumed that according to employee work styles, there might be a difference in reaction toward quietness/noise, so distraction and the relationship between control and performance might be different. Individual work style was measured with one indicator. The respondents were classified into two groups based upon a median split, one used to working in quiet areas and the other did not care that much about quietness. Before the hypothesis was tested, an independent sample t-test was conducted. There was no significant mean differences for the five distraction variables with respect to individual work style at .05 level of probability.

In order to test the hypothesis, an equality test was conducted to compared the two groups. Chi-square difference tests were performed to examine the difference in the paths between the two groups. Assuming that there are no differences in paths, equality

constraints were given in three paths. These constraints were released one by one. The results of chi-square difference tests are summarized in Table 16. In people who care more about quietness, the effect of distraction on performance (-.22) was negative, but the effect of distraction on performance (.35) in people who do less was positive. In other paths, there was no significant difference. Between the two groups, other positive or negative directions were consistent, however, the effect of distraction was significantly different for people who care more about quietness and for employees who do less care noise. Thus, the hypothesis was supported. This result is consistent with the findings of Kjellberg et al. (1996) but not with the findings of Block & Stokes (1989).

Table 16. Chi-square Difference Test by Individual Workstyle

Model Equality released	$\Delta\chi^2$ (df=1)
1st EQ GA (1,1) = GA (1,1)	5.55 (p<.01)
2nd EQ GA (2,1) = GA (2,1)	.00 (non significant)

Effects of Flexibility on Group Cohesiveness

With respect to antecedents of flexibility, four variables were examined in order to examine the effects of flexibility on task group cohesiveness. Openness and accessibility were also entered as independent variables to explain task group cohesiveness.

H6a: Flexibility in workspace use is positively related to task group cohesiveness.

H6b: The degree of openness in the workplace is positively related to task group cohesiveness.

H6c: The degree of accessibility in the workplace is positively related to task group cohesiveness.

The R^2 value for the model was .067 with an adjusted R^2 =.052. The F was statistically significant at .001 probability level, [F(361, 6)=4.324, P=.000]. The standardized and unstandardized regression coefficients are presented in Table 17. General flexibility contributed the most to task group cohesiveness (β=.139), followed by convertibility, flexible enough to adjust, rearrange, or reorganize (β=.137). The score of the Kolmogorov-Smirnov test was .937 (p=.343). Standard residuals were normally distributed. There was no specific pattern or clustering found in the scatter plots (see Figure B3).

Table 17. Regression Analysis of Flexibility on Task Group Cohesiveness

Independent variables	B	β	T	P	R^2
Constant	4.276		16.973	.000	
Openness	-.015	-.030	-.570	.569	
Accessibility	.038	.054	1.012	.312	.067
Convertibility	.072	.137	2.088	.037*	.052[a]
Versatility	.026	.045	.813	.417	
General flexibility	.084	.139	2.184	.030*	
Movable systems	-.034	-.061	-1.076	.283	

* p<.05 [a] = adjusted R^2

The results indicated that flexibility was positively related to task group cohesiveness although the proportion of explanation for task group cohesiveness was small. Therefore, hypothesis H6a was confirmed. No significant relationship was found between openness and task group cohesiveness or between accessibility and task group cohesiveness respectively. Thus, hypotheses H6b and H6c were not supported.

H7a: Flexibility in workspace use is not related to social group cohesiveness.

H7b: The degree of openness in the workplace is not related to social group cohesiveness.

H7c: The degree of accessibility in the workplace is not related to social group cohesiveness.

To examine the effects of flexibility on social group cohesiveness, the four flexibility variables were studied with openness and accessibility. This linear model was not statistically significant at the .05 probability level, [F(362, 6)=1.582, P=.151]. None of the t- values were significant; thus regression coefficients were considered as being equal to zero. There was no obvious evidence of multicollenearity (all tolerance values were higher than .1 and all VIF were lower than 2). The score of the Kolmogorov-Smirnov test was .748 (p=.630). Standard residuals were normally distributed. Thus, hypotheses H7a, H7b and H7c were not rejected.

As expected, flexibility was not associated with social group cohesiveness because social group cohesiveness refers to social relationships among colleagues outside of the workplace rather than inside the workplace. However, the findings support the hypothesis that flexibility in the workplace design had a positive influence on task group cohesiveness.

H8a: Degree of openness is positively related to distraction.

H8b: Distraction is negatively related to job satisfaction.

H8c: Job satisfaction is positively related to perceived performance.

H8d: Task group cohesiveness is positively related to perceived performance.

To test the hypothesis, the proposed model (see Figure 7) was analyzed using SEM. In the initial run, the model was not converged using both Maximum Likelihood estimation and Generalized Least Squares estimation. To test the hypothesis, Phi matrix (covariance matrix of latent factors) was used to conduct a path analysis. Phi matrix was

generated from the initial run of the Confirmatory factor analysis. Because CFA does not include the openness variable, H8a was not tested using path analysis. The path analysis results are presented in Table 18 and Figure 13. The initial result indicated that the path analysis was perfectly fit. In the initial run, the path coefficient between flexibility and task group cohesiveness was not significant and the path coefficient between control and task flexibility was significant.

Table 18. Summary of Path Analysis

Parameters		Estimates	T-value
PH (1,2)	Control ↔ Distraction	-.60**	-10.24
PH (1,3)	Control ↔ Flexibility	.67**	11.08
PH (2,3)	Distraction ↔ Flexibility	-.44**	-8.01
GA (2,1)	Control → Job satisfaction	.26**	7.32
GA (3,1)	Control → Performance	.06	-.76
GA (1,2)	Distraction → Task Group Cohesiveness	-.32**	-6.29
GA (2,2)	Distraction → Job satisfaction	.03	.85
GA (3,2)	Distraction → Performance	.03	.47
GA (1,3)	Flexibility → Task Group Cohesiveness	.16**	13.13
GA (3,3)	Flexibility → Performance	.05	.76
BE (1,2)	Task Group Cohesiveness→ Job Satisfaction	.72**	22.80
BE (1,3)	Task Group Cohesiveness→ Performance	.17*	2.13
BE (2,3)	Job Satisfaction → Performance	.21**	2.60

	Standardized Total effects			Standardized Indirect effects		
	Control	Distraction	Flexibility	Control	Distraction	Flexibility
TGS		-.32	.16	-	-	-
JS	.26	-.20	.11	-	-.23	.11
PER	.00	-.07	.10	.06	-.10	.05
	TGS	JS	PER	TGS	JS	PER
TGS	-	-	-	-	-	-
JS	.72	-	-	-	-	-
PER	.32	.21	-	.15	-	-

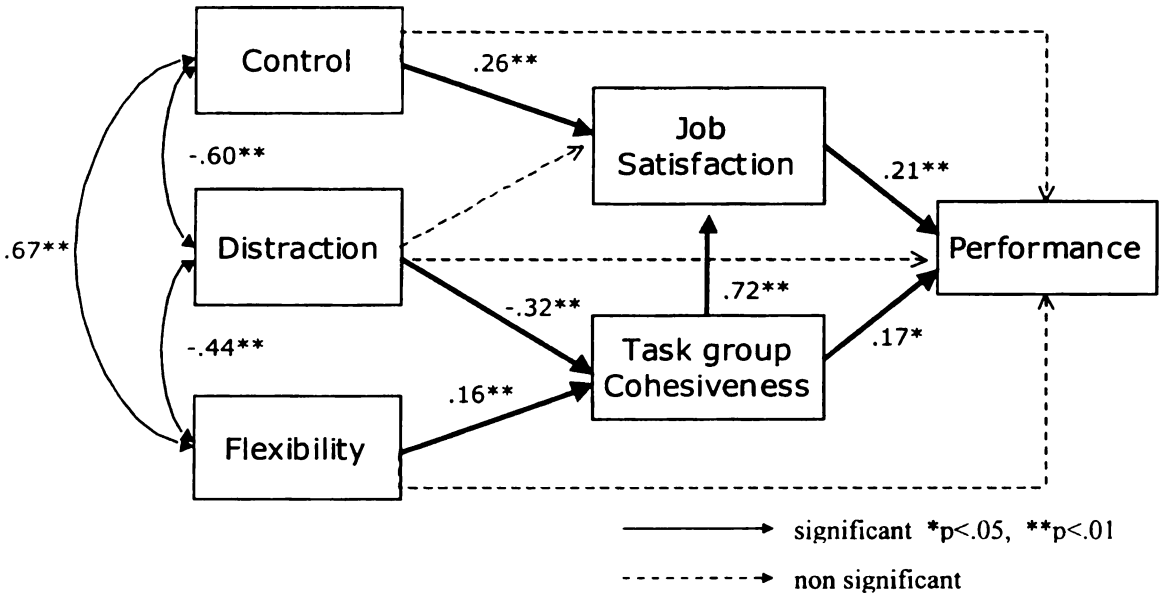
* p<.05, ** p<.01, Estimates are standardized.

The "theory trimming" approach was employed (Ferguson & Weisman, 1986). As two paths were trimmed from the initial run, the path relationships showed similarity to

the proposed model, however, the overall fit was reduced (χ^2=59.37, df=2, GFI=.95, RMSEA=.269).

In the path diagram, control was negatively associated with distraction, thus the result was consistent with previous findings of this study. No significant effect of distraction on job satisfaction was found (T value=.85). Thus, hypothesis H8b was not supported. A positive effect of job satisfaction on perceived performance was found (.21, T-value=2.60). Thus, hypothesis H8c was confirmed. T value indicated that task group cohesiveness was positively related to performance (.17, T-value=2.13). The total effect of task group cohesiveness on performance was .32 including an indirect effect of .15. Therefore, the hypothesis H8d was also confirmed. The significant results in the relationships among task group cohesiveness, job satisfaction and performance were not changed between the path analysis results before and after trimming.

Figure 13. Path Analysis Results



Path coefficients reflect only the direct effects of one variable on another in the model, while correlation coefficients include direct effects, indirect effects, and

correlation between two variables and a third variable not included in the model (Ferguson & Weisman, 1986, p99).

In order to examine the effects of openness on distraction, correlation analysis was conducted between openness and the five distraction variables. Visual distraction was significantly associated with openness (r =.168, p=.001). A summated distraction indicator of five variables was also positively associated with openness (r =.111, p=.03). Thus, hypothesis H8a was confirmed. This result was consistent with the previous finding (Ferguson & Weisman, 1986)

The effect of distraction on job satisfaction was examined using regression analysis. The squared multiple correlation (R^2) was .100 with an adjusted R^2=.088. The linear combination of five variables accounted for 10% of the variance in the overall job satisfaction variable. The F was statistically significant at .001 probability level, [F(373,5)=8.247, P=.000], allowing rejection of the null hypothesis. The standardized and unstandardized regression coefficients are presented in Table 19.

Table 19. Regression Analysis of Distraction on Job Satisfaction

Independent variables	B	β	T	P	R^2
Constant	6.058		27.133	.000	
Undisturbed workplace (R)	-.013	-.018	-.282	.778	
Easily distracted	-.083	-.111	-2.067	.039*	.100
Quietness (R)	-.079	-.110	-1.781	.076	.088[a]
Quiet and undisturbed time alone (R)	-.116	-.173	-2.793	.005**	
Visual distraction	-.007	-.011	-.207	.836	

* p<.05, ** p<.01 [a] = adjusted R^2

The beta coefficients indicated that all variables related to distraction were negatively associated with job satisfaction. However, the significant value of

Kolmogorov-Smirnov test indicated that the residuals were significantly different from normal (z=1.386, p=.043). The distribution values in each scatter plot were not all equally distributed above and below the regression line across the values of an independent variable (see Figure B4). Especially for 'quietness' and 'quiet and undisturbed time alone,' variance increases with the independent variables. This violates residual assumptions. Since the path analysis result did not support hypothesis H8b, and regression results were not robust, due to violations of linear regression assumptions, hypothesis H8b was not supported.

Gaps between Perceptions and Expectations

In order to determine employee's expectations toward their workplace, expectation levels were investigated with perception levels for physical environmental features. The differences between perceptions and expectations are presented in Table 20. Standard deviations are shown in parentheses.

The largest gap was found in temperature and air control (The mean difference was –3.698). The results indicated that employees participating in this study expected to have more flexibility in their workplaces to readjust, reorganize, have quiet and undisturbed time, have more lighting control, have more adequate storage area, and have more control over social contacts compared with the existing condition of their workplaces. The results showed the importance of control and flexibility in the workplace. The gaps showed which features should be improved in the workplace.

Table 20. Summary of Differences between Perceptions and Expectations

	Items	Perception Mean (St. D)	Expectation Mean (St. D)
1	My workplace is open enough to see my colleagues working.	4.12 (2.088)	3.12 (1.722)
2	My workplace provides an undisturbed environment so that I can concentrate on my work.	3.35 (1.709)	5.64 (1.272)
3	My furniture is flexible enough to adjust, rearrange, or reorganize my workspace.	3.05 (1.985)	5.32 (1.460)
4	I am able to control the social contact with others around me.	3.94 (1.792)	5.48 (1.300)
5	I have informal and impromptu meetings in my private workstation.	5.52 (1.493)	5.91 (1.191)
6	The quality of my equipment is more than sufficient to work effectively.	4.89 (1.626)	6.23 (0.942)
7	My workplace serves multi-purpose functions for informal and instant meeting.	4.80 (1.754)	5.65 (1.283)
8	I am able to personalize my workspace.	5.18 (1.558)	5.90 (1.067)
9	I am able to control temperature or airflow in my office.	1.40 (1.004)	5.10 (1.750)
10	My work environment is quiet.	3.18 (1.676)	5.46 (1.221)
11	I am able to determine the organization/appearance of my work area.	4.73 (1.802)	5.75 (1.126)
12	I am able to be easily accessed from my colleague's workstation.	5.43 (1.520)	5.29 (1.393)
13	My workstation is over-equipped for my typical needs.	2.05 (1.246)	3.08 (1.777)
14	In general, my workspace is flexible.	3.81 (1.716)	5.41 (1.094)
15	My furniture is a fixed system.(R)	2.55 (1.857)	4.50 (1.710)
16	My workstation is large.	3.85 (1.692)	4.82 (1.319)
17	I am able to have quiet and undisturbed time alone.	3.24 (1.806)	5.79 (1.101)
18	My work area has many visual distractions.	3.10 (1.794)	2.54 (1.500)
19	I have ample storage in my work area.	4.32 (2.007)	5.95 (1.088)
20	I am able to control the lighting level in my workstation.	3.23 (1.998)	5.59 (1.329)

Next, the effectiveness of gap measures and perception measures was examined.

H9a: Gap measures between the perceived environmental features and the expected environmental features are stronger predictors in explaining environment satisfaction and job satisfaction than perception based measures.

Table 21. Variation explained by Perceptions and Expectations toward Workplace

Variables		Perception		Gap	
		WS	JS	WS	JS
1	My workplace is open enough to see my colleagues working.				
2	My workplace provides an undisturbed environment so that I can concentrate on my work.	.218***		.175**	
3	My furniture is flexible enough to adjust, rearrange, or reorganize my workspace.			.148**	.117*
4	I am able to control the social contact with others around me.		.133*		.144**
5	I have informal and impromptu meetings in my private workstation.				
6	The quality of my equipment is more than sufficient to work effectively.	.108***	.142**		
7	My workplace serves multi-purpose functions for informal and instant meeting.				
8	I am able to personalize my workspace.		.122*		.124*
9	I am able to control temperature or airflow in my office.	.105*			
10	My work environment is quiet.				.144*
11	I am able to determine the organization/appearance of my work area.	.114*	.144**	.150**	
12	I am able to be easily accessed from my colleague's workstation.				
13	My workstation is over-equipped for my typical needs.	-.083*			
14	In general, my workspace is flexible.	.137**		.151**	
15	My furniture is a fixed system.(R)	.111**			
16	My workstation is large.				
17	I am able to have quiet and undisturbed time alone.	.173***	.126*	.147**	
18	My work area has many visual distractions.				
19	I have ample storage in my work area.	.178***		.126**	
20	I am able to control the lighting level in my workstation.	.114**		.120**	
	R^2	.476	.173	.445	.134
	Adjusted R^2	.460	.161	.433	.124

* p<.05, ** p<.01, *** p<.001
Entries in the cells represent standardized coefficients. All nonsignificant coeffcients are omitted.
WS: satisfaction with work environment JS: Job satisfaction

Stepwise regression analysis was conducted for each measure. The results are summarized in Table 21. Perception measures had a larger number of significant predictors (10 items) among 20 items for work environment satisfaction than did gap measures (7 items). For job satisfaction, no substantial difference between perception measures and gap measures was found. The values of squared multiple correlation (R^2) and adjusted R^2 were not considerably different. Based on this result, the gap measure did not have greater predictive power compared to the simple perception measure. Therefore, the hypothesis H9a was not confirmed. The results are further discussed in a later part of this chapter.

H9b: Satisfaction with the physical environment is positively related to the job satisfaction.

To examine the relationship between satisfaction with the physical environment and job satisfaction, correlation analysis was conducted between openness and four job satisfaction variables at the .001 probability level. A summated job satisfaction indicator of four variables was also positively associated with work environment satisfaction ($r= .434$, $p=.000$). Thus, hypothesis H9b was confirmed. This result was consistent with previous findings. Ferguson & Weisman (1986) also found that satisfaction with workspace was positively related to job satisfaction.

DISCUSSION

In this section, further interpretations of the findings are discussed for each hypothesis.

H1a: Control over the physical work environment is positively related to job satisfaction.

Results regarding control in the workplace on employee's job satisfaction are consistent with previous findings. The results of this study found that control was a predictor of job satisfaction, which was consistent with previous findings (McLaney & Hurrell, 1988; Spector, 1989). Control over the physical environment was a weaker predictor of job satisfaction than control over one's work. Especially, control over temperature and control over lighting were not significantly related to job satisfaction, although employees indicated that they should have more control over temperature and lighting than they had. This may be due to the building conditions of the participants included in the study. Not all of the buildings provided a local unit or control device for heating and ventilation. Thus, inability to control temperature, air flow or lighting did not affect employee's job satisfaction because they recognized these as factors outside of their control.

The study findings emphasized that control is an important feature in the workplace in order to obtain high quality employees and have them satisfied with their jobs. The results showed that being able to control social contact was a predictor of job satisfaction. In order to balance individual work and group work, employees needed to have control over social contact. Social contact control could be achieved by providing movable doors for individual workspaces, separate closed rooms, or hubs which

employees could stay temporarily and do their works. It would be especially important for workers who require a high degree of concentration. Control over organization and personalization were predictors of job satisfaction. Providing options for workplace layout could increase control over the workplace.

H1b: Control over the physical work environment is positively related to perceived performance.

The findings indicated that control over the physical work environment was not positively related to perceived performance. This may be due to the questionnaire design or the complicated nature of measuring performance. For the perceived performance variables, the results indicated that employees were more likely to evaluate their performance as above the mid point (the data were negatively skewed). This finding may result from the small variations available in using 5 point- scale performance variables.

Research findings in this area have not been consistent. Some researchers have found that control regarding the physical aspects of the office environment was not positively related to performance (Veitch & Gifford, 1996) while control over one's work was positively related to performance (Spector, 1989).

Although the findings did not support the hypothesis, the common belief that control will increase performance remains questionable since actual performance may be different from perceived performance. This could be further examined by using different questionnaire designs or a different methodological approach.

H2 : Control over the physical environment and work is negatively related to distractions.

The findings indicated that as employees perceived higher control over their work and work environment, they were less distracted by their workplace. This finding

supported the proposition that control plays a role in not only increasing job satisfaction, but also in decreasing distraction.

As previously mentioned, open offices have been viewed as problematic, distraction from noise and frequent interruptions are common in them (Brooks & Kaplan, 1972; Hedge, 1982; Evans & Johnson, 2000). Control over the physical environment can directly or indirectly reduce the negative effects of distraction, reduce perceived helplessness from distraction and compensate employees experiencing distractions in the workplace.

H3a: Perceived distraction levels in the workplace are negatively related to perceived employee performance.

H3b: Perceived distraction levels in the workplace are positively related to an employee's inclination to work alone.

H3c: Perceived distraction levels in the workplace are positively related to an employee's inclination to avoid meeting people in the workplace.

H3d: An employee's inclination to avoid meeting people in the workplace is positively related to an employee's inclination to work alone.

The findings did not support the hypothesis that distraction was negatively related to perceived performance. This may result from the distraction level not being severe enough to keep employees from working. O'Neill (1994) found that distraction was negatively related to self-assessed performance.

As expected, if employees felt more distracted, they were more likely to want to work alone and avoid meeting people in their workplace. If employees did not need to work collaboratively or in teams, the propensity to work alone or avoid meeting people would not cause problems. However, if high group cohesiveness is required for work or

if employees need to work intensively collaboratively, the propensity to work alone would not be desirable.

This finding can be applied to workplace design and management. If employees need to work individually or require concentration for their work, facility managers need to reduce the distraction level, for instance, by dividing working zones, using higher panels, using sound absorbing materials, raising ceiling heights, or using sound masking devices. If high distraction levels result from the nature of work activities, facility managers can provide work areas for employees to work alone or to avoid meeting people when it is necessary.

H4: There is a difference in terms of effects of distraction on performance between the high control group and the low control group.

According to different levels of control, there was no significant change on the effects of distraction on performance. This may be the result of from several reasons. There may be little distinction between the two groups since the two groups were defined based on continuous factor scores. If control and distraction are independent of each other, factorial design may reveal the moderating effects clearly. For instance, comparing the performance by groups of high control-high distraction, high control-low distraction, low control-high distraction and low control-low distraction, can explain moderating effects clearly. If the direct effect of distraction is much stronger than the indirect effect moderated by control, the moderating effects may appear non significant. This inquiry was explored in the following hypothesis by testing the mediating effect of control in the relationship.

H5a: Control plays a mediating role in the relation of distraction to performance.

H5b: According to the individual work style, there is a difference in the relationship between distraction, control and performance.

Interestingly, a mediating role of control and its relationship was found regarding negative physical environmental features, distraction. This is a support for Sundstrom's (1986) proposition that performance not only is affected by noise but also by one's sense of control. It is evident that control relieves the negative effects of distraction on performance.

The results indicated that individual work styles moderated the effects of distraction on control and performance. For an employee who desired quietness and who was used to working alone, the effect of distraction on performance was negative. However, for an employee whose work style is coffee shop regular and less relied less on quietness, distraction was not negatively related to perceived performance. This finding emphasized the individual differences and preference toward the workplace, and the importance of various options of the workplace conditions to support individual needs.

H6a: Flexibility in workspace use is positively related to task group cohesiveness.

H6b: The degree of openness in the workplace is positively related to task group cohesiveness.

H6c: The degree of accessibility in the workplace is positively related to task group cohesiveness.

It was found that employees who perceived their workspace to be more flexible, have higher task group cohesiveness. This result emphasized the importance of flexibility in workplace design, especially for workers who worked as teams or required frequent collaboration to achieve group goals.

However, the roles of openness and accessibility in office design remain questionable. The results did not confirm whether openness or accessibility leads to an increase or decrease in communication and interaction, or in group cohesiveness. Since openness was positively correlated with distraction and negatively correlated with task cohesiveness, it may due to the reasoning in Evans and his colleague's proposition (1994). They proposed that insufficient privacy hampers the development of close interpersonal relationships because workers feel unable to hold confidential conversations and have limitations placed on feedback from supervisors (Oldham & Rochford, 1983; Evans, Johansson, & Carrere, 1994). Among the respondents from this study, some people added the following comments supporting this reasoning. "*For a manager the open air office is not effective. Private discussions on performance, pay, goals, etc. are difficult to have in a public environment.*" "*For consumer interaction, ...manager should be able to control the social contacts with others around him/her... confidential information, voice should not transfer....*" This indicates that one of the intentions for planning openness in office design, which is to increase interaction and communication, fails to be fulfilled and instead resulted in reverse effects. This result was consistent with that of Brennan and her colleagues (2002). They found that the open office did not facilitate communication since employees felt that open offices disallowed employees to have confidential conversations.

In this study, accessibility referred to the degree to which an employee can be accessed by colleagues. For future study, accessibility needs to be measured containing broader dimensions of the concept.

H7a: Flexibility in workspace use is not related to social group cohesiveness.

H7b: The degree of openness in the workplace is not related to social group cohesiveness.

H7c: The degree of accessibility in the workplace is not related to social group cohesiveness.

As expected, flexibility was not related to social group cohesiveness, i.e., social relationships among colleagues out side of the workplace. It also found that openness and accessibility in the physical environmental features of the workplace were not related to social group cohesiveness. Interestingly, flexibility was positively related to task group cohesiveness, but not to social group cohesiveness. If social cohesion refers to interpersonal closeness in the workplace, the result might be different.

H8a: Degree of openness is positively related to distraction.

H8b: Distraction is negatively related to job satisfaction.

H8c: Job satisfaction is positively related to perceived performance.

H8d: Task group cohesiveness is positively related to perceived performance.

The results indicated that the more open the workplace is, the more distractions employees in the workplace experience. Therefore, open office design inherently faces some degree of distraction problems compared to a closed office type. Especially for open offices, it is important to deal with distraction. Hedge (1982) also concluded that a workplace which has greater openness and accessibility between the staff would unavoidably produce a variety of disturbance problems.

Regarding hypothesis H8b, there was a conflict in the findings based on the regression analysis and the path analysis. Regression analysis indicated that distraction was negatively associated with job satisfaction. However, path analysis failed to support the direct effect of distraction on job satisfaction. The regression analysis result was not

robust since assumptions for regression analysis were deviated. Therefore, it was concluded that the direct effect of distraction on job satisfaction was not supported.

The result of path analysis indicated that job satisfaction was positively related to self- reported performance. It was also found that people who had higher task group cohesiveness, rated their performance higher. This result is consistent with the findings of Carless and DePaola (2000), where task group cohesiveness was more closely related to work performance than was social cohesiveness.

H9a: Gap measures between the perceived environmental features and the expected environmental features are stronger predictors in explaining environment satisfaction and job satisfaction than perception-based measures.

H9b: Satisfaction with the physical environment is positively related to the job satisfaction.

The research finding supported that as employees are more satisfied with their physical work environment, they have greater job satisfaction. The result indicated strong correlation between satisfaction with work environment and job satisfaction. This results is consistent with the previous findings (Sundstrom et al., 1994; Ferguson & Weisman, 1986)

When using the gap measure, employees showed large discrepancies between perception of their current status and their expectations toward control, flexibility and workplace adequacy aspects. However, the study findings did not show superiority of the gap measure to simple perception measures in explaining satisfaction with the workplace environment and job satisfaction.

There are two possible interpretations regarding these results. One may be due to the questionnaire design. To reduce the time and to increase response rates from

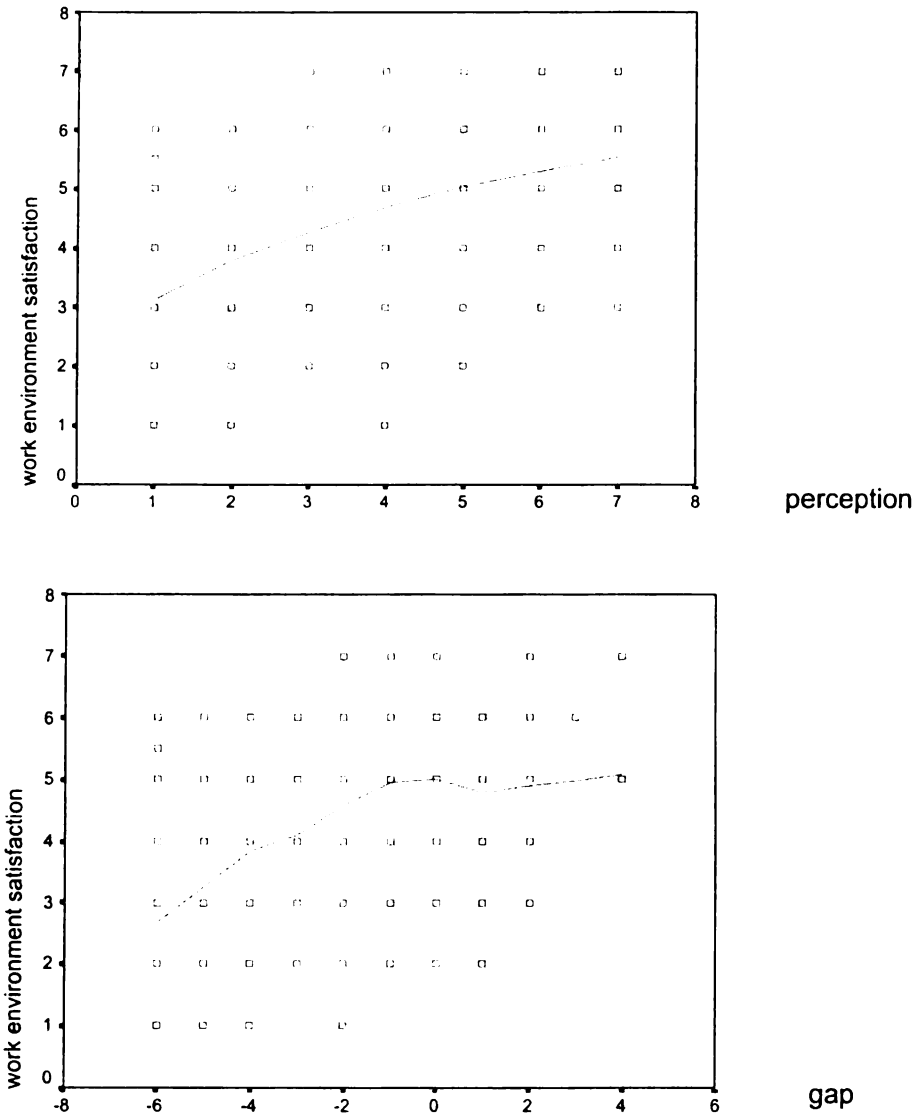
employees, the items for measuring perception and expectation were parallelized (See Appendix A). Respondents showed a strong tendency to reply on both measures at the same degree of agreement or disagreement. People may judge two items as similar because they look almost identical or people may be reluctant to answer differently to the similar questions.

The other interpretation may be due to the method of analysis. Cronin and Taylor (1992) conducted stepwise regression analysis to test whether a weighted performance – based measure of service quality (perception only, SERVPERF) is a more appropriate basis for measuring service quality than SERVQUAL (gaps between perception-expectation). In this study, the Cronin and Taylor method was repeated. To decide the predictor of the physical work environment satisfaction, linear stepwise regression analysis was used. Linear regression analysis assumes linear relationships between independent variables and dependent variables. If there is no straight linear relationship, the results indicate weaker relationships between the independent variables and dependent variables. For instance, as shown in Figure 14, once people fulfill their expectation level (no discrepancy between the perception and expectation), the exceeding portion (current status exceed the desired level) does not increase satisfaction any more, thus, it does not have a straight linear relationship.

To test this assumption, scatter plots with fit lines were generated. The two figures show the differences when a researcher uses a linear regression option vs, quadratic regression or lowess options. The difference proves the proposition. For the relationship between simple perception of physical environmental features and physical

environmental satisfaction, the linear line option and quadratic or squad option did not produce a great amount of difference in the shape of lines.

Figure 14. Linear and Nonlinear Relationship in Perception and Gap Measure



However, for the gaps, there are big differences in the shape of the linear line option and in that of the quadratic or lowess option. In the non linear line plot, the line shows that the increase of gaps is in proportion to that of satisfaction until the point at which the gap is 0. After that point, the value of Y (satisfaction) does not increase in proportion to that of X (gaps). Therefore, this result indicates that there is a weakness in

the conclusion Cronin and Taylor (1992) made. In their conclusions, based on linear analysis, a simple perception measure explains more of the variation to predict service quality.

Since the gaps do not have straight linear shapes, it is not valid to compare the results based on linear regression analysis. Furthermore, this result indicated that physical environmental features that are lower in quality than people expect are strongly related to satisfaction, while the physical environmental features which surpass the expectation do not affect satisfaction notably.

In a simple graphical presentation, the gaps model is of use to present which physical aspects should be improved. The issue of which is a better predictor of work environment satisfaction is different from that of which aspects improve the work environment. This study did not deal with thorough and in-depth comparisons for perception measures and gap measures regarding the objective physical environmental features. Instead, search in-depth comparisons are left for future study since there were limitations to investigating the objective physical environmental characteristics.

CHAPTER VI SUMMARY AND CONCLUSION

This concluding chapter summarizes the objectives of the study, conceptual models, research methods, and the main findings of the study. It concludes with a discussion of the limitations of the study and suggestions for future studies. Implication for practice in workplace design and management are also presented.

Summary of Research Objectives and Literature Review

In today's changing workplace, the importance of the role of the physical environment in supporting organizational goals and changing needs is increasingly acknowledged. However, many workplace designs have not yet successfully supported these changing needs, since they do not resolve the conflict of placing people in individual workplaces while at the same time expecting them to work collaboratively. Therefore, the objective of this study was to examine the effects of control and flexibility on employee's out comes in the workplace. The purposes were 1) to investigate the effects of control (including control over the physical environment by individuals), whether control plays a role in mitigating the negative effects of distraction and disturbance in the work environment, and to lead to better job satisfaction and higher performance at the individual level, and 2) to investigate the effects of flexible use of the workplace on group cohesiveness at an interpersonal level.

Control has been intensively explored in the field of psychology and in job design. However, control over the physical environmental features has not been investigated in a comprehensive way in its relationships with work control. Some studies regarding control

over physical environmental features limit the scope to lighting or the thermal environment. Furthermore, a very few studies have dealt with a moderating or mediating role of control in physical milieu. For instance, density in residential design was investigated to examine the moderating role of control. In the workplace, noise, a stressful source, has been investigated intensively among ambient environmental features, however, with a lack of interrelationship with other physical environmental aspects. Therefore, based on the literature review, it was concluded that the effects of control over both work dimensions and physical environmental dimensions need to be studied to find the influences on work outcomes and on mediating processes in the workplace.

While teamwork and group work have been emphasized in the workplace, few studies have been conducted to investigate the relationship between the physical environmental and interpersonal relationships within the workplace. Few studies have explored how the physical environment might support not only individual work, but also group work. Flexibility has been emphasized in workplace design and in workplace management, but little empirical study has been conducted.

Besides the effects of control and flexibility, this study dealt with how important these features were to employees. Research into satisfaction with the physical environment has focused primarily on how satisfied employees are with certain features of the physical environment instead of measuring perceptions and expectations toward the physical environmental features.

Summary of Methods

In order to carry out the objectives of this research most effectively, questionnaires were used in a natural setting with cross- sectional design. A questionnaire was developed for this study and was pre-tested. Research participants were office employees in manufacturing corporations located in Michigan. Organizations with more than 150 employees were sought. An organizations list was developed from the 'largest employer' list from the Lansing Chamber of Commerce, the local stock interest listings in the Lansing State Journal, a list from the Troy Chamber of Commerce and the IFMA (International Facility Management Association) Michigan directory. Formal letters and follow-up calls or e-mails were sent to human resource managers or facility managers. Three companies agreed to participate in this study. A total of 409 questionnaires were collected though web survey and written paper survey and 384 responses were analyzed for this study. Data were analyzed using SPSS and Lisrel based on the proposed hypotheses.

Summary of Findings

The majority of respondents indicated that they worked individually as well as collaboratively. Approximately 28% of the participants were intensively involved in engineering, 12% of the respondents work for marketing/sales, and 10% of the respondents work in finance. An open office with high partitions was dominant in proportion for office type. Sizes of buildings where participants work varied (square footage per occupant varied from 51 to 243). All buildings provided central heating and ventilation systems. None of the building had a history of major renovation.

The results of each hypothesis tested are summarized in Table 22.

Multiple methods were employed to test each hypothesis. For simple relationships, linear regression analysis and correlation analysis were conducted. SEM was also used to test the hypothesis in the proposed models.

The reliability test of the variables indicated that most constructs achieved good or acceptable reliability. A confirmatory factor analysis was performed for the constructs with multiple indicators. The results of CFA showed a marginal acceptable level. Therefore, for each model, CFA was conducted again for the latent factors of the sub model. The proposed model had an adequate level of goodness of fit.

For hypothesis tests, T-values and chi-square differences were used. For group analysis by different levels of control and by individual work styles, chi-square difference test were performed.

Based on the results of the study, control had a positive effect on job satisfaction. For physical dimensions, 'personalization,' and 'determination of organization and appearance in the workplace' were significantly related to job satisfaction. 'Control over social contacts' was also a predictor of job satisfaction. Control over temperature and lighting control were positively related to satisfaction with the work environment but not to job satisfaction. It was not found that control was positively related to perceived performance.

The results indicate that control plays a mediating role in the relationship between distraction and perceived performance. Different levels of control did not produce significant differences in the negative effects of distraction on performance. It was found that individual work styles affected the effects of distraction. Individual work style was

measured with a semantic differential scale ('go to an office or a private and quiet area' versus 'coffee shop regular'). In people who care more about quietness, the effect of distraction on performance was negative, but the effect in people who do less about quietness was positive.

As expected, flexibility was positively related to task group cohesiveness and not related to social group cohesiveness. Among antecedents of flexibility, the regression result indicated that general flexibility and convertibility were significantly related to task group cohesiveness. There was no significant relationship found between openness and group cohesiveness including both task group cohesiveness and social group cohesiveness. Accessibility was also not related to group cohesiveness for either task group cohesiveness or social group cohesiveness.

Participants in this study expected that they should have more control over social contacts, temperature and lighting control, and should have more flexibility in their workplaces to readjust, reorganize, and to have quiet and undisturbed time. Participants also expected that they should have more adequate storage area compared with the existing condition of their workplaces.

Against the proposition, it was not found that gap measures were superior predictors for explaining work environmental satisfaction or job satisfaction to simple perception measure. However, scatterplots showed some explanation for possible flaws in the conclusion based on linear projection. The gaps model is useful for managerial implication because the methods present which physical aspects should be improved. The issue of which is a better predictor of work environment satisfaction is different from that of which aspects improve the work environment.

Table 22. Summary of Hypotheses Tests

Hypothesis	Method	Results
H1a: Positive effects of control on job satisfaction	Regression	Supported
H1b: Positive effects of control on performance	Regression	Not supported
H2: Negative effects of control on distraction	Regression	Supported
H3a: Negative effects of distraction on performance	SEM	Not supported
H3b: Positive effects of distraction on avoidance meeting people	SEM	Supported
H3c: Positive effects of distraction on working alone	SEM	Supported
H4: Difference in effects of distraction on performance by control levels	SEM	Not supported
H5a: Existence of mediating role of control	SEM	Supported
H5b: Difference in the relationship by solo work style	SEM	Supported
H6a: Positive effects of flexibility on task group cohesiveness	Regression	Supported
H6b: Positive effects of openness on task group cohesiveness	Regression	Not supported
H6c: Positive effects of accessibility on task group cohesiveness	Regression	Not supported
H7a: No effects of flexibility on social group cohesiveness	Regression	Supported
H7b: No effects of openness on social group cohesiveness	Regression	Supported
H7c: No effects of accessibility on social group cohesiveness	Regression	Supported
H8a: Positive relationship between openness and distraction.	Correlation	Supported
H8b Negative effects of distraction and job satisfaction.	Path analysis	Not supported
H8c: Positive relationship between job satisfaction and performance	Path analysis	Supported
H8d: Positive effects of task group cohesiveness and perceived performance.	Path analysis	Supported
H9a: Gap measures are stronger predictors than perception based measures	Regression	Not supported
H9b: Positive relationship between work environment satisfaction and job satisfaction	Correlation	Supported

Limitation of the Study

This research used a questionnaire to investigate employee perceptions and expectations toward physical environmental features in their workplace settings. Physical environmental characteristics were inferred from employees' perceptions since data were collected by self-reporting. Barnes (1981) enumerated some problems in using self reporting measures to assess environments. On one hand, if the effects of the environment are subtle, people are unaware of the influence of physical aspects. On the other hand, self-reporting measures are subject to all the biases associated with inaccurate recall of experience (Taylor & Fiske,1978; Barnes,1981). Although it is a weakness of the study, the research findings show that perception of the physical aspects such as lighting control and temperature control reflect a very low degree of control, which was not significantly deviated from the objective physical environmental condition. There might be questionable differences between the degree of control expressed and the actual degree of control people possessed. Objective measures of physical aspects can provide in-depth understanding of the physical environmental features, however, individual's appreciation for the same features might be quite different. Therefore, self-reported assessments and measurements of objective environmental features need to compliment the interactive nature of built environments.

This study dealt with multiple relationships in the workplace. Interpretation for causal relationships should be based on the context and proposed model. Some organizational characteristics may influence the relationships. The results will be valid only for the established model and contexts. In spite of this weakness, the model suggests a comprehensive approach in dealing with complicated and interwoven physical aspects.

The study is limited to three selected Michigan firms and the industry type is limited to manufacturing corporations. The results should be interpreted with characteristics of those organizations and participating employees. It requires careful consideration for generalizations of the results based on the demographic profiles of employees, the physical settings of offices investigated and the corporation characteristics.

The scope of flexibility in this study is very narrow. It is mainly related to workplace characteristics, and how flexibly individuals can switch their workplace use for either individual work or group work. Since there are few empirical studies, it is meaningful to investigate the effects of flexibility, but the measurement of flexibility needs to also be developed for different levels.

Implication for Future Studies

For future studies, several research directions need to be sought. First, the analysis frame should be developed more thoroughly for the workplace. This study primarily focused on control and flexibility, and included other physical and behavioral variables associated with control and flexibility. To develop the analysis frame, focus groups or other qualitative approaches might be conducted to reveal the new changing workplace characteristics.

Second, the measurement needs to be improved to cover the comprehensive nature of physical environmental aspects and to produce more reliable and predictable results. The measurement used in this study was developed based on previous studies and literature. Because of a lack of reliable tools to measure the proposed concepts, the

present construct of control and concept of flexibility need to be improved further to reflect more facets of control and flexibility as well as to get more reliable results. With physical dimension, behavioral characteristics associated with a certain physical setting should be measured properly. Teamwork and individual work characteristics should be explored more regarding the physical characteristics. In this study, individual work style was measured with one indicator. Instead of directly asking questions, several behavioral indicators need to be developed to measure a propensity toward a certain physical setting. As mentioned earlier, multiple methods might be used to measure the concept. For instance, for physical dimensions, both objective and subjective measures can be used together.

Third, a different research design might reveal interesting facts regarding the effects of control and flexibility. Longitudinal design can reveal effects that cannot be caught in cross sectional design. For instance, by comparing employee's reactions before and after physical environmental changes, a researcher would reveal how people gain control coping with the changes or how different levels of control aspects affect the employees in their individual work and team work.

This study dealt with the effects of control on job satisfaction and performance. It would be intriguing to identify physical environmental stress sources and investigate the moderating role of control. The distinction between moderating role and mediating role of control needs to be further elucidated.

The areas for teamwork should be further identified. As this study was based on individuals focusing on balancing individual needs and interpersonal needs, collaborative activities were not fully explored. Various collaborative activities and team- based work

should be described. A focus group method might reveal the shared thoughts of a group regarding what kinds of physical environmental features should be provided to support their collaborative work. Some inquires still remained, such as what kind of flexibility in space use can be given to individuals; flexibility in which areas, for which specific job responsibilities, doing traditional team based work vs Internet based meetings.

Finally, the results indicate the effectiveness of measuring both perception and expectation toward physical environmental features. The gaps represented the major weakness in physical environmental features and showed which aspects should be improved from the user's perspective. The remaining area is to develop more comprehensive physical environmental dimensions that influence satisfaction. These will include the essential issues of designing, planning and managing the physical environmental features in the workplace.

Practical Implications and Suggestions

Implications for workplace managerial practice and workplace design and planning are suggested from this study.

Control over physical issues is related to the organizational culture and to workplace options. Paciuk (1989) emphasized careful use of control action in the workplace because if occupants fail to appreciate the efficiency of control devices, or if they have a lack of required information, or a lack of understanding of energy use and the consequence of alternative control, the benefits of control may be impaired. Control cannot be achieved in a straightforward method. For instance, temperature control is associated not only with local control devices, but also with direct sunlight. Fixed

windows and uncontrollable sunlight may severely add thermal discomfort. In order for employees to be able to determine the organization and appearance of their workplaces, workplace solutions should be based on required needs rather than on a set of fixed system furniture solutions. To control social contacts, sliding doors or semi transparent doors might be added for individual work stations, especially for managers or professionals who deal with confidential matters. The results indicate that it is necessary to provide workplace options that allow employees to control social contacts.

People inherently try to gain control. It is interesting to see how people gain control, or try to gain it, from the following sentence one of the respondents voluntarily added. "*.....We do adjust light and temperature in the cubicle space, although we are not allowed to do so. Some people unscrew the fluorescent lights in the ceilings over their desks, others buy desk lights, heaters, and fans, which are against the fire code. We also have small refrigerators and coffee pots tucked on or under our desks. ...*" It may be an extreme case, however it emphasizes an insightful fact that people try to make their own work environment comfortable enough to work properly. Therefore, it is important to provide appropriate controls to individuals through various workplace options and workplace use guidelines.

Control issues are about utilizing limited resources to support individual needs and satisfy occupants. Therefore, a facility manager, planner or designer should think comprehensively and provide options that contribute to an appropriate level of control. It is hard to satisfy every individual need, but it is feasible to allow workers to find better ways to use their workspaces based on guided directions. Since the findings of this study

highlighted the importance of control and its interactive nature, a planner or a facility manager should consider the physical workplace elements in a comprehensive way.

Flexible use of space should be designed based on individual work characteristics and categories individuals fall into. This study focused on a narrow scope of flexibility, the solution for individual workplaces and surrounding spaces for employees who switch from individual work to group works, and vice versa. Flexibility in arrangement should be carefully provided so it does not become a source of distraction.

Physical environmental features are interrelated, and require a comprehensive approach. Improving control and flexibility for users cannot be one straightforward solution, instead, it requires deliberately comprehensive procedures to fit the amount and type of control and flexibility with the organizational culture, work activities, and resources.

APPENDICES

Appendix A: Questionnaire

Workplace Evaluation Questionnaire

Dear ____ employee:

This survey will help us understand more about how you work and what you expect from your workplace. This research is conducted by So Young Lee, a doctoral candidate in the Dept. of Human Environment Design, specializing Facilities Design and Management at Michigan State University. This questionnaire is intended to assess employees' perceptions and expectations of their physical work environment. The findings of this study could contribute to planning, management and improvement of workplaces from a user's perspective.

Your organization has agreed to cooperate with the research. Your participation is absolutely voluntary. You may discontinue answering the questionnaire at any time or may refuse to answer certain questions. You indicate your voluntary agreement to participate by completing and returning this questionnaire. Please try to answer each question as honestly as possible. With my best knowledge, there is little potential risk to participate in this study. The questionnaire takes approximately 10-15 minutes for an employee to finish. Be assured that your response will be anonymous and confidential. Your privacy will be protected to the maximum extent allowable by law.

If you have any questions about this study, please contact the investigator, So Young Lee. If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspects of this study, you may contact - anonymously, if you wish- Ashir Kumar, M.D., Chair of the University Committee on Research Involving Human Subjects (UCRIHS) by phone: (517) 355-2180, fax: (517) 432-4503, e-mail: ucrihs@msu.edu., or regular mail:202 Olds Hall, East Lansing, MI 48824. Thank you for your cooperation.

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College of Human Ecology, Michigan State University

Section I General Workplace

Please check the appropriate box.

Your workplace is

☐ Closed to the public

☐ Open & accessible to the public

My current office is best described as:

☐ Private closed (four walls to ceiling; door)

☐ Individual open and high (>54 inch) panels/cubicle

☐ Individual open and low (<54 inch) panels/cubicle

☐ Open office (no partitions)

Your company offers :

☐ Work at home options

☐ Telecenter options

☐ Hoteling options: Use hotel as an workplace for a certain period of time.

☐ Satellite options

☐ None of them

Section II Your job activities

Please check the appropriate box.

Your current job:

☐ Clerical/Support (*for example, Administrative Assistant; Data Entry; Reservations*)

☐ Engineer/Technical/Professional

☐ Manager (*for example, Director; Supervisor; Vice President*)

☐ Other (*please describe*): _____

Please, write down the approximate time you spend working.

Your regular work hours: from ____ to ____

Work hours per week in this office: _____ hours

Work hours per week outside of the office: _____ hours

Please circle the appropriate number.

Your job responsibilities:	No Involvement ↓						Extensive involvement ↓
Sales/Marketing	1	2	3	4	5	6	7
Engineering	1	2	3	4	5	6	7
Operations	1	2	3	4	5	6	7
Human Resources	1	2	3	4	5	6	7
Finance/Accounting	1	2	3	4	5	6	7
Purchasing	1	2	3	4	5	6	7
Research/ Development	1	2	3	4	5	6	7
Strategic Planning	1	2	3	4	5	6	7
Other _____	1	2	3	4	5	6	7

Please indicate yes or no by checking the appropriate box.

Do you work as team?

☐ Yes

☐ No

→ *If yes,* do you have a designated shared space for your team when you do team work?

☐ Yes

☐ No

→ *If yes,* is your team work area fully enclosed? *Please circle one of the numbers.*

No, not at all 1 2 3 4 5 6 7 Yes

Please circle the appropriate number.

Your solo work style:

Go to an office or a private and quiet area ...1 2 3 4 5 6 7 ...coffee shop regular

Here are a few statements about people's jobs. Please indicate how often each statement is true for your job by circling the numbers.

	Never	Rarely	Sometimes	Often	Always
When I'm at the office, I work alone rather than in workgroups or teams.	1	2	3	4	5
My work is simple and demands little concentration.	1	2	3	4	5
My job requires a lot of cooperative work with others.	1	2	3	4	5
I take work home because it is difficult to complete at work.	1	2	3	4	5
I share common work areas with others	1	2	3	4	5
I do teleconferencing.	1	2	3	4	5

	Never	Rarely	Sometimes	Often	Always
My work requires deep thoughts and concentration.	1	2	3	4	5
I would like to work alone.	1	2	3	4	5
I often avoid meeting people in my workplace.	1	2	3	4	5
My workplace has been moved within my office.	1	2	3	4	5
My workplace has been moved between offices.	1	2	3	4	5
I have moved between teams	1	2	3	4	5

Section III Physical environmental features of workplace

The following set of statements related to your feelings and opinions about your workplace. In each set, please show the extent to which you agree or disagree the statement and show the extent to which you think your workplace should possess the features described by each statement. You may circle one of the numbers. If you strongly agree, circle the number 7. If you strongly disagree the statement, circle the number 1. If your feelings are not strong, circle one of the numbers in the middle. There are no right or wrong answers-all we are interested in is a number that best shows your perception about your work environment.

	Strongly disagree						Strongly agree
My workplace is open enough to see my colleagues working.	1	2	3	4	5	6	7
My workplace should be open enough to see my colleagues working.	1	2	3	4	5	6	7
My workplace provides an undisturbed environment so that I can concentrate on my work.	1	2	3	4	5	6	7
My workplace should provide an undisturbed environment so that I can concentrate on my work.	1	2	3	4	5	6	7
My furniture is flexible enough to adjust, rearrange, or reorganize my workspace.	1	2	3	4	5	6	7
My furniture should be flexible enough to adjust, rearrange, or reorganize my workspace.	1	2	3	4	5	6	7
I am easily distracted from my work.	1	2	3	4	5	6	7
I should not be easily distracted from my work.	1	2	3	4	5	6	7
I am able to control the social contact with others around me.	1	2	3	4	5	6	7
I should be able to control the social contact with others around me.	1	2	3	4	5	6	7
I have informal and impromptu meetings in my private workstation.	1	2	3	4	5	6	7
I should be able to have informal and impromptu meeting in my private workstation.	1	2	3	4	5	6	7

	Strongly disagree						Strongly agree
My work schedule is flexible.	1	2	3	4	5	6	7
My work schedule should be flexible.	1	2	3	4	5	6	7
I am able to determine the scheduling and duration of rest breaks.	1	2	3	4	5	6	7
I should be able to determine the scheduling and duration of rest breaks.	1	2	3	4	5	6	7
The quality of my equipment is more than sufficient to work effectively.	1	2	3	4	5	6	7
The quality of my equipment should be more than sufficient to work effectively.	1	2	3	4	5	6	7
My workplace serves multi-purpose functions for informal and instant meeting.	1	2	3	4	5	6	7
My workplace should serve multi-purpose functions for informal and instant meeting.	1	2	3	4	5	6	7
I am able to personalize my workspace.	1	2	3	4	5	6	7
I should be able to personalize my workspace.	1	2	3	4	5	6	7
I am able to control temperature or airflow in my office.	1	2	3	4	5	6	7
I should be able to control temperature or airflow in my office.	1	2	3	4	5	6	7
My work environment is quiet.	1	2	3	4	5	6	7
My work environment should be quiet.	1	2	3	4	5	6	7

	Strongly disagree						Strongly agree
I am able to determine the organization/appearance of my work area.	1	2	3	4	5	6	7
I should be able to determine the organization/appearance of my work area.	1	2	3	4	5	6	7
I am able to control the amount and timing of contact with other people including co-workers or clients.	1	2	3	4	5	6	7
I should be able to control the amount and timing of contact with other people including co-workers or clients.	1	2	3	4	5	6	7
I am able to be easily accessed from my colleague's workstation.	1	2	3	4	5	6	7
I should be able to be easily accessed from my colleague's workstation.	1	2	3	4	5	6	7
My workstation is over-equipped for my typical needs.	1	2	3	4	5	6	7
My workstation should be over- equipped for my typical needs.	1	2	3	4	5	6	7
In general, my workspace is flexible.	1	2	3	4	5	6	7
In general, my workspace should be flexible.	1	2	3	4	5	6	7
I am able to choose among available methods to complete my tasks.	1	2	3	4	5	6	7
I should be able to choose among available methods to complete my tasks.	1	2	3	4	5	6	7
My furniture is a fixed system.	1	2	3	4	5	6	7
My furniture should be fixed system.	1	2	3	4	5	6	7

	Strongly disagree						Strongly agree
I am able to determine the order in which tasks are completed.	1	2	3	4	5	6	7
I should be able to determine the order in which tasks are completed.	1	2	3	4	5	6	7
My workstation is large.	1	2	3	4	5	6	7
My workstation should be large.	1	2	3	4	5	6	7
I am able to have quiet and undisturbed time alone.	1	2	3	4	5	6	7
I should be able to have quiet and undisturbed time alone.	1	2	3	4	5	6	7
My work area has many visual distractions.	1	2	3	4	5	6	7
My work area should have many visual distractions.	1	2	3	4	5	6	7
I have ample storage in my work area.	1	2	3	4	5	6	7
I should have ample storage in my work area.	1	2	3	4	5	6	7
I am able to control the lighting level in my workstation.	1	2	3	4	5	6	7
I should be able to control the lighting level in my workstation.	1	2	3	4	5	6	7
I am able to determine the order in which tasks are completed.	1	2	3	4	5	6	7
I should be able to determine the order in which tasks are completed.	1	2	3	4	5	6	7

Please circle the appropriate number.

How are you satisfied with your workplace in general?

very unsatisfied 1 -- 2 -- 3 -- 4 – 5 -- 6 -- 7 very satisfied

Section IV Toward outcomes of your general work activities

This survey deals with your work outcomes. Please show the extent to which you think how well you work as described by each statement if you strongly agree, circle the number 7. If you strongly disagree the statement, circle the number 1. If your feelings are not strong, circle one of the numbers in the middle, there are no right or wrong answers – all we are interested in is a number that best shows your evaluation about your works.

	Strongly disagree						Strongly agree
My colleagues would like to spend time together outside of work hours.	1	2	3	4	5	6	7
My colleagues are united in trying to reach its goals for performance.	1	2	3	4	5	6	7
Generally speaking, I am very satisfied with my work.	1	2	3	4	5	6	7
I would consider taking another job.	1	2	3	4	5	6	7
My colleagues have conflicting aspirations for the group work performance.	1	2	3	4	5	6	7
My colleagues would rather go out on their own than get together.	1	2	3	4	5	6	7
My colleagues do not stick together outside of work time.	1	2	3	4	5	6	7

	Strongly disagree						Strongly agree
I would recommend my job to a friend who was qualified and looking for work.	1	2	3	4	5	6	7
My work group does not give me enough opportunities to improve my personal performance.	1	2	3	4	5	6	7
I am unhappy with my group's level of commitment to the task.	1	2	3	4	5	6	7
I communicate effectively with my colleagues within the office.	1	2	3	4	5	6	7
If I had it to do over, I would choose to work here again.	1	2	3	4	5	6	7

The following statements are related your work performance. Please circle the numbers that reflect how you rate your own work performance on each of the following dimension.

	Never	Rarely	Sometime	Often	Always
My work is of high quality.	1	2	3	4	5
I make mistakes or errors.	1	2	3	4	5
I do a large amount of work each day.	1	2	3	4	5
I can accomplish a great deal each day.	1	2	3	4	5
My work outcome is creative.	1	2	3	4	5

Section V Demographic Information

Please check the appropriate box.

Your gender: ☐ Male ☐ Female

Your age:
☐ Under 25
☐ 25-34
☐ 35-44
☐ 45-54
☐ 55-64
☐ 65 or over

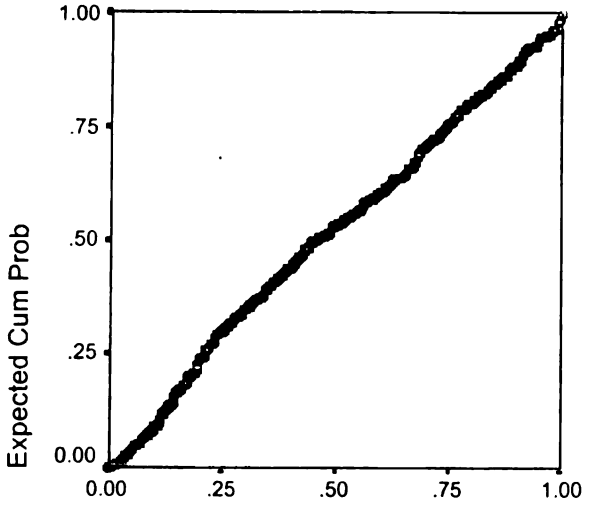
Your education:
☐ High school degree/ G.E.D.
☐ College degree
☐ Master's degree
☐ Higher degree than master's

Thank you for your cooperation!!!

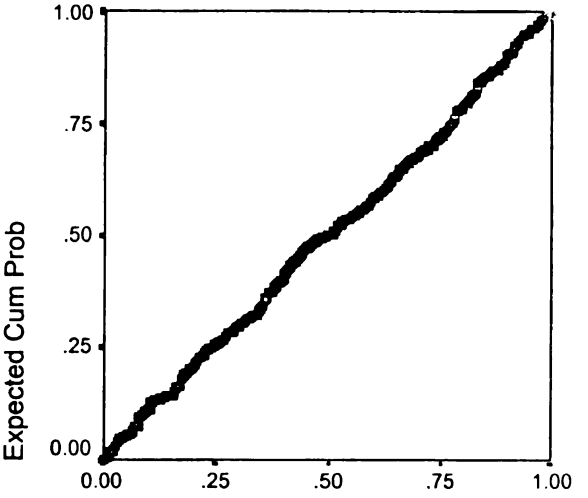
Appendix B: Regression Assumptions

Figure B1. Normal Probability Plots of the Standardized Residuals

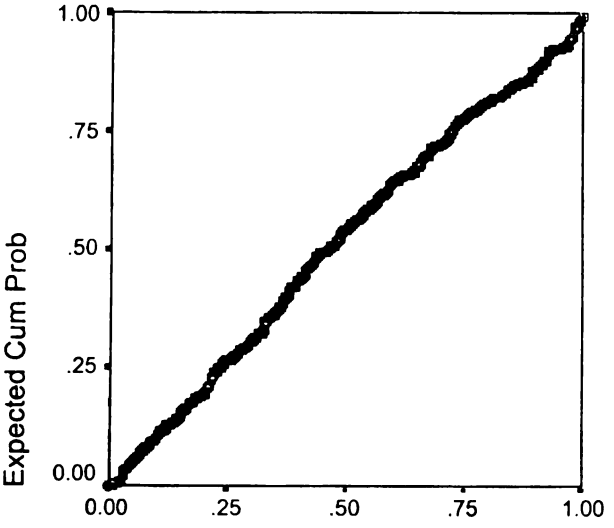
B1a: Job satisfaction (control)



B1b : Performance (control)



B1c: Task Group Cohesiveness (flexibility)



B1d: Job Satisfaction (distraction)

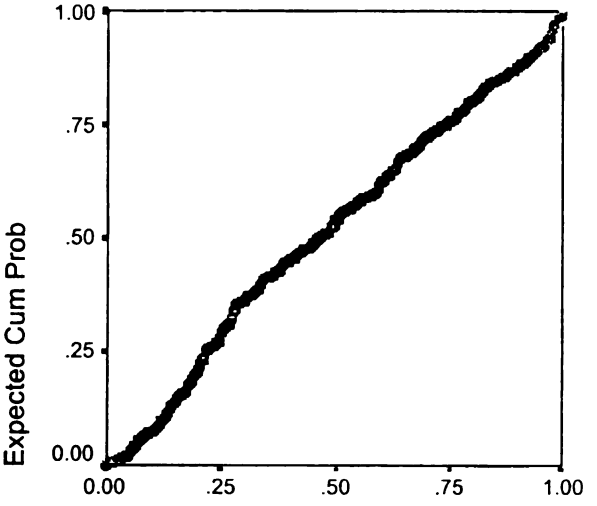


Figure B2. Scatter plots between Control variables and Standard Residuals of Job Satisfaction

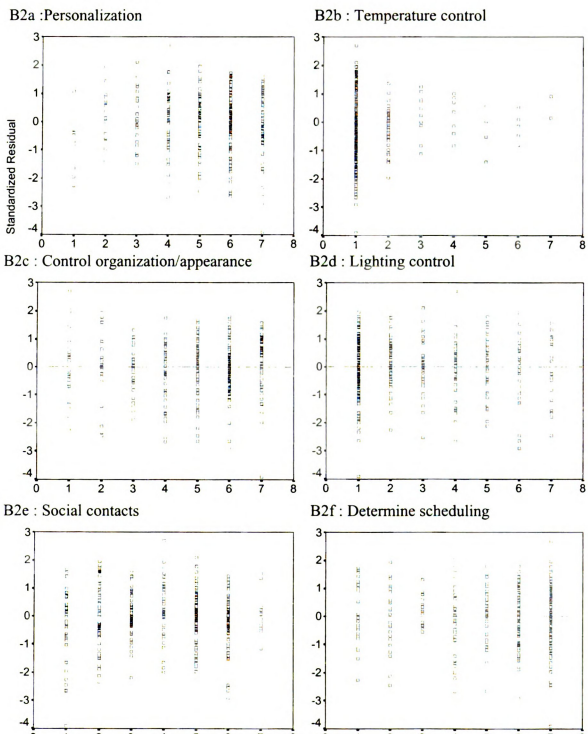
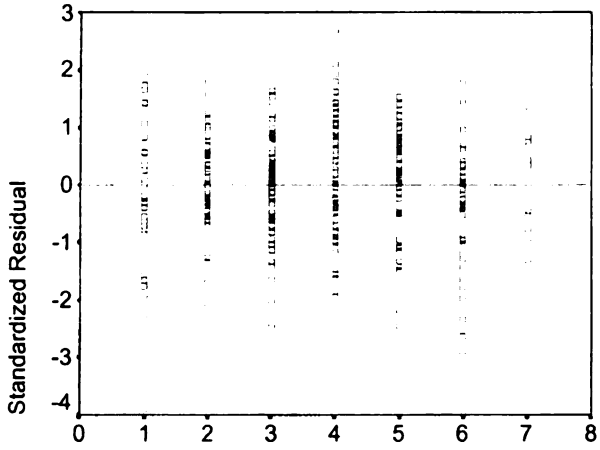
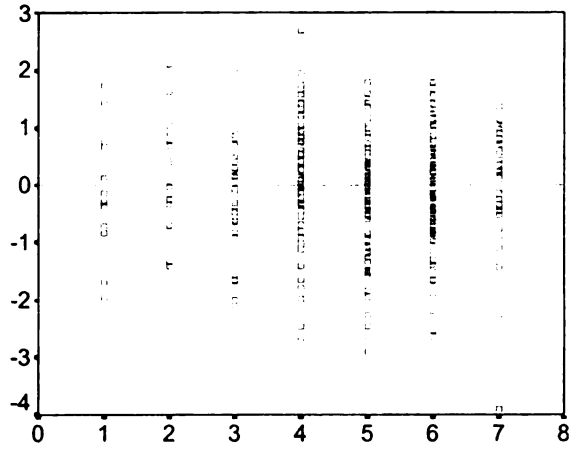


Figure B2. Scatter plots between Control variables and Standard Residuals of Job Satisfaction (*Continued.*)

B2g : Control amount & timing of contact



B2h : Choice among available methods



B2i : Determine order

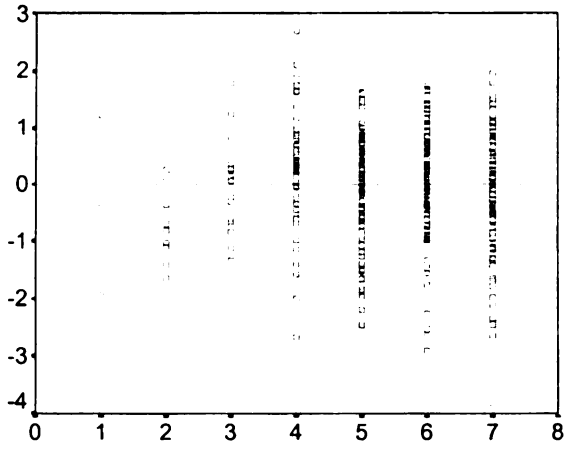
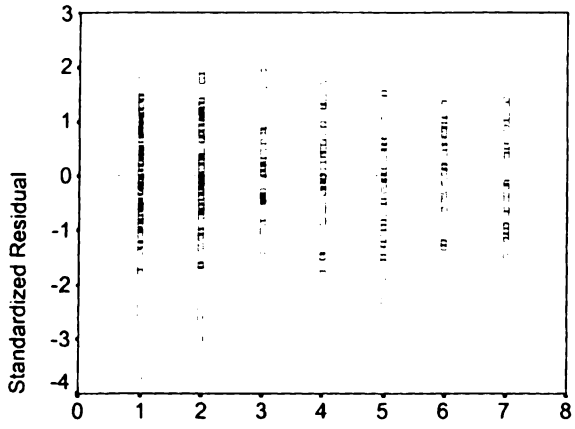
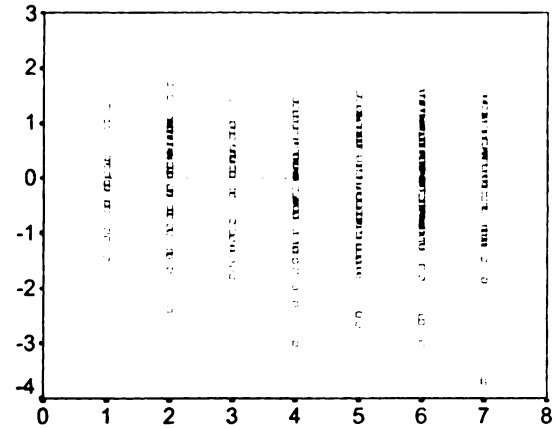


Figure B3. Scatterplots between Flexibility variables and Standard Residuals of Task Group Cohesiveness

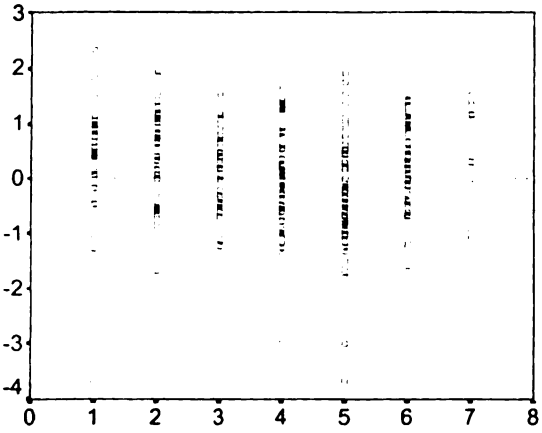
B3 a : Convertibility



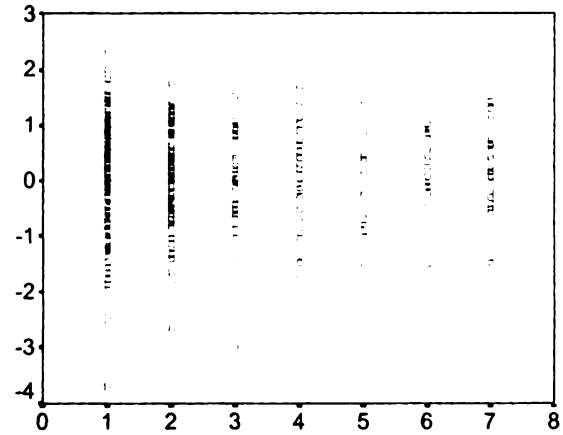
B3 b :Versatility



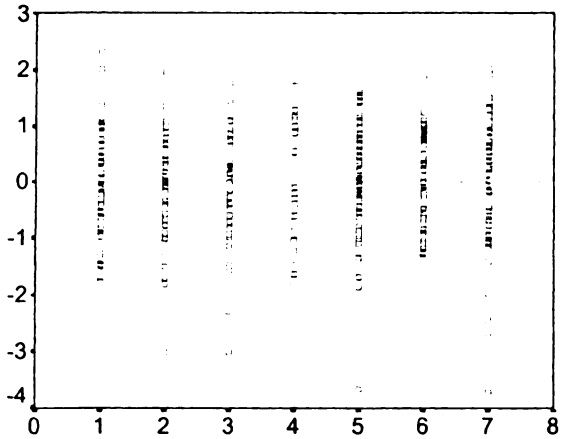
B3 c : General flexibility



B3 d : Movable system



B3 e : Openness



B3 f : Accessibility

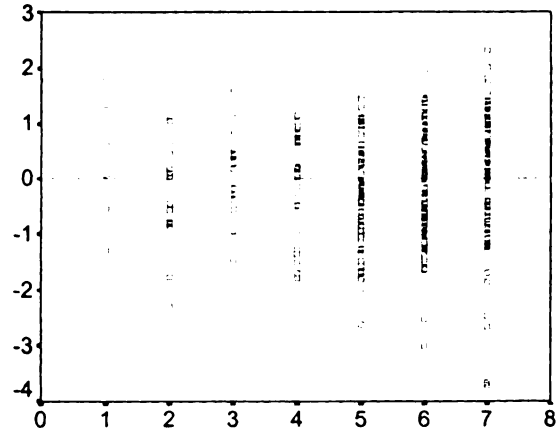
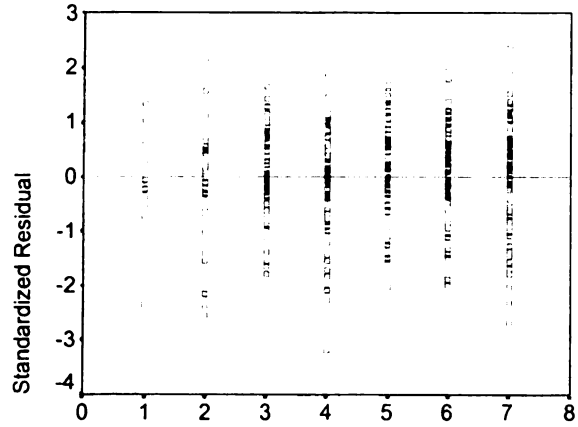
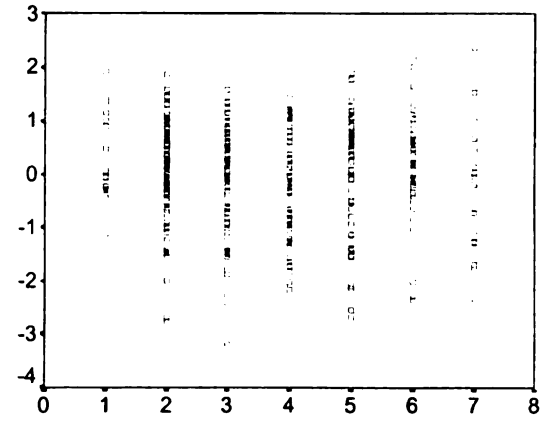


Figure B4. Scatter plots between distraction variables and standard residuals of job satisfaction

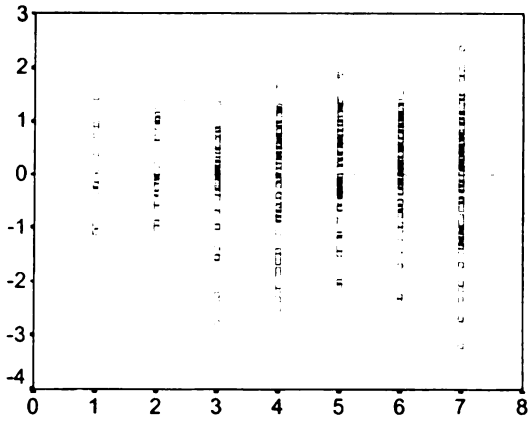
B4 a : Undisturbed workplace (R)



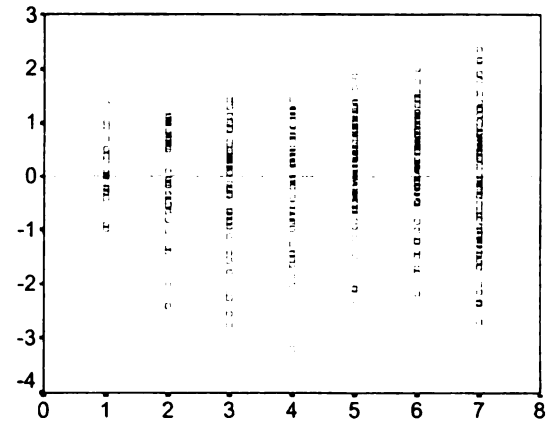
B4 b : Easily distracted



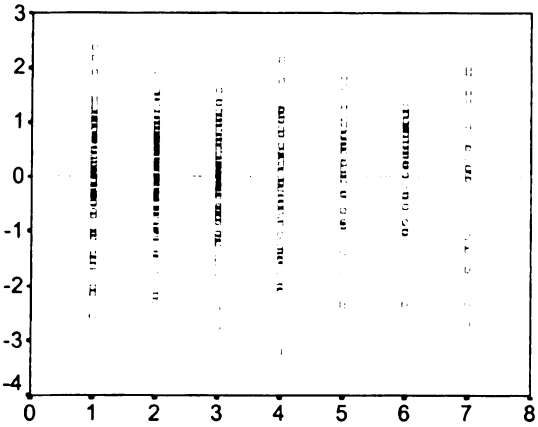
B4 c : Quietness (R)



B4 d : Quiet and undisturbed time (R)



B4 e : Visual distraction



Appendix C: Covariance Matrices

Office environment - A CONFIRMATORY FACTOR ANALYSIS

Covariance Matrix to be Analyzed

	c1	c2	c3	c4	c5	c6
c1	2.42					
c2	1.15	3.28				
c3	0.53	0.52	3.21			
c4	0.74	0.51	0.24	3.53		
c5	0.46	0.60	1.28	0.60	2.65	
c6	0.56	0.74	0.57	0.45	0.59	2.14
c7	0.40	0.36	0.16	0.46	0.23	0.59
gs1	0.26	0.26	0.02	0.03	-0.03	0.35
gs2	0.46	0.24	0.30	0.24	0.13	0.35
gs3	0.37	0.18	0.28	-0.12	0.12	0.32
tg1	0.19	0.34	0.49	0.10	0.24	0.35
tg2	0.38	0.38	0.56	0.11	0.35	0.31
tg3	0.49	0.57	0.53	0.18	0.38	0.61
tg4	0.53	0.57	0.55	0.19	0.49	0.45
tg5	0.28	0.39	0.21	0.19	0.14	0.36
j1	0.47	0.50	0.57	0.34	0.37	0.53
j2	0.28	0.57	0.51	0.33	0.17	0.44
j3	0.64	0.69	0.63	0.56	0.45	0.58
j4	0.60	0.73	0.51	0.52	0.36	0.66
p1	0.01	0.08	0.02	0.00	-0.04	0.06
p2	-0.01	0.01	0.00	-0.22	-0.03	0.03
p3	0.07	0.12	0.15	-0.02	0.14	0.10
p4	-0.01	0.02	0.11	0.13	0.13	0.20
d1	-0.52	-0.43	-1.02	-0.52	-0.73	-0.26
d2	-0.04	-0.23	-0.46	-0.09	-0.32	-0.13
d3	-0.52	-0.55	-1.06	-0.49	-0.61	-0.39
d4	-0.63	-0.58	-1.28	-0.57	-1.00	-0.47
d5	-0.42	-0.54	-0.50	-0.04	-0.50	-0.13
f1	0.94	0.86	0.83	0.09	0.46	0.55
f2	0.83	0.61	0.51	0.45	0.36	0.78
f3	1.00	1.05	0.85	0.41	0.64	0.85
f4	0.14	0.35	0.06	-0.07	-0.20	-0.10

Covariance Matrix to be Analyzed

	c7	gs1	gs2	gs3	tg1	tg2
c7	1.75					
gs1	0.01	2.13				
gs2	0.13	0.79	1.98			
gs3	0.17	1.06	1.33	2.56		
tg1	0.36	0.56	0.54	0.60	1.84	
tg2	0.26	0.31	0.67	0.84	1.07	2.67
tg3	0.36	0.30	0.72	0.82	0.88	1.08
tg4	0.45	0.38	0.56	0.58	1.02	1.17
tg5	0.32	0.15	0.35	0.23	0.52	0.40
j1	0.42	0.25	0.43	0.47	0.93	0.73
j2	0.25	0.06	0.35	0.33	0.41	0.69
j3	0.58	0.43	0.61	0.57	0.88	0.75
j4	0.42	0.22	0.53	0.29	0.77	0.71
p1	0.09	0.08	0.06	0.03	0.10	-0.08
p2	0.09	0.15	0.06	0.14	0.19	0.01

p3	0.12	0.05	0.12	0.10	0.13	0.00
p4	0.01	0.09	0.05	0.07	0.14	-0.03
d1	-0.34	0.09	-0.32	-0.18	-0.31	-0.52
d2	-0.21	0.12	-0.18	-0.26	-0.32	-0.38
d3	-0.20	-0.02	-0.45	-0.29	-0.36	-0.48
d4	-0.11	-0.04	-0.37	-0.34	-0.44	-0.35
d5	-0.12	0.05	-0.08	-0.32	-0.18	-0.43
f1	0.04	0.28	0.36	0.24	0.44	0.46
f2	0.30	0.04	0.12	0.13	0.20	0.26
f3	0.24	0.37	0.35	0.26	0.36	0.40
f4	-0.34	-0.06	0.24	0.20	-0.08	0.07

Covariance Matrix to be Analyzed

	tg3	tg4	tg5	j1	j2	j3
tg3	2.81					
tg4	1.16	2.35				
tg5	0.43	0.48	1.21			
j1	1.13	0.92	0.51	1.84		
j2	1.10	0.74	0.38	0.91	3.04	
j3	1.19	0.93	0.63	1.31	0.75	2.55
j4	1.02	0.89	0.65	1.20	0.95	1.49
p1	0.08	0.02	0.12	0.08	0.02	0.05
p2	0.17	0.17	0.11	0.12	0.07	0.14
p3	0.16	0.16	0.16	0.21	0.12	0.19
p4	0.28	0.09	0.12	0.29	0.22	0.34
d1	-0.48	-0.51	-0.12	-0.46	-0.27	-0.55
d2	-0.30	-0.49	-0.27	-0.40	-0.22	-0.28
d3	-0.55	-0.55	-0.26	-0.57	-0.23	-0.49
d4	-0.61	-0.60	-0.22	-0.65	-0.46	-0.60
d5	-0.23	-0.51	-0.11	-0.31	-0.21	-0.23
f1	0.47	0.49	0.21	0.58	0.42	0.46
f2	0.34	0.20	0.16	0.44	0.40	0.51
f3	0.39	0.47	0.29	0.49	0.28	0.53
f4	0.27	0.01	-0.05	0.08	0.04	0.03

Covariance Matrix to be Analyzed

	j4	p1	p2	p3	p4	d1
j4	2.35					
p1	0.02	0.27				
p2	0.15	0.11	0.45			
p3	0.15	0.08	0.17	0.44		
p4	0.17	0.10	0.15	0.19	0.71	
d1	-0.39	0.04	0.15	-0.09	-0.01	2.87
d2	-0.39	-0.06	-0.07	-0.31	-0.15	0.89
d3	-0.65	-0.03	0.05	-0.19	-0.03	1.49
d4	-0.64	0.03	0.01	-0.18	-0.14	1.61
d5	-0.18	-0.01	0.06	-0.11	0.14	0.62
f1	0.77	-0.05	0.05	0.15	0.11	-0.79
f2	0.51	0.01	0.05	-0.01	0.14	-0.32
f3	0.76	0.02	0.06	0.15	0.05	-0.69
f4	0.10	-0.12	0.00	-0.03	-0.02	-0.11

Covariance Matrix to be Analyzed

	d2	d3	d4	d5	f1	f2
d2	2.65					
d3	0.86	2.79				
d4	0.80	1.49	3.28			
d5	0.64	0.49	0.88	3.11		

f1	-0.30	-0.74	-0.88	-0.43	3.90	
f2	0.27	-0.32	-0.43	-0.05	0.93	3.07
f3	-0.34	-0.97	-0.76	-0.17	1.91	0.91
f4	-0.14	-0.27	-0.42	-0.20	1.49	0.17

Covariance Matrix to be Analyzed

	f3	f4
f3	2.94	
f4	0.83	3.42

Control factor analysis 1

Covariance Matrix to be Analyzed

	pe1	pe1	pe3	pe4	pc1	pc2
pe1	0.27					
pe1	0.11	0.45				
pe3	0.08	0.17	0.44			
pe4	0.09	0.15	0.19	0.73		
pc1	0.01	-0.05	0.09	0.00	2.46	
pc2	0.07	-0.01	0.11	0.01	1.14	3.31
pc3	0.00	-0.02	0.14	0.11	0.54	0.52
wc1	0.00	-0.20	-0.02	0.12	0.68	0.55
wc2	-0.04	-0.05	0.13	0.13	0.44	0.59
wc3	0.06	0.00	0.11	0.20	0.62	0.74
wc4	0.09	0.10	0.14	0.04	0.43	0.34
di1	0.05	0.18	-0.11	0.00	-0.56	-0.46
di2	-0.05	-0.05	-0.31	-0.16	-0.10	-0.22
di3	-0.02	0.07	-0.19	-0.04	-0.53	-0.56
di4	0.04	0.04	-0.18	-0.13	-0.66	-0.58
di5	-0.01	0.07	-0.13	0.13	-0.43	-0.50

Covariance Matrix to be Analyzed

	pc3	wc1	wc2	wc3	wc4	di1
pc3	3.22					
wc1	0.28	3.48				
wc2	1.33	0.60	2.68			
wc3	0.56	0.44	0.54	2.15		
wc4	0.18	0.43	0.27	0.58	1.81	
di1	-1.04	-0.51	-0.78	-0.29	-0.33	2.93
di2	-0.45	-0.05	-0.29	-0.19	-0.21	0.94
di3	-1.08	-0.46	-0.62	-0.40	-0.21	1.50
di4	-1.27	-0.53	-1.02	-0.48	-0.11	1.63
di5	-0.61	-0.04	-0.60	-0.10	-0.13	0.72

Covariance Matrix to be Analyzed

	di2	di3	di4	di5
di2	2.67			
di3	0.88	2.77		
di4	0.79	1.53	3.29	
di5	0.63	0.56	0.94	3.23

Control-distraction-performance

Covariance Matrix to be Analyzed

	alo	avoi	pe1	pe2	pe3	pe4
alo	0.60					
avoi	0.17	0.73				
pe1	0.04	0.00	0.27			
pe2	0.04	-0.03	0.11	0.45		
pe3	0.00	-0.05	0.08	0.17	0.44	
pe4	0.03	-0.11	0.09	0.15	0.19	0.72
di1	0.19	0.13	0.05	0.17	-0.11	-0.01
di2	0.13	0.20	-0.05	-0.05	-0.32	-0.16
di3	0.18	0.12	-0.02	0.06	-0.19	-0.04
di4	0.14	0.08	0.04	0.03	-0.18	-0.14
di5	0.09	0.11	0.00	0.06	-0.13	0.12
pc1	-0.12	-0.16	0.01	-0.05	0.09	0.01
pc2	-0.11	-0.19	0.07	-0.01	0.11	0.02
pc3	-0.09	-0.12	0.00	-0.02	0.14	0.11
wc1	0.00	-0.02	0.00	-0.21	-0.02	0.12
wc2	-0.04	0.00	-0.04	-0.04	0.14	0.14
wc3	-0.18	-0.13	0.06	0.00	0.10	0.20
wc4	-0.05	-0.11	0.09	0.10	0.13	0.04

Covariance Matrix to be Analyzed

	di1	di2	di3	di4	di5	pc1
di1	2.94					
di2	0.94	2.68				
di3	1.50	0.88	2.78			
di4	1.63	0.78	1.52	3.30		
di5	0.70	0.63	0.54	0.92	3.19	
pc1	-0.56	-0.10	-0.52	-0.65	-0.41	2.45
pc2	-0.46	-0.22	-0.55	-0.58	-0.48	1.12
pc3	-1.04	-0.44	-1.08	-1.28	-0.60	0.53
wc1	-0.53	-0.06	-0.47	-0.54	-0.07	0.70
wc2	-0.76	-0.28	-0.61	-1.01	-0.58	0.44
wc3	-0.31	-0.19	-0.41	-0.49	-0.10	0.63
wc4	-0.33	-0.21	-0.21	-0.11	-0.13	0.42

Covariance Matrix to be Analyzed

	pc2	pc3	wc1	wc2	wc3	wc4
pc2	3.31					
pc3	0.51	3.23				
wc1	0.56	0.29	3.49			
wc2	0.60	1.34	0.61	2.67		
wc3	0.75	0.56	0.44	0.55	2.16	
wc4	0.33	0.17	0.43	0.28	0.58	1.81

Effects of control (high control group)

Covariance Matrix to be Analyzed

	alo	avoi	pe1	pe2	pe3	pe4
alo	0.56					
avoi	0.24	0.71				
pe1	0.03	0.03	0.28			
pe2	-0.02	-0.06	0.11	0.46		
pe3	-0.03	-0.05	0.08	0.17	0.41	
pe4	-0.03	-0.15	0.08	0.20	0.17	0.70
di1	0.08	0.14	0.07	0.19	-0.07	0.06
di2	0.16	0.16	-0.07	-0.03	-0.23	-0.10
di3	0.17	0.23	0.01	-0.06	-0.17	0.05
di4	0.01	0.22	0.04	-0.01	-0.13	-0.17
di5	0.04	0.04	-0.04	0.02	-0.11	0.14
pc1	-0.10	-0.16	0.06	0.01	-0.01	0.01
pc2	-0.12	-0.12	0.08	0.05	0.09	0.05
pc3	0.02	-0.19	-0.11	-0.02	0.07	-0.06
wc1	-0.20	-0.19	-0.04	-0.11	-0.05	0.12
wc2	-0.01	-0.01	-0.06	-0.05	0.10	0.09
wc3	-0.14	-0.09	0.11	0.11	0.13	0.25
wc4	-0.07	-0.08	0.05	0.10	0.12	0.01

Covariance Matrix to be Analyzed

	di1	di2	di3	di4	di5	pc1
di1	3.04					
di2	1.06	2.74				
di3	1.61	0.97	3.07			
di4	1.64	0.91	1.52	3.49		
di5	0.77	0.62	0.49	1.18	3.15	
pc1	0.03	0.17	-0.22	0.04	-0.04	1.35
pc2	0.08	-0.19	-0.13	0.02	-0.15	0.33
pc3	-0.61	-0.36	-0.65	-0.68	-0.12	-0.14
wc1	-0.28	0.08	-0.08	-0.06	-0.04	0.16
wc2	-0.53	-0.14	-0.30	-0.60	-0.29	-0.26
wc3	-0.05	-0.16	-0.03	-0.19	-0.13	0.18
wc4	-0.09	-0.19	-0.01	0.08	-0.05	0.04

Covariance Matrix to be Analyzed

	pc2	pc3	wc1	wc2	wc3	wc4
pc2	1.81					
pc3	-0.26	2.67				
wc1	0.02	-0.34	2.26			
wc2	-0.20	0.59	0.17	2.47		
wc3	0.15	0.00	0.27	0.04	1.11	
wc4	-0.02	-0.29	0.17	0.13	0.14	1.08

Effects of control (low control group)

Covariance Matrix to be Analyzed

	alo	avoi	pe1	pe2	pe3	pe4
alo	0.66					
avoi	0.10	0.75				
pe1	0.05	-0.03	0.27			
pe2	0.11	0.01	0.11	0.45		
pe3	0.04	-0.05	0.07	0.17	0.47	
pe4	0.09	-0.06	0.10	0.10	0.21	0.74
di1	0.28	0.08	0.06	0.16	-0.09	-0.04
di2	0.09	0.22	-0.01	-0.08	-0.38	-0.21
di3	0.17	-0.04	-0.01	0.19	-0.16	-0.09
di4	0.25	-0.11	0.09	0.08	-0.16	-0.05
di5	0.12	0.16	0.06	0.10	-0.12	0.11
pc1	-0.11	-0.08	-0.11	-0.10	0.07	-0.08
pc2	-0.07	-0.17	-0.01	-0.08	-0.01	-0.12
pc3	-0.18	0.02	0.04	-0.02	0.10	0.19
wc1	0.21	0.21	-0.01	-0.31	-0.07	0.05
wc2	-0.04	0.08	-0.08	-0.04	0.08	0.11
wc3	-0.19	-0.11	-0.06	-0.12	-0.02	0.06
wc4	-0.01	-0.09	0.09	0.09	0.08	0.02

Covariance Matrix to be Analyzed

	di1	di2	di3	di4	di5	pc1
di1	2.54					
di2	0.67	2.57				
di3	1.05	0.62	2.13			
di4	1.17	0.44	1.03	2.45		
di5	0.47	0.57	0.42	0.43	3.18	
pc1	-0.51	-0.07	-0.13	-0.41	-0.46	2.25
pc2	-0.27	0.10	-0.18	-0.12	-0.44	0.41
pc3	-0.88	-0.24	-0.88	-1.02	-0.79	-0.03
wc1	-0.30	0.03	-0.35	-0.33	0.15	0.25
wc2	-0.43	-0.15	-0.30	-0.59	-0.59	-0.04
wc3	0.04	0.06	-0.13	0.08	0.22	-0.16
wc4	-0.17	-0.05	0.02	0.28	-0.02	-0.03

Covariance Matrix to be Analyzed

	pc2	pc3	wc1	wc2	wc3	wc4
pc2	3.09					
pc3	-0.13	2.67				
wc1	-0.02	0.00	4.01			
wc2	0.05	0.99	0.19	1.83		
wc3	-0.07	-0.03	-0.32	-0.03	2.06	
wc4	-0.25	-0.14	0.09	-0.31	0.25	2.05

distraction-control-performance (individual work style coffeeshop)

Covariance Matrix to be Analyzed

	pe1	pe1	pe3	pe4	pc1	pc2
pe1	0.28					
pe1	0.13	0.46				
pe3	0.09	0.27	0.46			
pe4	0.14	0.29	0.25	0.77		
pc1	0.14	0.09	0.19	0.05	2.38	
pc2	0.11	-0.14	0.04	0.12	1.20	3.32
pc3	0.07	0.26	0.20	0.37	0.32	0.37
wc1	0.00	-0.01	0.02	0.13	0.52	0.74
wc2	0.07	0.14	0.17	0.21	0.35	0.53
wc3	0.04	-0.07	0.13	0.15	0.49	1.13
wc4	0.15	0.18	0.22	0.08	0.47	0.46
di1	0.00	-0.03	0.08	0.00	-0.16	0.02
di2	-0.12	-0.23	-0.28	-0.33	0.18	-0.37
di3	-0.14	-0.19	-0.20	-0.28	-0.48	-0.47
di4	0.03	-0.11	-0.06	-0.20	-0.34	-0.28
di5	0.04	-0.04	-0.11	0.05	-0.18	-0.18

Covariance Matrix to be Analyzed

	pc3	wc1	wc2	wc3	wc4	di1
pc3	3.09					
wc1	-0.10	3.25				
wc2	1.09	0.55	2.39			
wc3	0.45	0.67	0.53	2.19		
wc4	0.02	0.77	0.22	0.55	1.97	
di1	-0.82	-0.45	-0.38	-0.24	-0.04	2.45
di2	-0.52	0.12	-0.25	-0.28	-0.16	0.76
di3	-1.21	-0.10	-0.54	-0.60	-0.11	0.88
di4	-1.28	0.02	-0.53	-0.17	0.12	1.00
di5	-0.33	-0.13	-0.67	0.30	0.21	0.41

Covariance Matrix to be Analyzed

	di2	di3	di4	di5
di2	2.67			
di3	0.69	2.47		
di4	0.60	1.06	2.78	
di5	0.49	-0.01	0.53	2.96

distraction-control-performance (individual work style quiet)

Covariance Matrix to be Analyzed

	pe1	pe1	pe3	pe4	pc1	pc2
pe1	0.28					
pe1	0.10	0.43				
pe3	0.07	0.11	0.41			
pe4	0.06	0.10	0.16	0.72		
pc1	-0.07	-0.18	0.02	-0.02	2.46	
pc2	0.03	0.02	0.11	-0.06	1.05	3.23
pc3	-0.06	-0.18	0.08	-0.05	0.60	0.55
wc1	0.00	-0.33	-0.05	0.12	0.74	0.48
wc2	-0.12	-0.17	0.12	0.09	0.52	0.59
wc3	0.04	0.03	0.07	0.20	0.68	0.43

wc4	0.06	0.04	0.09	0.02	0.38	0.24
di1	0.08	0.29	-0.22	-0.02	-0.77	-0.69
di2	0.01	0.04	-0.34	-0.09	-0.13	-0.01
di3	0.07	0.18	-0.22	0.09	-0.56	-0.57
di4	0.06	0.13	-0.24	-0.13	-0.77	-0.76
di5	-0.01	0.08	-0.16	0.16	-0.61	-0.61

Covariance Matrix to be Analyzed

	pc3	wc1	wc2	wc3	wc4	di1
pc3	3.23					
wc1	0.51	3.66				
wc2	1.48	0.72	2.76			
wc3	0.50	0.37	0.54	1.99		
wc4	0.24	0.26	0.34	0.52	1.66	
di1	-1.25	-0.58	-0.96	-0.33	-0.46	3.19
di2	-0.41	-0.09	-0.30	-0.05	-0.24	0.99
di3	-1.00	-0.68	-0.69	-0.25	-0.23	1.79
di4	-1.32	-0.83	-1.27	-0.69	-0.22	1.98
di5	-0.82	-0.08	-0.64	-0.22	-0.26	0.84

Covariance Matrix to be Analyzed

	di2	di3	di4	di5
di2	2.58			
di3	0.90	2.89		
di4	0.85	1.77	3.47	
di5	0.64	0.80	1.14	3.20

Appendix D: Command Files for LISREL

A CONFIRMATORY FACTOR ANALYSIS

```
DA NI=32 NO=400
la
c1 c2 c3 c4 c5 c6 c7 gs1 gs2 gs3 tg1 tg2 tg3 tg4 tg5 j1 j2 j3 j4 p1 p2 p3 p4 d1 d2 d3 d4 d5 f1 f2
f3 f4
Ra fi=cfa11.dat
MO nX=32 NK=7 lx=fu,fi td=sy,fi
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1 lx 6 1 lx 7 1 lx 8 2 lx 9 2 lx 10 2 lx 11 3 lx 12 3 lx 13 3 lx 14 3
fr lx 15 3 lx 16 4 lx 17 4 lx 18 4 lx 19 4 lx 20 5 lx 21 5 lx 22 5 lx 23 5 lx 24 6 lx 25 6 lx 26 6 lx
27 6 lx 28 6
fr lx 29 7 lx 30 7 lx 31 7 lx 32 7
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5 td 6 6 td 7 7 td 8 8 td 9 9 td 10 10
fr td 11 11 td 12 12 td 13 13 td 14 14 td 15 15 td 16 16 td 16 16 td 17 17
fr td 18 18 td 19 19 td 20 20 td 21 21 td 22 22 td 23 23 td 24 24 td 25 25
fr td 26 26 td 27 27 td 28 28 td 29 29 td 30 30 td 31 31 td 32 32
fr td 32 39 td 5 3 td 1 2 td 11 13 td 6 7 td 1 4 td 4 21 td 17 18 td 18 19 td 13 15 td 11 17

LK
control sgc tgc jobs perf dis flex
pd
OU rs mi me=ml ad=off
```

CONTROL MODEL (CONFIRMATORY FACTOR ANALYSIS)

```
DA NI=16 NO=400
la
pe1 pe1 pe3 pe4 pc1 pc2 pc3 wc1 wc2 wc3 wc4 di1 di2 di3 di4 di5
ra fi=cf-con1.dat
mo  lx=fu,fi td=sy,fi nx=16 nk=3

fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 2 lx 6 2 lx 7 2 lx 8 2 lx 9 2  lx 10 2 lx 11 2
fr lx 12 3 lx 13 3 lx 14 3 lx 15 3 lx 16 3
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5 td 6 6 td 7 7 td 8 8 td 9 9 td 10 10 td 11 11
fr td 12 12 td 13 13 td 14 14 td 15 15 td 16 16
fr td 6 5 td 1 2 td 8 11 td 10 11

lk
perfo control distraction

path diagram
OU rs mi me=ml ad=off
```

MODEL OF CONTROL -DISTRACTION-PERFORMANCE

```
DA NI=18 NO=400
 la
 alo avoi pe1 pe2 pe3 pe4 di1 di2 di3 di4 di5 pc1 pc2 pc3 wc1 wc2 wc3 wc4

 ra fi=cf-con2.dat
 mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=7 nk=1 ny=11 ne=4
 fr ly 1 1 ly 2 2 ly 3 3 ly 4 3 ly 5 3 ly 6 3 ly 7 4 ly 8 4 ly 9 4 ly 10 4 ly 11 4
 fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1 lx 6 1 lx 7 1
 fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5 td 6 6 td 7 7
 fr te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
 fr be 1 4 be 2 4 be 3 4 be 1 2
 fr ga 4 1 ga 3 1
 fr ph 1 1
 fr ps 1 1 ps 2 2 ps 3 3 ps 4 4
 fr td 3 1
 fr td 1 2 td 2 3 td 1 5 td 3 4 te 5 8 td 7 6

 le
 alon avoi perfor distraction
 lk
 control

 path diagram
 OU rs me=ml ad=off mi sc
```

MULTI SAMPLE ANALYSIS - EFFECTS OF CONTROL (HIGH CONTROL GROUP)

```
DA NG=2 NI=18 NO=200
la
alo avoi pe1 pe2 pe3 pe4 di1 di2 di3 di4 di5 pc1 pc2 pc3 wc1 wc2 wc3 wc4
ra fi=high.dat
mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=7 nk=1 ny=11 ne=4
fr ly 1 1 ly 2 2 ly 3 3 ly 4 3 ly 5 3 ly 6 3 ly 7 4 ly 8 4 ly 9 4 ly 10 4 ly 11 4
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1 lx 6 1 lx 7 1
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5 td 6 6 td 7 7
fr te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
fr ph 1 1
fr ps 1 1 ps 2 2 ps 3 3 ps 4 4
fr be 1 4 be 2 4 be 3 4 be 1 2
fr ga 4 1 ga 3 1

le
alon avoi perfor distraction
lk
control

OU me=ml se tv mi ad=off
```

```
Effects of control (low control group)
DA NI=18 NO=200
la
alo avoi pe1 pe2 pe3 pe4 di1 di2 di3 di4 di5 pc1 pc2 pc3 wc1 wc2 wc3 wc4
ra fi=low.dat
mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=7 nk=1 ny=11 ne=4
fr ly 1 1 ly 2 2 ly 3 3 ly 4 3 ly 5 3 ly 6 3 ly 7 4 ly 8 4 ly 9 4 ly 10 4 ly 11 4
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1 lx 6 1 lx 7 1
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5 td 6 6 td 7 7
fr te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
fr ph 1 1
fr ps 1 1 ps 2 2 ps 3 3 ps 4 4

fr be 1 4 be 2 4 be 3 4 be 1 2
fr ga 4 1 ga 3 1

le
alon avoi perfor distraction
lk
control

eq ga 1 3 1 ga 3 1
eq ga 1 4 1 ga 4 1
eq be 1 1 4 be 1 4
eq be 1 2 4 be 2 4
eq be 1 3 4 be 3 4
!eq be 1 1 2 be 1 2

OU
```

DISTRACITON-CONTROL-PERFORMANCE (MEDIATING ROLE)

```
DA NI=16 NO=400
la
pe1 pe1 pe3 pe4 pc1 pc2 pc3 wc1 wc2 wc3 wc4 di1 di2 di3 di4 di5
ra fi=cf-con1.dat
mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=5 nk=1 ny=11 ne=2
fr ly 1 1 ly 2 1 ly 3 1 ly 4 1 ly 5 2 ly 6 2 ly 7 2 ly 8 2 ly 9 2 ly 10 2 ly 11 2
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5
fr te 1 1 te 2 2 te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
fr be 1 2
fr ga 2 1
fr ga 1 1
fr ph 1 1
fr ps 1 1 ps 2 2

fr te 6 5 te 11 10 te 5 11 te 1 2 te 1 2 te 5 10 te 6 10
le
perfor control
lk
distraction

path diagram
OU rs me=ml ad=off mi sc
```

COMPARISON 2: DISTRACTION-CONTROL-PERFORMANCE

(individual work style coffeeshop)

```
DA NG=2 NI=16 NO=200
la
pe1 pe1 pe3 pe4 pc1 pc2 pc3 wc1 wc2 wc3 wc4 di1 di2 di3 di4 di5
ra fi=indcoffe.dat
mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=5 nk=1 ny=11 ne=2
fr ly 1 1 ly 2 1 ly 3 1 ly 4 1 ly 5 2 ly 6 2 ly 7 2 ly 8 2 ly 9 2 ly 10 2 ly 11 2
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5
fr te 1 1 te 2 2 te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
fr be 1 2
fr ga 2 1 ga 1 1
fr ph 1 1
fr ps 1 1 ps 2 2

le
perfor control
lk
distraction

path diagram
```

```
OU rs me=ml ad=off sc

distraction-control-performance (individual work style quiet)
DA NI=16 NO=200
la
pe1 pe1 pe3 pe4 pc1 pc2 pc3 wc1 wc2 wc3 wc4 di1 di2 di3 di4 di5
ra fi=indquiet.dat
mo ly=fu,fi lx=fu,fi be=fu ph=sy,fi ga=fu,fi te=sy,fi td=sy,fi nx=5 nk=1 ny=11 ne=2
fr ly 1 1 ly 2 1 ly 3 1 ly 4 1 ly 5 2 ly 6 2 ly 7 2 ly 8 2 ly 9 2 ly 10 2 ly 11 2
fr lx 1 1 lx 2 1 lx 3 1 lx 4 1 lx 5 1
fr td 1 1 td 2 2 td 3 3 td 4 4 td 5 5
fr te 1 1 te 2 2 te 3 3 te 4 4 te 5 5 te 6 6 te 7 7 te 8 8 te 9 9 te 10 10 te 11 11
fr be 1 2
fr ga 2 1 ga 1 1
fr ph 1 1
fr ps 1 1 ps 2 2

le
perfor control
lk
distraction

!EQ ga 1 2 1 ga 2 1
EQ ga 1 1 1 ga 1 1
EQ be 1 1 2 be 1 2

OU
```

PATH ANALYSIS

```
data NI=6 no=400
labels; control tgc jobs perf dis flex
KMATRIX
1
.53 1
.60 .81 1
.18 .32 .33 1
-.60 -.39 -.39 -.11 1
.67 .30 .37 .13 -.44 1
select; 2 3 4 1 5 6
model ny=3 nx=3 be=sd ps=di

pd
ou se Ad=off tv ef sc mi
```

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