

Work Environment: A Study on Satisfaction

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**Dissertação de Mestrado em Ciências da Comunicação – área de
especialização em Comunicação Estratégica**

Dissertação apresentada para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Ciências da Comunicação – área de especialização em Comunicação Estratégica, realizada sob a orientação científica da professora Doutora Ana Margarida Barreto.

*For my mother: your unflinching belief in me is inexplicable.
I love you very much.*

Acknowledgements

This Master thesis is the result of many months' hard work and I could not do it if I did not have the help and encouragement of so many people in my life.

My advisor is one of those people: professors have a huge importance in shaping the person and the professional you will be in later years and I have had two of those professors in my life – one is my seventh grade English teacher and the other is my Master thesis advisor. She is a great teacher and she has inspired me to be a better student and a better investigator. Thank you for your guidance throughout this enriching journey.

This thesis would also not be possible without the support of my family:

My mother, to whom I dedicate this work because she is the most amazing human being I have ever met. Mother, I love you more than words can express;

Tiago, my partner in everything – never letting me forget why I want to do this and constantly reminding me that I have many more goals in my life to achieve by his side;

My father who taught me that discipline and hard work always bring good results in the end;

My brother because I know he is proud of his baby sister: he is the toughest critic I know but he is also the best friend and the best supporter someone could ask for;

Nessa and Rui, because you are the best of friends – you have had the patience to put up with me throughout all these years. You are very much cherished by this restless soul.

Mafalda, because she is the most amazing teacher and person. I wish everyone could have a coworker like you. You never let me get bored with my work and you have, more than once, helped me keep my ambitions strong. I am so very happy that my path has crossed yours, because you make such a great difference in my life.

Rita, because she is brilliant and one of the most intelligent people I know. She let me vent whenever I needed to and she discussed many ideas of this work with me, always challenging me to do better. Thank you for your help, it meant the world to me!

Finally, to all my friends and family that participated in my study. I have the most delightful people surrounding me. Thank you all! I could not have done it without you.

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ABSTRACT

Jobs define part of our everyday lives. In some societies, work is a defining role of your whole life. Governments and economists have stressed out, throughout the years, the importance of jobs for the common good of a country and its economy. In certain countries, jobs have such a central role in people's lives that expressions such as "workaholic" become part of everyday vocabulary and become part of people's reality. That being said, certain fields of investigation such as organizational behavioral have come to study different aspects of how people behave while at work such as performance of employees and job satisfaction.

Although job satisfaction is one of the most studied thematic of organizational behavior, little has been said about the impact that lighting and temperature has on satisfaction levels while performing a certain task. It is recognized that ergonomic factors do affect peoples' response to their work but there are very few studies that explore the impact it has on satisfaction. Although job satisfaction measurement tools include a question (and it is generally a question only) about work environment, it is in this query that everything about work environment is included: disposition of furniture, lighting, temperature, privacy, natural lighting, comfort of furniture, etc.

For this reason, the main research question of this dissertation is: can temperature and luminosity impact satisfaction levels while performing a task? This research question was explored in different ways: through a literature review that resumed investigation on job satisfaction and physical environment of the office and through an empirical study with recourse to a questionnaire in order to test the different hypotheses.

KEYWORDS: job satisfaction, physical environment, internal communication, human resources, satisfaction

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List of Abbreviations

EVP – Employee Value Proposition

JCM – Job Characteristics Model

JDI – Job Description Index

MSQ – Minnesota Survey Questionnaire

ISO – International Standards Organization

IESNA – Illuminating Engineering Society of North America

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

LUX – Lumens

I. Introduction

1.1. Contextualization and framing of the research topic

According to Mark Andrew Woodcock, “jobs play an integral role in the mental and physical health of a society” (2011, n.p.). We spend at least eight hours a day, forty hours a week, one hundred and seventy-six hours a month working. There has never been a time when jobs are considered so fundamental to everyday life. To be unemployed is a stigma in our society and even when you are employed, you are judged by the type of work you do. Your station in life is defined by the job you can land. The way other people see you is sometimes defined by the work you do, the company you work for and also your education.

Since a job is such a fundamental part of our lives and since we give so many hours and dedication to the performance of our duties within the companies that we work for, it is ideal that one feels satisfaction in the performance of those everyday life tasks and responsibilities.

Companies not always have considered their employees as partners or even their most important clients. In fact, companies have, in past times, looked at their employees as machines that are useful tools for production, efficiency, efficacy and profits.

That has been changing slowly, however. Organizational theories have, throughout the years, shown many different perspectives on the human element of organizations. Studies like the ones in Hawthorne have shown that employees play a larger role in the success of every organization that was at first believed.

That being said, companies have slowly come to recognize that their employees are not machines but different persons with different motivations, skills, strengths and weaknesses. Today, many organizations regard their employees as their best resource. Because of that, organizations have come to understand that satisfied employees may result in more gains to the company.

What is exactly job satisfaction? What is the difference between a satisfied and a dissatisfied employee? What brings satisfaction to an employee?

Job satisfaction is the most studied concept in organizational behavior literature. Numerous authors have tried to demystify the meaning of satisfaction in a professional environment but there is no consensus whatsoever and there are multiple perspectives.

It is recognized that job satisfaction can be influenced by certain factors. For instance, pay, working conditions, supervision, can have an influence on the levels of satisfaction. It is also recognized that the physical environment can also have an influence on job satisfaction levels. However, authors have consistently paid more attention to factors such as pay rates, authority, work, promotions, peers and colleagues than to the impact of physical environment of the office. Example of that is the most commonly relationship studied in job satisfaction: the correlation between job satisfaction and productivity/ performance. There are numerous studies that show a positive correlation between these two variables.

Other authors have studied how the physical environment of the office impacts job satisfaction regarding privacy at work. Does an open office space contribute more or less to job satisfaction? Do impediments to employees' socialization affect job satisfaction levels? The position of the desks (i.e. when one is facing a wall instead of colleagues) affects our satisfaction?

However, there are few studies that consider the effects of luminosity or temperature on job satisfaction, for instance. These kind of factors, as has been mentioned before, are mentioned only in passing when talking about job satisfaction and its facets. That is exactly why it is pertinent to study the impact of the physical environment and, more particularly, factors such as temperature and lighting, because these elements can create an impact on not only how we perform our work but also in how we feel about our work and its conditions.

There are international norms as is the case with ISO 8995-1:2002 that regulate levels of luminosity in the workplace depending on the type of activity you perform and the kind of space you perform your work in. ISO 8995-1:2002's introduction says: "Good lighting will create a visual environment that enables people to see, to move about safely and to perform visual tasks efficiently, accurately and safely without causing undue visual fatigue and discomfort...".

With temperature, the same is true. It is recognized that the ideal temperature for human beings is between 16 to 24 degrees. In fact, the Workplace Regulations 1992 from

British Government state that workplace temperatures should be at a minimum of 16 degrees but, it is emphasized, that temperature should be adapted to the kind of task employees have to perform (i.e. temperatures in environments such as factories should be lower than 16° and offices should be at 20°).

There are studies that show that temperature can have an impact on employee's productivity. ¹ Once again, it is clear that the physical environment of the office is consistently correlated with performance and productivity levels. Satisfaction, on the other hand, is never correlated with the physical environment of the workplace. Why is that? These two elements are fundamental for the performance of your work, of that there is no doubt, but can they be responsible for changing the way you feel about your job? Does temperature affect your feelings while performing a task at your workplace?

If one can garner a clearer understanding of how these factors impact our feelings of satisfaction while performing a task then we can do something to keep our employees happy while carrying out their work and, hence, give them the tools to be more productive, more creative, more stabilized, etc.

1.2. Formulation of the problem of the thesis

The Hawthorne Studies were the first studies to focus on how physical conditions of the workplace influenced employees' productivity. The results were rather interesting as it was concluded that whether the luminosity level was reduced or enhanced, there was an increase on productivity. However, these results were not due to changes in the physical environment of the workplace but rather because employees knew they were being observed and this knowledge enhanced their productivity.

Nonetheless, these studies raised an interesting question: does the physical environment of the office influence how we feel about our jobs?

Let us consider temperature, for example: 20°C is considered the optimum temperature for human beings. Imagining your workspace is consistently on 30°C, is there

¹ Seppanen et al, 'Effect of Temperature on Task Performance in Office Environment', Helsinki University of Technology, 2006. This study showed that the higher the temperature, the lower the performance and productivity of the employee.

a perceived impact on satisfaction levels while performing a task? The same question can be asked if the temperature of the workspace were to be on 10°C.

The same scenario can be applied to luminosity. Both these elements are part of the physical environment of the office and they are elements that are usually not decided by employees but rather established by someone or are established by universal standards.

Few academic studies explore how the physical environment of the office can influence job satisfaction. Still, when talking about different job facets, it is generally recognized that the workspace and its physical elements can make a difference in job satisfaction levels.

It is this author's belief that the way a workspace is organized (disposition of office furniture, natural luminosity, comfort of furniture, luminosity, temperature, etc.) contribute to feelings of satisfaction or dissatisfaction.

This work, therefore, aims to add to the job satisfaction literature by exploring a relationship that it is not often studied by academics: environmental factors and task performance.

In doing that, this work also wishes to provide useful notions not only for this field of investigation but also to internal communication professionals or human resources specialists that have their employees' job satisfaction in their hands.

1.3. Research question

Job satisfaction is, in fact, a much-discussed theme and there is not any consensus as to its definition or to its measurement. Since it is such an important part of everyday life, it is pertinent to understand if and how this attitude can be influenced by the physical environment of the spaces we perform a task in. If these elements do influence our satisfaction levels, in what manner do they change our satisfaction with the task we perform? Can they be controlled so that our employees' can be more satisfied at their workplace? Therefore, the research question this work intends to explore is – can temperature and luminosity influence satisfaction levels while performing a task?

1.4. Hypotheses' development

Following the above-mentioned research question, this study will also strive to deliver the necessary data to assess the following assumptions:

(H1): High levels of luminosity will affect positively the satisfaction one feels while performing a certain task;

(H2): Standard levels of luminosity will affect positively the satisfaction one feels while performing a certain task;

(H3): High temperature will affect negatively the satisfaction one feels while performing a certain task;

(H4): Standard temperature levels (20 C°) will affect positively the satisfaction one feels while performing a certain task.

Following Mary Bitner's research on the impact of the physical surroundings on customers and employees and also following the work of environmental psychologists, the presented hypotheses follow the assumption that standard levels of temperature and luminosity will trigger a positive internal response in a certain person who is performing a given task. This positive internal response will trigger in itself higher levels of satisfaction during the performance of the task.

Contrarily, high levels of temperature will trigger a negative internal response and therefore, will influence negatively the satisfaction of that person. Since the optimal temperature for the human being is between 16 and 20°C, one can expect that a higher temperature will have a negative influence.

Finally, the last hypothesis states that higher levels of luminosity will trigger a positive response and consequently, influence positively satisfaction levels. This hypothesis follows the assumption that we need light in order to be able to perform any visual task. Therefore, the higher level of lighting, the better we can perform a visual task. The fact that we can perform a certain task better can, in turn, trigger a positive response. That positive response will result in higher satisfaction levels.

1.5. Dissertation structure

Concerning the research question mentioned above, this dissertation is divided in four different parts: Introduction, Literature review and conceptual framework, Empirical study including Results and Findings and finally, Conclusions.

The first part of this work is intended to give an overview of what this work wishes to achieve, presenting the contextualization and framing of the research topic, the research questions it will explore and the hypotheses it will develop. It also reflects on why this theme still merits investigation after so many articles and books have been written by many different authors.

The second part of this work consists of a literature review and conceptual framework building which presents an overview of some of the authors that have studied this theme. Their academic considerations are, in this chapter, collated in order to give a better understanding of how this concept has developed throughout the years and the different definitions that exist (2.1.).

In this chapter, there is also a brief analysis of the different theories that study job satisfaction in various perspectives (2.2.), the different facets of job satisfaction (2.2.2.) and also an overview of the different tools available for measuring job satisfaction: there are two survey measures that are the most-commonly used when measuring job satisfaction – Job Description Index (JDI) and Minnesota Satisfaction Questionnaire (MSQ) (2.2.3.).

A study about the physical environment of the office follows the theoretical considerations on job satisfaction (2.3.) in which there is an exploration of what the physical environment is and how it has been studied by various authors. The end of this chapter (2.3.2.) intends to explore the impact the physical environment can have on job satisfaction.

The third chapter comprises the empirical study. This empirical study is divided in five sub chapters.

The first, titled problem definition presents the problem that we intend to study by defining the different possible hypotheses (3.1.). The second chapter describes the goals of this study (3.2.) while the third chapter explains the methodology chosen for the empirical study of the problem (3.3.). The fourth chapter defines the sample used for the

purposes of the empirical study (3.4.) and, finally, the fifth chapter discusses and presents the results and findings of the empirical study (3.5.).

The final chapter, the fourth of this dissertation describes the conclusions of the study. The first sub chapter presents general conclusions of the study and its implications (4.1.). The second sub chapter discusses limitations of this study that were found throughout the application of the empirical study (4.2.) and the final one explores new avenues in this field of investigation (4.3.).

II. Literature review and conceptual framework building

2.1. Organizational theories and internal communication – The rising importance of the employee

The employee is a fundamental part of any organization and management has throughout the years, regarded the employee in different ways. One could even say that the different organizational theories have come to reveal a rising importance of the employee.

In fact, an important part of an organization's management comes from knowing your employees and giving them the tools they need to be productive by making sure they are satisfied with their jobs. However, it was not always like that. The various organizational theories show an evolution in the way management regards employees and their importance for the economic survival of an organization.

In 1909, Frederick Taylor published *The Principles of Scientific Management* proposing that the productivity of the employees would increase if jobs were simplified and optimized. Furthermore, Taylor believed that a worker could be motivated by money, so he promoted his motto “a fair day's pay for a fair day's work”. His principles of scientific management relied on the importance of efficiency so that the employee could perform specific tasks at maximum level of productivity.² Rationalization would therefore, make employee's jobs more productive and less arduous.

Henry Fayol, considered to be one of the authors of the classic school of management alongside Taylor, published in 1916 the book *General and Industrial Management* in which he defends that management consists of six functions which are: planning, organizing, commanding, coordinating and controlling. Furthermore, he considered that the manager, in organizing and interacting with the staff, should follow 14 principles that comprise division of work, authority, discipline, unity of command, unity of direction, subordination of individual interests to the general interest, remuneration, centralization, scalar chain, order, equity, stability of tenure of personnel,

² Ford's factory popularized Taylor's principles of management. Henry Ford was a follower of Taylor's *Principles of Scientific Management*. He was responsible for changes in the organization of production lines, namely the diminution of the production cycle, maximization of efficiency and agility of production.

initiative, and esprit de corps. In his seven principle regarding remuneration, Fayol admits that employees' satisfaction derive from fair remuneration (financial and non-financial compensation).

Classical school of management has been highly criticized for regarding employees based only on their economical and physical needs and not on their social needs; elements like job satisfaction were most of the times regarded as unimportant or even non-existent (business dictionary). However, as Pina e Cunha (2004, p.24) emphasise, this school of management has made possible the existence of various techniques that are still useful nowadays like the standardization of procedures, definition of goals, bonus compensation system and performance reviews. Therefore, at this moment in time, internal communication was a descendant vertical communication, strictly formal and related with policies, rules and organizational goals.

Another management theory that has also been highly criticized for the way it regards employees is the one published by Max Weber in 1922 in the book *The Theory of Social and Economic Organization*. Popularly known as the bureaucratic management theory and sometimes referred to as the Max Weber's Theory of Impersonal Management, the author proposed a system built on the principles first delineated by Taylor. Weber believed that an employee should only be hired if he met specific qualifications for the job and his function inside an organization should be his only and most important activity. An employee should be integrated in a clear chain of command and have a defined job role. This theory regards the organization as a closed system where rules form a legitimate authority and proposes a mechanistic view of employees' functions. Therefore, the social needs of an employee are not regarded as a priority. That meant that the only communication that existed inside this system was written and formal communication in the form of rules, regulations and authority.

At the time Weber's book was published, many of Taylor's principles of management had already been implemented in the organizations. At the same time, there were studies that proved that the gains for the organization were not as high as it was expected and because of the Bolshevik revolution, there was fear that confrontations would arise (Pina e Cunha, 2004, p. 23). Consequently, the congregation of these events made possible the emergence of human relations school of management. There arose a need to study the human factor in organizations.

Elton Mayo's investigations at Western Electric (1924-1933), which later become known as Hawthorne Studies, concluded that psychological and social factors play a larger role in productivity than physical factors. The work of Elton Mayo began as an attempt to discover ways to increase efficiency in a time that workers were losing interest for their work and were showing signs of fatigue.

Elton and his team began their investigation by studying the relationship between physical conditions of the workplace and productivity. The first set of studies investigated how lighting could affect workers' productivity. The results were confounding: productivity rose when lighting increased but it also increased when lighting decreased. These results suggested that productivity might be more related to psychological factors than to physical factors. In the next 6 years Elton's team investigated other factors such as pay, break times, work environment and type of supervision and their results showed that the human factor plays an important role in the motivation and productivity of employees. In fact, the conclusion was that "it was not the changes in physical conditions that were affecting the workers' productivity. Rather, it was the fact that someone was actually concerned about their workplace..." (Economist, 2008).

For that reason, human relations school of management defended that employees have social and psychological needs that are directly related to their levels of productivity and they are motivated in part by the need to belong to a group. Therefore, if employees want to feel they belong, then arises the need to have leadership that assures that group norms are aligned with the organization's interests and create work conditions that make employees feel realized in their respective job functions. For this to happen, there needs to be communication inside the organization and management needs to know what motivates and satisfies their employees. At this stage, organizations realized their workers needed more than rigid systems and a hierarchy of authority to be productive. From this point on, internal communication evolved from a strictly descendant vertical communication to lateral communication. Employee publication (by employees for employees) was established and this type of publications "reflected recognition of the importance of employee relations..." (Ruck and Yaxley, 2013., p. 4).

This is one of the first steps to the rising importance of the employee. However, in reality, these publications were often edited by the company to ensure that what was published was aligned with the management's interests: "the majority of early company magazines were 'of the company, funded and edited by the company, and produced in the

name of the company, even though material to fill the pages of the publication may have emanated from the staff’.” (Ruck and Yaxley, 2013, p. 4).

In the years after the Second World War, organizations focused on organizational problems such as planning and control. The rational organization theory brought back some of Taylor’s ideas on scientific management but was adapted to the reality of computer engineering. The organization was at the time seen as an open system that received inputs from other systems and in turn, exported outputs to other systems. Employees in light of this theory are regarded as rational beings, almost like automatons whose behavior can be predicted. Therefore, employees are seen as almost irrelevant (Pina e Cunha, 2004, p.31).

However, in the 80s and 90s there were significant changes in the corporate world driven by technology and global competition. The house journal had been a popular practice during the previous decades and still dominated in the 1980s (Ruck and Yaxley, 2013, p.7). But due to economic changes and increasing preoccupation with employees’ performance, “employees were reported to increasingly expect their companies to do something about their problems and at all levels they were complaining that they wanted and needed a lot more information than their companies provided” (Ruck and Yaxley, 2004, p. 7). Later on, there arose a new concept called internal marketing that influenced how internal communication was thought of by management. From this point on, management began to use advertising techniques that would persuade their employees. They were asked to believe in their company but they were not asked to participate in its message, rather they were asked to only listen to the company’s message.

However, in the U.K., “by the end of the 1980s the processes of internal communication were becoming more established. An Institute of Directors survey in 1989 found that in companies with more than 1,000 employees, 80% had some sort of planned [internal] communication system...” (Ruck and Yaxley, 2013, p.8).

In the 1990s, William Kahn published an article called “Psychological Conditions of Personal Engagement and Disengagement at Work” in which he stated: “people are constantly bringing in and leaving out various depths of their selves during the course of their work days. They do so to respond to the momentary ebbs and flows of those days and to express their selves at some times and defend them at others” (1990, p.692-3). From this work, emerged the concept of engaged employee in which workers

would employ themselves physically, emotionally and cognitively in the course of their functions. As Kular et al summarize,

The cognitive aspect of employee engagement concerns employees' beliefs about the organisation, its leaders and working conditions. The emotional aspect concerns how employees feel about each of those three factors and whether they have positive or negative attitudes toward the organisation and its leaders. The physical aspect of employee engagement concerns the physical energies exerted by individuals to accomplish their roles. (2008, p. 3).

Thus, for Kahn, an engaged employee would therefore be psychological and physically invested in the organizations' beliefs, its work conditions and its leaders: in other words, employees would feel invested in their work and the organization they were part of. However, communication inside the company at this time was still descendant, from leaders to front-line employees and that type of communication may have had an impact in the degree to which employees engaged or disengaged from his work. Kahn proposes that an engaged employee will express himself in different dimensions (physically, cognitively and emotionally) whilst a disengaged employee will, in the same dimensions, retract himself from his work. Kahn's analysis is interesting because it shows that different personality types can have an influence on individual satisfaction levels.

The 1990s were also described as an era of downsizing. Employees were, at this time, more concerned with job security than with job satisfaction or any form of employee engagement. Only with the emergence of technology in the millennium, when new forms of communication appeared did organizations begin to regard their employees in a different light. Technology not only changed the way organizations communicate externally but also internally. In fact, internal communication has evolved from a management tool for giving out information from the top to the bottom to a strategic function of every organization's business: in getting to know their employees better, organizations realized they could attract the best candidates and show them that they had the best opportunities to offer. This is an employee-centred approach or what is called an Employee Value Proposition (EVP) in which an organization, according to Minchington (2005, n.p.) presents "a set of associations and offerings in return for the skills, capabilities and experiences an employee brings to an organization".

In 2008, McLeod and Clarke published "Engaging for Success: Enhancing Performance through Employee Engagement", one of the first serious investigations into

employee engagement and how this notion affects their levels of productivity and performance. The conclusion of this report was that organisations that engage and inspire their employees are rewarded with high levels of productivity, performance and innovation. Throughout the years, organizations' tendency has been not to take their employees for granted, as they have been led to recognize that their employees are a fundamental part of their existence. In addition, as internal communication has evolved and become more important, there is a growing need to ask employees to partake in this engagement. Not only organizations need to engage their employees by making sure they are active participants in the company's goals and achievements but they are now asking employees, by utilizing internal communication tools, to voice their opinions and let organizations know what satisfies them.

Some authors have studied the effect that certain organizational models have over job satisfaction of employees. Robbins (2006), while emphasizing that one must not oversimplify matters, states that employees that are highly specialized are considered to be more productive and feel less satisfaction with their job. On the other hand, Robbins affirms that there is evidence that shows that less centralized organizations are able to share more decisions. The participation in the decision process of the company by the employees fosters a more positive attitude toward job and thus, higher levels of job satisfaction. However, organizations need to be aware that every employee has a different perspective and personality and that those individual differences arise in any group situation.

Teresa Ruão's paper, titled "Organisational Communication and Human Resources Management: Evolution and Actuality" (1999), presents an overview of the different theories of communication and how they influence the management of an organization's human resources. The author recognizes that communication and human resources are indivisible elements and one influences the other. The author goes on to state that the evolution of organizational communication shows that at the same time that organizations valued employees' participation in the organization's everyday life, communication inside the organization was also emphasized.³ Communication, argues the author, is an essential tool that serves multiple purposes inside an organization: the

³ Original reference: "E a tendência era a de que à medida que se valorizava a participação dos trabalhadores no todo organizacional, realçava-se a dimensão da comunicação." (Ruão, 1999, p. 12).

selection, social integration and development of human resources. Nevertheless, more important than that, communication is also important for motivating employees and evaluates their performance.

Nowadays, satisfaction of employees is something that organizations do not take for granted and it is, in fact, accepted as a fundamental element, be it in the external or internal reality of any organization. In knowing what satisfies and how to engage their employees, organizations now have the knowledge to retain talent and give purpose, not only to the work their employees perform, but also to the organization. That, however, does not mean that all organizations regard satisfaction of their employees in the same way.

2.2. Job satisfaction

2.2.1. Job satisfaction: a concept

As has been established in the brief overview of organizational theories and evolution of internal communication, employees' satisfaction was not always a priority. However, changes in the organizational world have made possible the emergence of the employee as a key element of every organization. The different approaches throughout time all point to a single reality: that satisfied employees signify an opportunity to retain talent and to make sure that talent is directed toward the organization's success.

Looking at the various organizational theories and coupling the various approaches to organizational reality to the evolution of internal communication, one can understand how job satisfaction came to be an important concept that organizations should take seriously. Scientists have correlated job satisfaction with performance and productivity and is generally accepted that satisfied employees are more productive.

Job satisfaction comes to be an important concept at the time that organizations feel the need to rethink their communicative approach toward its employees. When organizational theories started to focus more on the human aspect of organizations, satisfaction seemed to reveal itself as a natural field of investigation.

However, job satisfaction is a very complex concept as there are multiple definitions for it and every author has his view on the matter. Numerous authors have contributed to this field trying to understand which factors influence job satisfaction

levels, why it is important to satisfy employees, why satisfied employees are important for an organization and what are the consequences of job dissatisfaction. As Gruneberg affirms “the major difference between definitions is in terms of the different ways in which aspects of job satisfaction are combined (1979, p. 3).

In fact, job satisfaction is the most studied variable concerning organizational behavior, because as Pina e Cunha state (2004, p.126) it is one of the most important results of work and job satisfaction has, directly or indirectly, been correlated with performance. That being said, companies expect that satisfied workers will be the most productive ones as well and hence will bring more profit to organizations.

One of the first authors to study job satisfaction was Hoppock. His perspective on this theme is nowadays considered the traditional approach to job satisfaction. His view is very straightforward. He considers that if “the presence of a variable in the work situation leads to satisfaction, then its absence will lead to job dissatisfaction, and vice versa” (as cited in Gruneberg, 1979). What Hoppock’s studies concluded was that there is a correlation between job satisfaction and satisfaction with personal life and also that there is a close proximity between job satisfaction and mental health. If employees are satisfied with their personal lives that is reflected on their mental health and in turn they are more likely to feel satisfaction with their job. Hoppock showed, with these correlations, that job satisfaction index levels might be more related with factors related to our personality than with external factors that have nothing to do with our personality or state of being.

On the other hand, Edwin Locke, one of the most quoted authors in this field of investigation in his article “The Nature and Causes of Satisfaction”, defines job satisfaction as “a pleasurable or positive emotional state resulting from the appraisal of one’s job or job experiences” (as cited in Judge, 2007). In this definition, Locke emphasizes the emotional aspect of the employee’s job. For the author, an employee is satisfied when positive emotions derive from the performance of his or her work. Emotions do play an important part in our lives and that includes emotions we have toward our jobs. Therefore, although Locke does not propose, like Hoppock does, that job satisfaction relates not only with our personality and the way you feel about your personal life, both propose that there is a strong influence that derives from the way we export our personal emotions toward our jobs and toward the functions we perform. We feel satisfaction when there are positive stimuli around us (and that includes not only

work but also our personal life and even our mental health); on the other side, when we are surrounded by negative stimulus we tend to transfer those stimuli to other aspects of our lives, such as our jobs and other aspects of our everyday lives.

In 1968, Frederick Herzberg with his Two-Factor Theory contested Hoppock's approach and proposed that there were factors that influenced our levels of satisfaction – called motivators – such as responsibility, job function, recognition, and factors that influenced our levels of dissatisfaction – called hygienic factors – such as pay, security, company's policies. He also stated that these factors were both separate and distinct contrary to what Hoppock had earlier proposed. Herzberg also identified that when people were satisfied with their jobs, they tended to attribute this satisfaction to themselves whereas people who were dissatisfied with their jobs tended to attribute this dissatisfaction to other external factors like the ones mentioned above.

Furthermore, Herzberg considered that the opposite of satisfaction was not dissatisfaction, as the removal of the less satisfying characteristics of a job function does not make that job satisfactory. That is, for the author, when one thinks about job satisfaction, one must consider the elements that influence satisfaction and the ones that influence non-satisfaction. This theory, however, has been criticized and Locke (1976) even considers that this theory is no longer valid because both motivators and hygienics lead not only to satisfaction but also to dissatisfaction.

For Stephen Robbins (2006), job satisfaction is a set of feelings a person has in relation with his or her job and it is more an attitude than a behavior. In this author's view, an attitude is an evaluative affirmation, that is, an attitude reflects the way an individual feels toward something (an object, a person or an event). As the author mentions, when someone says "I like my job", that person is expressing his or her attitude toward her job (2006, p.60). Robbins also reminds us that an attitude is a complex concept comprised of three different components: cognitive, affective and behavioral components. These three components intertwine themselves into a general attitude toward one's job. Therefore, if the organization wants to understand their employees' feelings toward their jobs they need to take into account all three components.

In the same perspective, Hulin and Judge define job satisfaction as "multidimensional psychological responses to one's job. These responses have cognitive (evaluative), affective (emotional), and behavioral components" (2009, p.5). Both perspectives offer a more holistic view of the concept of job satisfaction. Very much like

the ABC model of attitudes, it condenses the set of reactions an employee has toward her or his job. These authors defend that this three-way approach can be a more effective tool not only to predict work behaviors but also to better understand employees' job satisfaction levels.

Pina e Cunha (2004) also defend that the process of job satisfaction is a constant dialogue between cognitive factors and emotional factors and that this process tends to stabilize throughout time. Ultimately, every one of us creates his own standard of satisfaction – this standard results from the fulfillment of personal needs. In that view, the same authors conclude that job satisfaction is the result of three factors: “the individual, the work itself, the interaction between individual/work” (128). However, the authors emphasize, it is not clear if these individual components are the principal motivators of job satisfaction, if that falls to the characteristics of the work itself or even if both variables act simultaneously.

That being said and in order to understand if different types of personality result in different levels of job satisfaction and how these elements relate to each other, Furnham (1992, p.198) devised the following equation:

$$JS = f(P * J * PJF * \epsilon)$$

In this equation, JS represents job satisfaction, P is personality, J represents job characteristics, PJF is person-job fit and ϵ represents error. In Furnham's view, this equation has two fundamental elements, personality and job, that, when combined can create three possible outcomes:

- 1) Different personality types reflect different levels of job satisfaction (or dissatisfaction) regardless of job characteristics;
- 2) Some jobs cause more satisfaction (or dissatisfaction) than others irrespective of the personality of the worker;
- 3) A particular fit (or misfit) between a person and a job causes particular sources of satisfaction (or dissatisfaction).

Campbell et al. (1970) have divided theories of job satisfaction in two categories: content theories and process theories. Content theories such as Herzberg's Two Factor Theory study the factors that lead to job satisfaction whereas process theories study the relation between job satisfaction and other variables. Therefore, concern theories aim to

deconstruct the concept of job satisfaction, making it comprehensible through the identification of different factors that influence job satisfaction. Furthermore, process theories aim to study how different variables relate to the feeling of satisfaction with one's work. As Gruneberg mentions (1979, p.19) "process theories see job satisfaction as being determined, not only by the nature of the job and its context, but by the needs, values and expectations that individuals have in relation to their job".

On the other hand, Judge and Klinger (2007) in their article titled "Job Satisfaction: Subjective Well-Being at Work" identify three categories of theories – "situational theories, dispositional theories, interactive theories" (p.398-399). These authors state that situational theories are studies that assume that job satisfaction results from the nature of one's job or other aspects of the environment. An example of this type of theory is the Job Characteristics Model (JCM) that was initially a situational model but was later modified by two authors to consider the interaction that may exist in the work environment. Dispositional theories suggest that job satisfaction is deep-rooted in the personality of the individual and interactive theories assume that job satisfaction is the result of the interaction between personality and situational factors.

Locke's Value-Percept Model is an example of an interactive theory of job satisfaction in which is proposed that "individual's values would determine what satisfied them on the job" (2007, p. 400).

Locke presented a formula in which one could calculated the job satisfaction level of the employee:

$$S = (V_c - P) \times V_i$$

Satisfaction: (want – have) x importance

Therefore, in this equation, S represents satisfaction, Vc is the value content or the amount wanted, P stands for the perceived amount of the value provided by the job, and Vi represents the importance of that particular value to the individual.

As Judge and Klinger (2007) emphasize, the "value-percept model expresses job satisfaction in terms of employees' values and job outcomes" (p. 400). In Locke's equation, satisfaction is calculated by the difference between what the employee desires

and what is received. However, this difference only results in a feeling of dissatisfaction if the job facet is considered important by the individual.

Therefore, as has been noted before, job satisfaction seems to be a construction largely based on an individual's feelings and perceptions about his job and not an objective concept that you can measure with high reliability.

It is rather difficult to establish a tendency in this field of investigation for different authors reflect about job satisfaction in different ways. Therefore, job satisfaction is a very rich and complex concept that allows you some liberty when it comes to its interpretation.

However, there seems to be a consensus that job satisfaction is a multifaceted reality, which can have many denominators or facets. Therefore, in order to comprehend the various factors that together are responsible for this construction, an explanation of what these facets are and what influence they have in making a person satisfied or not satisfied with their job is needed.

2.2.2. Facets of job satisfaction

If on one hand we can define job satisfaction in multiple ways, we can also measure it in many different ways. The majority of the authors regard the concept of job satisfaction as a global concept influenced by various facets resulting in the complexity of its definition and measurement, as we have seen in the previous suggested models.

The most commonly used categorization of facets is: pay, promotions, coworkers, supervision, and the work itself. That means that, when measuring job satisfaction levels, researchers that make use of this categorization give a different weight to every one of these facets and they influence the overall measure.

Locke, for example, is one of the authors that considers that job satisfaction is a global measure that is influenced by different individual facets. To the already stated above, he also adds these facets: recognition, working conditions, company and management.

The question that arises is: are all facets equal or some are more important than others? How can you dissect such a complex concept into five different constructs? Furthermore, how does one measure the affective component of job satisfaction

mentioned earlier? The affective component tends to be unstable throughout time, and therefore, can be difficult to measure. More important than that, the affective component may not be reliable throughout time.

Our feelings toward our job are not constant. They are in fact the opposite. There are some elements of our job that may be more constant than others, but in general, feelings are not immovable. As Judge and Klinger (2007) so accurately note, “affective reactions are likely to be fleeting and episodic...measurement of affect should reflect its state-like, episodic nature” (p.395).

Furthermore, every person is different and therefore, everyone’s feelings toward his or her job will be different. There will be people who give more importance to how much does a job pay and there will be people for whom working conditions will be the principal motivator of satisfaction. It is because of those differences that various authors started to focus on job satisfaction as a multi-faceted concept and not a global measure. Proof of that is authors like Locke or Furnham that, with their investigations, show that different people have distinct job satisfaction levels.

Furnham with his investigation proposed that satisfaction was influenced by three fundamental facets: personality, job characteristics and finally, the fit between a job and a person. Like stated before, Locke is another author that defends that job satisfaction is a concept that is subdivided in different facets.

Different authors feel that these different elements influence the global measure of job satisfaction and as such, it is “likely that people’s overall attitude toward their job or work causes specific satisfactions to be positively correlated” Judge and Klinger (2007, p. 395).

This positive correlation does not contribute to a reliable measurement of job satisfaction. In fact and because job satisfaction is a construct based on personal feelings and attitudes, it turns the task of measuring it much more difficult. More than that, facets raise an important question: is there one facet that should weigh more than the others or is job satisfaction a sum of the parts?

Scarpello and Campbell, in their 1983 article titled “Job Satisfaction: Are All Parts There?” defend that faceted measures and global measures of job satisfaction are not part of the same reality but rather of two different realities that are measuring two different things. Consequently, asking people questions about a specific part of their jobs did not

correlated with the global level of satisfaction, suggesting that studying different facets individually was an unreliable way of measuring job satisfaction.

This view has been disputed by authors who defend, on their part, that single-item measures are a reliable way of measuring job satisfaction levels like Judge and Hulin (1993). Judge and Klinger (2007) advocate that “job satisfaction facets are correlated highly enough to suggest that they indicate a common construct” (p.397). Other authors have also studied the reliability of global versus faceted measures of job satisfaction. However, in much the same way that there is not a consensus about its definition, opinions diverge.

Because of that difference in opinions, there is a multitude of ways in which organizations can measure job satisfaction more or less accurately. Scientists in this field of investigation have come up, throughout the years, with various satisfaction questionnaires aiming to get to know the degree to which employees feel satisfied offering this abstract construct some objectivity.

Job satisfaction measurement, ideally, would be useful to clearly identify which elements are responsible for feelings of contentment and satisfaction and, on the other hand, what facets contribute to feelings of dissatisfaction. The question that remains is, how is this measurement applied to such a complex concept?

2.2.3. Measurement of job satisfaction

Studies have shown that measuring job satisfaction is not always reliable or easy. In fact, given the various ways in which it can be thought of and analyzed, the measurement of this variable not always presents clear or faithful results. Various authors have presented multiple ways that aim to measure employees’ job satisfaction levels but since it is such a subjective concept the question of reliability is a constant when talking about measuring this variable.

If one has an especially stressing day at work, the affective component will necessarily show negative feelings toward one’s job. However, if the next day is rather peaceful and one even manages to be productive and get everything done for the day, personal feelings toward the job will be positive or will be more positive than they were the day before. How, then, can one measure with some degree of reliability these variations on job satisfaction levels?

The complexity inherent to the concept of job satisfaction extends itself to the measuring of this concept: there are facet-based measurements and global measurements depending on how one regards job satisfaction. The fact that there is not a single solution to the problem raises an important question: the reliability of your results.

However, there are two measurement tools that are identified as the most reliable in the literature of job satisfaction: the Job Descriptive Index (JDI) devised by Smith et al. in 1969 and the Minnesota Satisfaction Questionnaire (MSQ) presented by Weiss, Dawis, England, & Lofquist (1967).

In order to understand how these two tools regard the measurement of job satisfaction, it is required an individual analysis of both these measurement tools.

2.2.3.1. JDI

JDI or Job Description Index is an index used for measuring job satisfaction and it was first introduced in 1969 by a team of investigators (Smith, Kendal and Hulin). It has remained, throughout the years, one of the most widely used tools for measuring job satisfaction levels.

The JDI assesses job satisfaction in five different job areas. Those comprise pay, promotion, coworkers, supervision and finally, the work itself. This index evaluates job satisfaction dividing this concept into different facets instead of evaluating job satisfaction as a global concept.

Each facet is evaluated through simple phrases, that is, “each JDI facet scale contains either 9 or 18 adjectives or short adjectival phrases describing various aspects of the respondent's work experiences - the work itself, pay, opportunities for promotion, supervision, and coworkers” Stanton and Sinar (2002, p.174).

Its scale is rather simple: the answers are divided between yes, no or cannot decide as shown in the sample below.

Many authors defend that this index offers reliability and its scales are simple to read and to interpret. However, N. Van Saane et. al, who studied the reliability and validity of seven different job satisfaction measurement instruments state that “the JDI...

did not meet the quality criteria, although it is the most frequently used job satisfaction instrument in organizational science” (2002, p.195).

Work on Present Job	Pay	Opportunities for Promotion	Supervision
Think of the work you do at present. How well does each of the following words or phrases describe your work? In the blank beside each word or phrase below, write	Think of the pay you get now. How well does each of the following words or phrases describe your present pay? In the blank beside each word or phrase below, write	Think of the opportunities for promotion that you have now. How well does each of the following words or phrases describe these? In the blank beside each word or phrase below, write	Think of the kind of supervision that you get on your job. How well does each of the following words or phrases describe this? In the blank beside each word or phrase below, write
Y for "Yes" if it describes your work N for "No" if it does not describe it ? for "?" if you cannot decide	Y for "Yes" if it describes your pay N for "No" if it does not describe it ? for "?" if you cannot decide	Y for "Yes" if it describes your opportunities for promotion N for "No" if it does not describe them ? for "?" if you cannot decide	Y for "Yes" if it describes the supervision you get on the job N for "No" if it does not describe it ? for "?" if you cannot decide
..... <input type="checkbox"/> Fascinating <input type="checkbox"/> Routine <input type="checkbox"/> Satisfying <input type="checkbox"/> Boring <input type="checkbox"/> Good <input type="checkbox"/> Gives sense of accomplishment <input type="checkbox"/> Respected <input type="checkbox"/> Exciting <input type="checkbox"/> Rewarding <input type="checkbox"/> Useful <input type="checkbox"/> Challenging <input type="checkbox"/> Simple <input type="checkbox"/> Repetitive <input type="checkbox"/> Creative <input type="checkbox"/> Dull <input type="checkbox"/> Uninteresting <input type="checkbox"/> Can see results <input type="checkbox"/> Uses my abilities <input type="checkbox"/> Income adequate for normal expenses <input type="checkbox"/> Fair <input type="checkbox"/> Barely live on income <input type="checkbox"/> Bad <input type="checkbox"/> Comfortable <input type="checkbox"/> Less than I deserve <input type="checkbox"/> Well paid <input type="checkbox"/> Enough to live on <input type="checkbox"/> Underpaid <input type="checkbox"/> Good opportunities for promotion <input type="checkbox"/> Opportunities somewhat limited <input type="checkbox"/> Promotion on ability <input type="checkbox"/> Dead-end job <input type="checkbox"/> Good chance for promotion <input type="checkbox"/> Very limited <input type="checkbox"/> Infrequent promotions <input type="checkbox"/> Regular promotions <input type="checkbox"/> Fairly good chance for promotion <input type="checkbox"/> Supportive <input type="checkbox"/> Hard to please <input type="checkbox"/> Impolite <input type="checkbox"/> Praises good work <input type="checkbox"/> Tactful <input type="checkbox"/> Influential <input type="checkbox"/> Up-to-date <input type="checkbox"/> Unkind <input type="checkbox"/> Has favorites <input type="checkbox"/> Tells me where I stand <input type="checkbox"/> Annoying <input type="checkbox"/> Stubborn <input type="checkbox"/> Knows job well <input type="checkbox"/> Bad <input type="checkbox"/> Intelligent <input type="checkbox"/> Poor planner <input type="checkbox"/> Around when needed <input type="checkbox"/> Lazy
(Go on to next page)		(Go on to back page)	

Figure 1: JDI sample (free sample from Bowling Green State University)

It is quite difficult to attest to this instrument’s reliability but investigators throughout the years have been using this measurement tool to better understand employees’ satisfaction. Its facets have been revised a number of times in order to adapt the survey to the ever-changing organizational reality.

2.2.3.2. MSQ

The Minnesota Satisfaction Questionnaire (MSQ) was first presented in 1967 by Weiss, Dawis, England and Lofquist. It is a more versatile survey measure that analyses job satisfaction in both faceted measures and overall measures. It can measure up to 20 facets of job satisfaction and it uses both long and short forms.

The long form is comprised of 100 questions with five items from every facet and the short form comprises 20 questions with one item per facet. The answer score comprises five possibilities: very dissatisfied, dissatisfied, ‘N’ (neither satisfied nor dissatisfied), satisfied and very satisfied. The twenty facets that the MSQ evaluate

include: ability utilization, achievement, activity, advancement, authority, company policies, compensation, co-workers, creativity, independence, moral values, recognition, responsibility, security, social status, social service, supervision (human resources), supervision (technical), variety and, finally, working conditions.

Because it evaluates more facets, one can say that the MSQ can gather more specific information about employees' feelings about their job in any given facet, and therefore, can be more reliable.

The MSQ, surprisingly, also did not pass the reliability and validity test performed by N. Van Saane et. al. being consistently paired with JDI in terms of both reliability and validity. However, different authors have studied and defended the reliability and fidelity levels of this type of instrument like Weiss et al. (1967) and Robert, Young e Kelly (2006).

The developing reality of the organizational world makes it necessary to revise continuously these measurement tools since there are facets that were important at any given time but may not be at present. Accordingly, the same employee can value a given facet at one point in his life and a very different one some years later. Therefore, job satisfaction should be measured in a continuum. As was mentioned before, feelings are fleeting and they change rapidly: since job satisfaction can be a set of feelings, it can change surprisingly fast. Because of those rapid changes, these feelings should be monitored with some frequency. A continued analysis can offer a more detailed examination of satisfaction throughout any given period of time, giving these measures greater reliability and even validity.

On my present job, this is how I feel about . . .	Very Dissat.	Dissat.	N	Sat.	Very Sat.
1. Being able to keep busy all the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The chance to work alone on the job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. The chance to do different things from time to time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. The chance to be "somebody" in the community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. The way my boss handles his/her workers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. The competence of my supervisor in making decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Being able to do things that don't go against my conscience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. The way my job provides for steady employment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The chance to do things for other people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. The chance to tell people what to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. The chance to do something that makes use of my abilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. The way company policies are put into practice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. My pay and the amount of work I do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. The chances for advancement on this job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. The freedom to use my own judgment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. The chance to try my own methods of doing the job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 2: MSQ sample (free sample from University of Minnesota)

2.3. The physical environment of the office

2.3.1. Physical environment: its impact in employees

Although there are not many works that reflect on the impact of the physical environment in an office space, research indelibly shows that we are influenced by what surrounds us. Therefore, if physical elements of a store (lighting, music, odor, disposition of furniture, etc.) influences our consumer experience (Paco Underhill, *Why we Buy- The Science of Shopping*, Simon & Schuster, 1999), physical elements of our work office can also influence our response to that environment. As Mary Bitner puts it, "management of the physical setting typically is viewed as tangential in comparison with other organizational variables that can motivate employees, such as pay scales, promotions, benefits, and supervisory relationships" (Bitner, 1992, p.58).

There are many different environmental dimensions. The physical environment can comprise temperature, air quality, noise, music, odor, equipment, furnishings, luminosity, disposition of furniture, etc. and it is generally recognized that physical surroundings can have an impact on how people perceive things. More than that, the physical environment of a space you are in can change the way you respond to any given situation.

In fact, the physical environment is mentioned in almost every organizational behavior text (Pina e Cunha, M., et al., *Manual de Comportamento Organizacional*, 2004; Robbins, Stephen P., *Comportamento Organizacional*, 2006). Job satisfaction literature also identifies the physical environment as an important factor that can influence employee's satisfaction levels.

However, very few authors have debated on how the physical environment can influence satisfaction even though “research in organizational behavior suggests that the physical setting can influence employee satisfaction, productivity, and motivation” (Bitner, 1992, p.57).

Environmental psychologists have studied the interplay between individuals and the environment that surrounds them. Consequently, some authors in this field have suggested that individuals have two opposite reactions toward environmental elements: approach and avoidance (Mehrabian and Russel, 1974). The first is comprised of positive feelings and attitudes toward physical surroundings and the second is exactly the opposite: negative feelings concerning physical environment.

Physical surroundings, argues Mary Bitner, generate an internal response in individuals. It can be said that “employees...respond to dimensions of their physical surroundings cognitively, emotionally, and physiologically and that those responses are what influence their behaviors” (1992, p.62).

Mary Bitner has presented in her article titled “The Impact of Physical Surroundings on Customers and Employees” (1992), a very legible graphic that lists the different behavior responses that employees and customers have, considering a given physical environment. She states that different aspects of the environment that surrounds us trigger an internal response. This internal response, in turn, triggers a certain behavior. When the internal response is positive, our behavior reflects a tendency to approach, as the author calls it. That is, employees feel positive feelings towards that environment. The opposite behavior is categorized as avoidance.

The abovementioned research shows what has been studied in the present dissertation: satisfaction derives, among other factors, from the way we feel toward a certain element. If we experience positive feelings towards the environment we work in, the probability to feel satisfied while performing a task is much greater than if we experience negative feelings.

2.3.2. Work environment: norms regarding lighting and temperature

2.3.2.1. Temperature

Regarding temperature, there seems to be a consensus that the minimum temperature in closed spaces should be held at 16°C. Numerous studies show the ideal temperature for human beings is set between 16 to 24 degrees, and we have come to accept this range as the standard level of temperature. In fact, if one tries to regulate an air conditioning device, for example, one can verify that the minimum temperature is set at 16°C.

However, the Canadian Centre for Occupational Health and Safety presents the following standards when it comes to temperature in offices:

Temperature/Humidity Ranges for Comfort			
Conditions	Relative Humidity	Acceptable Operating Temperatures	
		°C	°F
Summer (light clothing)	If 30%, then	24.5-28	76-82
	If 60%, then	23-25.5	74-78
Winter (warm clothing)	If 30%, then	20.5-25.5	69-78
	If 60%, then	20-24	68-75

Table 1: Temperature Standards in offices (Adapted from ASHRAE Standard 55, 2010)

As can be seen in Table 1, in summertime, acceptable temperatures in a work environment would be between 23°C to 28° while in winter the temperature range is from 20°C to 25.5°C, depending on the percentage of humidity in any given day.

Health, Safety and Welfare regulations in the UK do not go so far as to set a maximum temperature level. However, it sets a minimum of 16°C. Yet, The Chartered Institute of Building Services Engineers recommends a temperature of 20°C for office environments.

One can see that there is not a definite consensus on temperature levels although there is a general agreement that the maximum comfortable temperature is 28°C, depending on the percentage of humidity.

Curiously, one does not find this problem with regulating levels of luminosity as they are well defined according to the type of activity one performs. Regarding both variables, though, there is still a long way when it comes to set definite rules for making sure that organizations follow these standards as they are closely related to how employees respond to their work environment, hence, how they behave towards it.

What is pertinent, therefore, is to explore how these two variables can influence, in practice, our levels of satisfaction while performing a task.

2.3.2.2. Lighting

Legislation and different norms show that there are optimum levels of luminosity and temperature for the performance of tasks. ISO 8995-1:2002, which regulates levels of luminosity in the workplace depending on the type of activity you perform and the kind of space you perform your work in, states very clearly that lighting is essential for how well we perform our work.

Regarding luminosity, IESNA Lighting Handbook presents the following standards:

Type of Activity	Ranges of Illumination (Lux)	
Public spaces with dark surroundings	20-50	
Simple orientation for short temporary visits	50-100	Low
Working spaces where visual tasks are only occasionally performed	100-200	
Performance of visual tasks of high contrast or large scale	200-500	Standard
Performance of visual tasks of medium contrast or small size	500-1000	
Performance of visual tasks of low contrast or very small size	1000-2000	
Performance of visual tasks of low contrast and very small size over a prolonged period	2000-5000	High
Performance of very prolonged and exacting visual tasks	5000-10000	

Table 2: Recommended Illumination Levels (IESNA Lighting Handbook, 2000, p.10-13)

One can see that for the performance of visual tasks of high contrast, as eight hours of work office, the ranges of illumination recommended is 200 to 500 lux.⁴ For any kind of visual task where some kind of effort is needed, the range of illumination is always above the 200 lux.

Contrastingly, if one analyses the range of illumination for public spaces, one can see the enormous difference in the required range of illumination (20 to 50 lux).

Many different regional organisms have regulated the type of lighting required for workspaces. However, it is clear that there seems to be a degree of unanimity when talking about visual tasks that required some effort and that is the range between 200 to 500 lux.

Regarding the type of lamps that are most adequate for the performance of a certain task, the matter is a more complex one. There are different types of lamps: incandescent, halogen, fluorescent, compact fluorescent and LED.

Different bulbs have different characteristics. While the first type of lamps are the cheapest and the most common, halogen bulbs emit a light that is approximate to natural daylight. Conversely, fluorescent bulbs are more efficient and are the common choice for office spaces. Led bulbs are usually considered the most efficient type of lamp although there is some data that states that this is not the right choice as it can be harmful for the human eye (Zumbotel, *The Lighting Handbook*, n.d.).

Although there are many different elements to consider when it comes to the type of lighting one uses to perform a certain task, it seems clear that different intensities are required for different activities and, where visual effort is concerned, the intensity of lighting should be at a range that minimizes a person's visual effort.

⁴ Lux is short for lumens which is the quantity of light per square meter.

III. Empirical study

3.1. Problem definition

As has been shown in chapter 2.3.1., the physical environment can affect not only our performance while executing a task but also our internal response to what surrounds us. This environment can result in a positive response, therefore influencing our levels of satisfaction while performing a certain task, or it can result in a negative response that can influence negatively our satisfaction.

Not many studies explore the influence lighting and temperature can have on satisfaction and although we recognize, without thinking long and hard about the subject, that we must be influenced by it, studies on satisfaction regard this facet as only marginally important.

The JDI or MSQ are tools that, while measuring overall satisfaction, also question employees regarding ergonomic factors of the office their work in summing all elements in a question.

These reasons explain the present thesis aim: to explore the impact of temperature and lighting has on satisfaction while performing a task. In order to study this question and better understand if these variables do have an influence on people's satisfaction when performing a certain task, a questionnaire was designed to achieve this goal.

In a simple scenario where different participants were asked to perform a task with different complexity levels in 30 minutes, the main purpose was to expose participants to the effects of lighting and temperature while performing a task. Then, after participants ended the task (either when finished it or when the time ran out) we asked them to answer a questionnaire with different questions in order to assess their satisfaction levels.

There were different groups, in which variables were modified in order to understand differences of satisfaction in different scenarios, therefore exploring the research question mentioned in chapter 1.3. and testing the different hypotheses mentioned in chapter 1.4.

The results and findings of this study will be discussed in chapter 3.5. and, in subsequent chapters (4.1., 4.2.), conclusions, implications and limitations will be presented to the reader.

The methodology presented in the next chapter strives to provide information in order to answer the following assumptions:

(H1): High levels of luminosity will affect positively the satisfaction one feels while performing a certain task;

(H2): Standard levels of luminosity will affect positively the satisfaction one feels while performing a certain task;

(H3): High temperature will affect negatively the satisfaction one feels while performing a certain task;

(H4): Standard temperature levels (20 C°) will affect positively the satisfaction one feels while performing a certain task.

3.2. Objective of the study

Having established in Literature review and conceptual framework building that human beings are deeply influenced by what surrounds them, this empirical study strives to put these concepts in practice.

The objective of the empirical study is to identify the different behaviors of the participants while they are exposed to different variables (differing levels of lighting and temperature).

After identifying different behaviors in distinct variables by exposing participants to different stimulus, the goal was to verify if those behaviors would be generalized, either confirming or denying the previously mentioned hypotheses.

3.3. Methodology

For the purposes of this study, a specific task and survey were designed to test the different hypotheses stated above. In order to be able to test the positive or negative impact temperature and lighting had while participants performed the task, different variables needed to be considered for the purposes of this study.

In this study, there were two different scenarios that were to be tested: lighting and temperature. In turn, each scenario had different variables that were considered. These variables were: intensity and complexity of the task.

The first scenario, lighting, had three different levels regarding intensity in which participants were to be tested: high levels of luminosity, standard levels of luminosity, and low levels of luminosity. For this scenario, two different lamps with different intensities were used. The recommended lux for visual efforts that require some kind of effort is 200 to 500 lux. Therefore, two different LED lamps were utilized in this scenario – the first had 470 lux and the second had 1100 lux.

Similar to what would happen in temperature scenario, it was not possible to find a lamp that had a lower intensity than what is recommended by the generality of Health and Safety at Work offices. Consequently, for this dissertation, the lower variable of luminosity was not studied. Although it can be discussed that it could be simulated a task by exposing participants to near darkness, there was not a sure way to measure the intensity of light that participants were being exposed to.

For the temperature scenario, originally there were three scenarios to test also. However, as has been stated before, and because air conditioning does not allow temperature levels to be set at levels below 16°C, it was decided that, for the purposes of this study only two variables regarding temperature intensity would be tested and those were high temperature levels and standard temperature levels.

Therefore, different people would have to be tested in different variables. With the intention of being able to expose participants to all these different variables for a certain amount of time, they would have to complete a task (a Sudoku) with two different levels of complexity: easy and hard (Appendix 5.1. and 5.2.). These tasks were randomly assigned to participants.

Scenario	Luminosity	Temperature
High	Easy/Hard	Easy/Hard
Standard	Easy/Hard	Easy/Hard

Table 3: Scenarios of the empirical study

After the resolution of this task, participants were asked to answer a questionnaire according to the scenario they were placed in: lighting or luminosity. The used questionnaire was built with the main goal of studying participants' answers right before they finished the task they were assigned to do and would, therefore, permit a direct feedback after the task had been finalized.

The questionnaire was the chosen method because "it can be used with people directly involved in the issues to be investigated" (as cited in Currie, 2005, p. 95). In this way, it was possible to gather instant reaction from the participants regarding the task they had been given.

The designed survey was divided into four different sections of questions: Task, Personal Feelings about the Task, Logistic Conditions about the Task and Personality. The first three sections had the intention to study specific elements related to the performance of the task and the impact it had on satisfaction of participants while the last section of questions focused specifically on personality traits.

The survey employed at the empirical study was, almost in its entirety, built in light of JDI and MSQ's methods for assessing job satisfaction levels. The Minnesota Satisfaction Questionnaire assesses satisfaction by asking participants to state their satisfaction in different facets while the Job Description Index asks participants to decide if certain statements describe their present job. The main difference between these two job satisfaction measurement tools is the scale they use. MSQ uses a very dissatisfied – very satisfied answer scale (with five answer options) while JDI uses a three answer scale divided between the options Yes, No and '?'.

In the designed survey used for this empirical study, participants were asked to state their degree of agreement with different statements. A four answer scale was used in which '1' was answer option "I totally disagree" and '4' was answer option "I totally agree".

Authors' opinions differ whether opting for an even numbered scale is better than opting for an odd numbered scale. There are advantages and disadvantages for both methodologies. The first option is said to "force" participants to stake a position while the second option is said to "facilitate" participants to claim a neutral position. Even

though these arguments are both convincing, it was not possible to find a consensus in literature and authors' opinions differ a lot.

Thus, since there was not any consensus regarding this subject, the author of the present dissertation opted for an even number scale hoping to avoid participants choosing the so-called "middle ground". Therefore, through this scale, the author of this dissertation wanted to offer participants definite choices. The goal was not to offer a neutral ground in which participants could feel comfortable choosing but rather to offer a set of options that could reflect their true feelings about their own personal satisfaction while performing a task.

The questionnaire was divided in four sections as has been mentioned before. These were Task, Personal Feelings about the Task, Logistic Conditions about the Task and Personality. The goal of the first three sections was to evaluate feelings and perceptions about the task participants had to solve and, hence, their satisfaction towards it.

The fourth section of the questionnaire was built in the semblance of "The 'X - Y Theory' Questionnaire" (Alan Chapman, 2001-2008. Retrieved from businessballs.com). The goal of this section was to see if, in the analysis of the participants' answers, could be found any correlation between satisfaction levels and the X Theory or the Y Theory of Management developed by Douglas McGregor. The importance of personality traits and the influence it can have on job satisfaction has already been studied by many authors.⁵ Therefore, it would be important to understand if personality traits could have a direct bearing on the satisfaction people feel while performing a task. This knowledge is fundamental, especially when talking about different management styles and how these styles can be adapted to different personality types. By getting to know how personality traits influence satisfaction, companies will adapt better to their employees and will better understand how can they be motivated and kept satisfied.

The rooms where the task took place had to respect certain requisites: the site where the lighting scenario was to be tested had no access to natural light. In order to test the different lighting intensities, a floor lamp was used. Participants were placed around

⁵ Kahn and Hoppock are only two of these authors who have emphasized the importance of personality traits and how it can influence behavior and attitudes in the workplace.

the floor lamp in order to benefit from the light. Additionally, the site where the temperature scenario took place had an air conditioner in order so that it was possible to test the different temperature intensities.

Finally, with this task it was intended to simulate a work environment situation. More than that, the 30 minutes that participants were given to perform the task was intended so that we could expose them to the different variables for a reasonable amount of time.

3.4. Sample definition

The present empirical study counted with the participation of 48 people, distributed throughout the different scenarios in evaluation. The sample was a random one and therefore, representability of the sample is not guaranteed in this study.

Although a social and demographic characterization of participants was not performed, there was a single requirement while asking people to participate in the present study. The only requirement need to participate in this study was that participants had to be at least 18 years old. That is because, for the purposes of this study and because this study is correlated with job satisfaction, participants would need to be adults. In that way, there would be a higher probability that participants would have a sense of responsibility and obligations commonly associated with the work environment.

This requirement was intended to not only to give the opportunity for more people to be able to participate in this experience but also so that the study could benefit from a variety of people, backgrounds and cultures because these elements could prove fundamental while analyzing the different results of the empirical study.

In the first scenario there were 32 participants divided equally throughout the different variables in evaluation. It was fundamental (in both variables) that participants were distributed equally in all variables that were in evaluation. Only in that way, could we compare their questionnaire answers.

The distribution of participants was the following:

Temperature		
Scenario	Easy	Hard
High (32°C)	8	8
Standard (20°C)	8	8
Total	32	

Table 4: Temperature Sample - distribution of participants

In the second scenario there were 16 participants also divided equally throughout the different variables in evaluation (higher and standard levels of luminosity). The distribution of the participants of the second scenario was as follows in the table 5:

Lighting		
Scenario	Easy	Hard
High (1100 lux)	4	4
Standard (470 lux)	4	4
Total	16	

Table 5: Lighting Sample - distribution of participants

3.5. Results and Findings

3.5.1.1. Temperature

In this scenario, the goal was to understand the impact temperature could have on satisfaction levels regarding the task that was assigned to the different participants of the study.

The whole sample of this scenario comprises 32 participants. From those 32 people, 16 were exposed to 20°C (Group A) while other 16 were exposed to 32°C (Group B) – the maximum temperature the air conditioning allowed. Two different tasks were distributed with two levels of complexity – easy and hard (Sudoku 1 and Sudoku 2, respectively).

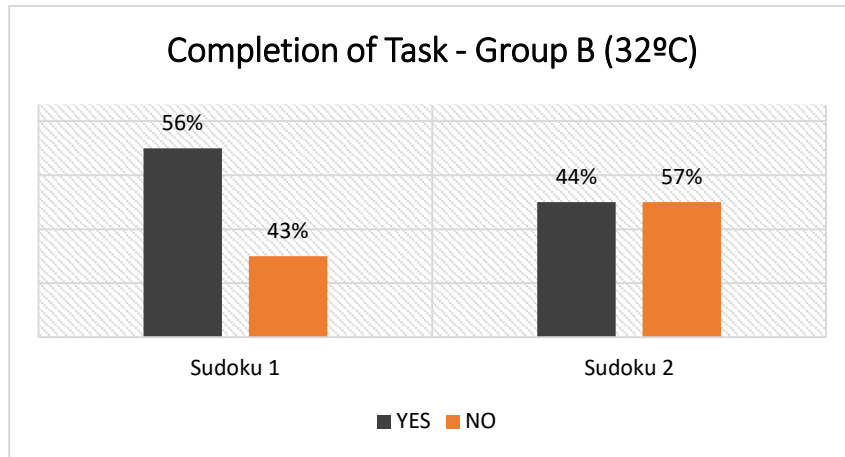
Of the two different tasks that participants were asked to perform, we concluded that the easiest Sudoku shows the higher completion rate while the harder Sudoku shows the lowest completed rate. 65% of the participants, who were assigned Sudoku 1, were able to finish it in the allotted time (30 minutes) while 67% of the participants who were given Sudoku 2 were not able to finish the task in the same amount of time.

The participants of Group A were separated: 8 participants were given the easiest Sudoku (Sudoku 1) while the other 8 were given the hardest Sudoku (Sudoku 2). Since participants were given different tasks with different levels of complexity, we also were interested in getting to know how their success rates of task completion differed.

Group A, who was exposed to what is called the standard level of temperature – 20°C – had a success rate of completion of task of 50%, meaning that half of the participants managed to finish the task. Half of participants were able to finish the assigned Sudoku in the allotted time given (maximum 30 minutes). However, the completion of task is higher for the easiest Sudoku. 75% of participants that were assigned the easiest Sudoku were able to finish it while 75% of participants who were assigned the more difficult Sudoku were not able to finish the task in the given 30 minutes.

On the other side, Group B, who was exposed to a higher level of temperature – 32°C – had a slightly different behavior. The majority of participants who were assigned the easiest Sudoku were able to finish it (56%). However, a surprisingly 44% of the participants were able to finish the hardest Sudoku while in Group A only 25% were able to complete it.

Nonetheless, it is easily verified that the harder the Sudoku, the higher the probability of not completing it in the allotted time. Regardless of the level of temperature that these participants were exposed to for 30 minutes, the easiest the task, the higher the completion rate (Graphic 1).



Graphic 1: Completion of Task - Group B

With regard to the personal feelings of participants while performing the task, when we asked them if they had felt satisfaction while performing the task, we had a wide range of answers. However, the 32 participants totaled an average answer of 3.125. That means that in the used answer scale (1 to 4), the average answer of all participants was a 3, which stands for “I agree”.

Profile	Average of I enjoyed doing this task.	Average of I felt pleasure while doing this task.	Average of I identified myself with this task.	Average of I felt satisfaction while performing this task.
Sudoku1	3.4	2.9	2.6	3.1
Sudoku2	3.3	3.1	2.7	3.1
Grand Total	3.3	3	2.7	3.1

Table 6: Personal Feelings

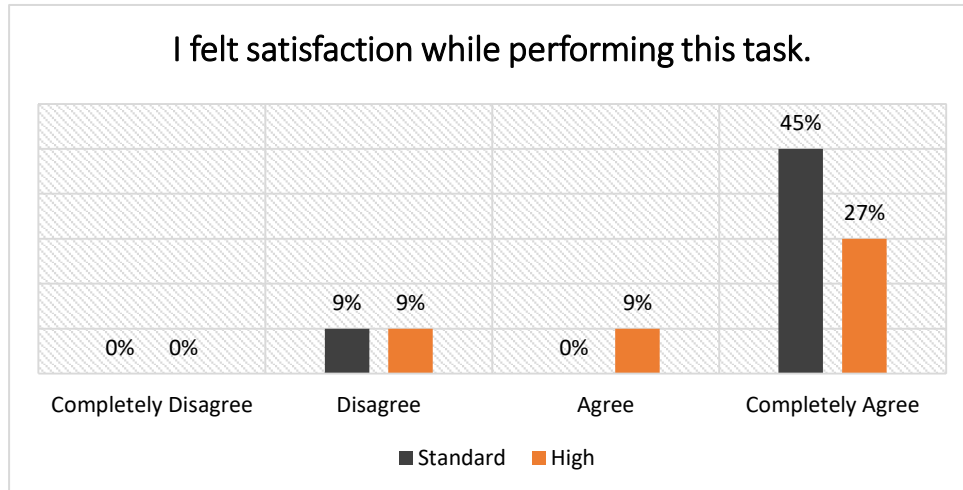
The same tendency is observed when we asked participants if they had felt pleasure while doing the task where the average of answers was 3. The average answers of enjoyment was a little higher, showing a 3.375 average. However, when we asked participants if they identified themselves with the task, the average answer was a 2.6, which in the answer score translates into a “Do not agree” (Table 6).

It is interesting to note that differences between participants that were given the easiest Sudoku and the participants who were given the hardest Sudoku were rather slight. It is true that when we asked participants about their enjoyment and pleasure, we see that

the easiest Sudoku shows the highest average except when asked if they had identified themselves with the task where the highest average was in the hardest Sudoku.

When the task was completed and when we asked about participants' satisfaction levels, we concluded that people who were given the easiest Sudoku, when exposed to standard levels of temperature, were generally more satisfied while performing the task. The majority of people (45%) who were exposed to the standard temperature stated that they felt satisfaction while performing the task.

On the contrary, people who were exposed to the higher temperature of 32°C were less satisfied – only 27% of the participants asserted their complete agreement with the statement “I felt satisfaction while performing the task” while 9% said they agreed that they had felt satisfaction.⁶ However, 9% people were exposed to standard temperature levels, affirmed that they did not agree that they had felt satisfaction while performing the task, raising the question that we want an answer to – did temperature had an impact on the dissatisfaction of these participants or were other factors responsible for this dissatisfaction? (Graphic 2).



Graphic 2: Satisfaction Levels (Sudoku 1 Complete)

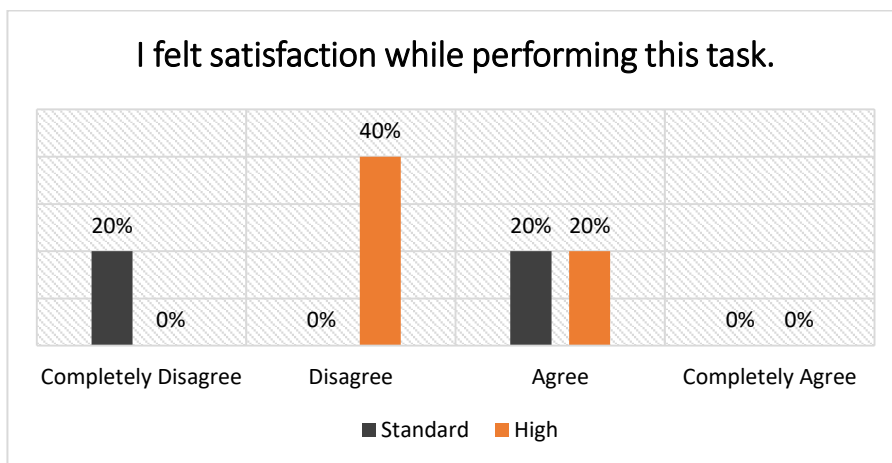
When the task was completed, participants who were given the hardest Sudoku had a different behavior: the majority of participants agree that they had felt satisfaction

⁶ The answer scale used for this questionnaire was the following: 1 – I totally disagree; 2 – I don't agree; 3 – I agree; 4 – I totally agree.

while performing the task, regardless of the temperature they had been exposed to (33% in both variables agreed with the statement – “I felt satisfaction while performing this task”). However, only 17% of participants totally agreed with the same statement and only participants that were exposed to a higher temperature. Concordantly, in the same temperature scenario (32°C), 17% of participants disagreed with the before mentioned statement.

We also wanted to understand what happened when participants did not finished the task at hand. Participants who were given the easiest Sudoku, when they could not finish the task they were assigned to do, stated that they had felt less satisfaction while performing the task. 40% of participants who were exposed to a higher temperature stated their disagreement with the declaration “I felt satisfaction while performing the task” while 20% of participants said they totally disagreed with the same statement, while exposed to a standard temperature.

In contrast, 20% of participants in each of the variables (standard and high temperature) responded that they agreed that they had felt satisfaction while performing the task (Graphic 3).



Graphic 3: Satisfaction Levels (Sudoku 1 Incomplete)

Participants who were assigned the hardest Sudoku, when they could not finish the task show a slightly different behavior: it is easily confirmed that none of the participants affirmed that they completely disagreed with the present statement. Contrastingly, the majority of participants who did not complete the hardest Sudoku (40%) affirmed that they completely agreed that they had felt satisfaction while performing the task when exposed to 20°C. 20% of participants did not agree that they

had felt satisfaction when exposed to the higher temperature of 32°C. Conversely, 20% of participants in each of the two variables agreed that they had felt satisfaction while they were performing the task.

Our analysis shows that when participants managed to finish the task in the allotted time and regardless of the temperature were exposed to (either 20°C or 32°C) and also regardless of the complexity of the task they were given, they confirmed that they had felt satisfaction while performing this task.

A different analysis shows that the majority of higher average of answers were always of participants that finished the task regardless of the complexity of the task they were given or the temperature they were exposed to (Table 7).

Profile	Average of I felt satisfaction while performing this task.
T1	3.1
High	3.0
Complete	3.4
Incomplete	2.3
Standard	3.3
Complete	3.7
Incomplete	2.0
T2	3.1
High	2.8
Complete	3.0
Incomplete	2.5
Standard	3.5
Complete	3.0
Incomplete	3.7

Table 7: Satisfaction Levels (average of answers)

More than studying satisfaction levels, we wanted to understand how participants responded when questioned about the temperature where the task took place. When analyzing the average of answers of the different profiles, we came to the conclusion that it did not matter the complexity of the Sudoku, that the participants who were exposed to the standard temperature of 20°C showed a higher average of answers, whether they were given the hardest or easiest Sudoku.

Profile	Average of The site of the task was comfortable in terms of temperature.	Average of The temperature of the room was adequate.
T1	2.9	2.8
High	2.4	2.1
Standard	3.4	3.4
T2	2.8	2.8
High	2.0	1.9
Standard	3.6	3.8
Grand Total	2.8	2.8

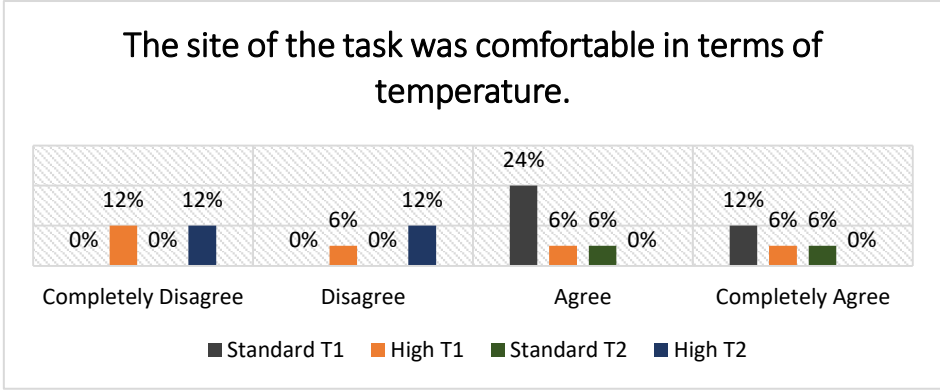
Table 8: Temperature (average of answers)

We asked participants to state their level of agreement with the following sentence: “The site of the task was comfortable in terms of temperature” (Table 8). We wanted to understand if, correlated with their satisfaction levels, temperature might have a positive or negative influence on those same satisfaction levels.

When we analysed the answers of participants who finished the task, the first thing we notice is that, regardless of the complexity of the Sudoku they were given, the level of agreement with the sentence is much lower in the higher temperature variable than the standard. Participants who were exposed to 32°C while they were performing the task, agreed that the site of the task was less comfortable in terms of temperature (Table 8).

What is also interesting to note is that people who were exposed to this temperature but were given the easiest Sudoku seemed to agree that the site was comfortable in terms of temperature: 6% of participants of this variable state their agreement or full agreement with the sentence. However, it is clear that when participants who were exposed to higher temperatures and were given the hardest Sudoku felt the site was uncomfortable: 12% stated their disagreement and complete disagreement with the presented statement.

Conversely, participants who were exposed to the standard temperature of 20°C never disagreed with the abovementioned statement: when they were give the easiest Sudoku, 24% agreed with the affirmation and 12% fully agreed that the site was comfortable. When they were given the hardest Sudoku, 6% agreed and other 6% fully agreed that the site was comfortable when it came to temperature levels (Graphic 4).

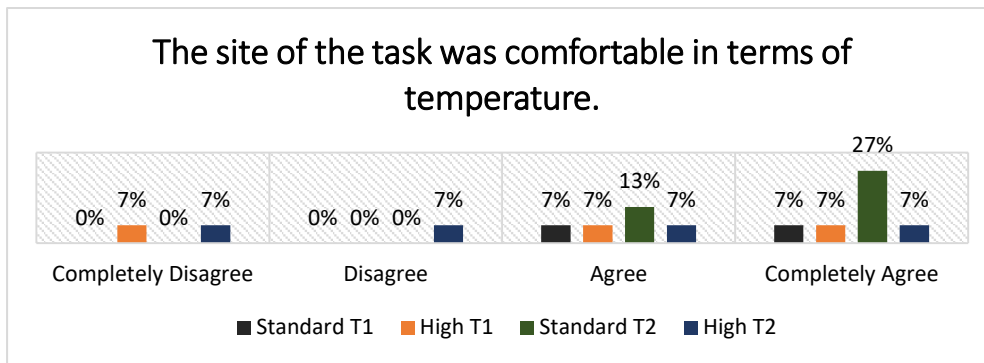


Graphic 4: Temperature (Task Finished)

Then again, when participants could not finish the task they were assigned, we can see a slightly different behavior, especially when it comes to participants who were exposed to higher temperatures.

Participants who were exposed to the standard temperature of 20°C always agreed that the site was comfortable in terms of temperature (just like what had happened when participants finished the assigned Sudoku): participants who did not complete the easiest Sudoku agreed with the statement (7%) and other 7% fully agreed with the same statement. Seemingly, participants who did not finish the hardest Sudoku but were exposed to 20°C, said that the room was comfortable in terms of temperature: 13% agreed with that statement while 27% fully agreed with it.

Surprisingly, participants who were exposed to 32°C and did not finish the easiest Sudoku present a wide variation of answers: 7% completely disagreed with the statement, 7% agreed with it and finally, other 7% completely agreed with the affirmation that the site of the task was comfortable, temperature-wise. The same happened with participants who did not finish the hardest Sudoku: 7% stated their full disagreement, other 7% said that they disagreed with the statement. On the positive pole of the scale, 7% agreed that the site was comfortable and other 7% completely agreed with the statement (Graphic 5).

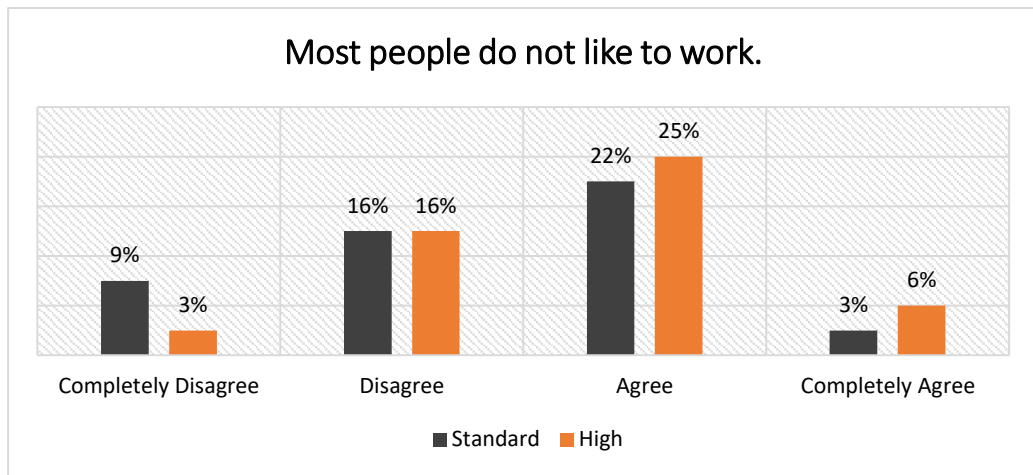


Graphic 5: Temperature (Task not Finished)

In the survey we asked participants to answer after they had performed the task, there was a group of statements in the last section that focused on personality traits. As has been mentioned before, this section’s goal was to assess if it was possible to make any correlation with participants’ answers either the X Theory or the Y Theory of Management developed by Douglas McGregor.

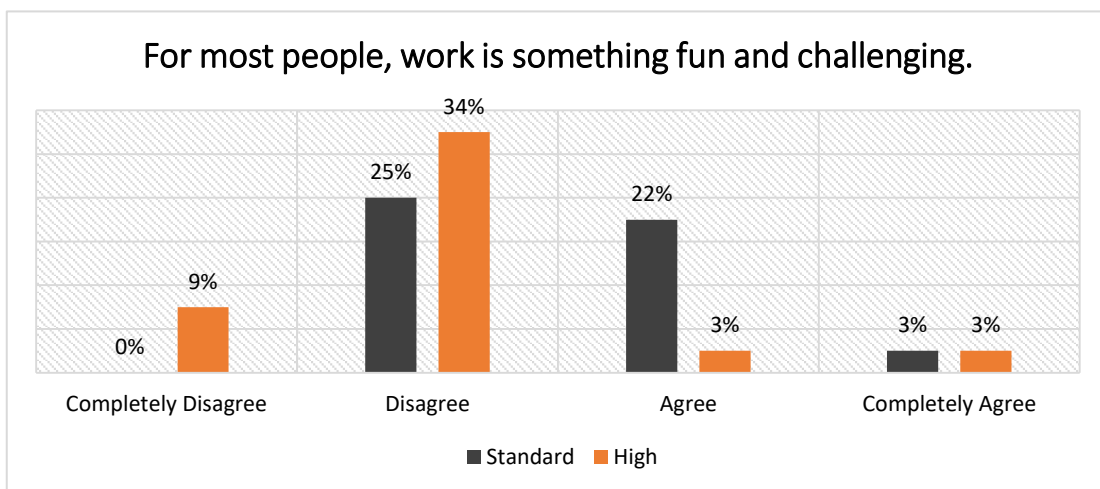
When we asked participants to state their level of agreement with the sentence “Most people do not like to work”, we found that the majority of people in both settings (standard temperature and high temperature) agree with the sentence. However, 16% of participants in each of the variables said that they did not agree with the sentence (Graphic 6). Even though the differential between participants who did not agree with the sentence and the ones that said they agreed, it can be said that the majority of participants feels that people generally do not like to work. Therefore, most participants feel that the human being is naturally averse to work or responsibilities.

This is the kind of posture one finds when defining a worker of the X theory developed by Douglas McGregor. This theory states that this type of worker will usually avoid work, avoid all types of responsibilities and, consequently, they will need to be directed or even controlled by employers. The theory also states that workers that fit this profile will value security more than anything else, so they will be motivated to work by elements that increase their sense of security in the work they perform or the company they work in.



Graphic 6: Personality Traits

When we asked participants to state their level of agreement with the sentence – “For most people, work is something fun and challenging” we can observe the opposite behavior (Graphic 7). That is, the majority of participants answered that they did not agree with that statement (34% in high temperature variable and 25% in standard temperature).



Graphic 7: Personality Traits 2

Therefore, this seems to confirm that participants of this empirical have the perception that people generally do not enjoy work and that it is not something the majority of people would find enjoyable or even challenging.

In conclusion, participants seem to think that people generally are X-type workers.

3.5.1.2. Lighting

In this second scenario of lighting, the goal was to understand the impact luminosity could have on satisfaction levels regarding the task that was assigned to the different participants of the study.

The whole sample of this scenario was comprised of 16 participants. From those 16 people, 8 were exposed to 470 LUX (Group A) while other 8 were exposed to 1100 LUX (Group B) – a much higher intensity that is needed for visual tasks. Similarly to what happened in the first scenario, two different tasks were distributed with two levels of complexity – easy and hard (Sudoku 1 and Sudoku 2, respectively).

Of the two different tasks that participants were asked to perform, it was established that the easiest Sudoku shows the higher completion rate while the harder Sudoku shows the lowest completed rate (exactly what happened in the first scenario of temperature).

88% of the participants, who were assigned Sudoku 1, were able to finish it while only 13% of the participants, who were given Sudoku 2, were able to finish the task in the amount of time that allotted for this task – 30 minutes. Group A participants' were separated: 4 participants were given the easiest Sudoku (Sudoku 1) while the other 4 were given the hardest Sudoku (Sudoku 2). Given the difference in the complexity of task, we wanted to know the completion success rate of each group.

Group A, who was exposed to what is called the standard level of lighting – 470 LUX – had a success rate of completion of task of 50% (half of the participants were able to finish the task they were given).

What we can verify, though, is that the completion success rate is much higher for the easiest Sudoku than it is for the harder one. 75% of participants that were assigned the easiest Sudoku were able to finish it while 75% of participants who were assigned the more difficult Sudoku were not able to finish the task in the given 30 minutes.

On the other side, Group B, who was exposed to a higher level of luminosity – 1100 LUX – behaved completely differently. We can see that the whole of participants assigned the easiest Sudoku were able to finish it (100%). However, the whole of participants who were assigned Sudoku 2 were not able to finish it in this second group that was exposed to a higher intensity of light.

As had been already proven in the scenario of temperature, that the harder the Sudoku, the probability of not finishing is much higher. Once again, regardless of the level of luminosity participants were exposed to for the duration of half an hour, the easiest the task, the higher the completion rate.

When we asked participants about their personal feelings while performing the task, we obtained an average of answers higher from participants who were given the easiest Sudoku. When we asked them if they had felt satisfaction while performing the task, the total of participants had an average answer of 3.1 which stands from “I agree”.

Profile	Average of I enjoyed doing this task.	Average of I felt pleasure while doing this task.	Average of I identified myself with this task.	Average of I felt satisfaction while performing this task.
Sudoku1	3.4	3.0	2.6	3.1
Sudoku2	3.2	2.7	2.7	3.0
Grand Total	3.6	3.3	2.5	3.3

Table 9: Personal Feelings

We can observe exactly the same tendency when analyzing the level of pleasure participants felt while doing the task where the average of answers was 3. The average answers of enjoyment was a little higher than the one scored on pleasure, showing a 3.4 average in the easiest Sudoku. However, when we asked participants if they identified with the task they were assigned to do, the average answer was a 2.6, which in the answer score utilized in this survey converts into a “do not agree” (Table 9). It is true that when we asked participants about their enjoyment and pleasure, we verified that the easiest Sudoku showed the highest average except when asked if they had identified themselves with the task where the highest average was in the hardest Sudoku.

When participants finished the assigned Sudoku and analyzing their answers regarding their own satisfaction levels, we concluded that people who were given the easiest Sudoku showed a behavior very much similar to the ones that were assigned the harder Sudoku. The majority of people (29% in both the standard and high scenario), when they finished the task, stated that they felt satisfaction while performing the task, regardless of the levels of lighting they were exposed to. Similarly, in each of both

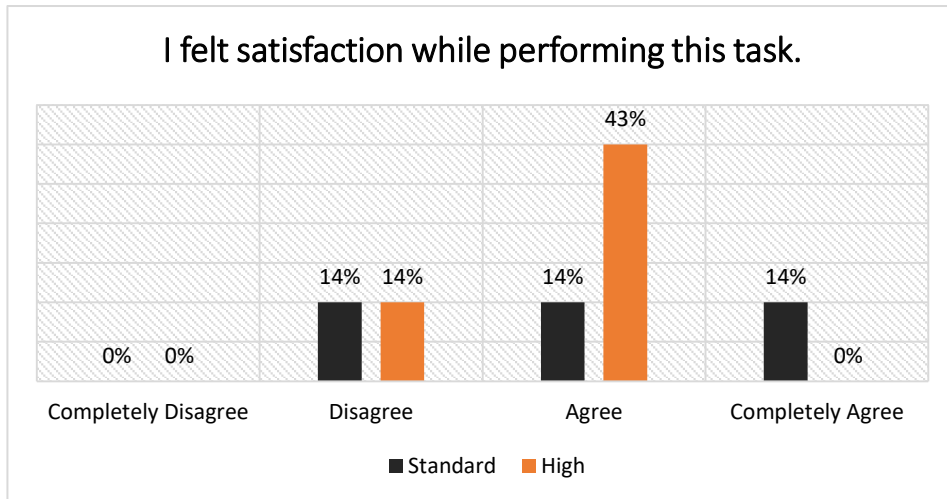
variables 14% of participants stated their complete agreement with the sentence: “I felt satisfaction while performing this task”. Conversely, 14% of the participants who were exposed to high lighting levels, affirmed that they did not agree that they had felt satisfaction while performing the task.

Participants who were given the hardest Sudoku and were able to finish it showed that they completely agree that they had felt satisfaction while performing the task, and the entirety of those participants were exposed to standard levels of luminosity.

We also wanted to get to know what happened with satisfaction of participants who did not manage to finish the task at hand, in order to understand if being unable to finished the Sudoku had any influence whatsoever on participants’ satisfaction while performing that task.

Participants who were given the easiest Sudoku, agreed that they had felt satisfaction while performing this task (100%) and were exposed to a standard level of luminosity – 470 LUX. Moreover, participants who were assigned the hardest Sudoku, when they could not finish the task showed a completely different behavior: in this instance, none of the participants affirmed that they completely disagreed with the present statement. However, the majority of participants who did not complete the hardest Sudoku (43%) affirmed that they agreed that they had felt satisfaction while performing the task when exposed to the higher level of luminosity of 1100 LUX.

14% of participants did not agree that they had felt satisfaction when exposed to higher levels of lighting and other 14% also did not agree with the statement when exposed to standard levels of luminosity. Conversely, 14% of participants completely agreed that they had felt satisfaction while they were performing the task when exposed to the standard level of lighting (Graphic 8).



Graphic 8: Satisfaction Levels (Sudoku 2 Incomplete)

This analysis shows that, contrarily to what happened in the temperature scenario, participants' satisfaction levels were not as influenced by luminosity levels as they were by temperature levels. Therefore, it did not matter if the task was complete or not, in this scenario, participants showed higher satisfaction levels.

Profile	Average of I felt satisfaction while performing this task.
T1	3.1
High	3.0
Complete	3.2
Incomplete	2.3
Standard	3.3
Complete	3.6
Incomplete	2.3
T2	3.1
High	2.8
Complete	3.0
Incomplete	2.6
Standard	3.4
Complete	3.3
Incomplete	3.4

Table 10: Satisfaction Levels (average of answers)

However, a diverse analysis in the figure above shows that the majority of higher average of answers were always of participants that finished the task regardless of the

complexity of the task they were given or the intensity of lighting they were exposed to. The only exception can be found in the group of participants who were assigned the harder Sudoku, where task incomplete shows a higher average of answers than the complete one (Table 10).

When analyzing the average of answers of the different profiles, we came to the same conclusion that we had come to in the temperature scenario: it did not matter the complexity of the Sudoku. Participants who were exposed to the standard intensity of lighting almost generally displayed a higher average of answers.

Profile	Average of The site of the task was comfortable in terms of lighting.	Average of The lighting of the room was adequate.
T1	2.6	2.5
High	2.5	2.3
Standard	2.8	2.8
T2	2.6	2.6
High	2.3	2.3
Standard	2.8	2.9
Grand Total	2.6	2.5

Table 11: Lighting (average of answers)

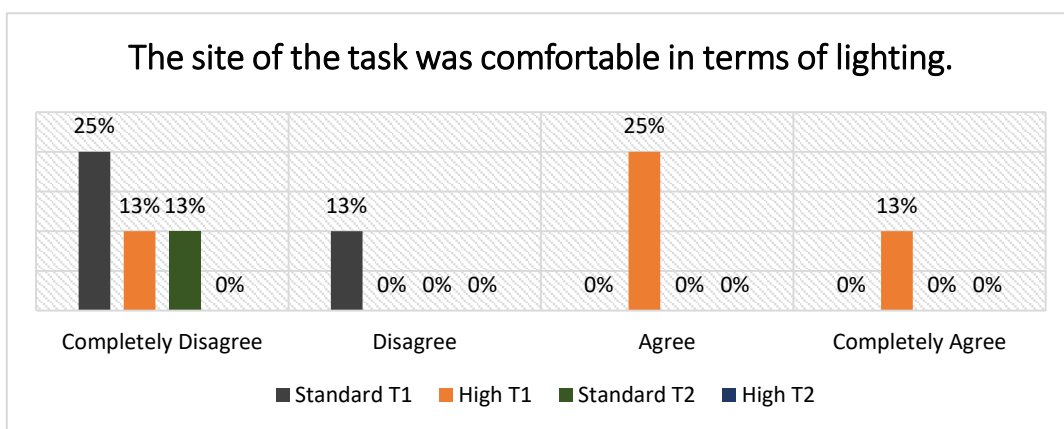
On the third section of our survey, we asked participants to state their level of agreement with the following sentence: “The site of the task was comfortable in terms of lighting”. Similar to the previous scenario, we wanted to understand if, correlated with their satisfaction levels, lighting might have a positive or negative influence on participants’ satisfaction levels.

When we examine the answers of participants who finished the task, we notice that, regardless of the complexity of the Sudoku they were given, their level of agreement with the sentence is lower in the higher lighting variable than the standard one. Therefore, participants who were exposed to 1100 LUX while they were performing the task agreed that the site of the task was less comfortable in terms of lighting intensity (Table 11).

When the task was completed, we asked participants to state their level of agreement regarding the comfortability of the site in terms of lighting. The majority of participants who finished the easier task in both variables (high and standard) did not agree that the site was comfortable in terms of luminosity intensity – 25% of participants

who were exposed to standard lighting levels said they completely disagreed that site of the task was comfortable in terms of lighting while 13% said they did not agree with the same statement. Then again, participants who were exposed to higher levels of luminosity had different reactions to this statement: only 13% stated their complete disagreement with the statement while other 13% stated their complete agreement. The majority of participants, however, stated their agreement with the statement.

Finally, participants who managed to finish the assigned task and who were exposed to standard levels of lighting state their complete disagreement, saying that the site of the task was not at all comfortable in terms of lighting (Graphic 9).

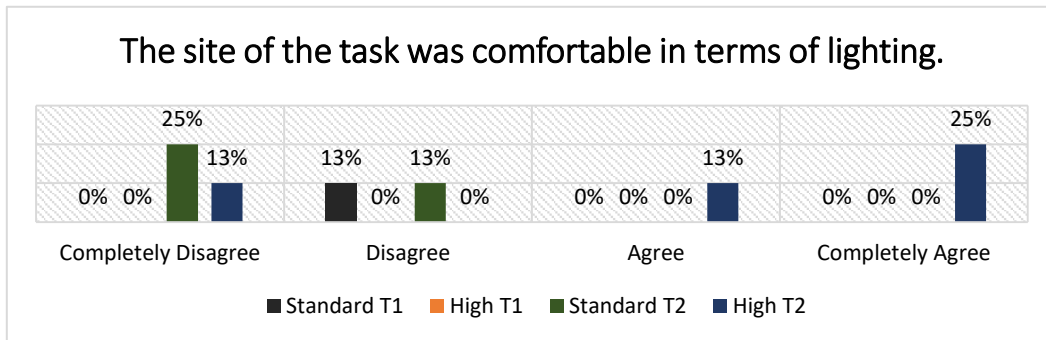


Graphic 9: Lighting (Task Finished)

When we asked participants who did not finish the task their level of agreement with the following statement: “The site of the task was comfortable in terms of lighting”, we observed that participants who were exposed to standard levels of lighting felt that the site of the task was less comfortable than the ones that were exposed to higher levels of lighting.

From the participants who were exposed to 470 LUX, 25% answered that they completely disagree with that statement and 13% (participants who did both the easy and hard Sudoku) said they disagreed with that statement, showing that were less satisfied with the luminosity conditions. Participants who were exposed to higher levels of luminosity responded that they completely disagreed with the statement in 13% of the cases (participants who were assigned the harder Sudoku) and 13% disagreed, while even other 13% agreed with the statement.

We also can observe two different poles where the majority of answers are: the positive one: 25% of participants said they completely agreed with the statement and another 25% said they completely disagreed – participants were assigned the harder and the easier Sudoku, respectively (Graphic 10).

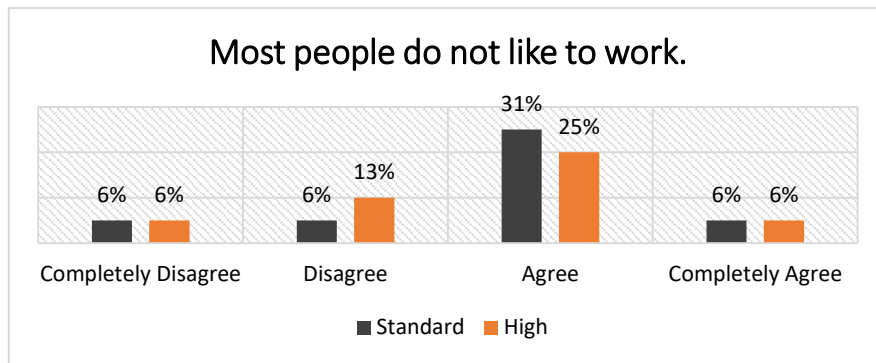


Graphic 10: Lighting (Task not Finished)

Regarding personality traits, following the same analysis we did for the scenario of temperature, we wanted to understand if participants would identify themselves with either the X Theory or the Y Theory of Management developed by Douglas McGregor.

When we asked participants to state their level of agreement with the sentence: “Most people do not like to work”, we realized that the majority of people in both settings (standard lighting and high lighting) agree with the sentence.

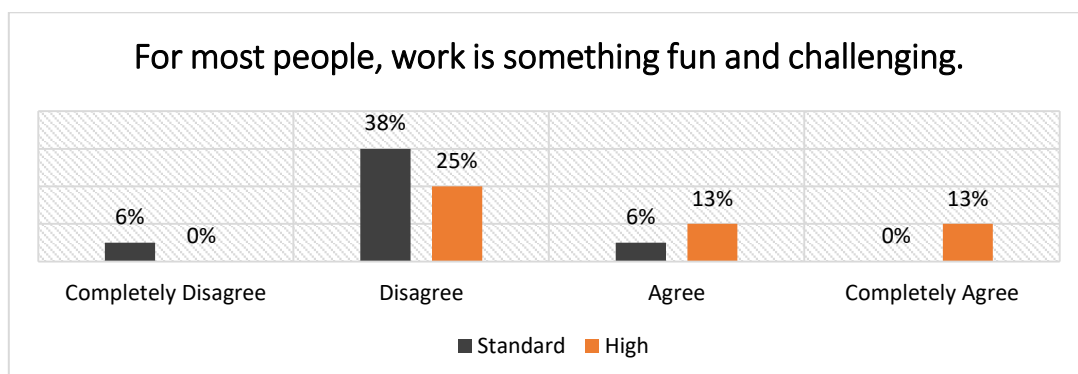
Participants that were exposed to standard levels of lighting showed a higher level of agreement with the evaluated statement (31% answered they agreed that most people did not like to work) and participants who were exposed to higher levels of lighting also showed that they agreed with the same statement in 25% of the cases. 13% of participants who were exposed to 1100 LUX said they did not agree with that sentence and the other answers scales show an equal distribution – 6% in each of the variables in study (Graphic 11).



Graphic 11: Personality Traits

Then again, when we asked participants to state their level of agreement with the sentence – “For most people, work is something fun and challenging” we could observe a different behavior, similar to what had happened in the temperature scenario. The majority of participants answered that they did not agree with that statement (38% in the standard lighting variable and 25% in high lighting variable). Participants who were exposed to a standard level of lighting show, once again, a higher level of agreement while participants who were exposed to a higher level present the same percentage (Graphic 12).

Once again, participants of this empirical study seem to think that most of the people will generally not like to work and that seems to be a characteristic of the human being, something we are born with. It is interesting to note that participants across the different scenarios display the same behavior in these two questions, cementing the notion that workers that identify themselves with the X theory will most assuredly be more difficult to motivate, “control” and, more important than that, to keep them satisfied.



Graphic 12: Personality Traits 2

IV. Conclusions

4.1. Conclusions and implications

The present empirical study has focused on trying to explore the impact the variables of temperature and lighting might have on the satisfaction of participants while they were performing a task.

Although this study does not offer definitive answers, we were able to understand that participants who finished the task were generally more satisfied than the ones who did not, regardless of the temperature they were exposed to. However, in the scenario of lighting that did not happen: participants who did not finished the task also answered that they had felt satisfaction while performing the task.

Then again, participants who were given the easiest Sudoku also showed higher levels of satisfaction regardless of their success in completing the task they were assigned to do, either in the temperature scenario or the lighting scenario. This result highlights a well-known human characteristic – we are generally more satisfied when we accomplish something. If someone accomplishes a certain goal, they will not only feel happy that they did it but they will also feel pride, hence, will be even more satisfied. Contrarily, when we cannot finish something we were trusted to do we feel dispirited, let down and even frustrated, hence, less satisfied.

When we asked participants if they had felt the site of the task comfortable regarding its temperature, we concluded that participants who were exposed to standard temperature (20°C) generally regarded the site of the task as more comfortable than the ones that were exposed to a higher temperature (32°C).

However, in the lighting scenario, we observed a different behavior: participants who were exposed to higher levels of luminosity regarded the site of the task as more comfortable in terms of lighting than the ones who were exposed to standard levels of luminosity.

The analysis of the answers in both scenarios regarding satisfaction levels shows that participants might be more sensitive to temperature levels than lighting levels. While high levels of temperature might create physical discomfort which is much more noticeable and might, in turn, influence negatively satisfaction, that is not the case with

high levels of lighting which might not be as noticeable and, hence, might not influence as much satisfaction. This would explain why participants state that the site of the task is more comfortable when they are exposed to higher levels of luminosity but not when they are exposed to higher levels of temperature.

The present empirical study concluded that, indeed, high levels of luminosity will affect positively the satisfaction one feels while performing a certain task and also that high standard temperature levels (20 C°) will affect positively the satisfaction one feels while performing a certain task.

From the conclusions of this study we can also conclude that high temperature levels (32°C) will affect negatively the satisfaction one feels while performing a certain task but we reached the conclusion that standard levels of luminosity will not affect positively the satisfaction one feels while performing a task, but quite the contrary. Standard levels of luminosity do not seem to noticeable influence their satisfaction levels, or at least, as noticeable as higher levels did.

Although the IESNA Lighting Handbook and other regulations state that the standard level (or the most adequate) of lighting for the performance of visual tasks of high contrast should be between 200 and 500 LUX, we concluded that participants regard the site of the task more comfortable when they are exposed to higher levels of lighting than that.

Regarding personality traits, it was our intention to see if a correlation between participants' satisfaction and X Theory or the Y Theory of Management (Douglas McGregor) could be found. Our results showed that most participants will affirm that people generally do not like to work and confirm that affirmation when generally disagreeing with the sentence that says "work is something fun and challenging". However, while analyzing participants' answers to these questions we came to the conclusion that participants' might be using the answer scale to identify a human characteristic rather than recreating their own personal view of work-related questions.

These results and findings show that a lot has yet to be explored in this field and possible implications it might have on companies' reality. Our work environment has an influence on how we perceive that said environment – if we understand how the physical elements of the work setting can influence our satisfaction, we can be better prepared to provide the right logistic conditions to improve employees' satisfaction levels.

As has been said before, the moving force of every company are their employees and nowadays it is fundamental that they derive satisfaction from the work they perform. Although we know satisfaction is a complex mixture of facets, if we better understand the elements that can be changed, we can most assuredly manage our employees better, make them happier, more fulfilled and, hence, even more productive.

4.2. Limitations

As happens with any other empirical study, there are certain limitations that are important to discuss. The logistic of the present study was not easy to accomplish and there are certain elements that were not considered for the purposes of this study taking into account those same limitations.

Originally, this study was built in order to evaluate three different variables inside the context of temperature and lighting. These variables included – high level, standard level and, finally, low level. However, due to the fact that air conditioning systems do not allow temperatures below 16°C and that we could not find lamps with a lower intensity than the one recommended for visual tasks, it was not possible to explore the effects those variables could have on participants.

Therefore, this study presents only two variables – standard and high. Although we theoretically assume that low levels of light and temperature will influence negatively our satisfaction levels, it would prove most interesting to simulate those conditions in order to understand the real impact it can have on people while they perform a certain task.

The greater difficulty was finding the most appropriate logistic conditions for the lighting scenario as it without counting on adequate mechanisms to measure light intensity, it proved more difficult to simulate this scenario. Nevertheless, this limitation was surpassed by arranging a room that had no natural light in order to be able to control the only available source of light – lamps with different intensity.

Furthermore, the present study was limited to studying only two variables – those of temperature and lighting. Job satisfaction is a much bigger field than these two variables and when talking about ergonomic elements, there are many others that could be studied in relation to satisfaction, like noise, natural light, disposition of furniture, comfortability of furniture, etc.

Adding to that, another limitation to this study was the sample – the present study has a very limited sample and therefore, the answers that derive from it will never be representative of a given universe. However, they were useful to bring to light some behaviors that will be interesting to study in depth in the future while at the same time showing the potential this field has – getting to know what satisfies employees is a fundamental tool to better our communication with them but also to improve logistic conditions of offices.

Finally, as has been mentioned in the previous chapter of conclusions and implications, the used answer-scale in the questionnaire presented a limitation when it comes to analyze participants' personality traits. Rather than reflecting their own personality regarding work (if they enjoy work, if they desire responsibilities, etc.), participants reflected their views on general characteristics of human beings. Therefore, the used answer scale proved to have a limitation, not allowing us to extrapolate their answers to their personal feelings about work-related questions.

On that view, this study has a limited scope because it focus on only two different elements that are part of a much greater picture. However, it was only in this way that we could perform a more detailed analysis of how these variables could influence satisfaction.

4.3. Future research

As has been seen in the present dissertation, job satisfaction has a lot to explore and discover. That are many different elements to it and this theme could not be exhausted in this dissertation or even in the many texts that have already been written.

The present study has brought into mind different themes that could prove very interesting to study in depth:

- Performance is something usually correlated with job satisfaction. However, performance is always associated with job satisfaction only in the sense that productive workers will be more satisfied and vice-versa. Further research on the topic of performance would prove interesting, namely, if one can predict performance of any given worker be getting to know their satisfaction levels in connection with the work environment;

- Job satisfaction also is very much correlated with motivation, pay scales and some authors emphasize the importance of personality. Further research on personality would prove fundamental in order to understand if there is a deeper relationship between personality traits and the satisfaction one feels in a certain job;
- Finally, the author of the present dissertation is very much interested in getting to study if or how different types of communication (formal, informal, downward, upward or horizontal communication) can influence employees' satisfaction.

V. Appendix

5.1. Task 1

Complexity level: Easy

5				8	6			1
		2	7		1	6		
	7	1				2	5	
9	1			2			7	
3			1	4	5			6
	6			9			2	4
	5	3				4	6	
		8	9		3	5		
2			5	1				7

5.2. Task 2

Complexity level: Hard

	5			3			7	
				1				9
3			7		8			
		4	9		7	6		
5	6						8	2
		1	5		6	3		
			3		1			
8	7			5				1
				7			9	

5.3. Temperature Survey

On a scale of 1 to 4, please indicate your level of agreement with the following sentences:

1 = I totally disagree

2 = I don't agree

3 = I agree

4 = I totally agree

TASK

The resolution of this task involved logical thinking.

I found the task complex.

The task was easy to solve.

In my opinion, the solution was easy to find.

I found the task uncomplicated.

This task required maximum attention.

I found this task interesting.

I found the task boring.

This task was challenging.

Creativity was needed to solve this task.

	1			4

PERSONAL FEELINGS ABOUT THE TASK

I enjoyed doing this task.

I felt pleasure while doing this task.

I felt dissatisfaction while performing this task.

I felt bored while doing this task.

I identified myself with this task.

I felt satisfaction while performing this task.

I felt unhappy while doing this task.

I did not like this task.

I did not identify myself with this task.

	1			4

LOGISTIC CONDITIONS OF THE TASK

The site of the task was comfortable in terms of temperature.
The disposition of the tables was adequate.
The temperature of the room was adequate.
Chairs' disposition was adequate.
The chairs were comfortable.

PERSONALITY

Most people do not like to work – it is a characteristic of human nature.
People are trustable.
Most people wish to have responsibilities.
Most people are lazy.
For most people, work is something fun and challenging.
Most people prefers to work in order to eat and pay their bills instead of the opportunity of being creative and solving problems.
Most people are not ambitious.
Most people does not use their own initiative to do things unless someone has asked them specifically to.
Different person's ideas generally result in the development of useful suggestions.
People are imaginative and creative.

Thank you for your participation!

5.4. Lighting Survey

On a scale of 1 to 4, please indicate your level of agreement with the following sentences:

1 = I totally disagree

2 = I don't agree

3 = I agree

4 = I totally agree

TASK

- The resolution of this task involved logical thinking.
- I found the task complex.
- The task was easy to solve.
- In my opinion, the solution was easy to find.
- I found the task uncomplicated.
- This task required maximum attention.
- I found this task interesting.
- I found the task boring.
- This task was challenging.
- Creativity was needed to solve this task.

	1			4

PERSONAL FEELINGS ABOUT THE TASK

- I enjoyed doing this task.
- I felt pleasure while doing this task.
- I felt dissatisfaction while performing this task.
- I felt bored while doing this task.
- I identified myself with this task.
- I felt satisfaction while performing this task.
- I felt unhappy while doing this task.
- I did not like this task.
- I did not identify myself with this task.

	1			4

LOGISTIC CONDITIONS OF THE TASK

The site of the task was comfortable in terms of lighting.
The disposition of the tables was adequate.
The lighting of the room was adequate.
Chairs' disposition was adequate.
The chairs were comfortable.

PERSONALITY

Most people do not like to work – it is a characteristic of human nature.
People are trustable.
Most people wish to have responsibilities.
Most people are lazy.
For most people, work is something fun and challenging.
Most people prefers to work in order to eat and pay their bills instead of the opportunity of being creative and solving problems.
Most people are not ambitious.
Most people does not use their own initiative to do things unless someone has asked them specifically to.
Different person's ideas generally result in the development of useful suggestions.
People are imaginative and creative.

Thank you for your participation!

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