

Worker Characteristics moderate the Impact of Socio-technical Workplace Interventions on Job Satisfaction

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Abstract

Workers' job satisfaction is considered a critical indicator for the effectiveness of socio-technical interventions in the work place. However, job satisfaction represents a complex psychological phenomenon with many contributing factors that can be difficult to assess. To facilitate assessments of job satisfaction we review psychological theories and metrics of job satisfaction to investigate implications for socio-technical interventions. The findings suggest that the design and introduction of socio-technical workplace interventions that impact workers' job satisfaction need to take into account and adapt to worker-specific characteristics.

1 Introduction

Job satisfaction (JS) is an indicator for positive work motivation and has been intensely investigated over the last 60 years. Socio-technical interventions make technical and organizational changes to achieve desired outcomes (e.g. Appelbaum 1997, Alkhalifa 2011) and therefore have an impact on workers and their JS. While JS is often not directly associated with high job performance (see Smith 1967, Smith, Kendall, Hulin 1969; Spector 1985) JS may be an important measure for the successful design and introduction of

socio-technical work place interventions because:

1. Socio-technical interventions that reduce JS may reduce the intervention's longer term acceptance by workers and reduce its effectiveness.
2. Reduced JS may lead to undesired effects such as increased absenteeism and higher worker turnover.
3. Rapid technological changes in production processes can render the skills of workers insufficient (Barling, Kelloway & Frone 2005) which may not only decrease JS but also decrease the ability to recover from situations when manual take-over is needed.
4. An increase in JS may improve other relevant activities such as group decision making, participative management, and job enlargement, etc. (Smith 1967).

The work that is reported in this paper was motivated by the EU funded project "FACTS4WORKERS – Worker-Centric Workplaces in Smart Factories"¹ which intended to develop and demonstrate workplace solutions that incorporate knowledge work. Information and Communication Technologies (ICT) have a critical role in the smart factory of the Industry 4.0 concept (see Richter et al. 2015). ICT is used to improve internal efficiency to enable higher value-creation through the use of information, in particular by the shop-floor workers. Workers are the base on which factories in the Industry 4.0 concept increase their flexibility, agility and competitiveness. Actual monotonous and repetitive tasks are automated or executed by robots while workers execute tasks requiring more intelligent approaches (cognitive skills and implicit knowledge to solve problems, etc.). In other words, workers have to be more dynamic, they have to be able to improve their competencies proactively and to share and communicate acquired knowledge. Smart factory ICT solutions, such as in FACTS4WORKERS are intended to empower workers, increase JS, and provide contextually relevant information while avoiding information overload. Augmented reality solutions and technologies that allow hands free-operations should enable knowledge sharing in an intuitive and comfortable way so that the shop floor can also become a learning environment.

The introduction of such ICT represents socio-technological interventions that have effects on several working conditions (Barling, Kelloway & Frone 2005):

- Supervision: impact on autonomy and self-management
- Operating procedures: impacts flexibility, work orders and task monotony
- Communication and collaboration: impacts how workers are kept "in the loop" and their knowledge sharing and team work
- Nature of work: impacts work variety and responsibilities

The intent of this paper is to provide researchers and designers with information that should help create socio-technical interventions that increase JS, or at least keep JS at pre-interventional levels. For this, first several psychological theories of JS are reviewed in section 2, then common measures of JS are described in section 3 and conclusions for the design and introduction of socio-technical workplace interventions are presented in section 4.

¹ See <http://facts4workers.eu/>

2 Theories of Job Satisfaction

While many theories of JS exist, we focus in our review on a diverse subset of several prominent theories that span the overall frame.

Our reviewed JS theories fall into three theoretical approaches, see e.g. Weiss & Cropanzano (1996) which provides the structure of the following subsections:

- **Cognitive theories** base JS on cognitive judgments that workers make about their work experience and work conditions.
- **Dispositional theories** emphasize certain predispositions of worker toward expressing JS.
- **Motivational theories** focus on the factors in the work environment and the work itself that influence workers motivation and increase JS. We review two such theories: the “two factors theory” and the “job characteristics model”.

2.1 Cognitive Theories

Cognitive theories describe job satisfaction essentially as an outcome of cognitive assessments. An example of such theory is Fishbein & Ajzen (1975) who describe the conditions under which attitudes lead to intentions which in turn lead to behavior. Many of the underlying assumptions of cognitive theories come from information processing theory. However, beside cognitive information also social and affective information can be included. One example of such extended theory is the Affective Events Theory (AET) which views JS as a result of evaluative judgments with affective as well as cognitive components (Weiss & Cropanzano 1996). Affective components consist of feelings that the work environment engenders whereas cognitive components consist of the workers’ beliefs about the work environment. AET thereby expands purely cognitive theories of JS that would consequently claim a constant, static picture of JS: Once an attitude has been formed from the workers’ experiences in their work environment, the attitude should remain relatively stable over time (see also Wegge et al. 2006). AET, in contrast, postulates that affective reactions are triggered by certain events and individual dispositions. Because affect fluctuates over time, JS judgements are expected to fluctuate over time as well. As the figure below indicates, affective reactions are in the center of AET theory that influence work attitudes and driving behaviors.

AET especially explains the intra-individual variability of JS measurements and implies that a single measurement of JS does not capture the whole range of possible JS states for a set of workers. Therefore, measurements have to be repeated over time to achieve accuracy.

2.2 Dispositional Models

A principle assumption of dispositional models for JS is that certain dispositional properties of workers influence JS (Judge & Larsen 2001, Dugguh & Ayaga 2014) such as the workers’ self-evaluations (“core-evaluations”: Judge et al. 1998, Srivastava, et al. 2010) and negative and positive affectivity.

“Core self-evaluations” are fundamental and subconscious conclusions that people have formed about themselves, about other people, and about the world around them. These conclusions concern their self-esteem, their self-efficacy, neuroticism, and locus of control. Therefore, core-evaluations moderate the impact of work place experiences on the worker’s emotional responses. For example, workers with the belief “people will hurt me” are likely to respond with different emotions to changes in their work environment than workers who believe that “Life is an adventure”.

Negative and positive affectivity is another dispositional factor (e.g. Watson, Clark & Carey 1988). Negative affectivity includes fear, anxiety, and hostility, whereas positive affectivity reflects positive engagement with the environment that includes enthusiasm, higher energy, alertness, and determination. Both dimensions should be viewed not as single but as independent dimensions that an individual can experience at the same time. These dispositions have a direct or indirect impact on JS. Dispositional models do not negate the influences of cognitive components on JS but focus on the workers’ dispositions and personality traits that trigger them. For example, the first two of the “Big Five” personality dimensions (*extraversion, neuroticism*, agreeableness, conscientiousness, and openness) were found to be especially relevant for JS. (Judge & Larsen 2001). The model is illustrated in the figure below:

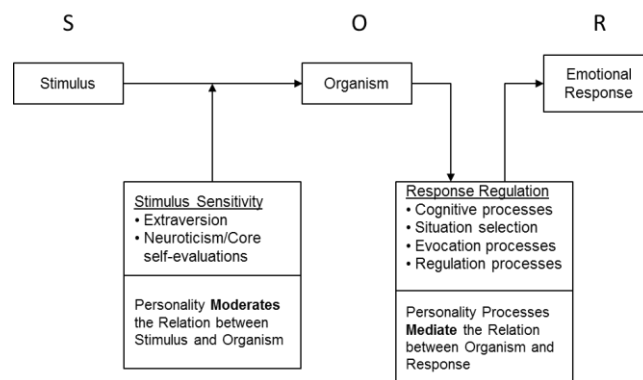


Figure 1: Judge & Larsen (2001): SOR Model of Personality Moderating Affective Responses

Dispositional theories explain the inter-individual variability of JS measurements and imply that different workers will respond to socio-technical job interventions in different ways. Therefore, to meet the needs of all workers, socio-technical interventions should be adaptable to specific worker characteristics. Initial fieldings of socio-technical interventions should also be sensitive to any dominant dispositional qualities of the involved work force. For example, it would be preferable to field prototypes of socio-technical interventions among workers with generally positive affective dispositions who would be emotionally more likely to engage with them.

2.3 Motivational Theories of Job Satisfaction

Two motivational theories of JS are here reviewed, the job characteristics model and the two factors model.

2.3.1 Job Characteristics Model

The job characteristics theory by Hackman & Oldham (1976) investigates the conditions under which workers are motivated to perform effectively on their jobs. The theory is based on the interaction of three aspects in the work environment:

1. The workers' psychological states that internally motivate them,
2. The characteristics of the jobs that create those psychological states, and
3. Certain individual attributes that are required to positively respond to challenging jobs.

The variables are further connected via the workers need for growth (“growth need strength”) that moderates the connection between job characteristics, psychological states, and outcomes, thereby reflecting inter-individual differences of workers in their workplace, see figure below.

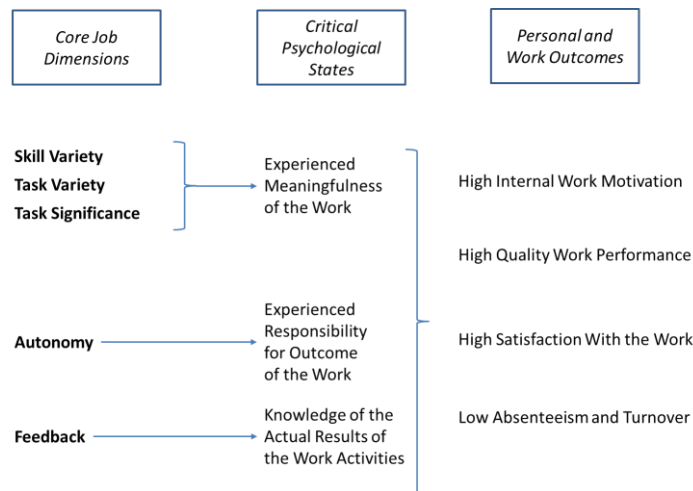


Figure 2: The Job Characteristics Model by Hackman & Oldman (1976)

The model also conceptually links the core job dimensions to the workers motivation, see Hackman & Oldham (1976). Worker motivation (referred to as Workers “Motivation Potential Score”) is thereby the product of the average of skill variety, task identity, and task significance that is conceptually multiplied by the factors autonomy and feedback.

The job characteristics model was empirically confirmed by the Job Diagnostic Survey (JDS, which will be described in the next section. The model focuses on positive motivational incentives and is especially useful to determine desired work place changes that could

strengthen JS. It is less suitable for potentially dysfunctional work aspects such as highly repetitive work. The model considers the relationship between work and individuals (i.e. not teams); it does not explicitly consider interpersonal, technical, or situational variables.

2.3.2 Two Factor Theory

Herzberg, Mausner & Snyderman (1959) investigated the events that lay behind workers' attitudes about their jobs. Based on large numbers of conducted interviews they found that workers tended to report high JS when they reflected on the nature of their work itself but tended to refer to their work environment when reporting dissatisfaction (see also Herzberg 1987). This led to their formulation of the two-factors theory of JS. According to this theory, attitudes that increase JS are called "motivator" factors whereas those that lead to job dissatisfaction are called "hygiene" factors. Therefore, JS and dissatisfaction are not considered two endpoints of the same dimension but two different dimensions altogether such that workers could experience JS and dissatisfaction at the same time. The factors are listed in Table 1:

Primary job attitude factors	Hygiene factors
1. Achievement	1. Salary
2. Recognition	2. Possibility of growth
3. Work itself	3. Interpersonal relations - subordinates
4. Responsibility	4. Status
5. Advancement	5. Interpersonal relations - superior
	6. Interpersonal relations - peers
	7. Supervision - technical
	8. Company policy and administration
	9. Working conditions
	10. Personal life
	11. Job security

Table 1: Factors related to work satisfaction

The theory has important implications for the potential of socio-technical interventions to increase work satisfaction. For example, it disconfirms traditionally held notions that supervisor training or pure salary alone would increase workers JS. Also, merely decreasing technical or administrative inconveniences would not lead to increased JS but would only reduce perceived dissatisfaction. Instead, the theory implies that JS would grow as work is experienced in meaningful ways, results are recognized, and personal growth is achieved. The theory was criticized by pointing out that the distinction between motivator versus hygiene factors on JS may have only inter-individual applicability such that it is more valid for some workers than for others (see Hackman 1976).

To determine socio-technical interventions that increase workers JS, designers would need to investigate the intervention's relation to the worker. There, research has investigated empowerment (e.g. Spreitzer 1995) that combines factors from Hackman and Herzberg's theories: meaning, competence, self-determination (see also Deci et al. 1989) and impact.

3 Selected Measurement Methods of Job Satisfaction

3.1 Job Satisfaction Survey

The JS survey was developed by Paul Spector from the University of South Florida (Spector 1985) to measure JS specifically to human services, public, and nonprofit sector organizations. The survey is based on an understanding of JS as evaluative feelings about the job which are measured by the survey. Questions are to be answered on five point Likert-style ratings scales, ranging from strongly agree to strongly disagree. The survey contains nine subscales that were extracted from a review of literature at the time: pay, promotion, supervision, benefits, contingent rewards, operating procedures, co-workers, nature of work, and communication. Reliability is reported as $r = .91$ for internal consistency, and between .34 to .74 for a long interval test-retest based on a sample of 2,870 participants. Also various types of validity were assessed and are reported in Spector (1985). Access to the JSS can be gained from Spector's website².

3.2 Job Descriptive Index

The job descriptive index (JDI) was developed by researchers at Cornell University in the late 1960's (Smith, Kendall & Hulin 1969) and since then has been validated with large groups of participants. It assesses attitudinal aspects of JS without imposing specific structural or process models. Workers are assumed to relate their work environment to their internal frame of reference, representing an internal standard and adjusting their responses to their experiences, thereby reflecting their specific adaptation level (Smith, Kendall & Hulin 1969).

There are 90 questions on the JDI that can be answered on a three point scale (yes, no, and undecided) and are grouped in following five factors (respective number of questions):

- Work (18)
- Pay (9)
- Promotions (9)
- Supervision (18)
- Co-workers (18)
- Job in General (18)

JDI validations (see Brodke et al. 2009) indicate good internal consistency of items within each factor (all $r \geq .88$, average $r = .91$) and good differentiation between factors (all $r \leq .67$, average $r = .42$). External validity was assessed via correlations with intent to quit (average $r = -0.42$), feelings of job stress ($r = .21$) and a single measure of JS ($r = .53$). Various forms of the JDI and descriptive information can be accessed from the website at the Bowling Green State University³ free of charge.

² <http://shell.cas.usf.edu/~pspector/> retrieved on June 1, 2016

³ <http://www.bgsu.edu/arts-and-sciences/psychology/services/job-descriptive-index.html> Retrieved on June 1, 2016

3.3 Job Diagnostic Survey

The Job Diagnostic Survey (JDS) is based on the Job Characteristics Model as described above and consists of 83 items in 7 subsections plus a short biographic questionnaire (Hackman & Oldham 1974). Response scales are seven point scales except one scale that uses a five-point Likert scale (agree – disagree). The JDS is intended to diagnose the motivational properties of jobs prior to interventions or redesign as well as to assess the effects afterwards (Hackman & Oldham 1975). It was validated with over 1,500 individuals in more than 100 jobs in about 15 different organizations. Hackman and Oldham (1976) report satisfactory reliability, that ranges for internal reliability (i.e. item consistency within a scale) between .56 to .88 and for discriminative reliability (ie. differentiation between scales) between .12 to .28. Hackman et al. (1975) report JDS validity; workers with a higher Motivating Potential Score (MPS) report lower absenteeism than those with low MPS (about 3 versus 7 days per year). Also workers with higher MPS show slightly higher job performance when rated by their supervisors than those with lower MPS.

Job Dimensions	<ul style="list-style-type: none"> • Skill Variety • Autonomy • Dealing with others • Task Identity 	<ul style="list-style-type: none"> • Feedback from Job • Task Significance • Feedback from Agents
Psychological States	<ul style="list-style-type: none"> • Experienced Meaningfulness of work 	<ul style="list-style-type: none"> • Knowledge of Results
Affective Responses to the Job	<ul style="list-style-type: none"> • General Satisfaction • Internal Work Motivation 	<ul style="list-style-type: none"> • Specific Satisfaction: Job Security, Pay, Social, Supervisory, Growth
Growth Need Strength	<ul style="list-style-type: none"> • Measured as “would like” 	<ul style="list-style-type: none"> • Measured as “job choice”

Table 2: JDS Scales

4 Summary and Implications for Measuring the Impact of Socio-Technical Interventions

The reviewed theories lead us to expect that workers’ JS is not only based on evaluations of their work and work environment but also based on their own inherent dispositions and how they experience work related events. Specifically, Affective Event Theory explains intra-individual variations of JS as a function of affective events that workers naturally experience at their work place. Dispositional theories explain that people experience their work place with their dispositional background of positive or negative affectivity as well as how they see themselves. Both, affective and dispositional factors should influence any judgment of JS as related to the work place without being directly attributable to the socio-technical intervention. Therefore, such factors should be specifically measured so that they can be accounted in the evaluation of socio-technical interventions. Across the reviewed literature, following factors were determined to influence JS:

	JSS	JDI	JDS	Herzberg motivator factor	Herzberg hygiene factor
Achievement				✓	
Recognition				✓	
Task variety			✓	✓ "Work itself"	
Skill variety			✓	✓ "Work itself"	
Autonomy			✓	✓ Responsibility	
Experienced meaningfulness of the work			✓	✓ "Work itself"	
Compensation schemes	✓	✓	✓		✓
Supervision	✓	✓	✓		✓
Relation with co-workers		✓	✓		✓
Feedback			✓		
Opportunities for growth	✓	✓			✓
Growth Need Strength			✓		
Operating Procedures	✓				✓
Security			✓		✓

Table 3: Influencing Scales

The multitude of reviewed factors challenge the notion that work related socio-technical interventions could per-se be sufficient to positively influence JS if they focus only on work related aspects. Worker JS is influenced by many factors that are not just work-, or even work-environment related. Such inter- and intra- individual JS influences may overshadow the measurable impact of socio-technical work interventions and therefore would need to be specifically measured. Therefore, the findings suggest that individual, worker specific factors need to be considered for the design of socio-technical interventions. Interventions could be designed to also address **worker**-related needs, not just **work**-related needs and be adapted by workers to facilitate their specific dispositional, motivational, and affective needs. The worker needs would need to be investigated prior to the design of the intervention and then inherently influence its design. For instance, workers with a strong need for growth would be able to take advantage of the knowledge and connectivity that new ICT solutions provide achieve networking and other professional goals that go beyond the immediate work needs. Workers who habitually experience strong negative affectivity that disrupts their professional growth, could benefit from ICT to seek guidance or receive specific forms of affirmative

feedback. Such socio-technical interventions take a wider **worker**, not only **work** centered view. In this way both types of socio-technical interventions may provide independent contributions to workers productivity and satisfaction. We plan to report in the future to what extent our experiences with the FACTS4WORKER project will substantiate, modify, and sharpen this hypothesis.

Acknowledgements

This study has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 636778.

Peter Mörtl and Marlene Schafler acknowledge the financial support of the COMET K2 - Competence Centres for Excellent Technologies Programme of the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT), the Austrian Federal Ministry of Science, Research and Economy (BMWFW), the Austrian Research Promotion Agency (FFG), the Province of Styria and the Styrian Business Promotion Agency (SFG).

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