

# The influence of autonomy and supportive leadership on employee vitality: A multi-method study in the public sector



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## **Preface and acknowledgements**

In front of you lies my master thesis: *“The influence of autonomy and supportive leadership on vitality: A multi-method study in the public sector”*. This thesis is the final project of four years studying Public Administration at the Erasmus University Rotterdam. My thesis is the product of sincere dedication and hard work over the last seven months. During these seven months, my patience and confidence was severely tested since writing my thesis was a process of adjustments and constant improvements. During my Master, I wanted to perform to my absolute best. I choose to write my thesis under supervision of dr. Lars Tummers, because I knew he would stimulate me to do so. He gave me the opportunity to write an international scientific article. After much thought, I choose this direction because it seemed in line with my goal of performing optimal and pushing my own boundaries. Writing this article was an intensive learning process, which could not have come together without the help of several important people.

Therefore, first and foremost, I would like to thank dr. Lars Tummers for his constructive, skilled feedback and constant support. He constantly boosted my confidence during this process and made sure I would create a product to my absolute best. Without him, I would not have been able to write this article, something that I would not think I could ever do. Lars gave me space to write my own thesis, but guided me in a constructive manner. Especially his enthusiasm towards my experiment stimulated me to pursue my multi-method design.

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## **Abstract**

Most public management studies focus on passive employee outcomes such as job satisfaction and commitment. However, there is much less known about active employee outcomes. Therefore, this study focuses on active employee outcomes within the public sector: employee vitality. Using self-determination theory (SDT), which also has received relatively limited attention in public management, this study investigated two vitality-fostering aspects: autonomy and supportive leadership. According to SDT, situations that support autonomy will enhance a person's enjoyment of activities and the autonomous self-regulation of behavior. Furthermore, leaders who are supportive show concern for their subordinates and their feelings and enable the intrinsic motivation of their employees. Through their communication and information sharing, supportive leaders increase feelings of self-efficacy and increase the feeling that people are at the origin of their actions. It is hypothesized that employees' vitality is positively influenced when they have autonomy and have a leader with a supportive leadership style. This was investigated using a multi-method design: a survey amongst 1.502 healthcare sector employees and an experiment using 102 students from a Dutch university. By using a multi-method design, this study answers to calls for 1) more use of multi-method designs and 2) more use of experiments in the public sector. This increases the usable knowledge for public professionals. Results show that that a) autonomy positively influences employee vitality, b) supportive leadership positively influences employee vitality and c) autonomy and supportive leadership do not reinforce their effects on vitality, contrary to expectation. Implications for management scholars and practitioners are discussed.

**Keywords:** *Vitality, Self-Determination Theory, Public Sector, Autonomy, Supportive leadership*

## 1. Introduction

Since several years there has been a trend towards shortages in staffing in the public sector (Hart, 2005). An example is the healthcare, which is a large part of the public sector in the Netherlands. Ageing of the workforce (which will lead to a significant shortage over the next several years), will lead to a considerable increase in the workload for employees in this sector (Hart, 2006; Hart, 2007; Keepnews, Brewer, Kovner & Shin, 2007; Kocakülâh & David, 2007). The trend of more employees moving to retirement and fewer younger replacements puts substantial pressure on the social security system. Employment policies therefore encourage employees to stay on the job longer (Silverstein, 2008). In order to prevent shortages in staffing and simultaneously create employees who perform optimal during their job, organizations have to go to great lengths to assist their employees in alleviating the distress and support employee well-being (McQuaid & Lindsay, 2005; Ouweneel, Schaufeli & leBlanc, 2009). This can be done by implementing practices aimed at promoting the vitality of employees. Therefore, it is important to learn more about the underlying factors that maintain or enhance employee vitality.

Vitality refers to a dynamic reflection of well-being, which encompasses a feeling of high energy available to one's self and a feeling that one is the origin of action (Nix, Ryan, Manly & Deci, 1999; Ryan & Frederick, 1997). Vital employees show an attitude based on aliveness, vigor, engagement, resilience, proactive work behavior and high employability (Khalkhali & Golestaneh, 2011; Ryan & Frederick, 1997). Vital employees are more productive, display more developmental proactivity and are more willing to invest energy in their job; they cope better with stress and challenges and report greater mental health (Nix et al., 1999). Ryan & Frederick (1997) showed in a series of studies that vitality consists of both somatic and psychological factors. Regarding the somatic part, vitality is lower in employees who reported complaints as pain, ineffective body functioning and common physical symptoms. Psychologically speaking, they conclude that vitality should be maintained or enhanced under conditions where "*the basic psychological needs for autonomy, competence and relatedness are satisfied*" (Nix et al., 1999:269).

Vitality is related to intrinsic motivation (Deci & Ryan, 1985). Self-determination theory (SDT) provides a theoretical framework in order to understand motivational processes (Deci & Ryan, 1985; 2000; Khalkhali & Golestaneh, 2011; Nix et al., 1999). SDT suggests that the social environment influences intrinsic motivation through its impact of the satisfaction of the psychological needs. Satisfaction of the needs facilitates people's autonomous motivation (or self-determined motivation), whereas thwarting the needs promotes controlled motivation (Deci & Ryan, 2012). SDT predicts that activities that satisfy the psychological needs will result in energy maintenance or enhancement (Ryan & Deci, 2008). Given that vitality is defined as a feeling of possessing energy available to one's self, Ryan and Frederick argued that feelings of vitality should be higher when completing autonomously motivated actions (Nix et al., 1999). When employees experience autonomy, they will not experience their efforts as draining and may feel their energy or vitality enhanced (Khalkhali & Golestaneh, 2011). This study focuses on autonomy, since among the psychological needs, the

need for autonomy is deemed as being more essential than the need for competence and relatedness (Gagné & Deci, 2005).

Furthermore, it is expected that a supportive leadership style influences vitality. It is predicted that when managers show concern for their employees' feelings and needs and provide them information, they will experience more vitality (Oldham & Cummings, 1996). This is based on the notion that supportive leaders will facilitate the intrinsic motivation of employees by making information available and thereby enhance feelings of self-initiative and self-control (Amorose & Anderson-Butcher, 2006; Harde & Reeve, 2003). Little experimental work has been done on the effects of supportive leadership in public sector organizations (Bellé, 2013). This study therefore takes a step forward and tries to fill this gap.

Finally, a reinforcement effect may occur because employees who experience more autonomy and supportive leadership together, may experience more vitality than employees who don't experience this together, based on the notion that supportive leadership enhances feelings of eigenvalue and support self-initiative (Reeve, 2002) and that autonomy and supportive leadership can create "powerful combinations" (Combs et al., 2006).

The purpose of this study is to investigate the influence of two motivational factors (autonomy and supportive leadership) on employee vitality. This is done by means of a multi-method design; both a survey and an experiment are used in order to test the hypothesized relationships. The research question of this study is: *"In what degree do autonomy and supportive leadership influence employee vitality, and how do autonomy and supportive leadership reinforce each other?"*

This study is innovative in two main ways. Firstly, it focuses on active employee outcomes. Most of the research to date focuses on passive outcomes such as satisfaction and organizational commitment (Clark et al., 2010; Hirschfeld et al., 2000; McKinlay & Marceau, 2011; Sulu et al., 2010). Passive indicators aim at the functioning of the organization or employees as it is at the present moment. An employee can be very satisfied, without going "the extra mile" (see also Gould-Williams, 2004). However, active employee outcomes focus on self-starting and proactive behavior like engagement, work effort and employee vitality (Frese & Frey, 2001). Research on positive organizational psychology, although understudied, shows that active employee outcomes improve conditions for both workers and organizations (see also Kark & Carmeli, 2009; Tummers & Knies, in press). This study therefore contributes to a relatively new research area by focusing on active employee outcomes. It has become clear that specifically the activated forms of positive affect render people more resilient to stressors and less vulnerable to illness (e.g., Benyamini, et al., 2000; Cohen, et al., 2006; Polk et al., 2005). These consequences make vitality an important focus of research. However, employee vitality has been *"the subject of limited studies in organizational settings"* (Kark & Carmeli, 2009:786).

Secondly, this study consists of a multi-method design. The relationship between autonomy, supportive leadership and vitality is firstly analyzed by means of a survey. The advantages are that it is located in a real organizational environment and employs a large sample size. This increases the generalizability and makes it possible to say whether or not significant relationships exist between concepts (Field, 2005). Next, an

experiment is performed to test for causality (De Hoogh & Den Hartog, 2008). Here, we test whether autonomy and supportive leadership are really affecting employee vitality. The experiment could validate (or falsify) the results of the survey and provides an element of rigor (Bozeman & Scott, 1992; 294). By performing a survey and an experiment, and thus using a multi-method design, this study answers to calls for more multi-method research in public administration, especially using experiments (Margetts, 2011). This can generate usable knowledge for professionals (Perry, 2012).

The rest of this article is structured as follows. The second section presents the theoretical background and the proposed research model and hypotheses. The third section discusses the survey design, based on three independent samples of organization wide surveys, held in 2012 in the Dutch public healthcare. Section four reports the results from the experiment. In the fifth section, the conclusion and limitations of the study are described, next to the scientific importance of this article and the contributions to public management.

## **2. Theoretical Background**

### **2.1. Self-determination theory**

Self-determination theory (SDT) is useful in order to understand motivational processes and is often used as a theoretical framework in relationship with vitality (Deci & Ryan, 1985; 2000; Khalkhali & Golestaneh, 2011; Nix et al., 1999). Motivation is a general term and refers to people being “moved” to do something; people can be moved to do something by different types of forces (Nix et al., 1999). Motivation requires energy, direction and persistence, which are aspects of activation and intention (Ryan & Deci, 2002). SDT assumes that people are inherently active and thus proactively initiate engagement with their environments. Intrinsic motivation is thought to be the energizing basis for this activity (Deci & Ryan, 2012). When people act with an internal perceived locus of causality (when people experience their actions as self-determined or as a free choice) they tend to be more invested and have more positive experiences. The behavior is then perceived as internal (Deci, Vallerand, Pelletier & Ryan, 1991). When behavior is controlled, the regulatory process is compliant and people experience the locus of causality to be external, e.g. caused by forces outside themselves (Nix et al., 1999).

SDT addresses the perceived locus of causality issue by differentiating between specific kinds of motivation; autonomous motivation and controlled motivation, situated along a continuum ranging from high to low self-determination (Khalkhali & Golestaneh, 2011; Gagné & Vansteenkiste, 2013). Autonomous motivation is characterized by a sense of agency or personal causation; controlled motivation is characterized with feelings of coercion or pressuring to behave in certain ways (Gagné & Deci, 2005; Kuvaas, 2008). SDT differentiates the content of goals or outcomes and the regulatory processes through which the outcomes are pursued. Therefore it is, according to this theory, possible to make predictions for different contents and processes.

The basis for integrating the differentiations of goal contents and regulatory processes is the concept of psychological needs (Deci & Ryan, 2000). SDT suggest that human beings have psychological needs for

autonomy, competence and relatedness. Situations that support the satisfaction of these needs will enhance a person's enjoyment of activities and the autonomous self-regulation of behaviors (Ryan & Deci, 2002).

## **2.2. Self Determination Theory and Vitality**

This study focuses on active employee outcomes, of which vitality is considered one. Vitality is an affective experience, and is related to aspects such as flourishing (Fredrickson & Losada, 2005), engagement (Schaufeli & Bakker, 2004) and thriving at work (Spreitzer, et al., 2005). However, vitality differs from such related constructs. One can sense vitality without experiencing a sense of thriving or flourishing. To flourish means to live life within an optimal range of human function, one that connotes goodness, growth and resilience (Fredrickson & Losada, 2005). Thriving at work is a psychological state in which individuals experience both vitality and a sense of learning at work. Here, vitality is a dimension of thriving, although thriving cannot be captured without learning (Kark & Carmeli, 2009; Spreitzer et al., 2005). Vitality incorporates approaching life with excitement, energy, enthusiasm and vigor, feeling alive and activated and living life as an adventure (Kark & Carmeli, 2009). This state of aliveness makes a person feel that his or her actions have meaning and purpose (Kark & Carmeli, 2009; Ryan & Bernstein, 2004). In addition, although vitality is a positive emotional state, it is a more discrete emotion than happiness or pleasure (Nix et al., 1999).

Vitality is referred to as "*the experience of having energy available to one's self*" (Ryan & Frederick, 1997:2). Happiness can be defined as high pleasantness from attainment of a desired outcome regardless of the motivational state that yielded the outcome (Nix et al., 1999). Moreover, happiness is not necessarily characterized by high energy or activation like vitality. This distinction is important because it is necessary to clarify the theoretically important relationships between motivational processes and vitalization (Nix et al., 1999). Vitality is more than a sense of arousal (Ryan & Bernstein, 2004) and is a more discrete emotion than happiness. Although vitality is related to energy, vitality entails only energy experienced as positive and available to the self (Kark & Carmeli, 2009; Nix et al., 1999). It is characterized by a high level of activation and therefore differs from other non- or low activated positive emotions (Peterson & Seligman, 2003). SDT claims that intrinsic motivation, which is an important element of vitality, is enhanced by satisfaction of the basic psychological needs (Niemi & Ryan, 2009). This means that satisfactions associated with one of the basic needs of the self would enhance vitality and sustain self-regulatory capacities: SDT predicts that activities that satisfy the psychological needs will result in energy enhancement (Ryan & Deci, 2008).

## **2.3. Autonomy and vitality**

Vitality is related to the concept of intrinsic motivation; the desire to exert effort on a task in the absence of external constraints or contingencies (Deci, 1975; Deci & Ryan, 1985). Intrinsic motivation refers to behaviors that are done in the absence of external incentive and are characteristically interesting and enjoyable (Niemi & Ryan, 2009). This means such behaviors have an internal perceived locus of causality and are therefore experienced as stemming from the self, rather than from external sources (Niemi & Ryan, 2009).

Intrinsic motivation can be amplified by both work contexts and individual differences that raise feelings of competence, autonomy and relatedness (Rich, Lepine & Crawford, 2010). Intrinsically motivated behavior is prototypically autonomous, which means they are experienced as originating from one's self (Gagné & Deci, 2005). Autonomy is a sense of perceived internal locus of causality that is displayed by an individual with a high degree of self-determination with respect to extrinsic rewards (Barcza, 2010). Autonomy makes people act from their deep values, goals and interests (Graves & Luciano, 2012). Controlled behavior, on the other hand, is experienced as demands to think, feel or behave in certain ways and therefore could drain personal energy (Deci & Ryan, 2012).

SDT addresses the perceived locus of causality by contrasting autonomous motivation with controlled motivation (Ryan & Deci, 2002). Given that vitality is defined as a feeling of possessing energy available to one's self, Ryan and Frederick (1997) argued that it should be higher when successfully completing actions that are autonomously regulated than when successfully completing controlled ones. When feelings of autonomy are present, the integration of behavioral regulation will be facilitated and employees will feel more intrinsically motivated (Deci & Ryan, 2000).

According to Nix et al. (1999), motivational practices can enhance employee vitality because they will not experience their efforts as draining when they are autonomously regulated. Employees who experience autonomy during their work, will experience greater energy and vigor (Nix et al., 1999). Energetic employees can achieve their tasks with less effort, which leaves extra resources available to be spent on proactivity. This means that employees go beyond their assigned tasks, can develop their own goals and take a long-term perspective on their work and career (Frese & Fay, 2001). On the basis of the discussed literature above, the following hypothesis can be formulated:

*Hypothesis 1: Autonomy positively affects employee vitality.*

#### **2.4. Supportive leadership and vitality**

It is widely recognized that employees (or subordinates) are influenced by the support a supervisor gives them (Offermann & Hellmann, 1996; Sosik & Godshalk, 2000). By being the direct leader of the staff, managers are of pivotal importance in organizations. They can provide information that helps employees to do their job; they can develop constructive interaction and show supportive behavior; all have a positive effect on employee well-being (Baard, Deci & Ryan, 2004; Eisenberger & Stinglhamber, 2011).

The variables in the organizational literature that are closest to that of a manager's support for self-determination have been systemized in Bowers and Seashore's (1966) theory of leadership. The management function of support is defined as manager's behaviors that enhance subordinates' feelings of personal worth. This concept is aligned to Halpin and Winer's (1955) idea of consideration and Likert's (1961) principle of *supportive leadership* (Deci, Connell & Ryan, 1989). House (1981) defined a supportive leader as someone who provides informational, instrumental and appraisal support to subordinates.

Several studies of supportive leadership have all shown that the behavior of leader shapes feelings of self-efficacy and hence influence feelings of self-initiation (Fiedler, 1996; Hersey & Blanchard, 1993; House &



Mitchell, 1974). SDT research suggest that supportive leadership (e.g., giving employees some choice of assignments, acknowledging employees' feelings about tasks, encouraging initiative is important in facilitating need fulfillment (Baard et al., 2004; Gagné & Deci, 2005; Richer and Vallerand, 1995; Van den Broek et al., 2008).

Studies on the contextual factors that affect self-determination show that choice (Zuckerman, Porac, Lathin, Smith, & Deci, 1978) and positive feedback (Blanck, Reis, & Jackson, 1984; Deci, 1975) tend to be experienced as supportive, whereas task contingent rewards (e.g., Ryan, Mims, & Koestner, 1983), deadlines (Amabile, DeJong, & Lopper, 1976), threats of punishment (Deci & Ryan, 2000), surveillance (Lepper & Greene, 1975), and evaluations (Smith, 1974) tend to be experienced as controlling (Deci, Connell & Ryan, 1989). Supportive leaders facilitate, whereas controlling leaders interfere with the self-determined inner motives (Khalkhali & Golestaneh, 2011). Leaders who are supportive engage in behavior that acknowledge their subordinates' thoughts and feeling, encourages choice, self-initiation and minimizes the use of pressure and demands to control others (Amorose & Anderson-Butcher, 2007; Deci & Ryan, 1985). The perceived availability of support may elevate levels of intrinsic motivation because it enhances employees' confidence that the job will get done (Van Yperen & Hagedoorn, 2003).

According to goal setting theory, a supportive leader must provide a logic or rationale for assigning goals (Latham, Borgogni & Petitta, 2008). By being supportive, a leader can increase a person's outcome expectancies and self-efficacy. Employees will then see the relationship between what they do and the desired goal they will attain in order to be motivated (Latham, 2007). Explaining why it is important to achieve a goal can therefore help in increasing the self-efficacy and increase feelings of employees' self-control (Latham, Borgogni & Petitta, 2008). Based on the above, we hypothesize:

*Hypothesis 2: Supportive leadership positively affects employee vitality.*

### **2.5. The mutual reinforcement of autonomy and supportive leadership**

From a theoretical and practical point of view, it is interesting to analyze the question whether autonomy and supportive leadership reinforce each other. Research has suggested that several practices can create "powerful combinations" in which organizations use reinforcing practices. It could be that autonomy and supportive leadership have additive effects and create synergies (MacDuffie, 1995; Combs et al., 2006). The rationale is that autonomy and supportive leadership are related to employee's cognitive control (or self-efficacy) and task control. According to Frese and Fay (2001), employees who possess both aspects of control have a strong sense of responsibility, will not give up easily, search for opportunities to act and will actively search for information, which therefore can possibly lead to more vitality since the feeling of control is a pivotal aspect of vitality (Nix et al., 1999). Prior research has found that autonomous regulation is more likely to occur when leaders possess a supportive leadership style that includes behaviors such as providing employees with some choice of tasks and encouraging initiative (Baard et al., 2004; Graves & Luciano, 2012; Richer et al., 2002, Van den Broeck et al., 2008).

It has been said that leaders who engage subordinates in self-initiative is important, by which supervisors influence their subordinates into leading themselves towards performing in intrinsically motivating tasks (Schnake, Dumler & Cochran, 1993). Leaders encourage their employees to develop their own solutions to problems and make their own decisions, which could enhance feelings of intrinsic motivation (Manz & Sims, 1987). Furthermore, leaders who explain goals to their subordinates and give employees a voice, support their feelings of self-control and increase levels of autonomy (Gagné & Vansteenkiste, 2013). In sum, supportive managers who provide a vision or goal with a good rationale for them, who consider their subordinates' needs, who provide opportunities for initiative and show they believe in their subordinates, will increase the self-determination of employees (Gagné & Vansteenkiste, 2013). This means supportive leadership can reinforce the direct effect of autonomy. It is therefore expectable that the positive effect of autonomy on employee vitality would especially be strong when employees also experience a supportive leadership style. Based on the discussion above, the following hypothesis can be formulated:

*Hypothesis 3: The combined effect of autonomy and supportive leadership on employee vitality is larger than the sum of the individual effects.*

### 2.6. Theoretical model

The theoretical model to test the proposed hypotheses used in the present study is shown in figure 1.

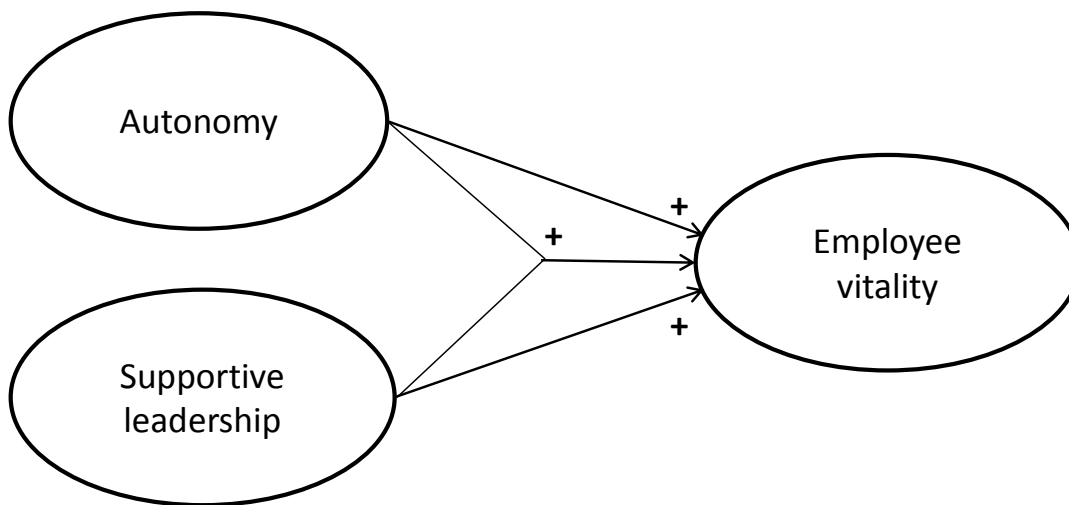


Figure 1. Theoretical model.

### 3. The survey

#### 3.1. Methods

First the survey is described. Hereafter, an experiment is performed to test the validity and causality of the results generated out of the survey.

##### 3.1.1. Data collection

Three organization-wide independent surveys are used, held in 2012 in the Dutch healthcare: two nursing and homecare organizations and one youth care center. The survey was sent to 2,346 healthcare professionals, which generated 1,502 respondents (response rate 64%).

The survey covered a range of issues associated with work and employment, including indicators of vitality and employees' experiences of work. Of this response, 91% were women (1368) and 9% men (134). This is reasonably consistent with the percentages women working in the Dutch healthcare (82%) (CBS, 2013). The average age is approximately 43 years. This is consistent with other findings, which state that the average age of employees in the healthcare lies between 41 and 45 year (UWV, 2013). Given the large numbers of the sample and similarity of the respondents on demographic variables, it is reasonable to say the respondents were quite representative for the population.

##### 3.1.2. Measures

*Vitality* was measured using a scale developed by Kark & Carmeli (2009). The scale consists of five items, which were measured using a 4-point scale (1= never, 4= always). An example of the statements is: "*I am full of positive energy when I am at work*". The reliability coefficient was 0.88.

*Autonomy* was measured using the measurement of "perceived self-determination" which describes the perceptions of employees with regards to their freedom to adopt approaches to the job, the opportunity for independent thought and action, control over their work, control over the rate of doing work and control over the quality of their work (Eisenberger & Rhoades, 2001). Autonomy was measured using a 5-point Likert scale (1= completely disagree, 5= completely agree). An example of the statements is: "*I have the freedom to adopt my own approach to perform my job*". The reliability coefficient was 0.83.

*Supportive leadership* included four items measured on a 5-point Likert scale (1= completely disagree, 5= completely agree) that measured the extent to which supervisors let subordinates know what needed to be done, explained changes in the workplace, explained policy and in what degree employees feel comfortable to discuss problems with their supervisor. The scale was developed by Price (1997). An example of the statements is: "*My supervisor discusses with me how to handle problems in my work*". The reliability coefficient was 0.87.

##### *Control Variables*

Although SDT considers the psychological needs, such as autonomy to be innate, it is possible that individuals from different age groups and education may express their needs in different ways (Van den Broeck et al., 2010). Therefore several control variables are taken into account: gender (1=male, 0=female), employee age

and educational level. Furthermore, the organizations participants work for are controlled for using two dummy variables.

### **3.1.3. Analysis**

To test the fit of the theoretical model in figure 1, several goodness-of-fit indices as suggested in SEM using AMOS 20.0 (Joreskog & Sorbom, 1993; Kline, 1998) such as comparative fit index (CFI), Tucker- Lewis coefficient (TLI) and root mean square error of approximation (RMSEA) are used. The following criteria for goodness-of-fit indices are used to assess the model-fit: values of CFI and TLI are recommended to be greater than 0.90 and RSMEA is recommended to be up to 0.05, and acceptable up to 0.08 (Hu & Bentler, 1999).

Multiple regression analyses were conducted to examine the extent to which the variables were able to predict changes in vitality. The data will be analyzed using SPSS 20.0

### **3.1.4. Preliminary analyses.**

In order to verify the factor structure of the set of observed variables, a CFA is performed (Suhr, 2006). Based on lower factor loadings and high modification indices, one item for supportive leadership was removed. No error terms were correlated. The standardized factor loadings were high and the relationship between each indicator variable and its respective variable was statistically significant ( $p < 0.01$ ). This established the relationships among indicators and constructs, and thus, convergent validity (Hair, Anderson, Tatham & Black, 1998). The overall results of the CFA and the goodness-of-fit indices showed acceptable fit with the data (CFI= .97; TLI= .96; RMSEA= .07).

### **3.1.5. Common method variance**

Because the measurements of the survey are all self-reported (and response biases such as acquiescence, social desirability or yea- and nay-saying), and collected through the same survey during the same period of time with cross-sectional research design, the possibility of common method variance is controlled for (Friske, 1982). Although recent research by Lance et al. (2010) has shown that common method variance is not a serious threat to substantive conclusions, the Harman one-factor test was performed to assess in what degree common method variance would be a problem. A factor analysis is performed on all the items of this study. The factor explained 27 % of the variance, which is not the majority. Therefore, it is plausible to conclude that there are no serious problems with common method variance (Podsakoff et al., 2003).

## **3.2. Results**

### **3.2.1. Descriptives**

The means, standard deviations and correlations for the variables are presented in table 1. The majority of the respondents had a secondary vocational education (58%), next to 22% who had a higher vocational education. 10% went to secondary school, 4% had a special education for nursing, and 3% of the respondents have an

academic decree. The bivariate correlations indicate that autonomy is significantly associated with vitality ( $r = .21, p < 0.01$ ). Supportive leadership is also significantly associated with vitality ( $r = .31, p < 0.01$ ).

*Table 1. Means, standard deviations (SD), and intercorrelations among variables.*

Variable	Mean	SD	1	2	3	4	5	6	7	8
1.Vitality	3.20	.51	-							
2.Autonomy	3.73	.74	.20**	-						
3.Supportive leadership	4.02	.71	.25**	.32**	-					
4.Gender (1=man)	.10	-	.00	-.11**	-.03	-				
5.Education	3.48	2.19	-.11**	.19**	.07*	.17**	-			
6. Age	43	2.18	.09**	.04	-.01	.09**	-.14**	-		
7. Organization dummy1	.57	-	.07**	-.16**	-.15**	-.10**	-.37**	.04	-	
8. Organization dummy2	.23	-	.02	.07**	.11**	-.01	-.11**	.11**	-.65**	-

\* $p < 0.05$ , \*\* $p < 0.01$ .

### 3.2.2. Hypotheses testing

Table 2 shows the multiple regression analyses that have been performed. The standardized regression coefficients (beta, or  $\beta$ ) are shown, because they are directly comparable since they are all measured in standard deviation units.

*Table 2. Multiple regression with Vitality as dependent variable.*

Variables	Model 1 Vitality	95% CI Lower	95% CI Upper	Model 2 Interaction on Vitality	95% CI Lower	95% CI Upper
Autonomy	.16***	.11	.21	.15**	.10	.20
Supportive leadership	.31**	.26	.36	.28**	.24	.35
Gender (1=man)	.01	-.03	.06	.01	-.03	.07
Education	-.09*	-.15	-.03	-.09*	-.15	-.03
Age	.03	.02	.08	.07	.02	.03
Organization (Dummy 1)	.07*	.00	.15	.13*	.00	.15
Organization (Dummy 2)	-.03	-.10	.04	.04	-.09	.05
Supportive leadership*Autonomy				-.05	-.09	-.01
R <sup>2</sup>	.151			.155		
$\Delta R^2$				.005		
F	36.44**			32.99**		

\* $P < 0.05$ , \*\* $p < 0.01$ . Assumptions (Field, 2005) have been met: test of independent errors (Durbin-Watson: 1.353), test of no multicollinearity (no VIF values above 10 and average close to 1), casewise diagnostics: 0.3% above standardized errors  $> |2|$ , Cook's distance max. 0.07 (criterion  $< 1$ ). Criteria of homoscedasticity and normality have been met.

Model one shows the effects of autonomy and supportive leadership on employee vitality. Hypothesis one stated that autonomy positively affects employee vitality. As shown in model one, the influence of autonomy is significant ( $\beta = .16, p < 0.01$ ). When employees experience more autonomy during their job, they feel more vital. Next, it is shown that supportive leadership has a significant effect on employee vitality. Hypothesis two is therefore accepted ( $\beta = .30, p < 0.01$ ). The  $R^2$  for this model is .15, which means that 15% of the variance in employee vitality can be explained by the included independent variables. Furthermore, it is shown that education has a significant negative effect on employee vitality ( $\beta = -.10, p < 0.05$ ). Employees who are higher

educated, experience less vitality than employees who have a lower educational level. In addition, the analysis shows that organization employees work in, have a significant effect on employee vitality. This means that employees experience different levels of vitality, depending on their work environment.

Finally, the interaction effect has been tested, shown in model two. Hypotheses three stated that the combined effect of autonomy and supportive leadership on employee vitality is larger than the sum of the individual effects. Multiple regression analysis shows that autonomy and supportive leadership do not reinforce each other and the effect of autonomy and supportive leadership is not larger than the sum of the individual effect. Therefore, hypothesis three has to be rejected.

### **3.3. In sum**

The goal of the first part of this study was to examine whether autonomy and supportive leadership, either on their own or taken together, had a significant positive effect on employee vitality, as tested using large scale surveys. Multiple regression analysis proved this partially to be true; autonomy and supportive leadership both have a significant, positive effect on employee vitality. Supportive leadership is proven to have the largest influence on employee vitality. However, autonomy and supportive leadership do not reinforce each other and therefore do not enhance each other's effect on employee vitality, contrary to the hypothesis.

The data of the first part of this study are also limited. The data were correlational and cross-sectional; therefore, it is not possible to determine the causal direction of the relationship between autonomy, supportive leadership and employee vitality (Patrick, Hisley & Kempler, 2000). The second part of this study can be seen as a controlled experiment to address the concern about causality, and to validate the results found in this part of the study.

## **4. Validating the results and proving causality- The experiment.**

### **4.1. Methods**

#### **4.1.1. Participants**

The participants comprised of 102 Dutch students of a University in the Netherlands. Two students who did not complete the entire questionnaire were excluded from the analyses. The average age of the respondents was 21 years old (SD= 2.33), 52% of the respondents was male, 48% was female.

#### **4.1.2. Procedure**

The experiment took place during participants' regular classes, which increased its ecological validity since the students took part in the experiment in a real situation (Khalkhali & Golestaneh, 2011; Margetts, 2011).

Students were asked to take part in a questionnaire for a graduation project. All subjects were randomly provided with a set of written instructions containing one of the manipulations (see below). The students were told to sit apart of each other, so that they would not see the different manipulations. Next, students were told to pretend they were employees in a hospital and that they work there as policy advisors. Because the respondents

were all public administration students, the task is one they could experience in their near future. This also increases the ecological validity and “*mundane reality*” (Bozeman & Scott, 1992: 309).

There were four different treatment groups in this manipulation, using a 2x2 design. The groups consisted of either (1) low autonomy, low supportive leadership, (2) low autonomy, high supportive leadership, (3), high autonomy, low supportive leadership and (4) high autonomy and high supportive leadership manipulations. Autonomy and supportive leadership were manipulated in the instructions and type of task. The autonomous context was operationalized by the type of task. In the high autonomy condition, subjects read an instruction from their supervisor saying he wants to know their ideas about elderly care in a time of ageing. The supervisor let the subjects know he “trusts the subjects’ thoughts” and used wording such as “I invite you to”, “you may want to do your best” and “you can decide for yourself what you think is important for me to know”. In the low autonomy, or controlling condition, subjects read an instruction from their supervisor saying he wants them to write a memorandum and used explicitly words such as “you have to”, “you need to perform such as I expect you to” and “follow my instructions explicitly”. They were presented with a text box in which they were told to “write the memorandum below”.

In the high supportive leadership condition, subjects were either given “extra information and support concerning the policy changes” in which the supervisor let the subjects know why he asked for their ideas to write a memorandum. In the low supportive leadership condition, subjects were not given any extra information and support. In order to assess the manipulations, the autonomy scale (Eisenberger & Rhoades, 2001) and supportive leadership scale (Penley and Hawkins, 1985) were analyzed.

#### **4.1.3. Pre-test**

A pre-test was performed to check the manipulations. Four different independent respondents were given the questionnaire used in the experiment and performed the same tasks. After the pre-test, the manipulation regarding autonomy was adjusted in order to be more autonomy manipulative. For instance, the text box in the high-autonomy condition was removed in order to enhance the autonomy participants experienced. Also, some small adjustments were made in other items for sake of readability.

#### **4.1.4. Measures**

In order to be able to compare the results of the experiment with the survey, the same scales as in the survey are used. However, there were some adjustments to the items to make the items more applicable in the experiment and to the specific task participants had to perform.

*Vitality* was measured using the scale developed by Kark & Carmeli (2009). The scale consists of five items which were measured using a 5-point Likert scale (1= completely disagree, 5= completely agree). An example of the statements is: “*I was full of positive energy during the task*”. The reliability coefficient was .88.

*Autonomy* was measured using the measurement of “Perceived self-determination” (Eisenberger & Rhoades, 2001). Autonomy was measured using a 5-point Likert scale (1= completely disagree, 5= completely

agree). An example of the statements is: “*I had the freedom to adopt my own approach to perform my task*”. Autonomy was used as a manipulation check.

*Supportive leadership* included four items measured on a 5-point Likert scale (1= completely disagree, 5= completely agree) that measured the extent to which supervisors let subordinates know what needed to be done, explained changes in the workplace, explained policy and in what degree employees feel comfortable to discuss problems with their supervisor. The scale was developed by Price (1997). An example of the statements is: “*I would discuss problems with my task with my supervisor*”. Supportive leadership was also used as a manipulation check.

#### *Control variables*

For the same reason as in the survey, a number of control variables were taken into account, such as gender (1=male, 0=female), employee age (in years) and educational level.

#### **4.1.5. Preliminary analysis**

Since the sample from the experiment differs from the sample of the survey, a second CFA was performed to assess in what degree the data fits the model. Just as in the survey, and based on lower factor loadings and high modification indices, the same item for supportive leadership was removed. No error terms were correlated. The standardized factor loadings were high and the relationship between each indicator variable and its respective variable was statistically significant ( $p < 0.01$ ). The overall results of the CFA and the goodness-of-fit indices showed acceptable fit with the data (CFI= .98; TLI= .99; RMSEA= .05).

## **4.2. Results.**

Multiple regression analyses were conducted to examine the extent to which the variables were able to predict changes in vitality. The data will be analyzed using SPSS 20.0

### **4.2.1. Descriptive statistics and manipulation checks**

Table 3 represents the means, standard deviations and correlations for the variables. Autonomy and supportive leadership correlated significantly with vitality ( $r = .59$  and  $r = .43$  respectively,  $p < 0.01$ ). Age proved to be significantly correlated with vitality ( $r = .19$ ,  $p < 0.05$ ). Gender did not correlate significantly with any of the variables.

*Table 3. Means, standard deviations (SD) and intercorrelations among variables.*

<b>Variable</b>	<b>Mean</b>	<b>SD</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>1. Vitality</b>	3.3	.80	-					
<b>2. Autonomy (low-high)</b>	.47	-	.56**	-				
<b>3.Supportive leadership (low-high)</b>	.50	-	.32**	-.01	-			
<b>4. Age</b>	21.5	2.33	.19*	.17	.04	-		
<b>5.Gender (1=man)</b>	.52	-	.11	-.02	.14	.05	-	
<b>6.Education</b>	5.2	.87	.09	.02	-.00	.43*	.	-

\* $p < 0.05$ , \*\* $p < 0.01$ .



#### 4.2.2. Manipulation check

The experimental set up was checked before analyzing any further results. A one way analysis of variance (ANOVA) of high versus low autonomously motivated subjects showed that the manipulation was successful. Participants in the low autonomy treatment, indeed reported they were lower autonomously motivated ( $M=2.9$ ,  $SD=.08$ ) than participants in the high autonomy treatment; they reported they were highly autonomously motivated ( $M=4.2$ ,  $SD=.09$ ),  $F(1, 98) = 367.91$ ,  $p < .001$ . Also, participants who received low supportive leadership, reported lower supportive leadership ( $M= 2.3$ ,  $SD=.77$ ), than participants in the high supportive leadership group ( $M=3.7$ ,  $SD=.67$ ),  $F(1, 98) = 101.66$ ,  $p < .001$ . However, the manipulation check showed that participants in the high autonomous condition also experienced slightly more supportive leadership.

#### 4.2.3. Hypotheses testing

Table 4 shows the multiple regression analyses that have been performed. Standardized regression coefficients are shown (beta, or  $\beta$ ).

Table 4. Multiple regression with Vitality as dependent variable.

Variables	Model 1 Vitality	95% CI Lower	95% CI Upper	Model 2 Interaction on Vitality	95% CI Lower	95% CI Upper
<b>Autonomy (low-high)</b>	.58**	.44	.73	.58**	.44	.73
<b>Supportive leadership (low-high)</b>	.35**	.20	.49	.35**	.20	.49
<b>Age</b>	.15	-.01	.32	.15	-.06	.32
<b>Gender</b>	-.08	-.24	.06	-.09	-.24	.06
<b>Education</b>	.04	-.13	.20	.04	-.12	.21
<b>Supportive leadership*Autonomy</b>				.08	-.13	.17
<b>R<sup>2</sup></b>	.48			.48		
<b><math>\Delta R^2</math></b>				.00		
<b>F</b>	17.81**			14.69**		

\* $p < 0.05$ , \*\* $p < 0.01$ . Assumptions (Field, 2005) have been met: test of independent errors (Durbin-Watson: 2.148), test of no multicollinearity (no VIF values above 10 and average close to 1), casewise diagnostics: 1% above standardized errors  $> |2|$ , Cook's distance max. 0.10 (criterion  $< 1$ ). Criteria of homoscedasticity and normally distributed errors have been met.

Model 1, which consists of the direct effect of independent variables on vitality, shows that autonomy as a positive significant effect ( $\beta=.56$ ,  $p < 0.01$ ) on vitality. The more autonomy participants feel, the more vitality they experience. Hypothesis one is therefore also accepted in this part of the study. Next, it is shown that supportive leadership has a significant, positive effect on vitality ( $\beta=.34$ ,  $p < 0.01$ ). Hypotheses two is therefore also accepted. The  $R^2$  for this model is .48, which means that 48% of the variance of vitality can be explained by the included independent variables.

Model two shows the reinforcement, which has been predicted in hypothesis three. The analysis shows, contrary to the hypothesis, that the effect is not significant. The combined effect of autonomy and supportive

leadership on employee vitality is not larger than the sum of the individual effects. Therefore, hypothesis three is also rejected by this part of the study.

## **5. General Discussion and limitations**

Since shortages in staffing are expected in the public sector due to ageing of the workforce, which places substantial pressure on the social security system, it is important to create employees who perform optimal in their organizations. Focusing on active employee outcomes, such as vitality, can be a means by which employees increase their performance and assist employees in alleviating the distress, and thereby increasing their well-being (Clark et al., 2010).

The purpose of this study was to examine the impact of autonomy and supportive leadership on employee vitality, using insights of SDT. The different methods in this study -the survey and the experiment- both provide strong and consistent evidence to suggest that autonomy and supportive leadership are important determinants of employee vitality. This is in line with previous research that has shown the effect of autonomously regulated behavior on employee vitality (Ryan and Fredrick, 1997; Nix et al., 1999; Deci and Ryan, 2000; Carmeli, 2009). Furthermore, the effect of supportive leadership on vitality is also in line with literature, since explaining why it is important to achieve a goal, providing information and show concern for employees' needs can help increase self-efficacy and increase the feelings of employees' self-control (Gagné & Vansteenkiste, 2013; Latham, Borgogni & Petitta, 2008). Results show that supportive leaders can influence the vitality of their subordinates. Employees who are vital, which is an active employee outcome, can "go the extra mile", are more productive, display more developmental proactivity and are more willing to invest energy in their job (Ryan & Frederick, 1997).

Although literature suggest that supportive leaders are able to influence feelings of autonomy (Gagné & Vansteenkiste, 2013), results showed that autonomy and supportive leadership do not reinforce their mutual effects on vitality. Contrary to Wang and Cheng (2010), who found a moderating effect of autonomy on the effect of leadership behaviors among employees, this study does not find any reinforcement of moderating effects. This is in line with research of van Yperen and Hagedoorn (2003), who studied the effect of support and autonomy on intrinsic motivation. They showed that although autonomy and support both have a direct positive effect on intrinsic motivation, when combined, they do not reinforce each other. They claim that receiving actual support may reduce feelings of autonomy and lower one's perceived competence and consequently, may lead to a decline in intrinsic motivation (Van Yperen & Hagedoorn, 2003). For instance, it may be that individuals with more autonomy feel less affected by the support a leader gives them, because they feel they are able to exercise control over their own successes and failures. The effect of supportive leadership may then be reduced (Aubé, Rousseau & Morin, 2007). Another possible explanation is that autonomy can be seen as a neutralizer of leader behavior (Podsakoff et al., 1995). Neutralizers are variables in the environment that eliminate the impact of a leader's behavior on subordinate outcome variables. However, these do not replace the impact of such behavior with an individual effect (Howell, Dorfman & Kerr, 1986). It may be

possible that autonomy serves as a neutralizer when combined with supportive leadership, and therefore autonomy eliminates the effect of supportive leadership when they are combined together.

Some limitations need to be acknowledged. Besides autonomy, competence and relatedness are described as basic psychological needs. For the purpose of this study, it was not taken into account. However, several studies have shown the effect of competence and relatedness on vitality and therefore both can be important indicators (Deci & Ryan, 2000; Ryan & Deci, 2002, Van den Broeck et al, 2009). Future research should take all the psychological needs based on SDT into account and could combine it with other theoretical insights such as goal setting theory (Locke & Latham, 1990) or the Job demands-resources model (Demerouti, Bakker, Nachreiner & Schaufeli, 2001).

Secondly, it is possible there are issues with generalizability. The survey is performed using a sample of employees working only in the healthcare sector; the experiment is performed using a sample of students. In order to explore the findings in a wider population, future studies should replicate this study with different public sector samples, with various public sector employees.

Another limitation is the path of the relationships tested in this study. Few studies have shown that the basic psychological needs mediate the relationship between supportive leadership and employee outcomes such as vitality (Hollembek & Amorose, 2005; Sarrazin et al., 2002). The behaviors exhibited by the leader influence perceptions of competence, autonomy and feelings of relatedness, which in turn may influence intrinsic motivation. This study exhibits straightforward analysis, although future research should explore the mediating role of the needs.

It is furthermore also possible different types of employees may feel different levels of need satisfaction (Van den Broeck et al., 2009). The influence of attachment styles can be of importance for the satisfaction of the basic psychological needs, and therefore have an influence on employee vitality. Prior research has shown that individuals with an avoidant attachment style prefer to have more autonomy than individuals with a secure attachment style (Popper, Mayseless & Castelnovo, 2000). Additionally, since intrinsic motivation can be amplified by both work aspects and individual differences (Rich, Lepine & Crawford, 2010), it is possible individual differences play an important role. Future research should connect these different theoretical insights in order to create a fully comprehensive image of what, why and how employee vitality is to be influenced.

In conclusion, the empirical results emphasize the importance of autonomy and supportive leadership in the public sector. Both supportive leadership and autonomy are important elements. When managers are supportive, employees feel more vital; they feel more energized and feel good in their organizations. Both supportive leadership and autonomy are important elements for subordinates to increase their self-control and their well-being.

By using an experiment and a survey this study answers to calls for more experiments and multi-method designs in public administration. Experiments are a valuable contribution to public management research, since it generates more usable knowledge for public professionals; it enhances rigor and theoretical orientation. This study does not completely fill this gap, although it makes an important contribution. More experiments in public administration are still necessary: the calls from Bozeman & Scott (1992), Margetts (2011) and Perry (2012) for more experiments and multi- methods designs in public administration are yet to be answered. Future researchers should therefore use more multi-method or experimental designs.

## References

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- Adler, P.S., & Kwon, S. (2002). Social capital: Prospects for a new concept. *Academy of Management Review*, 27(1), 17–40.
- Amabile, T. M., DeJong, W., & Lepper, M. R. (1976). Effects of externally imposed deadlines on subsequent intrinsic motivation. *Journal of Personality and Social Psychology*, 34(1), 92-98.
- Amorose, A. J., & Anderson-Butcher, D. (2007). Autonomy-supportive coaching and self-determined motivation in high school and college athletes: A test of self-determination theory. *Psychology of Sport and Exercise*, 8(5), 654-670.
- Aubé, C., Rousseau, V., & Morin, E. M. (2007). Perceived organizational support and organizational commitment: The moderating effect of locus of control and work autonomy. *Journal of Managerial Psychology*, 22(5), 479-495.
- Baard, P.B., Deci, E.L., & Ryan, R.M. (2004). Intrinsic Need Satisfaction: A Motivational Basis of Performance and Well-Being in Two Work Settings. *Journal of Applied Social Psychology*, 34(10), 2045-2068.
- Baker, W., & Dutton, J.E. (2007). Enabling positive social capital in organizations. In: J. E. Dutton & B. R. Ragins (Eds), *Exploring positive relationships at work: Building a theoretical and research foundation* [pp. 325- 345]. Mahwah, NJ: Lawrence Erlbaum Associates.
- Bellé, N. (2013). Leading to Make a Difference: A Field Experiment on the Performance Effects of Transformational Leadership, Perceived Social Impact, and Public Service Motivation. *Journal of Public Administration Research and Theory*. doi:10.1093/jopart/mut033.
- Benyamini, Y., Idler, E., Leventhal, H., & Leventhal, E. (2000). Positive health and function as influences on self-assessments of health: Expanding our view beyond illness and disability. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences*, 55(2), 107-116.
- Berson, Y., & Avolio, B. (2004). Transformational leadership and the dissemination of organizational goals: A case study of a telecommunication firm. *The Leadership Quarterly*, 15(5), 625-646.
- Blanck, E D., Reis, H. T., & Jackson, L. (1984). The effects of verbal reinforcements on intrinsic motivation for sex-linked tasks. *Sex Roles*, 10, 369-387
- Bowers, D. G., & Seashore, S. E. (1966). Predicting organizational effectiveness with a four-factor theory of leadership. *Administrative Science Quarterly*, 11, 238-263.
- Bozeman, B., & Scott, P. (1992). Laboratory experiments in public policy and management. *Journal of Public Administration Research and Theory*, 2(3), 293-313.
- Broeck, A. van den., Vansteenkiste, M., Witte, H. de., Soenens, B., & Lens, Willy. (2010). Capturing autonomy, competence and relatedness at work: Construction and initial validation of the Work-related Basic Need Satisfaction scale. *Journal of Occupational and Organizational Psychology*, 83(4), 981-1002.
- Carmeli, A. (2009). Positive work relationships, vitality and job performance. *Research on emotion in organizations*, 5, 45-71.

- CBS (2013). *Statline. Beroepsbevolking naar bedrijf en persoonskenmerken*.  
 [http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=80470NED&D1=0&D2=44&D3=0-7&D4=l&HDR=T&STB=G2,G1,G3&VW=T]. 10th juli 2013.
- Cohen, S., Alper, C. M., Doyle, W. J., Treanor, J. J., & Turner, R. B. (2006). Positive emotional style predicts resistance to illness after experimental exposure to rhinovirus or influenza A virus. *Psychosomatic Medicine*, 68(8), 809–815.
- Combs, J., Liu, Y., Hall, A., & Ketchen, D. (2006). How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance. *Personnel Psychology*, 59(3), 501-528.
- Daniels, H., & Bizar, M. (1998). *Methods that matter: Six structures for best practice classrooms*. Portland, ME: Stenhouse Publishers.
- DeCharms, R. (1976). *Enhancing motivation: Change in the classroom*.
- Deci, E.L. (1975). *Intrinsic Motivation*. New York: Plenum. New York, NY: Irvington.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Deci, E. L., & Ryan, R. M. (2012). Overview of self-determination theory. *The Oxford Handbook of Human Motivation*, 85.
- Deci, E.L., Connell, J.P., & Ryan, R.M. (1989). Self-determination in a work organization. *Journal of Applied Psychology*, 74(4), 580-590.
- Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational psychologist*, 26(3-4), 325-346.
- Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied psychology*, 86(3), 499.
- Eisenberger, R., & Rhoades, L. (2001). Incremental effects of reward on creativity. *Journal of personality and social psychology*, 81(4), 728.
- Eisenberger, R., & Stinglhamber, F. (2011). *Perceived organizational support: Fostering enthusiastic and productive employees*. American Psychological Association.
- Fiedler, F. E. (1996). Research on leadership selection and training: One view of the future. *Administrative Science Quarterly*, 241-250.
- Field, A. (2005). *Discovering statistics using SPSS*. SAGE publications. London.
- Fiske, D. W. (1982). Convergent–discriminant validation in measurements and research strategies. In: Brinbirg, D., & Kidder, L. H. (Eds.), *Forms of validity in research* (pp. 77–92). San Francisco: Jossey-Bass.
- Fredrickson, B. L., & Losada, M. F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist*, 60(7), 678.

- Frese, M. & Fay, D. (2001). 4. Personal initiative: An active performance concept for work in the 21<sup>st</sup> century. *Research in Organizational Behavior*, 23, 133-187.
- Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, 26(4), 331-362.
- Gagné, M., & Vansteenkiste, M. (2013). Self-Determination Theory's Contribution to Positive Organizational Psychology. *Advances in Positive Organizational Psychology*, 1, 61-82.
- Gould-Williams, J. (2004). The effects of 'high commitment' HRM practices on employee attitude: The views of public sector workers. *Public Administration*, 82(1), 63-81.
- Graves, L. M., & Luciano, M. M. (2012). Self-determination at work: Understanding the role of leader-member exchange. *Motivation and Emotion*, 1-19.
- Griffin, M.A., Patterson, M.G., & West, M.A. (2001). Job satisfaction and teamwork: the role of supervisor support. *Journal of Organizational Behavior*, 22(5), 537-550.
- Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice-Hall.
- Halpin, A. W., & Winer, J. (1957). A factorial study of the Leader Behavior Description Questionnaire. In: Stogdill, R. M., & Coons, A. E. (Eds.), *Leader behavior: Its description and measurement* (pp. 6-38). Columbus, OH: Bureau of Business Research, Ohio State University.
- Hardre, P. L., & Reeve, J. (2003). A motivational model of rural students' intentions to persist in, versus drop out of, high school. *Journal of Educational Psychology*, 95, 347-356.
- Hart, S.M. (2006). Generational diversity: Impact on recruitment and retention of registered nurses. *Journal of Nursing Administration*, 36(1), 10-12.
- Hart, K.A. (2007). The aging workforce: Implications for health care organizations. *Nursing Economics*, 25(2), 101-112.
- Hersey, P., & Blanchard, K. H. (1993). *Management of organizational behavior: Utilizing human resources*. Englewood Cliffs, NJ: Prentice Hall.
- Hollebeak, J., & Amorose, A. J. (2005). Perceived coaching behaviors and college athletes' intrinsic motivation: A test of self-determination theory. *Journal of Applied Sport Psychology* 17(1), 20-36.
- Hoogh, A.H.B, De & Hartog, D.N., Den (2008). Ethical and despotic leadership, relationships with leader's social responsibility, top management team effectiveness and subordinates' optimism: A multi-method study. *The Leadership Quarterly*, 19(3), 297-311.
- House, R. J., & Mitchell, T. R. (1974). Path-goal theory of leadership. *Journal of Contemporary Business*, 3, 81-97.
- Howell, J. P., Dorfman, P. W., & Kerr, S. (1986). Moderator variables in leadership research. *Academy of management review*, 11(1), 88-102.
- Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1-55.

- Jang, H., Reeve, J., & Deci, E.L. (2010). Engaging students in learning activities: It's not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, 102(3), 588-600.
- Joreskog, K. G., & Sorbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Chicago: Scientific International Software.
- Kark, R., & Carmeli, A. (2009). Alive and creating: the mediating role of vitality and aliveness in the relationship between psychological safety and work involvement. *Journal of Organizational Behavior*, 30(6), 785-804.
- Keepnews, D.M., Brewer, C.S., Kovner, C.T., & Shin, J.H. (2007). Generational differences among newly licensed registered nurses. *Nursing Outlook*, 58(3), 155-163.
- Khalkhali, V., & Golestaneh, S.M. (2011). Examining the impact of teacher motivational style and competition result on students' subjective vitality and happiness in physical education. *Procedia-Social and Behavioral Sciences*, 15, 2989-2995.
- Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.
- Kocakülâh, M.C. & David, A.A. (2007). Balanced Scorecard Application in the Health Care Industry: A Case Study. *Journal of Health Care Finance*, 34(1), 72-99.
- Kuvaas, B. (2008). A test of hypotheses derived from self-determination theory among public sector employees. *Employee relations*, 31(1), 39-56.
- Latham, G. P. (2007). *Work Motivation: Theory, Research and Practice*. Thousand Oaks, CA: Sage.
- Latham, G. P., Borgogni, L., & Petitta, L. (2008). Goal setting and performance management in the public sector. *International Public Management Journal*, 11(4), 385-403.
- Lepper, M. R., & Greene, D. (1975). Turning play into work: Effects of adult surveillance and extrinsic rewards on children's intrinsic motivation. *Journal of Personality and Social Psychology*, 31(3), 479-486.
- Likert, I. R. (1961). *New patterns of management*. New York: McGraw-Hill.
- Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*. Prentice-Hall, Inc.
- MacDuffie, J.P. (1995). Human resource bundles and manufacturing performance: Organizational logic and flexible production systems in the world auto industry. *Industrial and Labor Relations Review*, 48, 197-221.
- Manz, C. C., & Sims Jr, H. P. (1987). Leading workers to lead themselves: The external leadership of self-managing work teams. *Administrative Science Quarterly*, 106-129.
- Margetts, H.Z. (2011). Experiments for Public Management Research. *Public Management Review*, 13(2), 189-208.
- McQuaid, R.W., & Lindsay, C. (2005). The Concept of Employability. *Urban Studies*, 42(2), 197-219.
- Mierlo, H., van., Rutte, C.G., Seinen, B., & Kompier, M. (2001). Autonomous teamwork and psychological wellbeing. *European Journal of Work and Organizational Psychology*, 10(3), 291-301
- Nemanich, L. & Keller, R. (2007). Transformational leadership in an acquisition: A field study of employees. *The Leadership Quarterly*, 18(1), 49-68.



- Neuberg, S. L., & Newsom, J. T. (1993). Personal need for structure: Individual differences in the desire for simpler structure. *Journal of Personality and Social Psychology*, 65(1), 113.
- Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom Applying self-determination theory to educational practice. *Theory and Research in Education*, 7(2), 133-144.
- Nix, G.A., Ryan, R.M., Manly, J.B., & Deci, E.L. (1999). Revitalization through self-regulation: The effects of autonomous and controlled motivation on happiness and vitality. *Journal of Experimental Social Psychology*, 35(3), 266-284.
- Offermann, L. R., & Hellmann, P. S. (1996). Leadership behavior and subordinate stress: A 360° view. *Journal of Occupational Health Psychology*, 1(4), 382-390.
- Oldham, G.R., & Cummings, A. (1996). Employee Creativity: Personal and Contextual factors at Work. *Academy of Management Journal*, 39(3), 607-634.
- Otis, N., & Pelletier, L. G. (2005). A Motivational Model of Daily Hassles, Physical Symptoms, and Future Work Intentions Among Police Officers, *Journal of applied social psychology*, 35(10), 2193-2214.
- Ouweneel, E., Schaufeli, W., & leBlanc, P. (2009). Van preventie naar amplitie: interventies voor optimaal functioneren. *Gedrag & Organisatie*, 22(2), 118-135.
- Patrick, B. C., Hisley, J., & Kempler, T. (2000). "What's everybody so excited about?": The effects of teacher enthusiasm on student intrinsic motivation and vitality. *The Journal of Experimental Education*, 68(3), 217-236.
- Penley, L. E., & Hawkins, B. (1985). Studying interpersonal communication in organizations: A leadership application. *Academy of Management Journal*, 28(2), 309-326.
- Perry, J.L. (2012). How Can We Improve our Science to Generate More Usable Knowledge for Public Professionals? *Public Administration Review*, 72(4), 479-482.
- Peterson, C., & Seligman, M. E. (2003). Character strengths before and after September 11. *Psychological Science*, 14(4), 381-384.
- Podsakoff, P. M., MacKenzie, S. B., Ahearne, M., & Bommer, W. H. (1995). Searching for a needle in a haystack: Trying to identify the illusive moderators of leadership behaviors. *Journal of Management*, 21(3), 422-470.
- Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., & Podsakoff, N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of applied psychology*, 88(5), 879-903.
- Polk, D. E., Cohen, S., Doyle, W. J., Skoner, D. P., & Kirschbaum, C. (2005). State and trait affect as predictors of salivary cortisol in healthy adults. *Psychoneuroendocrinology*, 30(3), 261-272.
- Popper, M., Maysel, O., & Castelnovo, O. (2000). Transformational Leadership and Attachment. *Leadership Quarterly*, 11(2), 267-289.
- Price, J.L. (1997). Handbook of organizational measurement. *International Journal of Manpower*, 18(4/5/6), 305-558.

- Richer, S. F., & Vallerand, R. J. (1995). Supervisors' interactional styles and subordinates' intrinsic and extrinsic motivation. *The Journal of social psychology, 135*(6), 707-722.
- Reeve, J. (2002). Self-determination theory applied to educational settings. In: Deci, E. L., & Ryan, R. M. (Eds.), *Handbook of self-determination research* (pp. 183–203). Rochester, NY: University of Rochester Press.
- Rich, B.L., Lepine, J.A., & Crawford, E.R. (2010). Job engagement: Antecedents and Effects on Job Performance. *Academy of Management Journal, 53*(3), 617-635.
- Ryan, R. M., & Bernstein, J. H. (2004). Vitality. In: Peterson. C. & Seligman. M. E. P. (Eds.). *Character strengths and virtues: A handbook and classification* [pp. 273–290]. New York: Oxford University Press.
- Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory: An organismic-dialectical perspective. In: Deci, E. L., & Ryan, R.M. (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: The University of Rochester Press.
- Ryan, R. M., & Deci, E. L. (2008). From ego depletion to vitality: Theory and findings concerning the facilitation of energy available to the self. *Social and Personality Psychology Compass, 2*(2), 702-717.
- Ryan, R. M., & Frederick, C. (1997). On Energy, Personality and Health: Subjective Vitality as a Dynamic Reflection of Well-Being. *Journal of Personality, 65*(3), 529-565.
- Ryan, R. M., Mims, V., & Koestner, R. (1983). Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology, 45*(4), 736-750.
- Sarrazin, P., Vallerand, R., Guillet, E., Pelletier, L., & Cury, F. (2002). Motivation and dropout in female handballers: A 21-month prospective study. *European Journal of Social Psychology, 32*(3), 395–418.
- Scandura, T., & Williams, E. (2004). Mentoring and transformational leadership: The role of supervisory career Mentoring. *Journal of Vocational Behavior, 65*(3), 448-468.
- Schaufeli, W.B., & Bakker, A.B. (2004). Full Access Job demands. Job Resources and Their Relationship with Burnout and Engagement: A Multi-Sample Study. *Journal of Organizational Behavior, 25*(3), 293-315.
- Schnake, M., Dumler, M. P., & Cochran, D. S. (1993). The relationship between traditional leadership, super leadership, and organizational citizenship behavior. *Group & Organization Management, 18*(3), 352-365.
- Silverstein, M. (2008). Meeting the Challenges of an Aging Workforce. *American Journal of Industrial Medicine, 51*(4), 269-280.
- Suhr, D. D. (2006). *Exploratory or confirmatory factor analysis?* Cary: SAS Institute.
- Sosik, J. J., & Godshalk., V. M. (2000). Leadership, mentoring functions received and job-related stress: A conceptual model and preliminary study. *Journal of Organizational Behavior, 21*(4), 365–390.
- Spreitzer, G., Sutcliffe, K., Dutton, J., Sonenshein, S., & Grant, A. (2005). A socially embedded model of thriving at work. *Organizational Science, 16*(5), 537-549.

- Tummers, L.G. & Knies, E. (forthcoming 2014). Leadership and meaningful work in the public sector. *Public Administration Review*.
- UWV (2013). *De zorg. Sector beschrijving*.  
[<http://www.uwv.nl/overuwv/Images/Sectorbeschrijving%20Zorg%20januari%202013.pdf>]. 10th July 2013.
- Yperen, N. W., van, & Hagedoorn, M. (2003). Do high job demands increase intrinsic motivation or fatigue or both? The role of job control and job social support. *Academy of Management Journal*, 46(3), 339-348.
- Wang, A. C., & Cheng, B. S. (2010). When does benevolent leadership lead to creativity? The moderating role of creative role identity and job autonomy. *Journal of Organizational Behavior*, 31(1), 106-121.
- Zuckerman, M., Porac~ J., Lathin I D., Smith, R., & Deci, E. L. (1978). On the importance of self-determination for intrinsically motivated behavior. *Personality and Social Psychology Bulletin*, 4, 443-446

## **Appendix- Additional Analyses**

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*In this appendix, additional analyses that have been performed are presented. Because I choose to write an article, I was not able to include all my analyses in my thesis. However, some other important results are shown in order to sketch a more representative depiction of my study.*

In line with SDT, I reasoned that autonomy-supportive leadership could be an obvious variable that could have an effect on employee vitality (Deci & Ryan, 1985; 2000). Furthermore, literature shows that team collaboration, (which has proven to have an effect on vitality in earlier analyses) could be a predictor of employee vitality. Studies have shown that although a specific event (e.g. positive feedback) tends to have a functional significance, the interpersonal context within which the event is administered has an important impact on the significance of the event. It is therefore possible that the collaboration in a team has a significant influence on vitality. The level of collaboration in a work team can be seen as an aspect of relatedness; one of the core psychological needs of SDT (van Mierlo, Rutte, Seinen & Kompier, 2001). Relatedness is the fundamental desire for close ties with others (Graves & Luciano, 2012). This can be satisfied by the presence of secure and satisfying interpersonal connections. Being in a team means that people experience a sense of mutuality or relatedness. Mutuality refers to the extent to which people involved in an activity share a sense of full participation and contribute to one another's development (Carmeli, 2009). The social capital theory (Adler & Kwon, 2002; Baker, 2000) suggests that substantial resources flow and are shared through networks of relationships between team members and that positive social capital enables people to grow and flourish, and therefore, achieve better outcomes (Baker & Dutton, 2007; Carmeli, 2009). Furthermore, studies have shown that conversations in a team can increase or deplete energy and that team resources are important facilitators and enablers of behaviors (Spreitzer et al., 2005). People in teams feel an elevated sense of capability and completely engage and become involved in their work tasks. It is therefore arguable that working in a team could enhance vitality.

Next to vitality, I tested the effect of autonomy-supportive leadership and team collaboration on job satisfaction. Autonomy-supportive leaders help their employees and prevent the occurrence of work-related problems (Berson & Avolio, 2004), which ultimately enhances job satisfaction among employees (Scandura & Williams, 2004; Nemanich & Keller, 2007). Employees' self-determination (e.g. employees who are autonomously-supported motivated) has been related to positive job outcomes, such as commitment (Otis & Pelletier, 2005) and higher levels of job satisfaction and lower levels of emotional exhaustion (Richer et al., 2002). Furthermore, working in a team can enhance the motivational properties of work and increase job satisfaction. Working in teams can enhance motivation, the sharing of information and prevent stress (Griffin, Patterson & West, 2001). Working in teams increases effectively and provides support amongst team members, which indicates a positive effect on job satisfaction (Durham et al., 1997). The results can be found in table A1.

Table A1. Multiple regression with Vitality and Job satisfaction as dependent variables.

Model	Model 1 Vitality	Model 2 Job satisfaction	Model 3 team collaboration*autonomy supportive leadership on vitality
<b>Autonomy-Supportive leadership</b>	0.37**	0.33**	0.37**
<b>Teamwork collaboration</b>	0.20**	0.09*	0.21**
<b>Gender</b>	-0.02	0.05	-0.51
<b>Education</b>	-0.00	0.00	0.06
<b>Age</b>	0.00	0.07	-0.2
<b>Autonomy-Supportive leadership*Teamwork</b>			0.68*
<b>R<sup>2</sup></b>	0.21	0.14	0.29
<b>N</b>	1066	1238	1066

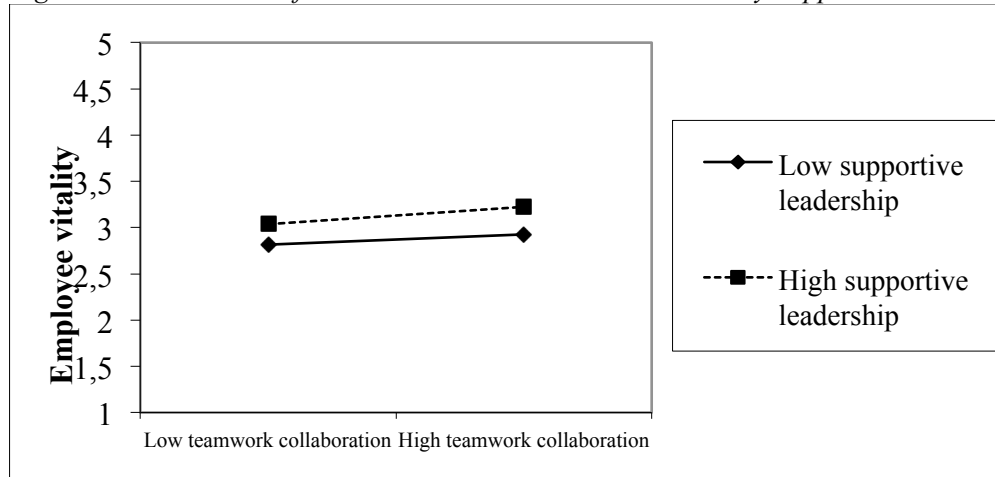
\*  $P < 0.05$ , \*\*  $p < 0.01$ .

Model one shows the effects of autonomy-supportive leadership and teamwork on vitality. As shown in model one, the influence of supportive leadership is significant ( $\beta = 0.37$ ,  $p < 0,01$ ). When employees experience their leader as autonomy supportive, they feel more vital. Next, it is shown that team collaboration has a significant ( $\beta = .20$ ,  $p < 0,01$ ) effect on employee vitality. Working in teams apparently positively influences employee vitality, because employees may feel more relatedness when working in teams. The  $R^2$  for this model is 0.21, which means that 21% of the variance in the model can be explained by the included variables.

Model two shows the effect of autonomy-supportive leadership and teamwork on job satisfaction. As can be seen, autonomy-supportive leadership has a positive effect ( $\beta = .33$ ,  $p < 0,01$ ) on job satisfaction. This means that employees who are autonomously motivated by their managers, experience more vitality. Next, it appears that teamwork collaboration has a significant, positive effect on job satisfaction ( $\beta = .09$ ,  $p < 0.05$ ), although the beta is not very high and the confidence interval is 95%. The  $R^2$  (.14) in this model is lower than for model one. This means that both supportive leadership and collaborating in a team explain less of the variance in this model (14%) than for employee vitality (21%).

Finally, an interaction effect has been tested, as shown in model three. The analysis shows that an interaction effect appears ( $\beta = .68$ ,  $p < 0.05$ ). However, further analysis, shown in figure A1, shows this is hardly significant. There is not, or hardly, a stronger positive influence of autonomy-supportive leadership and teamwork collaboration when they are both experienced at the same time.

Figure A1. Interaction of teamwork collaboration and autonomy-supportive leadership



Furthermore, I choose to test the influence of autonomy and communication on employee vitality and job satisfaction. The results can be found in table A2.

Table A2. Multiple regression with Vitality and Job satisfaction as dependent variables.

Model	Model 1 Vitality	Model 2 Job satisfaction	Model 3 Interaction supportive leadership and communication on vitality
<b>Supportive leadership</b>	0.29**	0.24**	0.23**
<b>Communication</b>	0.11**	0.14**	0.10**
<b>Gender</b>	0.05*	0.04	0.13
<b>Education</b>	-0.03	0.00	0.01
<b>Age</b>	0.05	0.05*	0.01
<b>Supportive leadership*communication</b>			0.05*
R <sup>2</sup>	0.15	0.13	0.16
N	1452	1451	1452

\*  $P < 0.05$ , \*\*  $p < 0.01$ .

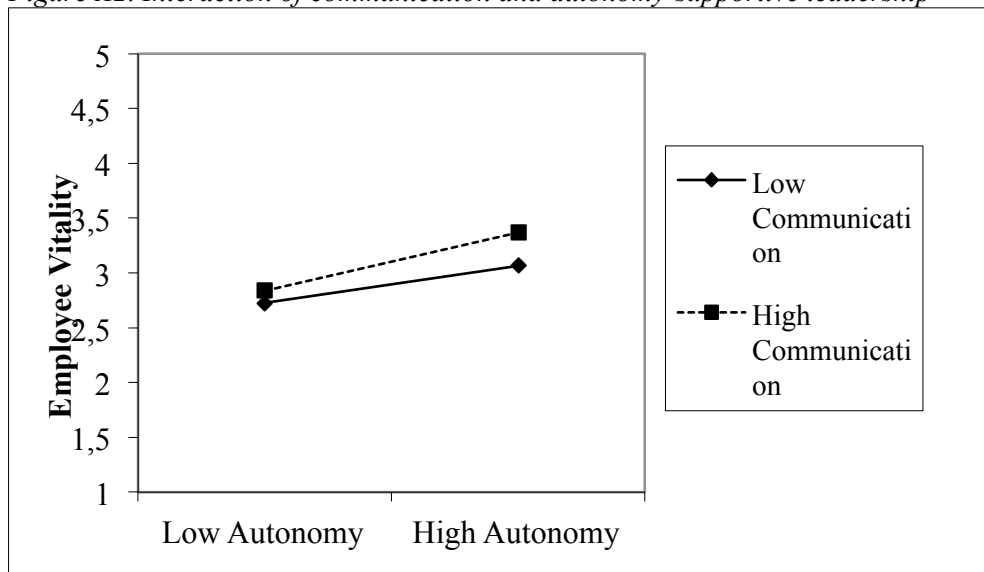
Model one shows the effects of supportive leadership (e.g. autonomy-supportive motivation) and communication on vitality. As shown in model one, the influence of supportive leadership is significant ( $\beta = .29$ ,  $p < 0,01$ ). When employees experience their leader as supportive and thereby feel that they are autonomously motivated, they feel more vital. Next, it is shown that communication has a significant effect ( $\beta = .11$ ,  $p < 0,01$ ) on employee vitality. Communication apparently positively influences employee vitality. The  $R^2$  for this model is .14, which means that 14% of the variance in the model can be explained by the included variables.

Model two shows the effect of supportive leadership (e.g. autonomy-supportive motivation) and communication on job satisfaction. As can be seen, supportive leadership has a positive effect on job satisfaction ( $\beta = .24$ ,  $p < 0,01$ ). Next, it appears that communication has a significant, positive effect on job satisfaction ( $\beta = .14$ ,  $p < 0,01$ ). The  $R^2$  (.13) is this model is slightly lower than for model one. This means that

both supportive leadership and communication explain less of the variance in this model (13%) than for employee vitality (14%).

Finally, the interaction effects have been tested, as shown in model three. The analysis shows that a reinforcement effect appears ( $\beta = .05, p < 0.05$ ). This can be seen in figure A2. The positive influence of supportive leadership and communication is stronger when they are both experienced at the same time. The positive effect of autonomy on employee vitality is higher if employees also experience high communication.

Figure A2. Interaction of communication and autonomy-supportive leadership



I also performed an Analyses of Variance (ANOVA) were during my process. In order to test the hypotheses, which stipulated that autonomously motivated tasks would have an influence on employee vitality, an ANOVA was performed, in which age was controlled for. Analysis of variance showed that autonomously motivated tasks employee vitality indeed influence ( $F(1,97)=58,63, p < 0.01, \eta^2 = .38$ ). This means that autonomously motivated tasks have a positive, significant effect on employee vitality. Gender does not seem to have a significant effect. The ANOVA also shows that supportive leadership has a significant effect on employee vitality ( $F(1, 97) = 19,84, p < 0.01, \eta^2 = .17$ ). Hypothesis three, which stated that autonomously motivated tasks and supportive leadership reinforce each other's' effect on vitality, is not confirmed ( $F(1,97)=.06, ns$ ).

Lastly, I tested the influence of the need for structure employees may experience along with the variables used in my current thesis. Because it has been found that people who have a high need for structure will appreciate a lower level of autonomy (Daniels & Bizar, 1998), the *need for structure scale* was also included and controlled for. However, it has also been found that giving too little structure, employees fail to develop the needed skills to experience high autonomy and high competence (deCharms, 1984; Jang, Reevi & Deci, 2010). Following the rationale of these studies, the need for structure scale was taken into account in the

experiment. The scale was developed by Neuberg and Newsom (1993) and was measured using a 5-point Likert scale (1= completely disagree, 5= completely agree). An example statement is: “*I don’t like situations that are uncertain*” ( $\alpha = 0.70$ ). The analysis showed however that the need for structure does *not* have a significant effect on employee vitality.

The additional analyses that have been performed all show a positive direct effect on employee vitality and/or job satisfaction. It appears that leaders have a crucial effect on employee well-being, whether they show supportive behavior or communicate in a constructive manner, both aspects show a positive direct effect on employee vitality and job satisfaction. The only interaction effect that seems to be significant is the effect of autonomy supportive leadership and communication. It appears that when employees who have a leader who is autonomy-supportive and provides information through communication, have higher employee vitality. A possible explanation is that both elements refer to different needs (e.g. autonomy and competence), which will reinforce the effects of the individual variables (Deci & Ryan, 2000). Furthermore, teamwork seems to have a positive effect on both employee vitality and job satisfaction. It appears that relatedness, next to autonomy, is an important predictor. This is in line with earlier research on SDT, which states that satisfaction of the needs will result in energy enhancement (Deci & Ryan, 1985; Ryan en Deci, 2002; 2008).

In order to replicate the results of the survey as much as possible, a multiple regression was performed using the results from the experiment. This is what is shown in my article. All in all it was an extensive process to come to the current results. The results of the appendix are not final results; it is an indication of my journey to the current article.