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An Exploration of Job Perceptions and Health in a Sample of Air Traffic Controllers Working in a Test Flight Centre Using an Integrative Approach

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Abstract

Introduction: Job perceptions and their relations with psychological and physical health were explored in a small group of military air traffic controllers (ATCOs) working in a test flight centre. Method: The participants rated dimensions of job requirements (psychological demands, overcommitment, work-family interferences), job resources (control, professional and personal social support) and health indicators. Results: The results show that the ATCOs in the study perceived their job as an active and demanding job but not in the same stressful way as civil ATCOs do. Some job requirement dimensions were positively associated with a number of health indicators. Overall and on-shift job resources were partially correlated, unlike overall and on-shift job requirements. Discussion: Results favor an integrative approach of job perceptions.

Key-words: job requirements, job resources, health, military ATCOs
Introduction

During the past decades, many studies have shown that job characteristics can have a profound impact on employee well-being and health, and job strain and its possible health consequences has been widely researched. In the occupational health research, job characteristics are typically explored by means of subjective evaluations referred to as job perceptions. Job perceptions concern different components of an employee’s job and job environment such as psychological demands and available resources. In the present study, job perceptions and their possible relations with mental and physical health were assessed in a small group of military air traffic controllers (ATCOs) working in a test flight centre. The questionnaires used for the assessments were based on a number of influential job strain models described below.

*The job demands-control-social support model (JDC-S)*

This model proposed by Karasek and Theorell (1990) is one of the most widely studied models. As already hypothesized in Karasek’s original model in 1979, mental job-strain results primarily from a mismatch between psychological job demands and job control. Psychological job demands correspond to “the psychological stressors involved in accomplishing the work load, stressors related to unexpected tasks, and stressors of job-related personal conflict” (Karasek, 1979, p. 291). Job control describes “the working individual’s potential control over his tasks and his conduct during the working day” (Karasek, 1979, pp. 289-290). Thus defined, the combination of high job demands and low control characterizes a “stressful” job-situation associated with job dissatisfaction and various self-reported symptoms of mental strain, including exhaustion or fatigue after work, sleep problems, and mood disturbances. In contrast, when job control matches the challenge of high job demands, the job is defined as an “active” job most likely associated with high job satisfaction and reduced strain symptoms. Karasek and Theorell defined two additional types
of job situations: low job demands met by either high job control (“relaxed job”) or low job control (“passive job”). In addition, low support (professional/social) in the workplace enhances the impact of job strain on self-reported stress symptoms (Karasek & Theorell, 1990). The JDC-S model has been largely supported in several job-situations and job-strain has been confirmed to be a serious risk factor in the development of various mental and physical illnesses, for instance in safety-critical jobs (for a review, Theorell et al., 2015).

The effort–reward imbalance model (ERI)

This model (Siegrist, 1996) uses effort and social reward as the crucial dimensions in job perceptions. The social reward dimension refers to job recognition, career perspectives, and job security, while the effort dimension may refer to both extrinsic efforts (i.e., work demands) and intrinsic efforts (i.e., motivation and overcommitment). The model proposes that combinations of high effort and lack of reward impair emotional well-being and self-esteem, and are associated with an increased risk of adverse health effects. Job overcommitment, corresponding to an individual’s exhaustive coping style, also increases the risk of reduced health, expressed for instance by higher rates of burnout (Euwema, Kopt, & Bakker, 2004), psychological distress (Janzen, Muhajarine, Zhu, & Kelly, 2007), increased musculoskeletal pain (Von Dem Knesebeck, David, & Siegrist, 2005), and decreased sleep quality (Wu, Gu, & Yu, 2014).

Work-Family conflict model (WFC)

This model proposes that strain arises when “participation in one role (work or other life domains) makes it difficult to fulfil requirements of another” (Greenhaus & Beutell, 1985, p.76). Work-family conflicts may be time-based (time demands associated with one role restricting the time that can be devoted to the other role), strain-based (stress built up in one role transferring to the other role) or behavior-based (behavior effective in one role inappropriately applied in the other role). As an example, in the case of role-produced strain,
any work or family characteristic may lead to strain symptoms such as tension, anxiety, fatigue or depression, and ultimately health problems (Allen et al., 2000; Frone, 2000; Dahm et al., 2015). Some studies have explored the overspill of work to non-work domains on a daily basis and showed, for instance, that interpersonal conflicts at work resulted in higher strain-based work-private life conflicts, whereas the presence of daily personal resources enabled buffering the overspill to the non-work domain (Martinez-Corts, Demerouti, Bakker, & Boz, 2015; Oerlemans & Bakker, 2013).

*Job demands and health in ATCOs*

Air traffic control (ATC) activities involve high demands, such as having to deal with different time scales simultaneously (‘here and now’ and ‘looking ahead’), the safety related responsibility, the unpredictability of critical events, and the demand of maintaining specific minimum separation standards and making quick interventions with little time for decision making in case of threats of violation. Concentration on the task may be a problem when it leads to tension that cannot be overcome (Baumgartner, 2004; Costa, 1995). A growing body of literature is reporting how occupational factors reported by ATCOs are associated with various stress indicators, and with health in the long run.

Research showed a significant relationship between physiological stress indicators and ATC job demands and/or workload (Collet, Averty, & Dittmar, 2009; Zeier, Brauchli, & Joller-Jemelka, 1996), this also in relation to decision latitude (Theorell et al., 1988). Costa (2000) reported that work stress in ATCOs was mainly related to mental workload and aggravated by time pressure and high responsibility, thereby highlighting the relationship between job demands and control. Studies focusing on diagnosed illnesses showed that burnout, though quite rare in ATCOs, was related to job demands and job resources in this population, and burnout predicted psychosomatic complaints (Martinussen & Richardsen, 2006).
Burnout in ATCOs has also been reported to be related to aging, years spent in ATC, job dissatisfaction and work stressors but social support by relatives was assumed to be beneficial in the prevention (Dell'Erba, Venturi, Rizzo, Porcù, & Pancheri, 1994). Overspill of job stressors to non-work domains in ATCOs was expressed by same day deterioration in physical and psychological well-being and spillover on parent-child interaction (Repetti, 1993). “The consequences of a stressful work environment depend on many 'intervening variables' concerning both individual factors (e.g. age, personality traits, physiological characteristics), as well as working situations (e.g. workloads, shift schedules) and social conditions (e.g. number and age of children, housing, commuting)” (Costa, 1996, p.9; Jenkins & Hurst, 1978).

Objectives of the study

As the models discussed suggest, many aspects of the work and non-work domains should be taken into account when assessing job perceptions and exploring the possible relations between job characteristics, job strain and possible health effects. The aim of the present study was to do so by combining variables from the various models and by also using both a more typical and a newly developed instrument for measuring job perceptions.

As to the combination of the different models, the authors grouped job characteristic aspects into two main categories: job requirements and job resources. Job requirements include the job demands (Theorell & Karasek, 1996), overcommitement (Siegrist, 1996), interferences between work and non-work domains (Greenhaus & Beutell, 1985) and organisational demands (relating to the conditions under which the different tasks and associated demands are carried out). Job resources include job control and social support in the work place (Theorell & Karasek, 1996), but also support by relatives (Dell'Erba et al., 1994).
Job perceptions have been mostly explored by means of questionnaires assessing the individual’s overall job perception that has evolved over a larger time frame (i.e. typically several months). More recently, several researchers proposed to capture the momentary experiences of individuals in reaction to their everyday working life (Demerouti, Bakker, & Halbesleben, 2015; Oerlemans & Bakker, 2013). These experiences typically reflect concrete and transient events and interfering tasks and changes that occur on a daily basis (changes in the team, unpredictable traffic load, significant weather conditions, etc.). They may also depend on the individual’s momentary mental state, and his or her mental and physical fatigue (Cascino, Mélan, & Galy, 2016; Mélan & Cascino, 2014). In the present study, a recently self-constructed questionnaire for assessing ‘on-shift’ or ‘in situ’ job perceptions was used in addition to the questionnaire measuring overall perceptions.

Research questions related to the job perceptions:

1. Are test flight control activities characterized by high job requirements and high job resources?

As found in previous studies performed with civil ATCOs, ATC activities are cognitively highly demanding tasks and require high levels of control. In reference to the JDC-S model, ATCOs would experience their job situation as an “active job”. The first aim of the study was to test this for the group of military ATCOs but in a slightly more comprehensive approach than suggested by the JDC-S model by including some extra job requirements and job resources dimensions in addition to those described in the JDC-S model. Both the job requirements and the job resources were expected to be rated ‘high’.

2. Is there a significant relationship between on-shift and overall job perceptions?

As on-shift or ‘in situ’ job perceptions develop as personal evaluations in response to the daily events, and may also depend on work-independent temporary situations (e.g.
illness of a family member, a bad sleep’s night), no significant relationships were expected between ATCOs’ on-shift and overall job perceptions.

Research question related to the relationship between job perceptions and health and well-being indicators:

3. Are indications of good health negatively associated with job requirements and positively associated with job resources?

In agreement with the literature, high levels of job requirements would be associated with poorer psychological well-being and more physical health complaints (positive correlations, except for the fatigue scale). Conversely, the authors expect high levels of job-resources to be associated with high psychological well-being and low levels of physical health complaints (negative correlations, except for the fatigue scale). As the psychological and physical health assessments concern the longer time period only and not the on-shift perceptions, this research question was examined in relation with the overall job perceptions only.

Method

Participants

Participants were military ATCOs trained in a French Air Force school. Ten of the eleven ATCOs working in the centre, 9 men and 1 woman, volunteered to participate in the study. Their mean age was 43.89 (SD = 8.78, median = 40, range 34 to 56). They worked 8-h day-shifts on weekdays, starting either at 08:30 or 10:30. This enabled to assess their job perceptions and health indicators independently of the well-known deleterious effects of shift-work (Costa, 1996; Tucker & Folkard, 2012).

They operated for at least ten years in the flight test centre in the South-West of France, controlling both commercial flight test programs (to certify that the aircraft meets all applicable safety and performance requirements) and military flight test programs (to certify
that a prototype is suitable and effective to carry out the intended mission). During individual test flights (no passengers on board) they had to provide sufficient air space and time to enable engineers and technicians to test the flight instruments on board. In this regard, their control activity differed from the one exerted by civil ATCOs in charge of commercial flights monitoring a high traffic flow. The two same controllers remained on duty in the control room across the day and could be momentarily relieved by another controller or by the supervisor (lunch time). They shared the control room with civil ATCOs operating commercial flights.

**Materials and Procedure**

The complete protocol included two different assessments:

(1) An *in situ* assessment by asking ATCOs being at work to rate a questionnaire specifically designed to assess their momentary ‘on-shift’ perceptions;

(2) An assessment of their overall job perceptions and health by asking them to rate (outside working time and in reference to a large time period) a survey including several scales and questionnaires. About 45 to 60 minutes were necessary to complete the survey.

Below, references providing the validation data for the standardized instruments are indicated. Cronbach’s alpha coefficients obtained in the present sample are indicated for each momentary and overall job perception dimension explored, as well as for all health scales used.

*In situ assessment of on-shift perceptions (job requirements and job resources)*

Eight dimensions were assessed with a non-validated but earlier used self-constructed instrument written in French (Cascino et al., 2016; Mélan & Cascino, 2014). Items of this 56-item scale were rated on a scale from 1 “not present at all” to 6 “very frequently present” in about five to ten minutes.

*On-shift* job requirements
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- Psychological demands (19 items, e.g. “Tasks requiring high levels of concentration”, $\alpha = .96$);
- Physical demands (six items, e.g. “Laborious, difficult or exhausting positions”, $\alpha = .97$);
- Family to work interferences (five items, e.g. “Strain due to personal worries about children or family”, $\alpha = .91$).

On-shift job resources
- Autonomy (four items, e.g. “I participate in decision making”, $\alpha = .93$)
- Skill discretion (eight items, e.g. “Diversity of skills required to perform the tasks”, $\alpha = .97$).
- Social support by supervisor (five items, e.g. “Advices and ideas from supervisors to help solving problems”, $\alpha = .74$);
- Co-workers support (three items, e.g. “Possibility to be replaced by colleagues”, $\alpha = .90$);
- Technical and human resources availability (five items, e.g. “Equipment is suitable to do my work properly”, $\alpha = .98$).

As in situ job perceptions may change across the shift (Cascino et al., 2016), participants rated this questionnaire three times during working time: 1h after work-beginning, in the middle of the workday, and 1h prior work-end. They were instructed to rate each item in regard to the previous hour.

Assessment of overall job perceptions (job requirements and job resources)

Overall perceptions were assessed with two well-established questionnaires and several new scales and items constructed by the authors. References providing the validation data for the standardized instruments are indicated below. All job dimensions considered were rated on 4-point scales (from 1 “strongly disagree” to 4 “strongly agree”), except for interferences between work and family rated on a 5-point scale (from 1 “strongly disagree” to 4 “strongly agree”). A mean score was calculated for each job dimension, a high mean score indicating a high level.
Overall job requirements (six dimensions in total)

- **Psychological demands** (5 items, e.g., “My job requires working very fast”, $\alpha = .59$) and **physical demands** (5 items, e.g. “At work, I have to move or carry heavy loads”, $\alpha = .90$) of the Job Content Questionnaire (JCQ, Karasek et al., 1998; Niedhammer, Chastang, Gendrey, David, & Degioanni, 2006, for validation of the French version).

- **Organizational demands** is a self-constructed sub-scale introduced to explore specific demands relating to the conditions to carry out the different tasks and associated demands (13 items, e.g. “In my work, I am constrained to work understaffed”, $\alpha = .59$).

- **Work overcommitment** was evaluated with Siegrist’s scale (Siegrist et al., 2004; Niedhammer, Siegrist, Landre, Goldberg, & Leclerc, 2000, for validation of the French version). 29 items described levels of engagement in the workplace and need for control (e.g. “Being better or faster than the others is a sort of game for me”, $\alpha = .93$).

- Interferences between work and family assessed by a homemade scale exploring spillover from work to non-work domains (25 items, e.g. “After work, I am too tired to do what I really want to do”, $\alpha = .95$) and from non-work domains to work (12 items, e.g. “At work people find unpleasant that I’m worried about my private life”, $\alpha = .85$).

Overall job resources (five dimensions in total)

- The two dimensions of job control were assessed with the JCQ: **decision latitude** (5 items, e.g., “My job requires that I learn new things”, $\alpha = .61$) and **autonomy** (3 items, e.g., “My job allows me to take many decisions on my own”, $\alpha = .68$).

- **Social support from co-workers** was assessed with the 6-item sub-scale of the JCQ completed by three items (9 items, e.g. “The people I work with are helpful in getting the job done”, $\alpha = .74$) and **social support from supervisors** with the 5-item sub-scale of the JCQ completed by four items (9 items, e.g. “My supervisor is concerned by the wellbeing of his subordinates”, $\alpha = .93$).
Social support by relatives was evaluated with a self-constructed sub-scale (6 items, e.g. “My parents and friends share ideas and advices with me”, $\alpha = .80$).

Assessment of health

Psychological health

Job satisfaction and self-esteem scales were used as indicators of psychological health, with higher mean scores indicating a better psychological health. References providing the validation data for the used standardized instruments are indicated below.

- Job satisfaction was assessed with the Minnesota Satisfaction Questionnaire (Weiss, Dawis, England, & Lofquist, 1967; Roussel, 1996, for validation of the French version), exploring affective responses associated with several facets of the work (21 items, e.g. “I have the chance to do something that makes use of my abilities”, $\alpha = .67$) rated on a 5-point scale (from 1 “very dissatisfied”, to 5 “very satisfied”).

- Self-esteem was assessed by Rosenberg’s scale (Vallières & Vallerand, 1990, for validation of the French version) presenting ten statements (e.g. “On the whole, I am satisfied with myself”, $\alpha = .79$) quoted on a 4-point scale (e.g. 1 “strongly disagree” to 4 “strongly agree”).

Physical health

ATCOs’ physical health was assessed by five indicators corresponding to self-reported illness symptoms with high scores indicating high levels of health complaints and fatigue (one of the self-reported symptoms of mental strain), and thus poorer health.

- Musculoskeletal symptoms (2 items, $\alpha = .99$) were rated on a 6-point scale (1 “never” to 6 “several times a day”),

- Cardio-vascular symptoms (7 items, $\alpha = .87$), digestive symptoms (eight items, $\alpha = .97$), and vertigo (one item) were rated on a 4-point scale (1 “almost never” to 4 “most of the time”).

- A fatigue scale indexed general feelings of vigor and energy (10 items, e.g. “I feel full of energy”, $\alpha = .85$) on a 5-point scale (1 “not at all” to 5 “very much”; Barton et al., 1995).
**Statistical analyses**

Differences between the high perceived job resources and job requirements were tested by comparing the mean score of each job dimension with the mean value of the scale (theoretical mean). This comparison was performed with a parametric one-sample *t*-test. Further, Spearman’s non-parametric correlation test was used to address the other research questions. In addition, the mean score of each health indicator was compared with the theoretical mean of the response scales. All statistical tests were performed with IBM SPSS version 17 and significant differences were reported for *p* < .05.

**Results**

*Research question 1: High job requirements and job resources: An active job situation?*

Table 1 summarizes the descriptive data for each dimension of overall job perceptions and the results obtained by comparing the observed mean score with the mean value of the scales (2.5 for each scale, except for interferences between work and family = 3). Results show that among job requirements, only mean psychological demands exceeded significantly the mean score (*t*(9)=3.44, *p* < .01). Mean organizational demands and overcommitment did not differ significantly from the mean value. Mean physical demands (*t*(9)=−10.92, *p* < .001), conflicts from work to family (*t*(9)=−6.13, *p* < .001), and from family to work (*t*(9)=−7.59, *p* < .001) were rated below the mean value. Professional resources were, in contrast, rated significantly above the mean value (autonomy *t*(9)=5.54, *p* < .001, skill discretion *t*(9)=12.68, *p* < .001, social support by supervisor *t*(9)=4.07, *p* < .001, social support by colleagues *t*(9)=9.89, *p* < .001), but not social support by relatives that scored at the mean value.

The ATCOs’ *in situ* job-perceptions are summarized in Table 2. As in the present sample ratings did not differ across the three recordings, the calculated mean score was used for each dimension, a high mean score indicating a high perception level.
All on-shift job requirement dimensions were rated significantly below the mean value of the scale, i.e. psychological demands ($t(9)=-4.59, p<.001$), physical demands ($t(9)=-6.10, p<.001$), and family to work conflict ($t(9)=-6.26, p<.001$). Ratings of job resource dimensions varied from significantly above the mean value (technical and human resources availability, $t(9)=3.17, p<.01$) to not differing significantly from the mean (skill discretion, autonomy and social support by colleagues) to significantly lower than the mean value (social support by supervisor, $t(9)=-2.88, p<.02$).

In summary, concerning the overall perceptions, except for the psychological demands the ATCOs rated the other job requirements on the low side while perceiving high levels of overall job resources. Similar results were obtained for the in situ job perceptions: evaluations of job resources tended to be rated above the mean while job requirements were rated below the mean (even the psychological demands). Taken together, the results for this group of test flight controllers contrast with the expectation of high ratings for both the job requirements and the resources.

Research question 2: Is there a significant relationship between on-shift and overall job perceptions?

No significant correlations occurred between any of the equivalent job requirement dimensions that were rated on both the in situ and overall questionnaires (Table 3). Similarly, for the job resources’ equivalent dimensions of autonomy and social support by supervisors no significant correlations were found between overall and in situ job perceptions. However, the positive correlations between the two types of questionnaires found for social support by colleagues ($r = .703, p < .05$), and for skill discretion ($r = .716, p < .05$) were significant.

Research question 3: Are good health indications positively associated with job resources and negatively associated with job requirements?
The ATCOs’ self-reported scores of health indicators were compared to the mean value of each scale (Table 4). Job satisfaction ($t(9) = 10.14, p < .001$) and self-esteem ($t(9) = 6.11, p < .001$) were rated significantly above the mean value, and fatigue ($t(9) = -8.74, p < .001$), and illness symptoms were rated significantly below the mean value (digestive symptoms $t(8) = -3.41, p < .01$, cardio-vascular symptoms $t(8) = -8.50, p < .001$, vertigo, $t(8) = -8.69, p < .001$), indicating few health problems. Thus, the ATCOs seemed to be in good health, as indicated by a high mental fitness and few physical health complaints.

Correlation analyses between the health indicators and ATCOs’ overall job perceptions are summarized in Table 5. Concerning psychological health indicators, results revealed no correlation between job satisfaction and either dimension of job resources or requirements. Concerning physical health complaints, positive correlations were observed with several job requirement dimensions. More especially, musculoskeletal symptoms were positively correlated with organizational demands ($r = .786, p < .05$), overcommitment ($r = .674, p < .05$), and work to family conflicts ($r = .748, p < .05$); digestive symptoms with organizational demands ($r = .708, p < .05$), and work to family conflicts ($r = .686, p < .05$); cardiovascular symptoms with organizational demands ($r = .765, p < .05$), and overcommitment ($r = .883, p < .01$); vertigo with physical demands ($r = .738, p < .05$) and overcommitment ($r = .676, p < .05$). An unexpected positive correlation was also found with one of the job resources dimensions, i.e. vertigo with social support by colleagues ($r = .690, p < .05$). The fatigue score was correlated with neither dimension of overall job requirements or resources.

In summary, the results show that several job requirement dimensions were significantly associated with physical illness symptoms.

**Discussion**

*Did ATCOs perceive their job as an active job?*
The results show that ATC activities in this test flight control centre can be perceived as an active job situation, providing possibilities of challenge and mobilization of skills. Self-reported measures exploring the ATCO’s overall job perceptions revealed psychological demands being rated significantly higher than the mean value and professional job resources, i.e. job control, skill discretion, social support by colleagues, social support by supervisor, rated high as well. Interestingly, the demands referring directly to the core ATC activities (psychological demands) were seen as more demanding than the requirements defining the context of their activities (physical demands, organizational demands, overcommitment and work-family interferences).

The results further indicate that in the present study only the dimensions that are proposed in the JDC-S model to define an active job situation (i.e. high psychological demands associated with high job control and social support) differed significantly. The additional dimensions of professional requirements (organizational demands, overcommitment) and job resources (social support by relatives) were not significantly deviating from the mean value. Moreover, the ATCOs rated the additional dimensions relating to job requirements (physical demands, work-family interferences) at a significant lower level than the mean value of the scale. Hence, the pattern of the job perceptions of this group would be indicative of an ‘active and relaxed’-job, implying sufficient resources to cope with job demands and requirements. These results partially contrast with the results reported previously for ATCOs in charge of controlling commercial flights, indicating a stressful job situation most of the time. Although both populations of ATCOs perform air traffic control activities, the test flight ATCOs seem to be less exposed to sources of stress than the controllers of commercial flight ATC activities (Baumgartner, 2004; Costa, 1995).

A similar analysis of ATCO’s self-reported in situ job perceptions revealed that no job requirement and only one job resource dimension (availability of human and technical
resources) scored significantly above the mean value of the scale. Moreover, all job requirement dimensions scored significantly below the mean value of the scale and job resources scored at the mean value except for social support by supervisors that scored significantly lower. These results were at odds with the patterns of an active and/or relaxed job-situation reported above for overall job perceptions. In addition, such a response pattern is not characteristic of any of the four job-situations described by the JDC-S model. These results also contrast with the findings in the literature reporting that stress indicators are associated with workload recorded on a daily basis in ATCOs (Collet et al., 2009; Zeier et al., 1996). As the latter studies concern ATCOs in charge of commercial flights, the apparently contradictory results may indicate that the control activities associated with test flights may be quite different from those characterizing control of constant traffic flow of commercial flights, as argued above. Also, the question may be raised whether in situ job perceptions will be able to yield ‘true’ job perceptions.

Is there a significant relationship between on-shift and overall job perceptions?

The ATCOs rated the on-shift and the overall job requirement scales differently, indicating that perceptions of job requirements differed according to the time period considered. This result appears to support the idea that momentary perceptions vary with the frequent changes that may characterize a job on an everyday basis, whereas overall job perception tools would provide a more stable view of the way work conditions are perceived. Accordingly, it may be that in situ job perceptions are frequently updated, which is consistent with studies reporting about day to day changes or between-shift changes (Demerouti et al., 2015; Mélan & Cascino, 2014). With respect to job resources, however, the ATCOs’ overall and in situ perceptions of skill discretion and social support by colleagues were correlated in the present study, probably indicating that in the flight test centre ATCOs may have perceived job resources as being more stable over time than job requirements.
Alternatively, it may be that the JDC-S model is not well suited to account for momentary job perceptions. However, some researchers have theoretically framed daily strategies at work in the Job Demand-Resources model, which would include mobilizing personal resources that enable a person to adapt to job demands, “include behaviours targeted toward minimizing the emotionally, mentally, or physically demanding aspects of one’s work” (Demerouti et al., 2015, p.458). Research shows that daily personal resources have a buffering effect on the interpersonal conflict at work, thus, being proposed as contributors to the JD-R model (Martinez-Corts et al., 2015). From a methodological point of view, these studies reported results collected by means of questionnaires completed at the end of the day, while in the present study the daily job perceptions were concerning a one-hour time period only and were assessed while ATCOs were in the workplace. Therefore it may be argued that daily changes in personal strategies that employees make to balance their job demands and job resources with their personal abilities and needs may be explored in relation to an overall job perception model (either JDC-S or JD-R), while momentary perceptions might be too variable to be framed in such a model. The present results then indicate that timely-situated job perceptions and overall job perceptions may be supplementary to each other in providing information about ATCOs’ job perceptions and may usefully complete job-strain studies exploring either of these aspects, i.e. physiological stress indicators in relation to high aircraft traffic load at work (Collet et al., 2009; Zeier et al., 1996) or ATCOs’ overall job perceptions in relation to diagnosed illnesses (mostly burnout; i.e. Dell’Erba et al., 1994; Martinussen & Richardsen, 2006; Rose et al., 1978). In future studies it would be useful to redesign the in situ job perception questionnaire into a whole-day measure to further explore daily job perceptions within the theoretical frame of a general job perception model.

Are health indicators positively associated with job resources and negatively associated with job requirements?
Overall, the ATCOs in the flight test centre reported few physical health complaints, as indicated by significant lower scores than the mean value of the scale for all self-reported physical illness symptoms (except for musculoskeletal complaints that scored at the mean value) and significant higher scores than the mean value for job-satisfaction and self-esteem.

As expected, several overall job requirement dimensions were positively associated with two or more health complaints. These results are in line with previous findings indicating that job demands may have deleterious effects on ATCO’ health (Dell'Erba et al., 1994; Martinussen & Richardsen, 2006) and other findings that have proposed the strategy of reducing job demands to protect employees’ health from excessively high demands (Martinez-Corts et al., 2015). However, in this group the ATCOs’ overall perceptions of job requirements were not correlated with job-satisfaction and self-esteem, while a negative relationship between job requirements and psychological health was expected. Likewise, the results of this group did not confirm the expected relationships between job resources and physical health complaints (negative correlation), and job-satisfaction and self-esteem (positive correlation). Thus, they did not allow confirming the beneficial effects of availability of resources on health reported previously.

Quite surprisingly, an unexpected positive correlation occurred between social support by colleagues and a single physical health complaint indicator (vertigo). It is not likely however that this finding would then indicate a deleterious effect of social support by colleagues in contradiction to the well-known beneficial effect of job resources on health (Theorell et al., 2015). In the literature, a mismatch between psychological demands and low job control, rather than an isolated job resource dimension has been found to be a risk factor in the development of various mental and physical illnesses (Theorell et al., 2015). Also, the small sample in this study would not allow any conclusion to be drawn from this unexpected finding.
Methodological Limitations

This study was performed with ATCOs controlling individual test flights and the findings may not be easily generalized to ATCOs controlling commercial airplanes. Generalization of the results is also restricted due to the small sample size (N = 10) and the number of variables tested in relation to the sample size. The ATCOs participating in the study may have been less alert when rating the last scales of the overall questionnaire, which included more than 125 items altogether. Finally, the study included only self-rating tools, including self-reported health complaints while no interview with a physician or medical health report was included.

Conclusion

The study indicates that high job requirements are not associated with job-strain per se.

Rather, in agreement with the JDC-S model, the results in the group of military ATCOs show that the challenge of high job requirements may be matched by equally high (or even higher) job resources. Moreover, in the sample this combination of job characteristics was associated with few health complaints and high psychological well-being.

The study has shown the usefulness of an integrative approach of job perceptions by including the visions and variables of different models. In a similar approach, Demerouti and collaborators (2001) proposed to include feedback on performance as a dimension of job resources and the dynamic way in which various risk factors may work together to produce job stress as a dimension of job demands and job resources. In agreement with the literature (Dell'Erba et al., 1994; Greenhaus & Beutell, 1985), our findings also stress that the understanding of job requirements and resources gains in clarity when the permeability between work and other life domains is considered. Moreover, some findings point to new research directions in the field of occupational psychology. For instance, it would be useful to further clarify to what extent the pattern between job requirements and resources observed in a given job situation may vary according to the dimensions considered and their implications.
Job perceptions reported on a daily basis may complete the overall job perceptions, raising the possibility that they could be used in future studies to anticipate upcoming health problems. The finding of two different patterns of job perceptions, an overall pattern and an on-shift pattern, provided a finer-tuned description of the particular job situation.

References


Table 1

ATCOs’ overall job perception data (job requirements and job resources) and their comparison with the mean value of the rating scales. Data are expressed as Median, Min/Max, Mean and standard deviation. The last column indicates the p-value obtained when mean scores of each dimension (N = 10) were compared with a t-test to the mean value of the Likert scales.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Median score</th>
<th>Min/max</th>
<th>Mean score</th>
<th>S.D.</th>
<th>Mean value</th>
<th>Comparison to mean value of the scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job requirements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological demands</td>
<td>2.90</td>
<td>2.00/2.78</td>
<td>2.78</td>
<td>0.26</td>
<td>2.5</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Physical demands</td>
<td>1.00</td>
<td>1.00/2.02</td>
<td>1.18</td>
<td>0.38</td>
<td>2.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Organizational demands</td>
<td>2.35</td>
<td>2.00/2.92</td>
<td>2.44</td>
<td>0.29</td>
<td>2.5</td>
<td>.53</td>
</tr>
<tr>
<td>Overcommitment</td>
<td>2.20</td>
<td>1.62/3.10</td>
<td>2.24</td>
<td>0.42</td>
<td>2.5</td>
<td>.08</td>
</tr>
<tr>
<td>Work to Family conflicts</td>
<td>2.12</td>
<td>1.48/2.80</td>
<td>2.11</td>
<td>0.46</td>
<td>3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Family to Work conflicts</td>
<td>1.96</td>
<td>1.00/2.58</td>
<td>1.83</td>
<td>0.49</td>
<td>3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Job resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill discretion</td>
<td>3.25</td>
<td>3.17/3.67</td>
<td>3.33</td>
<td>0.21</td>
<td>2.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Autonomy</td>
<td>3.33</td>
<td>2.33/3.67</td>
<td>3.30</td>
<td>0.46</td>
<td>2.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Social support by supervisor</td>
<td>3.31</td>
<td>1.75/4.00</td>
<td>3.30</td>
<td>0.62</td>
<td>2.5</td>
<td>&lt;.003</td>
</tr>
<tr>
<td>Social support by colleagues</td>
<td>3.43</td>
<td>3.15/4.00</td>
<td>3.51</td>
<td>0.32</td>
<td>2.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Social support by relatives</td>
<td>2.83</td>
<td>1.67/3.00</td>
<td>2.67</td>
<td>0.39</td>
<td>2.5</td>
<td>.21</td>
</tr>
</tbody>
</table>
Table 2

*In situ job perceptions (job requirements and job resources) and their comparison with the mean value of the rating scales. Data are expressed as Median, Min/Max, Mean and standard deviation. The last column indicates the p-value obtained when mean scores were compared with a t-test to the mean value of the scales of on-shift job perceptions (N = 10)*

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Median score</th>
<th>Min/max</th>
<th>Mean score</th>
<th>S.D.</th>
<th>Mean value</th>
<th>Comparison to mean value of the scale (3.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job requirements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological demands</td>
<td>1.94</td>
<td>1.90/3.76</td>
<td>2.04</td>
<td>0.76</td>
<td>3.5</td>
<td><em>p &lt; .001</em></td>
</tr>
<tr>
<td>Physical demands</td>
<td>2.46</td>
<td>1.00/3.42</td>
<td>2.63</td>
<td>0.60</td>
<td>3.5</td>
<td><em>p &lt; .001</em></td>
</tr>
<tr>
<td>Family to Work conflicts</td>
<td>2.00</td>
<td>1.33/3.53</td>
<td>2.13</td>
<td>0.69</td>
<td>3.5</td>
<td><em>p &lt; .001</em></td>
</tr>
<tr>
<td><strong>Job resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill discretion</td>
<td>4.21</td>
<td>2.63/5.96</td>
<td>4.15</td>
<td>1.06</td>
<td>3.5</td>
<td><em>P = .083</em></td>
</tr>
<tr>
<td>Autonomy</td>
<td>4.26</td>
<td>2.00/5.20</td>
<td>4.05</td>
<td>0.98</td>
<td>3.5</td>
<td><em>P = .253</em></td>
</tr>
<tr>
<td>Social support by supervisor</td>
<td>3.17</td>
<td>1.67/3.75</td>
<td>2.93</td>
<td>0.62</td>
<td>3.5</td>
<td><em>p &lt; .02</em></td>
</tr>
<tr>
<td>Social support by colleagues</td>
<td>4.44</td>
<td>3.00/6.00</td>
<td>4.07</td>
<td>1.03</td>
<td>3.5</td>
<td><em>P = .12</em></td>
</tr>
<tr>
<td>Technical and human resources availability</td>
<td>4.77</td>
<td>2.93/6.00</td>
<td>4.59</td>
<td>1.09</td>
<td>3.5</td>
<td><em>p &lt; .01</em></td>
</tr>
</tbody>
</table>
### Table 3

Results of Spearman's correlation analyses between equivalent dimensions of the in situ and the overall job perception questionnaires (N=10).

<table>
<thead>
<tr>
<th>Overall perceptions</th>
<th>Psy</th>
<th>Phy</th>
<th>FWI</th>
<th>Ski</th>
<th>Auto</th>
<th>Sup</th>
<th>Col</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psy</td>
<td>.358</td>
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<tr>
<td>Phy</td>
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<td>-.052</td>
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<td></td>
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<td>FWI</td>
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<td></td>
<td>.351</td>
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</tr>
<tr>
<td>Ski</td>
<td></td>
<td></td>
<td></td>
<td>.716*</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Auto</td>
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<td></td>
<td></td>
<td>.263</td>
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<td></td>
</tr>
<tr>
<td>Sup</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.364</td>
<td></td>
</tr>
<tr>
<td>Col</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.703*</td>
</tr>
</tbody>
</table>

*Psy: Psychological demands; Phy: Physical demands; FWI: Family to work interferences; Ski: Skill discretion; Auto: Autonomy; Sup: Social support by supervisors; Col: Social support by colleagues

*Note. *.05; **.01
Table 4

Scores of psychological health indicators and of physical illness symptoms reported by ATCOs and their comparison with the mean value of the rating scales. Data are expressed as Median, Min/Max, Mean and standard deviation. The last column indicates the p-value obtained when mean scores were compared with the mean value of the corresponding scale (t-test) of psychological health indicators and of physical illness symptoms (N = 10)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Median score</th>
<th>Min/max</th>
<th>Mean score</th>
<th>S.D.</th>
<th>Mean value</th>
<th>Comparison to mean value of scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Psychological health indicators</strong></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>3.88</td>
<td>3.33/4.29</td>
<td>3.89</td>
<td>0.28</td>
<td>3</td>
<td>(p &lt; .001)</td>
</tr>
<tr>
<td>Self-esteeem</td>
<td>3.30</td>
<td>2.50/3.70</td>
<td>3.19</td>
<td>0.36</td>
<td>2.5</td>
<td>(p &lt; .001)</td>
</tr>
<tr>
<td><strong>Physical illness symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musculoskeletal pathologies</td>
<td>2.00</td>
<td>1.00/4.00</td>
<td>3.33</td>
<td>2.00</td>
<td>3.5</td>
<td>(p = .81)</td>
</tr>
<tr>
<td>Digestive symptom</td>
<td>1.38</td>
<td>1.00/3.50</td>
<td>1.57</td>
<td>0.82</td>
<td>2.5</td>
<td>(p &lt; .01)</td>
</tr>
<tr>
<td>Cardiovascular symptoms</td>
<td>1.00</td>
<td>1.00/2.00</td>
<td>1.29</td>
<td>0.43</td>
<td>2.5</td>
<td>(p &lt; .001)</td>
</tr>
<tr>
<td>Vertigo</td>
<td>1.00</td>
<td>0.00/2.00</td>
<td>1.22</td>
<td>0.44</td>
<td>2.5</td>
<td>(p &lt; .001)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>1.75</td>
<td>1.00/2.70</td>
<td>1.78</td>
<td>0.44</td>
<td>3</td>
<td>(p &lt; .001)</td>
</tr>
</tbody>
</table>
Table 5

Results of Spearman’s correlation analyses of physical illness symptoms and psychological health indicators with overall perceptions of job requirements and job resources (N = 10)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>MUSC</th>
<th>DIG</th>
<th>CAR</th>
<th>VERT</th>
<th>FAT</th>
<th>SE</th>
<th>JS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall job requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological demands</td>
<td>.631</td>
<td>.656</td>
<td>.659</td>
<td>.159</td>
<td>-.134</td>
<td>.280</td>
<td>-.322</td>
</tr>
<tr>
<td>Physical demands</td>
<td>.443</td>
<td>.295</td>
<td>.299</td>
<td>.738*</td>
<td>-.173</td>
<td>.263</td>
<td>-.471</td>
</tr>
<tr>
<td>Organizational demands</td>
<td>.786*</td>
<td>.708*</td>
<td>.765*</td>
<td>.312</td>
<td>-.429</td>
<td>.277</td>
<td>-.361</td>
</tr>
<tr>
<td>Overcommitment</td>
<td>.674*</td>
<td>.647</td>
<td>.843**</td>
<td>.676*</td>
<td>-.327</td>
<td>.233</td>
<td>.250</td>
</tr>
<tr>
<td>WFI</td>
<td>.748*</td>
<td>.686*</td>
<td>.525</td>
<td>.260</td>
<td>-.021</td>
<td>.451</td>
<td>-.384</td>
</tr>
<tr>
<td>FWI</td>
<td>.337</td>
<td>.223</td>
<td>.323</td>
<td>.208</td>
<td>.080</td>
<td>.393</td>
<td>-.305</td>
</tr>
<tr>
<td>Overall job resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill discretion</td>
<td>.287</td>
<td>.264</td>
<td>.126</td>
<td>-.114</td>
<td>.259</td>
<td>.493</td>
<td>.278</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.040</td>
<td>-.056</td>
<td>-.005</td>
<td>-.551</td>
<td>-.205</td>
<td>.189</td>
<td>-.214</td>
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<tr>
<td>Support by supervisors</td>
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<td>.062</td>
<td>.551</td>
<td>.526</td>
<td>-.241</td>
<td>.124</td>
<td>.269</td>
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<td>Support by colleagues</td>
<td>.574</td>
<td>.397</td>
<td>.607</td>
<td>.690*</td>
<td>-.038</td>
<td>.440</td>
<td>.038</td>
</tr>
<tr>
<td>Support by relatives</td>
<td>-.440</td>
<td>-.563</td>
<td>-.024</td>
<td>-.159</td>
<td>-.279</td>
<td>.013</td>
<td>.524</td>
</tr>
</tbody>
</table>

MUSC: Musculoskeletal complaints; DIG: Digestive symptoms; CAR: Cardiovascular symptoms, VERT: vertigo; FAT: fatigue; SE: self-esteem; JS: Job satisfaction

Note. *.05; **.01