

Development and validation of the Spanish short version of the Work Design Questionnaire (WDQ-S)

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ABSTRACT

Job transformation is changing work characteristics at a fast pace. This makes work design matter more than ever before. The Work Design Questionnaire (WDQ) is a powerful measurement of current work characteristics that can be used when (re)designing work to be safe, healthy, and motivating. However, its length represents a relevant challenge to its application. This study aims to validate a short version of the WDQ (WDQ-S) for Spanish-speaking countries. Through a two-waves longitudinal design, the WDQ-S was validated in a sample of 653 workers from 27 Spanish companies. Results confirmed the hierarchical factor structure, which comprised four general and nine specific dimensions, good internal consistency, and acceptable levels of convergent and discriminant validity. Hierarchical regression analyses showed predictive and incremental validity on job satisfaction and performance. The main limitation is that the WDQ-S was not tested against the original version, instead test-retest reliability was performed. Future research should replicate these findings in other samples, validate this scale in other languages and expand research with other outcomes. This study is relevant to industrial and occupational ergonomics as it provides a useful tool for designing healthy, productive, and sustainable workplaces.

1. Introduction

Work design refers to “the content and organization of one’s work tasks, activities, relationships, and responsibilities” (Parker, 2014, p. 662). Work design is a crucial antecedent of important organizational outcomes (e.g., productivity, job satisfaction), a mediator (e.g., between leadership and outcomes), and an outcome of individual processes (e.g., job crafting) (Parker et al., 2017).

Since the early studies on work design, there has been a demand for a valid measure to assess work characteristics. The Work Design Questionnaire (WDQ), developed by Morgeson and Humphrey (2006), evaluates 21 work characteristics measured through 77 items. The WDQ offers a comprehensive measure of work characteristics, but its length makes it difficult to use by practitioners and researchers (Fernández Ríos et al., 2017). A large questionnaire of work design provides the

opportunity to measure more work characteristics than a shorter version. In fact, evaluating 21 work characteristics has the advantage of allowing for a detailed analysis of work design. Conversely, a short version of the WDQ (WDQ-S) would facilitate its application by practitioners in time-constrained organizations and by researchers to evaluate work characteristics in multivariate studies (Cassar et al., 2020; Sora et al., 2018).

There is a trade-off between a complete but difficult to apply questionnaire versus an incomplete but easy to apply questionnaire. Specifically, a version of the WDQ that would keep the most important work characteristics and the best questions might be a shorter and better version of the WDQ. Thus, given the need of a shorter, yet still valid, measure of work design, the main goal of this study is to develop and validate a short version of the WDQ.

Further, the integrated work design framework behind the WDQ

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proposes four general dimensions of work characteristics (task, knowledge, social, and contextual characteristics) manifested by 21 specific dimensions. Research on the WDQ to date has examined its multidimensional structure relying on different configurations of these 21 specific dimensions only. The hierarchical representation of work design in four general dimensions has remained unexplored. Empirical support to this hierarchical structure would provide a more clear picture on the dimensionality of WDQ and offer two levels of analysis for research and applied purposes. Thus, the specific goal of our study is to empirically test the hierarchical structure of the WDQ by examining the distinction between general dimensions (second-order factors) and specific dimensions (first-order factors).

1.1. The Work Design Questionnaire

The WDQ evaluates 21 work characteristics measured through 77 items. These 21 work characteristics are organized around four general dimensions: task, knowledge, social, and contextual characteristics.

The first dimension, *Task characteristics*, refers to how the work itself is done and the range and nature of the tasks associated with a specific job. This dimension includes five work characteristics: autonomy (work scheduling, decision-making, and work methods), task variety, task significance, task identity, and feedback from the job. The second dimension, *Knowledge characteristics*, refers to the different kinds of mental demands (knowledge, skill, and ability) that are required to do a job. This dimension includes five work characteristics: job complexity, information processing, problem solving, skill variety, and specialization. The third dimension, *Social characteristics*, reflects the degree to which a job involves other people in terms of advice, support, dependence, and interactions. This dimension includes four work characteristics: social support, interdependence (initiated and received interdependence), interaction outside the organization, and feedback from others. The fourth dimension, *Contextual characteristics*, refers to the physical and material conditions that are available to perform a job. This dimension includes four work characteristics: ergonomics, physical demands, work conditions, and equipment use.

The WDQ was first validated in 2006 (Morgeson and Humphrey, 2006). Since its publication, the WDQ has been successfully adapted and validated in Dutch (Gorgievski et al., 2016), Polish (Hauk, 2014), German (Stegmann et al., 2010), and Spanish (Bayona et al., 2015; Fernández Ríos et al., 2017). Thus, the long version of WDQ has well-established empirical evidence that supports its validity and reliability.

1.2. Structural dimensionality of the WDQ

Morgeson and Humphrey (2006) tested the factor structure of WDQ through five Confirmatory Factor Analyses (CFAs). The five models were all first-order factor models composed of 4, 18, 19, 20, and 21 factors respectively. After testing the alternative models, the authors found the best support for a 21 factor structure model. The four factor model examined the four general categories of work characteristics, but it was dismissed because CFA results showed poor fit.

Despite the relevant insight provided by these alternative models, the potential hierarchical structure of the WDQ seems to have been overlooked. In a hierarchical structure, the four categories represent second-order factors or latent factors, instead of first-order factors as tested by Morgeson and Humphrey (2006). The advantages of a hierarchical model are that it respects the structure proposed by theory of work design (task, knowledge, social, and contextual characteristics as general dimensions), and it maintains the independence of specific dimensions of work characteristics (i.e., specific dimensions are not statistically averaged). Thus, we propose a hierarchical factor structure model organized with four general or second-order factors (see Fig. 1). Consequently, we propose the following hypothesis:

Hypothesis 1. The WDQ-S presents a hierarchical factor structure.

1.3. Differences among occupations

The original WDQ can differentiate work characteristics among occupations. More specifically, Morgeson and Humphrey (2006) used different work characteristics to compare four occupational groups (i.e., professional, non-professional, human-life, and sales occupations). Following their reasoning, greater levels of autonomy may be expected from professional occupations generally than non-professional occupations because of the flexibility and adaptation they require to do complex and non-routine work. Non-professional occupations generally have less optimal conditions and greater levels of physical demands because of the physical effort required at work. Task significance is expected to be more important for human-life occupations because their results directly affect society. Sales occupations generally must contact other organizations to sell their products and thus are expected to show more interaction with others external to the organization.

It is important that the WDQ-S behaves in a similar way to the original scale as reported by Morgeson and Humphrey (2006) and Bayona et al. (2015) in its Spanish version. Following this rationale, we

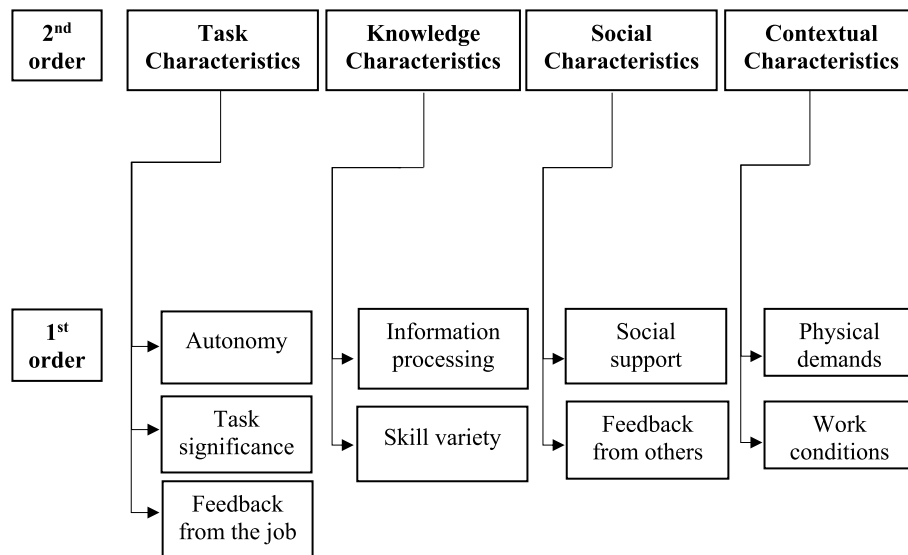


Fig. 1. Hierarchical structure of the WDQ-S.

analysed the ability of the WDQ-S to differentiate work characteristics among occupations as a measure of convergent validity. We examined differences among four groups of occupations (i.e., professional, non-professional, healthcare, and manufacturing). We did not examine jobs in sales occupations because we lacked data from this group. Accordingly, we formulate the following hypotheses:

Hypothesis 2a. Professional occupations will have significantly higher means in autonomy, information processing, and skill variety than non-professional occupations.

Hypothesis 2b. Non-professional occupations will have significantly higher means in physical demands and lower means in positive work conditions than professional occupations.

Hypothesis 2c. Healthcare occupations will have significantly higher means in task significance than manufacturing occupations.

1.4. Relationships to outcomes

Previous empirical evidence shows work characteristics as key antecedents of attitudinal and behavioural outcomes (Humphrey et al., 2007). In the validation of the WDQ, Morgeson and Humphrey (2006) reported positive correlations between task and knowledge characteristics and job satisfaction. In the Spanish version of the WDQ, Bayona et al. (2015) reported positive correlations between task, knowledge, and social characteristics and both job satisfaction and perceived performance. Obtaining similar results would support the predictive validity of the WDQ-S. Thus, we formulate the following hypothesis:

Hypothesis 3. Task, knowledge, and social characteristics will be positively related to job satisfaction and performance.

Previous work has suggested that knowledge, social, and contextual characteristics explain unique variance in work outcomes, beyond task characteristics. This is because each category of work characteristics presents a different focus. For example, task characteristics and knowledge characteristics focus on individuals, social characteristics focus on the interactions between individuals, and contextual characteristics focus on the work context. Therefore, the effects of these characteristics are expected to be non-redundant on work outcomes (Humphrey et al., 2007). In fact, in the original WDQ (Morgeson and Humphrey, 2006), social support strongly predicted satisfaction beyond task and knowledge characteristics. Further, meta-analytical results found that social characteristics explained unique variance in the attitudinal and behavioural outcomes, beyond task and knowledge characteristics (Humphrey et al., 2007). The Spanish version of the WDQ (Bayona et al., 2015) showed similar results. Accordingly, we hypothesize:

Hypothesis 4. Knowledge, social, and contextual characteristics will show incremental validity above task characteristics for job satisfaction and performance.

2. Material and methods

2.1. Construction of the WDQ-S

Our aim was to develop a manageable but still comprehensive measure of work design, which allowed to assess work characteristics in organizational settings both for research and applied purposes. In creating a short version of existing measures, it is important to ensure that the shortened version faithfully represents the underlying constructs measured by the original measure. Because most subscales in WDQ are composed of 3 or 4 items, and three is the minimum number of items to adequately assess any domain of interest (Raubenheimer, 2004), the strategy to obtain a short WDQ had to necessarily imply selecting a reduced number of work characteristics. The decision-making process for selecting subscales and items was based on both theoretical arguments and statistical criteria.

First, we reviewed in-depth the key studies published in this research field. Namely, (a) the original study (Morgeson and Humphrey, 2006), (b) published translated versions of the WDQ (Bayona et al., 2015; Fernández Ríos et al., 2017; Gorgievski et al., 2016; Hauk, 2014; Stegmann et al., 2010), and (c) the most recent meta-analysis on work design (Humphrey et al., 2007).

Second, in the process of selecting dimensions for the WDQ-S, we aimed to respect the theoretical structure and meaning of the original scale and respect the four general categories of work characteristics. Therefore, a minimum of two specific characteristics should be selected in each category. Because most practitioners and researchers are interested in linking work design aspects with outcomes related to well-being and performance, it was important to consider statistical relevance of work design characteristics in predicting such outcomes as shown in previous empirical research. More specifically, meta-analytical correlations of work design characteristics with satisfaction and performance were prioritized. Next, we justify the choice of dimensions.

Task characteristics have been the most researched work design characteristics since Hackman and Oldham's model (1975) was put forward. We selected autonomy, task significance, and feedback from the job because of their role in providing experienced responsibility for the outcomes, experienced meaningfulness, and knowledge of the results (the three psychological critical states; see Hackman and Oldham, 1976), as well as their strong meta-analytical relationship to both attitudinal and behavioural outcomes (Humphrey et al., 2007). Self-determination theory also helps explain how autonomy and feedback from the job are crucial for creating self-determination meaning, and positive work outcomes (Deci and Ryan, 2000).

Knowledge characteristics are becoming more important work characteristics in work design due to the large number of knowledge workers in current jobs (Hernaes and Mikulić, 2014; Nino et al., 2023). We selected information processing and skill variety because of existing meta-analytical evidence about their relationship with well-being and performance outcomes (Humphrey et al., 2007). Information processing refers to the high cognitive demands associated with the complexity of enriched work. Skill variety refers to the use of numerous skills, which is usually perceived as a challenge and engaging to perform. We excluded job complexity and selected instead skill variety because complexity is captured to a certain extent by information processing.

Social characteristics are important determinants of well-being because of the considerable social interactions present on workers' activities and growing relevance of teamworks in organizations (Grant and Parker, 2009; Oldham and Hackman, 2010). We selected two specific dimensions. Social support because it is essential for well-being, especially for stressful jobs or jobs poor in motivational work characteristics (Morgeson and Humphrey, 2006). Feedback from others because it helps define, clarify, and negotiate roles, and it is also a source of feedback on performance (Humphrey et al., 2007). We excluded interdependence and interaction outside the organization because they often have not very strong relationships with outcomes.

Contextual characteristics have been largely neglected in work design research, but other fields have demonstrated the importance of context for work outcomes (Asghari et al., 2019; Santos et al., 2016; Tàpia-Caballero et al., 2021). We selected physical demands and work conditions because both incrementally impact some outcomes (i.e., stress, burnout, and job satisfaction) beyond task, knowledge, and social characteristics (Humphrey et al., 2007). Furthermore, physically uncomfortable jobs may lead to absenteeism and turnover intentions (Humphrey et al., 2007). We excluded ergonomics due to its low internal consistency (Bayona et al., 2015; Morgeson and Humphrey, 2006), and equipment use because it shows non-significant relationships with outcomes and other work characteristics.

In the item selection phase, we aimed to select at least three items per dimension of the WDQ as recommended by Raubenheimer (2004). We reviewed the items' content and psychometric properties in previous validation studies. As a result, the proposed WDQ-S consists of 27 items

to measure nine dimensions of work characteristics (see Table 1). We took the items from the previous Spanish full version of the WDQ (Bayona et al., 2015). We did minor adaptations of the items from Colombian Spanish to Spanish as used in Spain (e.g., the Colombian Spanish item 'El lugar de trabajo está libre de ruidos excesivos' was adapted to 'En el trabajo no hay ruido excesivo' {The workplace is free from excessive noise} to {There is not excessive noise at work}). The response scale ranged from 1 to 5 (*strongly disagree* - *strongly agree*).

2.2. Procedure and sample

Research team members contacted human resources professionals in different organizations and invited them to collaborate in the study. All employees were invited to participate by completing a questionnaire during work hours. Approval was obtained from the Human Research Ethics Committee of the University of Valencia (project code: H1354632059685). Participants were informed of the title and objectives of the study, data protection policy, and provided informed consent. Confidentiality and anonymity were guaranteed. The procedures used in this study adhere to the fundamental principles established in the Declaration of Helsinki, respect the human rights defended on the Council of Europe Convention, and meet the requirements established in the Spanish legislation in the field of biomedical research, personal data protection, and bioethics.

Data were gathered in Spain at two points in time, with a gap between nine months and one year. There were some cohort attritions between waves, but they almost always happen to some extent in longitudinal research (Ployhart and Vandenberg, 2010). To maximize retention, researchers used follow-up methods as meetings with managers of the participating companies; support participants when fulfilling the surveys; reminders about the guarantee of anonymity and confidentiality; or sharing reports of results.

To be included in the study, respondents had to be Spanish or native Spanish-speakers and over 18 years old. For an unlimited population, a sample size of 385 or more respondents are needed for a confidence level of 95% and an estimated sampling error $\pm 5\%$. Further, the recommended sample size for validation studies including factor analysis is approximately 300 (Clark and Watson, 2016). The sample consisted of 1647 employees from 41 organizations in the first-wave, and 879 employees from 27 organizations in the second-wave, which included 226 new respondents. The final sample used for this study consisted of 653 employees working for 27 organizations (69% service sector) who

completed the questionnaire in both the first and second waves. Most participants were approximately 40 years old ($M = 39.95$, $SD = 8.29$), worked full-time (85%), and were women (55%). Tenure was over 5 years for most participants (77%).

Descriptive statistics by occupational category are presented in Table 1. Like in the Spanish validation of the full WDQ (Bayona et al., 2015), occupational categories were taken from the ISIC (International Standard Industrial Classification of All Economic Activities; United Nations. Statistical Division, 2008).

2.3. Occupations

We created four occupational groups. Professional vs. non-professional occupations was reported by employees (i.e., high-qualified professional, management vs. non-qualified manual profession). To classify participants in the healthcare or manufacturing occupations, we assigned the economic activity of their organizations to the categories offered by the ISIC's classification.

2.4. Outcome measures

Job satisfaction. We used the Spanish adaptation of the Overall Job Satisfaction scale (Warr et al., 1979; Pérez and Fidalgo, 1995), which consisted of 10 items (e.g., "How satisfied or dissatisfied are you with the recognition you get for good work?"). The response scale ranged from 1 to 7 (*extremely dissatisfied* - *extremely satisfied*) (Cronbach's alpha was 0.84).

Job performance. We operationalized job performance as task performance, organizational citizenship behaviour (OCB), and creative performance. We used three items to measure task performance (Williams and Anderson, 1991) (e.g., "I adequately complete assigned duties"); three items to measure OCB (Mackenzie et al., 2011) (e.g., "I do not hesitate to challenge the opinions of others that I feel are directing the store/company in the wrong direction"); and three to measure creative performance (Oldham and Cummings, 1996) (e.g., "How original and practical am I in my work?"). The items were translated from English to Spanish using the translation and back-translation procedure recommended by Brislin (1980). The response scale ranged from 1 to 7 (*strongly disagree* - *strongly agree*). We obtained a global performance score by calculating the overall average score for the three performance scales (Cronbach's alpha was 0.79).

2.5. Data analysis

First, we evaluated the factor structure of the WDQ-S by conducting confirmatory factor analyses (CFA) with AMOS 23 software (Arbuckle, 2006). We applied a maximum likelihood estimation method. Maximum skewness was - 2.01 and maximum kurtosis was 5.55. We retested the proposed model using a bootstrap method. Consistent with the original validation of the WDQ and its Spanish adaptation (Bayona et al., 2015; Morgeson and Humphrey, 2006), we present four fit indicators: χ^2/df ratio (good fit: value of 2), comparative fit index (CFI; good fit: values > 0.90), the standardized root-mean-square residual (SRMR; good fit: values < 0.08), and the root-mean-square error of approximation (RMSEA; good fit: values ≤ 0.05). We compared two first-order factor models:

- Four factor model examining the four broad categories of work characteristics, as conducted by Morgeson and Humphrey (2006).
- Nine factor model examining the nine work characteristics of the proposed WDQ-S.

Additionally, we compared two alternative models to test the proposed hierarchical structure:

Table 1
Descriptive statistics of the sample by occupation.

ISIC ^a Occupation category	n	Age (years)		Job tenure ^b (%)			Sex (% women)
		M	SD	<1	1–5	>5	
Manufacturing	171	41.24	7.79	11.9	31.4	56.6	33.5
Wholesale and retail trade	13	37.50	6.17	8.3	25	66.7	61.5
Transportation and storage	7	29.80	5.54	14.3	71.4	14.3	50
Financial and insurance activities	183	37.74	7.13	12.3	30.2	57.5	60.1
Administrative and support service activities	26	33.92	7.97	19.2	53.8	26.9	38.5
Public administration and defence	49	44.71	5.90	2	14.3	83.7	55.1
Education	99	43.14	7.60	25.8	19.1	55.1	64.6
Human health and social work activities	105	38.93	10.33	16.1	35.5	48.4	76.5
Total	653	39.95	8.29	14.2	29.8	56	55.1

^a International Standard Industrial Classification of All Economic Activities.

^b Job tenure three groups: <1 year; between 1 and 5 years; >5 years.

- A hierarchical structure model in which the nine first-order factors load onto four second-order factors (see Fig. 1).
- A hierarchical structure model in which the nine first-order factors load onto one single second-order factor of Work Characteristics.

Following Marsh and Hocevar (1985), even if the second-order model can adequately explain the factor covariations in a more parsimonious way, the corresponding first-order model will always show a better fit than the second-order model. When the fit indexes of the higher-order model to the data are like those of the corresponding first-order model, results support the higher-order model (Koufteros et al., 2009). Additionally, we computed target coefficients to examine to which extent each second-order model explained covariance among first-order factors (Marsh and Hocevar, 1985). This coefficient is calculated as a chi-squares ratio, it may range from 0 to 1, and values closer to 1 indicate better models.

Second, the internal consistency of WDQ-S was examined through Cronbach's alpha, interrater reliability (ICC [2]) (Bliese, 2000), and interrater agreement (r_{wg}) (James et al., 1984). Values of ICC [2] and r_{wg} equal or greater 0.70 are considered adequate (Woehr et al., 2015). Additionally, we calculated correlation coefficients between all the work characteristics dimensions to estimate the test-retest reliability of the Time 1 and Time 2 scores. Correlations greater than 0.40 show the stability of the measure over time (Robinson et al., 1991).

Third, we calculated the Average Variance Extracted (AVE) and Maximum shared Squared Variance (MSV) as a test for convergent and discriminant validity of the WDQ-S. For a good convergent validity, values of AVE equal or greater than 0.50 are considered adequate. For a good discriminant validity, MSV values should be lower than AVE values of each factor.

Fourth, we examined the ability of WDQ-S to detect differences among occupations for additional construct validity. More specifically, we used t-tests analyses to compare means of pairs of occupational categories (hypotheses 2a, 2b, and 2c): professional vs non-professional, and healthcare vs manufacturing. Fifth, predictive and incremental validity was also examined. To analyse hypothesis 3, we calculated bivariate Pearson correlations. To analyse hypothesis 3, we performed hierarchical regression analyses.

3. Results

3.1. Confirmatory factor analyses

CFA results are presented in Table 2. Following Morgeson and Humphrey's (2006) attempt to fit the data to the four categories of work characteristics, we tested a four-factor structure model. Like their results, this model showed a poor goodness of fit with all fit indexes being

Table 2
Results of confirmatory factor analyses.

Model	χ^2	df	χ^2/df ratio	SRMR	RMSEA	CFI	Target
First-order four factors	1902.87	309	6.15	0.09	0.08	0.73	–
First-order nine factors	892.16	286	3.11	0.05	0.05	0.90	–
Second-order one factor	1303.34	315	4.13	0.08	0.06	0.83	0.68
Second-order four factors	1042.91	307	3.39	0.07	0.06	0.88	0.85

Notes. SRMR = standardized root-mean-square residual. RMSEA = root-mean-square error of approximation. CFI = comparative fit index.

unacceptable. The nine-factor structure model obtained a better fit overall, with a lower χ^2/df ratio, SRMR, RMSEA, and a higher CFI. We also tested two hierarchical factor models (with the first-order factors loading onto either four second-order factors or one second-order factor). The models fitted the data reasonably well for a second-order structure. The results of target coefficients supported the superiority of the hierarchical four second-order factor model (see Table 2), which explains 85.5% of the covariance between the first-order factors compared to 68.4% of the model with one second-order factor.

The validity of the second-order factors was supported by the significant standardized factor loadings of the first-order factors onto the second-order factors (see Fig. 2). The correlation coefficients of the four second-order factors ranged from 0.32 to 0.82. The highest correlation (0.82) was found between task and knowledge characteristics but was deemed adequate (recommended threshold <0.85). Considering the global fit indices, the target coefficients, and the significant first-order factors loadings onto the second-order factors, we conclude that the hierarchical solution can be considered appropriate. Thus, the data suggest a good fit of the data to the hypothesized hierarchical structure of work design characteristics, and of the questionnaire, as enunciated by hypothesis 1.

3.2. Reliability of the scale

Table 3 presents the descriptive statistics and psychometric properties of the WDQ-S. We examined the internal consistency by exploring Cronbach's alpha of each factor. Cronbach's alphas were acceptable for all factors, except for social support ($\alpha = 0.47$). We run the same analysis without a problematic item in this dimension ("I have the chance in my job to get to know other people"), which improved Cronbach's alpha ($\alpha = 0.69$). However, the measurement models did not show significant differences whether the item was included or excluded. Thus, we kept all items for subsequent analyses. Overall, the results showed an appropriate internal consistency. The values of ICC [2] and r_{wg} (James et al., 1984) suggested that there were high levels of agreement about work characteristics within job categories and it was appropriate to aggregate them to the job level. We calculated the intercorrelations between the work characteristics dimensions in both times to estimate the test-retest reliability (see Table 4). Eight of nine correlations exceeded the criterion of a correlation greater than 0.40 (Robinson et al., 1991), showing adequate test-retest reliability. Social support showed a test-retest correlation of 0.35.

3.3. Convergent and discriminant validity

We examined convergent validity of the WDQ-S by calculating the AVE (see Table 3). Four out of nine factors obtained values below 0.50: task significance (0.43), skill variety (0.41), social support (0.38), and work conditions (0.42). We examined discriminant validity by comparing AVE and MSV values. The MSV values of two out of nine factors were greater than the AVE values: skill variety (AVE 0.41 < MSV 0.55) and social support (AVE 0.38 < MSV 0.40). The other seven factors showed acceptable levels of discriminant validity (see Table 3).

3.4. Differences among occupations

Additional analyses were computed to examine construct validity through the WDQ-S's ability to differentiate among four occupational groups (see Table 5). Professional occupations obtained significantly higher means in autonomy ($4.19 > 3.42$, $p < 0.001$), information processing ($4.14 > 3.09$, $p < 0.001$), and skill variety ($4.40 > 3.95$, $p < 0.001$) than non-professional occupations. Non-professional occupations obtained significantly higher means in physical demands ($3.56 > 1.89$, $p < 0.001$) and lower in positive work conditions ($3.30 < 3.77$, $p < 0.001$) than professional occupations. Healthcare occupations obtained significantly higher means in task significance ($3.66 > 2.82$, $p < 0.001$) than non-professional occupations.

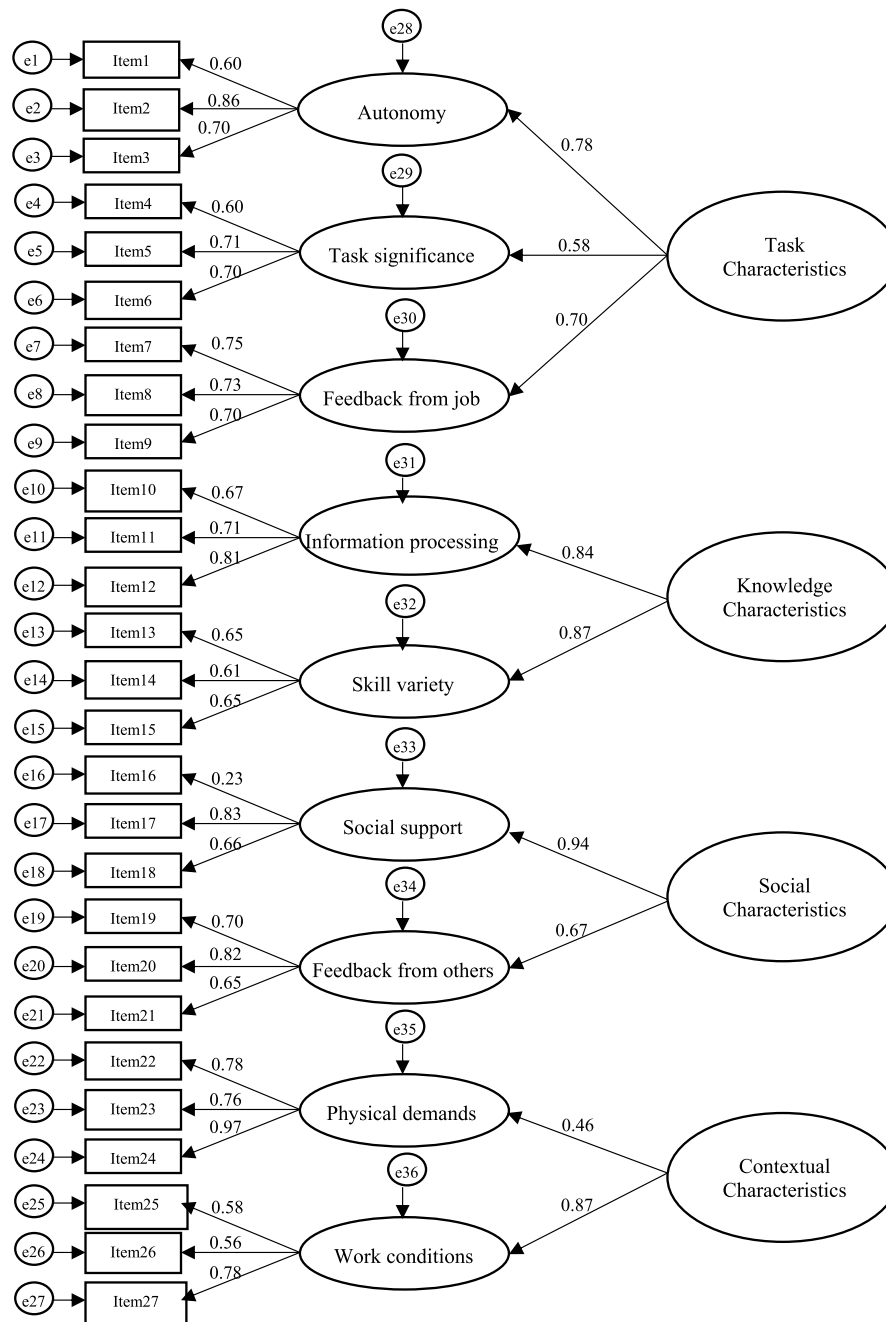


Fig. 2. Standardized factor loadings of the hierarchical model.

0.001) than manufacturing occupations. These results support the ability of WDQ-S to differentiate work characteristics among occupations, as enunciated by hypotheses 2a, 2b, and 2c. Overall, these results provide empirical support to the construct validity of WDQ-S.

3.5. Predictive and incremental validity

We examined predictive and incremental validity of the scale by correlations and regressions. As predicted by Hypothesis 3, all seven work characteristics classified under task, knowledge, and social characteristics were significantly related to job satisfaction and performance in both Time 1 and Time 2 (see Table 6). Correlations between job satisfaction and task characteristics ranged in magnitude from 0.14 to 0.45 (T1), and 0.10 to 0.30 (T2). Correlations between job satisfaction and knowledge characteristics showed a correlation of 0.24 (T1), and a

range from 0.18 to 0.20 (T2). Finally, correlations between job satisfaction and social characteristics ranged in magnitude from 0.29 to 0.32 (T1), and 0.19 to 0.25 (T2).

Regarding performance, correlations with task characteristics ranged in magnitude from 0.19 to 0.31 (T1) and 0.19 to 0.26 (T2). Correlations with knowledge characteristics were 0.29 (T1) and ranged from 0.23 to 0.24 (T2). Finally, correlations with social characteristics ranged in magnitude from 0.15 to 0.16 (T1), and 0.13 to 0.15 (T2). These results confirmed hypothesis 3. Overall, the results supported WDQ-S's predictive validity.

Hypothesis 4 predicted that knowledge, social, and contextual characteristics would yield incremental validity above task characteristics for job satisfaction and performance. This was also supported (see Table 7). For job satisfaction, introducing knowledge, social, and contextual characteristics in the regression equation demonstrated

Table 3

Means, standard deviations and reliability.

Variable	M	SD	Internal consistency ^a	Interrater reliability ^b	Hierarchical interrater reliability ^b	Interrater agreement ^c	Convergent-discriminant validity	
							AVE ^d	MSV ^e
Autonomy	4.14	0.85	0.76	0.87	0.94	0.66	0.52	0.35
Task significance	3.37	0.98	0.65	0.95	0.92	0.60	0.43	0.25
Feedback from job	3.86	0.82	0.76	0.66	0	0.66	0.52	0.35
Information processing	4.09	0.86	0.76	0.84	0.96	0.64	0.57	0.55
Skill variety	4.33	0.66	0.67	0.76	0.86	0.78	0.41	0.55
Social support	3.91	0.80	0.47	0.91	0.64	0.70	0.38	0.40
Feedback from others	3.17	1.04	0.76	0.82	0.82	0.48	0.52	0.40
Physical demands	1.97	1.15	0.86	0.89	0.97	0.38	0.70	0.13
Work conditions	3.82	0.98	0.67	0.90	0.94	0.55	0.42	0.18

Notes. n = 653 (except for hierarchical Interrater reliability n = 616).

^a Cronbach's alpha.

^b ICC [2].

^c $r_{wg(j)}$.

^d AVE = average variance extracted.

^e MSV = maximum shared squared variance.

incremental validity $\Delta R^2 = 0.11$, $p < 0.001$ (T1), and $\Delta R^2 = 0.07$, $p < 0.001$ (T2). Beta weights showed that knowledge characteristics explained no variance for job satisfaction. For performance, introducing knowledge, social, and contextual characteristics in the equation demonstrated incremental validity $\Delta R^2 = 0.03$, $p < 0.001$ (T1) and $\Delta R^2 = 0.01$, $p < 0.05$ (T2). Beta weights showed that social and contextual characteristics explained no amount of variance for performance. These results partially confirmed [Hypothesis 4](#). Overall, these results supported the incremental validity of the scale.

4. Discussion

The WDQ is consistent with the integrative and contemporary perspectives of work design ([Parker et al., 2017](#)). The WDQ can assess job properties and it is helpful in differentiating among occupations. Its length, however, makes it difficult to use in organizational settings. To overcome the disadvantage of the WDQ's length, our aim was to develop a shorter and more parsimonious measure of work design.

A challenge in providing a shortened version of the WDQ was to faithfully represent the underlying four general categories of work characteristics with a reduced number of dimensions. The selection of the specific characteristics was based on theoretical arguments of the relevance of WDQ characteristics and meta-analytical evidence of their relationship with satisfaction and performance outcomes. The availability of a short version of the WDQ is especially useful for researchers to include work characteristics in multivariable studies, and for practitioners to assess work characteristics and (re)design work.

Overall, this study found empirical support for the WDQ-S as a valid and reliable measure of work design, obtained with a strong and diverse sample, and measuring outcomes at two points in time. An important contribution of this study to the work design literature is the empirical testing and support found for the hierarchical nature of the WDQ model. This type of structure offers a theoretically-based representation of work characteristics at different levels (i.e., general and specific factors of work design). The structure consists of four general categories, and nine specific work characteristics. The CFA showed that the nine first-order factor structure had a good fit. Additionally, our results supported the hierarchical factor model, thus confirming [hypothesis 1](#).

This hierarchical structure offers a more systematic representation of work design theory and measurement than previous models based only on first-order factors, because it provides an organized way to describe and analyse the different components of work characteristics, with general and specific evaluations. Further, it also allows studying the main categories of work characteristics (task, knowledge, social, and contextual) and their correlates, while respecting statistical

independence of first-order factors. Validating the hierarchical structure is very important because it offers two levels of analysis for research and applied purposes. Such a structure also facilitates research on work characteristics and work design tasks by practitioners.

Psychometric analyses revealed adequate internal consistency reliabilities for all work characteristics, except for social support and work conditions. Further, some limitations were found regarding convergent validity of task significance, social support, and work conditions. This is in line with the results of the full Spanish version of the WDQ ([Bayona et al., 2015](#), p.193), where similar values were reported. Overall, these results suggest the need for additional research to clarify and improve these factors both for the full and short versions of the WDQ. In particular, this is important for the measurement of social support where internal reliability was low. We suggest using the full social support scale (6 items) and future research for the refinement and improvement of this scale. Given the importance of social support for organizational outcomes (Grant and Parker, 2009), another avenue for improvement would be to use alternative social support scales considering its instrumental, emotional, and informative facets.

Our results support the validity of the WDQ-S. First, the WDQ-S was able to differentiate work characteristics among occupations like the original WDQ validation ([Morgeson and Humphrey, 2006](#)). Our results supported the ability of the WDQ-S to differentiate work characteristics among occupations, as enunciated by hypotheses 2a, 2b, and 2c. Therefore, the WDQ-S is a versatile tool, which can be used in any occupational context.

Second, the WDQ-S showed predictive validity with significant and positive correlations between work characteristics and outcomes such as job satisfaction and job performance, both in cross-sectional and time-lagged data. We found positive and significant relationships between task, knowledge, and social characteristics and job satisfaction and performance in both Time 1 and Time 2 (confirming [hypothesis 3](#)). Task characteristics showed the highest correlation with job satisfaction, followed by social characteristics, and knowledge characteristics. Task characteristics showed the highest correlation with performance, followed by knowledge characteristics, and social characteristics. In summary, our results are congruent with previous empirical evidence in magnitude and relative importance (i.e., [Bayona et al., 2015](#); [Fernández Ríos et al., 2017](#); [Humphrey et al., 2007](#); [Morgeson and Humphrey, 2006](#)), thus providing additional support to the validity of the WDQ-S.

Third, we found support for incremental validity of the WDQ-S. Results showed that knowledge, social, and contextual characteristics incrementally predict job satisfaction and performance beyond task characteristics. Job satisfaction is explained by task characteristics but also by social and contextual characteristics, with no significant

Table 4
Test-retest reliability: Intercorrelation between work characteristics dimensions (T1 and T2).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Autonomy T1	–																
2. Task significance T1	0.32**	–															
3. Feedback from job T1	0.47**	0.29**	–														
4. Info. processing T1	0.43**	0.39**	0.34**	–													
5. Skill variety T1	0.41**	0.30**	0.38**	0.56**	–												
6. Social support T1	0.34**	0.31**	0.31**	0.25**	0.18**	–											
7. Feedback others T1	0.19**	0.12**	0.37**	0.13**	0.18**	0.44**	–										
8. Physical demands T1	0.26**	0.05	0.12**	–0.19**	0.02	–0.03	0.14**	–									
9. Work conditions T1	0.43**	0.20**	0.21**	0.23**	0.16**	0.29**	0.16**	–0.29**	–								
10. Autonomy T2	0.17**	0.21**	0.24**	0.24**	0.22**	0.16**	0.06	0.13**	0.22**	–							
11. Task significance T2	0.20**	0.54**	0.18**	0.21**	0.13**	0.20**	0.07	–0.02	0.19**	0.29**	–						
12. Feedback from job T2	0.18**	0.28**	0.42**	0.15**	0.14**	0.16**	0.20**	0.07	0.14**	0.48**	0.40**	–					
13. Info. processing T2	0.25**	0.29**	0.18**	0.56**	0.29**	0.18**	0.11**	–0.24**	0.22**	0.44**	0.44**	0.31**	–				
14. Skill variety T2	0.09*	0.11**	0.17**	0.35**	0.40**	0.08*	0.03	–0.07	0.14**	0.48**	0.41**	0.36**	0.62**	–			
15. Social support T2	0.04	0.15**	0.02	0.03	0.35**	0.35**	0.20**	0.02	0.20**	0.32**	0.33**	0.37**	0.25**	0.22**	–		
16. Feedback others T2	–0.17**	0.03	0.21**	–0.01	0.07	0.27**	0.44**	0.09*	0.11**	0.20**	0.23**	0.43**	0.18**	0.12**	0.53**	–	
17. Physical demands T2	0.15**	0.14**	0.14**	–0.28**	–0.06	–0.04	0.11**	0.70**	–0.21**	–0.09*	0.02	0.07	–0.25**	–0.02	0.06	0.15**	–
18. Work conditions T2				0.18**	0.10*	0.16**	0.06	–0.27**	0.51**	0.33**	0.28**	0.28**	0.31**	0.21**	0.28**	0.18**	–0.32**

Notes. n = 653. Test-retest correlations are in bold.

*p < 0.05, **p < 0.01.

Table 5

Means of jobs among occupational categories.

Work characteristics	Occupational category					
	Professional			Non-professional		
	Mean	IQR	SD	Mean	IQR	SD
Autonomy	4.19	0.67	0.80	3.42	1.67	1.11
Information processing	4.14	1.00	0.78	3.09	1.67	1.06
Skill variety	4.40	1.00	0.61	3.95	1.00	0.91
Physical demands	1.89	1.67	1.01	3.56	1.33	1.19
Work conditions	3.77	1.33	0.96	3.30	2.00	1.16
Healthcare						
Mean						
IQR						
SD						
Manufacturing						
Mean						
IQR						
SD						
Task significance	3.66	1.00	1.00	2.82	1.33	0.93

Notes. All means across occupational categories are significantly different; n professional = 492; n non-professional = 161; n healthcare = 176; n manufacturing = 171; IQR = interquartile range; SD = standard deviation.

variance explained by knowledge characteristics. Alternatively, performance is explained by task characteristics and knowledge characteristics, with social and contextual characteristics explaining no additional variance. These results partially confirmed [hypothesis 4](#).

Overall, the developed WDQ-S is a valid and reliable instrument that behaves similarly to the full Spanish version of the WDQ with regards to psychometric properties, convergent and discriminant validity, differentiating ability among occupations, and predictive and incremental validity.

4.1. Limitations

This study is not without limitations. First, the short-version was not tested against the original full-version because the data was obtained in a questionnaire used in the frame of a wider research project. Second, we only examined direct relationships between work characteristics and two work outcomes (i.e., job satisfaction and performance). While these outcomes are important, future research should shed light on the effects of work characteristics on relevant outcomes such as stress, objective performance, customer satisfaction and loyalty. Third, our study is a time-lagged study collecting data in two different points in time. Longitudinal data would allow studying the dynamics between work design, work redesign, satisfaction, and performance.

4.2. Practical implications and future research

Our study has four important practical implications. First, it provides a short version of the WDQ responding to the needs expressed by other researchers (e.g., [Fernández Ríos et al., 2017](#)). Second, this study provides an easier to use measure for practitioners in charge of designing or redesigning jobs. Third, it provides a measure that allows researchers to study work characteristics along with other variables of interest by facilitating the administration of a shorter but valid and reliable questionnaire to measure WDQ. Fourth, given that Spanish is the second language with most native speakers in the world (480 million of native speakers; [Eberhard et al., 2020](#)), providing an easier to use measure in Spanish will facilitate work design implementation and research in Spanish speaking countries.

Regarding future research, the confirmation of the hierarchical structure of the WDQ-S raises the possibility that it is also a valid structure for the original version of the WDQ, and it should be investigated in the future. Future research could also use this WDQ-S to examine direct and indirect relationships with other outcomes (e.g., absenteeism, turnover intentions, role ambiguity, anxiety, and experience of meaning), and could validate it in other cultures.

Table 6
Intercorrelation among study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Autonomy	–																	
Task significance	0.32**	–																
Feedback from job	0.46**	0.29**	–															
Info. Processing	0.42**	0.39**	0.34**	–														
Skill variety	0.40**	0.30**	0.37**	0.55**	–													
Social support	0.34**	0.34**	0.30**	0.25**	0.25**	–												
Feedback from others	0.19**	0.11**	0.36**	0.13**	0.17**	0.43**	–											
Physical demands	–0.12**	0.07	0.05	–0.19**	0.02	–0.02	0.13**	–										
Work conditions	0.25**	0.20**	0.21**	0.23**	0.15**	0.29**	0.15**	–0.29**	–									
Job satisfaction T1	0.45**	0.14**	0.42**	0.24**	0.24**	0.32**	0.29**	–0.22**	0.41**	–								
Global Perform. T1	0.28**	0.19**	0.31**	0.29**	0.29**	0.15**	0.16**	0	0.09*	0.34**	–							
Task T1	0.10**	0.05	0.14**	0.06	0.07	0.03	0.14**	0.04	0.03	0.16**	0.62**	–						
OCB T1	0.18**	0.15**	0.23**	0.26**	0.23**	0.20**	0.15**	–0.02	0.09*	0.25**	0.80**	0.30**	–					
Creativity T1	0.32**	0.20**	0.29**	0.29**	0.30**	0.09*	0.08*	–0.02	0.08*	0.33**	0.81**	0.31**	0.44**	–				
Job satisfaction T2	0.30**	0.10**	0.28**	0.20**	0.18**	0.25**	0.19**	–0.17**	0.28**	0.64**	0.26**	0.13**	0.23**	0.22**	–			
Global perform. T2	0.25**	0.19**	0.26**	0.24**	0.23**	0.15**	0.13**	–0.08*	0.15**	0.29**	0.63**	0.37**	0.55**	0.48**	0.37**	–		
Task T2	0.12**	0.08*	0.11**	0.07*	0.05	0.05	0.06	–0.02	0.06	0.12**	0.38**	0.52**	0.24**	0.18**	0.19**	0.67**	–	
OCB T2	0.19**	0.16**	0.24**	0.24**	0.24**	0.21**	0.17**	–0.08*	0.18**	0.27**	0.53**	0.17**	0.62**	0.35**	0.32**	0.84**	0.40**	–
Creativity T2	0.24**	0.20**	0.23**	0.21**	0.21**	0.07	0.06	–0.08*	0.08*	0.25**	0.50**	0.20**	0.35**	0.53**	0.75**	0.22**	0.46**	–

Notes. n = 653.

*p < 0.05; **p < 0.01.

Table 7

Incremental validity of work characteristics on job satisfaction and performance.

Predictor	Job Satisfaction		Performance	
	T1	T2	T1	T2
Step 1 R ²	0.02**	0.01*	0	0.01
Age, tenure, education				
Step 2 ΔR ²	0.25***	0.10***	0.13***	0.08***
Task Characteristics				
Step 3 ΔR ²	0	0	0.03***	0.01*
Knowledge Characteristics				
Step 4 ΔR ²	0.04***	0.04***	0	0
Social Characteristics				
Step 5 ΔR ²	0.07***	0.03***	0	0
Contextual Characteristics				
Total R ²	0.38***	0.19***	0.18***	0.12**

Notes. n = 653.

*p < 0.05; **p < 0.01; ***p < 0.001.

5. Conclusions

The present study provides a valid and reliable WDQ-S (Morgeson and Humphrey, 2006). This study provides empirical evidence supporting a hierarchical structure of the WDQ that contributes to the work design literature. The WDQ-S consists of four second-order factors, nine work characteristics, and 27 items. This WDQ-S is readily available for researchers and practitioners in Spanish-speaking countries. Future research should validate this WDQ-S in other languages and countries.

Informed consent statement

All participants of this research have given informed consent to participate in the research.

Methodological disclosure

We report how we determined our sample size, all data exclusions, and all measures in the study. We did not undertake manipulations. We report all measures analysed for the results presented in this study, but we have other measures of the larger study.

Author contributions

Maribel Montañez-Juan: Conceptualization, Writing- Original draft, Methodology, Formal analysis. **M. Esther García-Buades:** Conceptualization, Investigation, Supervision, Writing - Review & Editing. **José M. Peiró:** Validation, Project administration, Funding acquisition. **Beatriz Sora:** Data curation, Formal analysis, Writing - Review & Editing. **Silvia Ortiz-Bonnin:** Writing - Review & Editing. **Amparo Caballer:** Conceptualization, Writing - Review & Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ergon.2023.103501>.

References

- Arbuckle, J.L., 2006. AMOS (Version 23.0) [Computer Program]. SPSS.
- Asghari, E., Dianat, I., Abdollahzadeh, F., Mohammadi, F., Asghari, P., Jafarabadi, M.A., Castellucci, H.I., 2019. Musculoskeletal pain in operating room nurses: associations with quality of work life, working posture, socio-demographic and job characteristics. *Int. J. Ind. Ergon.* 72, 330–337. <https://doi.org/10.1016/j.ergon.2019.06.009>.
- Bayona, J.A., Caballer, A., Peiró, J.M., 2015. The work design questionnaire: Spanish version and validation. *Rev. Psicol. Del Trab. Las Organ.* 31 (3), 187–200. <https://doi.org/10.1016/j.rpto.2015.06.001>.
- Bliese, P.D., 2000. Within-group agreement, non-independence, and reliability: implications for data aggregation and analysis. In: Klein, K.J., Kozlowski, S.W.J. (Eds.), *Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions, and New Directions*. Jossey-Bass, pp. 349–381.
- Brislin, R.W., 1980. Translation and content analysis of oral and written material. In: Triandis, H.C., Berry, J.W. (Eds.), *Handbook of Cross-Cultural Psychology* (Methodolog. Allyn and Bacon, pp. 389–444.
- Cassar, V., Bezzina, F., Buttigieg, S., 2020. Investigating the psychometric properties and assessment capabilities of the short version of the health and safety executive's management standards indication tool. *Int. J. Hum. Resour. Manag.* 31 (16), 2115–2140. <https://doi.org/10.1080/09585192.2018.1431955>.
- Clark, L.A., Watson, D., 2016. Constructing validity: basic issues in objective scale development. In: Kazdin, A.E. (Ed.), *Methodological Issues and Strategies in Clinical Research*. American Psychological Association, pp. 187–203. <https://doi.org/10.1037/14805-012>.
- Deci, E.L., Ryan, R.M., 2000. The "what" and "why" of goal pursuits: human needs and the self-determination of behavior. *Psychol. Inq.: An International Journal for the Advancement of Psychological Theory* 11 (4), 227–268. https://doi.org/10.1207/s15327965pli1104_01.
- Eberhard, D.M., Simons, G.F., Fennig, C.D., 2020. *Ethnologue: Languages of the World. Twenty-third edition*. <http://www.ethnologue.com>.
- Fernández Ríos, M., Ramírez Vielma, R.G., Sánchez García, J.C., Bargsted Aravena, M., Polo Vargas, J.D., Ruiz Díaz, M.A., 2017. Spanish-language adaptation of Morgeson and Humphrey's work design questionnaire (WDQ). *Spanish J. Psychol.* 20, E28. <https://doi.org/10.1017/sjp.2017.24>.
- Gorgievski, M.J., Peeters, P., Rietzschel, E., Bipp, T., 2016. Betrouwbaarheid en validiteit van de Nederlandse vertaling van de Work Design Questionnaire. *Gedrag Organ.* 29 (3), 273–301. <https://doi.org/10.5117/2016.029.003.004>.
- Grant, A.M., Parker, S.K., 2009. Redesigning work design theories: the rise of relational and proactive perspectives. *Acad. Manag. Ann.* 3 (1), 317–375. <https://doi.org/10.5465/19416520903047327>.
- Hackman, J.R., Oldham, G.R., 1975. Development of the job diagnostic survey. *J. Appl. Psychol.* 60 (2), 159–170. <https://doi.org/10.1037/h0076546>.
- Hackman, J.R., Oldham, G.R., 1976. Motivation through the design of work: test of a theory. *Organ. Behav. Hum. Perform.* 16 (2), 250–279. [https://doi.org/10.1016/0030-5073\(76\)90016-7](https://doi.org/10.1016/0030-5073(76)90016-7).
- Hauk, M., 2014. Kwestionariusz Cech Pracy – opracowanie polskiej wersji narzędzia do badania cech pracy i środowiska zawodowego. Wstępne wyniki badań. *Acta Universitatis Lodzensis. Folia Psychologica*. 22, 17–32. <https://doi.org/10.18778/1427-969x.22.02>.
- Hernaus, T., Mikulić, J., 2014. Work characteristics and work performance of knowledge workers. *EuroMed J. Bus.* 9 (3), 268–292. <https://doi.org/10.1108/EMJB-11-2013-0054>.
- Humphrey, S.E., Nahrgang, J.D., Morgeson, F.P., 2007. Integrating motivational, social, and contextual work design features: a meta-analytic summary and theoretical extension of the work design literature. *J. Appl. Psychol.* 92 (5), 1332–1356. <https://doi.org/10.1037/0021-9010.92.5.1332>.
- James, L.R., Demaree, R.G., Wolf, G., 1984. Estimating within-group interrater reliability with and without response bias. *J. Appl. Psychol.* 69 (1), 85–98. <https://doi.org/10.1037/0021-9010.69.1.85>.
- Koufteros, X., Babbar, S., Kaighobadi, M., 2009. A paradigm for examining second-order factor models employing structural equation modeling. *Int. J. Prod. Econ.* 120 (2), 633–652. <https://doi.org/10.1016/j.ijpe.2009.04.010>.
- Mackenzie, S.B., Podsakoff, P.M., Podsakoff, N.P., 2011. Challenge-oriented organizational citizenship behaviors and organizational effectiveness: do challenge-oriented behaviors really have an impact on the organization's bottom line? *Person. Psychol.* 64 (3), 559–592. <https://doi.org/10.1111/j.1744-6570.2011.01219.x>.
- Marsh, H.W., Hocevar, D., 1985. Application of Confirmatory Factor Analysis to the Study of Self-Concept: First- and Higher Order Factor Models and Their Invariance across Groups. *Psy. Bulletin.* 97 (3), pp. 562–582. <https://doi.org/10.1037/0033-2909.97.3.562>.
- Morgeson, F.P., Humphrey, S.E., 2006. The Work Design Questionnaire (WDQ): developing and validating a comprehensive measure for assessing job design and the nature of work. *J. Appl. Psychol.* 91 (6), 1321–1339. <https://doi.org/10.1037/0021-9010.91.6.1321>.
- Nino, V., Claudio, D., Monfort, S.M., 2023. Evaluating the effect of perceived mental workload on work body postures. *Int. J. Ind. Ergon.* 93, 103399. <https://doi.org/10.1016/j.ergon.2022.103399>.
- Oldham, G.R., Cummings, A., 1996. Employee creativity: personal and contextual factors at work. *Acad. Manag. J.* 39 (3), 607–634. <https://doi.org/10.2307/256657>.
- Oldham, G.R., Hackman, J.R., 2010. Not what it was and not what it will be: the future of job design research. *J. Organ. Behav.* 31 (2–3), 463–479. <https://doi.org/10.1002/job.678>.
- Parker, S.K., 2014. Beyond motivation: job and work design for development, health, ambidexterity, and more. *Annu. Rev. Psychol.* 65 (1), 661–691. <https://doi.org/10.1146/annurev-psych-010213-115208>.
- Parker, S.K., Morgeson, F.P., Johns, G., 2017. One hundred years of work design research: looking back and looking forward. *J. Appl. Psychol.* 102 (3), 403–420. <https://doi.org/10.1037/apl0000106>.
- Pérez, J., Fidalgo, M., 1995. Satisfacción laboral: escala general de satisfacción. In: Instituto Nacional de Seguridad e Higiene en el Trabajo. Ministerio de Trabajo y Asuntos Sociales de España.
- Ployhart, R.E., Vandenberg, R.J., 2010. Longitudinal research: the theory, design, and analysis of change. *J. Manag.* 36 (1), 94–120. <https://doi.org/10.1177/0149206309352110>.
- Raubenheimer, J., 2004. An item selection procedure to maximise scale reliability and validity. *SA J. Ind. Psychol.* 30 (4) <https://doi.org/10.4102/sajip.v30i4.168>.
- Robinson, J.P., Shaver, P.R., Wrightsman, L.S., 1991. In: Robinson, J.P., Shaver, P.R., Wrightsman, L.S. (Eds.), *Measures of Social Psychological Attitudes*. Academic Press. <https://doi.org/10.1016/c2013-0-07551-2>.
- Santos, J., Baptista, J.S., Monteiro, P.R.R., Miguel, A.S., Santos, R., Vaz, M.A.P., 2016. The influence of task design on upper limb muscles fatigue during low-load repetitive work: a systematic review. *Int. J. Ind. Ergon.* 52, 78–91. <https://doi.org/10.1016/j.ergon.2015.09.010>.
- Sora, B., Caballer, A., García-Buades, E., 2018. Validation of a short form of job crafting scale in a Spanish sample. *Spanish J. Psychol.* 21, E51. <https://doi.org/10.1017/sjp.2018.52>.
- Stegmann, S., Dick, R. van, Ullrich, J., Charalambous, J., Menzel, B., Egold, N., Wu, T.T.-C., 2010. Der Work Design Questionnaire: vorstellung und erste Validierung einer deutschen Version. *Zeitschrift Für Arbeits- Und Organisationspsychologie A&O* 54 (1), 1–28. <https://doi.org/10.1026/0932-4089/a000002>.
- Tàpia-Caballero, P., Serrano-Fernández, M.J., Boada-Cuerva, M., Sora, B., Boada-Grau, J., 2021. Influence that job characteristics, personality and burnout have on fatigue in professional drivers. *Int. J. Occup. Saf. Ergon.* 28 (3), 1331–1341. <https://doi.org/10.1080/10803548.2021.1888019>.
- United Nations. Statistical Division, 2008. International Standard Industrial Classification of All Economic Activities (ISIC). <https://doi.org/10.7560/750920-012>. United Nations.
- Warr, P., Cook, J., Wall, T., 1979. Scales for the measurement of some work attitudes and aspects of psychological well-being. *J. Occup. Psychol.* 52 (2), 129–148. <https://doi.org/10.1111/j.2044-8325.1979.tb00448.x>.
- Williams, L.J., Anderson, S.E., 1991. Job satisfaction and organizational commitment as predictors of organizational citizenship and in-role behaviors. *J. Manag.* 17 (3), 601–617. <https://doi.org/10.1177/014920639101700305>.
- Woehr, D.J., Loignon, A.C., Schmidt, P.B., Loughry, M.L., Ohland, M.W., 2015. Justifying aggregation with consensus-based constructs: a review and examination of cutoff values for common aggregation indices. *Org. Res. Meth.* 18 (4), 704–737. <https://doi.org/10.1177/1094428115582090>.