Multistudy Report

An Economic Scale to Assess Work-Related Extended Availability

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Abstract: Modern information and communication technologies provide employees with greater flexibility, but they also blur the boundaries between work and personal life. *Work-related extended availability* (WREA) refers to the availability of workers for work-related matters and the availability of work tasks for workers beyond the boundary of the work domain. In the present study, we developed and validated a new instrument for assessing WREA. In Sample 1 (N = 310), we tested the initial item pool, and in Sample 2 (N = 591), we examined the nomological network of the finalized measure using data collected at two time points. Exploratory and confirmatory factor analyses supported a unidimensional structure. The scale demonstrated high correlations with conceptually closely related constructs, indicating convergent validity, and lower correlations with more distantly related constructs supported discriminant validity. Furthermore, associations with self-reported real-life behaviors, such as accepting work-related calls during personal time, and incremental validity in predicting work-to-family conflict demonstrated the scale's criterion validity. Overall, the scale offers a brief and psychometrically robust measure of WREA.

Keywords: work-related extended availability, technology assisted supplemental work, work-related technology use after hours

Modern information and communication technologies (ICT) have reshaped the way we work, offering greater flexibility in when and where work tasks are performed. While employee-oriented flexibility can benefit workers (Allen et al., 2013), ICT blur the boundaries between work and private life, exposing employees to work-related demands when they do not necessarily intend to engage with such demands. Organizations can reach workers virtually anywhere, and many employees feel compelled to continue working during leisure time to meet perceived expectations or responsibilities for work outcomes. This informal availability for work during non-work time has been referred to as work-related extended availability (WREA; Pangert et al., 2016).

Several constructs related to WREA exist, including technology-assisted supplemental work (Fenner & Renn, 2010), work-related smartphone use during off-job time (Derks & Baker, 2014), e-mail access (Reinke & Chamorro-Premuzic, 2014), and 24/7 availability (Day et al., 2012). Such constructs can be considered specific manifestations of the more general concept of WREA, which is defined as the availability of workers for work-related matters and the availability of work tasks for workers beyond the boundary of the work domain (Pangert et al., 2016). While some of these constructs are assessed by asking respondents how much time they engage in work-related matters during leisure time (e.g., Pauls et al., 2017), others are captured with ultra brief scales (e.g., Derks & Bakker, 2014). Given the large number of overlapping constructs and their varying operationalizations, comparability across studies poses a challenge. Furthermore, most instruments were developed ad hoc for specific studies without being formally validated (e.g., Derks & Bakker, 2014). As these instruments are very brief, they rely on items of medium difficulty, which may work well in samples with low or moderate levels of WREA but may not adequately capture the variability in individuals with higher levels of WREA.

The present study aimed to develop, refine, and validate a psychometrically sound instrument for assessing WREA. Specifically, we sought to create an economic, reliable scale that has the capacity to differentiate between individuals with higher levels of WREA (i.e., an instrument that does not suffer from ceiling effects), and we aimed to establish the scale's factorial, construct, and criterion validity. In Sample 1, we examined the initial item pool, while Sample 2 was used to examine the construct's nomological network. The final scale was refined based on data from both samples. The resulting scale may be useful for both research and applied settings, where it could help assessing risks and opportunities that WREA poses for organizational personnel (Thörel et al., 2022).

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Theory

Work-Related Extended Availability

WREA is defined as the availability of workers for work-related matters and the availability of work tasks for workers beyond the boundary of the work domain (Pangert et al., 2016). In contrast to on-call duty, WREA is neither regulated in employment contracts, collective labor nor company agreements and, in practice, often falls outside the scope of working time legislation (Thörel et al., 2022). To understand what WREA means and what the differences are between WREA and phenomena such as teleworking or mobile work, we delve into boundary theory (Nippert-Eng, 1996): According to boundary theory, life domains are separated by spatial (e.g., workplace), temporal (e.g., working hours), and psychological (e.g., social roles) boundaries (Hall & Richter, 1988). These boundaries vary in their degree of flexibility and permeability, which jointly determine boundary strength. If flexibility and permeability are high, the boundaries between two domains or roles are weak (Ashforth et al., 2000; Clark, 2000). Albeit related, flexibility and permeability are conceptually distinct (Matthews & Barnes-Farrell, 2010). Whereas flexibility refers to the extent to which physical time and location markers, such as working hours and the place of work, can be adjusted, permeability relates to being in one domain while psychologically or behaviorally involved in another domain (Ashforth et al., 2000). Employee-oriented forms of flexible working arrangements such as flextime or telecommuting are instances of boundary *flexibility* (Clark, 2000). Here, work schedules or locations are adjusted to accommodate employees' needs, yet the distinction between work and private life remains intact. WREA, on the other hand, is a manifestation of boundary *permeability* (Thörel et al., 2022). Examples of WREA include accepting work-related calls at dinner (Thörel et al., 2020a), working over breakfast or dinner (Hecht & Allen, 2009), or continuing to work at home during spare time to meet work deadlines (Fenner & Renn, 2010). In such cases, employees engage in work-related tasks while being in the private domain, allowing work to permeate their personal time. Whereas flexible boundaries facilitate the management of work and personal life demands (Allen et al., 2013), permeable boundaries enable work to spill over into private life, effectively expanding working hours (Thörel et al., 2020b). Thus, WREA captures a behavioral involvement in work beyond the boundaries of the work domain, and it is distinct from employee-oriented flexible arrangements that maintain clear domain boundaries. This distinction is not only theoretical but also supported by empirical findings regarding relationships with relevant outcomes: Whereas there is meta-analytic evidence for positive effects of telecommuting on employee well-being and life-domain balance (Gajendran & Harrison, 2007), WREA is linked to poorer recovery, well-being, and life-domain balance (Thörel et al., 2022).

Another issue concerns the difference between availability expectations or demands (e.g., Dettmers et al., 2016) and availability behaviors (e.g., Pauls et al., 2017): Although both likely increase boundary permeability and are similarly associated with employee recovery, well-being, and life-domain balance, they are conceptually distinct (Thörel et al., 2022). Availability demands refer to employees' perceived expectations to respond to work-related requests (Dettmers, 2017), whereas availability behaviors describe employees actually engaging in work during personal time (Thörel et al., 2022). Our new scale specifically measures availability behaviors.

Overview of Existing Instruments

Constructs and Instruments Based on Boundary Theory

There is a number of theory-inspired instruments that assess various aspects of boundary theory such as boundary strength (Hecht & Allen, 2009), flexibility (Matthews & Barnes-Farrell, 2010), permeability (Clark, 2002), and role transitions (Kossek et al., 2012; Matthews et al., 2010). Some of these instruments could be used to assess WREA, and studies employing them were included in a meta-analysis on WREA (Thörel et al., 2022). However, using these instruments to assess WREA would be suboptimal: First, apart from the instrument by Clark (2002), each of these instruments contain items that do not distinguish between flexibility and permeability (e.g., "I often do work at home."). Second, although the authors of these instruments made some attempt at scale validation, the instruments fall short of standards for some of the following reasons. In all cases, important information on factor analyses are not reported (e.g., communalities, explained variance), sample sizes are low (e.g., Clark, 2002), factor analyses are not performed adequately (Kossek et al., 2012), results of factor analyses do not indicate an adequate model fit (Hecht & Allen, 2009), the explained variance is very low (Matthews et al., 2010) or there was no systematic attempt to capture criterion validity (Matthews et al., 2010), construct validity or both (Clark, 2002).

Ad hoc Measures

Apart from these theory-inspired scales, numerous other instruments assess work-related behaviors during personal time. The instruments discussed in the following are more implicitly based on boundary theory and were developed as ad-hoc measures without explicit validation. While they overlap with WREA as an umbrella construct (Thörel

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et al., 2022), they typically focus on specific media, periods, or particular metrics for work-related behaviors. Regarding media, some instruments target the use of work-related technology in general (e.g., Fenner & Renn, 2009), some the use of smartphones (e.g., Derks & Bakker, 2014), or email (Reinke & Chamorro-Premuzic, 2014). In terms of periods, they emphasize specific time frames such as after-hours (Derks & Bakker, 2014), the evening (Ohly & Latour, 2014), nighttime (Lanaj et al., 2014), or vacation (Kirillova & Wang, 2016). With respect to particular metrics, these measures focus, for instance on the number of work-related contacts (Pauls et al., 2017), the duration of engagement (Lanaj et al., 2014), or the frequency (Richardson & Thompson, 2012). Apart from these measures assessing work-related behaviors, there exist instruments that specifically target availability expectations or demands, the most prominent among them the brief scale developed by Dettmers et al. (2016).

Among all instruments we mentioned, the number of items varies considerably. Some instruments use one (e.g., Lanaj et al., 2014) or two items (e.g., Richardson & Thompson, 2012), while others employ brief scales of four (e.g., Derks & Bakker, 2014) to seven items (e.g., Ragsdale & Hoover, 2016). While assessing specific aspects of work-related behaviors during personal time – such as work-related smartphone use at night – can be valuable, the number of similar constructs and varying operationalizations pose a challenge. Although results across studies may be comparable, differences in measurement approaches can cause variations in effect sizes, as reflected in the high variability indices reported in the meta-analysis on WREA (Thörel et al., 2022). In sum, while there are instruments to assess work-related behaviors during personal time, they tend to conflate related concepts such as flexi-bility and permeability, lack validation, or focus on specific aspects that limit comparability.

Construct Validity

A measure must be both psychometrically sound and theoretically relevant within its domain. Establishing its place in the nomological network requires examining multiple forms of validity. The following two subsections will address construct validity, including convergent and discriminant validity. For convergent validity, we selected three constructs that are theoretically close to WREA but serve different functions in the nomological network: (1) boundary strength, as a construct from relevant theory that is conceptually very close, (2) perceived availability demands, as an antecedent to availability behaviors in many cases, and (3) work-related smartphone use, as a specific manifestation of the more general concept of WREA. For discriminant validity, we have chosen three constructs that are more distal from WREA in the nomological network and fulfil different functions: (1) segmentation supplies and (2) segmentation preferences, both rooted in boundary theory, capture structural and attitudinal aspects of work–life segmentation and (3) extraversion as a personality trait that may be associated with increased WREA. After construct validity, we will also consider criterion and incremental validity. In the following, when we refer to weak, moderate, and strong correlations, we draw on the benchmarks proposed by Cohen (1988).

Convergent Validity

Boundaries between life domains vary in strength (Clark, 2000). A boundary is strong when it is inflexible and impermeable (Matthews et al., 2010). A strong boundary around the work domain prevents private matters from interfering with work, while a strong home boundary protects individuals against work-related intrusions into personal life (Hall & Richter, 1988). As noted, WREA reflects a permeable home boundary (Thörel et al., 2022), allowing work to cross the physical, temporal, and psychological boundaries typically safeguarding the home domain (Hall & Richter, 1988). Individuals with weaker home boundaries are less likely to take measures that prevent work from encroaching on their personal time (Olson-Buchanan & Boswell, 2005), making them more prone to engaging in work-related activities off work. Thus, we expect:

> *Hypothesis 1a (H1a)*: Scores on the WREA scale are strongly and negatively associated with the strength of the home boundary.

Availability expectations refer to the extent to which employees perceive an explicit or implicit requirement to respond to work-related requests outside of regular working hours (Dettmers, 2017). While WREA reflects behavioral dispositions to be available for work during personal time (Pangert et al., 2016), availability expectations represent perceived external demands for availability (Thörel et al., 2022). Although conceptually distinct, availability expectations can antecede WREA, as many individuals likely comply with perceived availability demands by making themselves available outside of working hours. Still, these constructs should remain empirically distinguishable as employees may perceive high availability expectations but resist being actually available, while others may be available for work regardless of external expectations (Thörel et al., 2022). Previous studies assessing availability demands and behaviors have found substantial correlations (e.g., Dettmers et al., 2016). Thus, we expect:

> *Hypothesis 1b (H1b)*: Scores on the WREA scale are strongly positively associated with availability expectations.

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Work-related smartphone use during after-work hours (Derks & Bakker, 2014) is a narrower construct under the umbrella of WREA (Thörel et al., 2022). While not everyone who is available for work-related matters during leisure time uses their smartphone, those who do regularly engage in work-related tasks via smartphone exhibit high WREA. Therefore, we expect:

Hypothesis 1c (H1c): Scores on the WREA scale are strongly and positively associated with work-related smartphone use off-work.

Discriminant Validity

Segmentation is a key concept in boundary theory (Ashforth et al., 2000), referring to the degree to which individuals separate work and private life cognitively, physically, and behaviorally (Kreiner, 2006). The central assumption is that individuals fall along a continuum between segmentation and integration of domains and roles (Ashforth et al., 2000). Whether individuals actually segment work and private life depends on segmentation supplies – the extent to which organizations provide means to separate work and private life – and segmentation preferences (Kreiner, 2006). Segmentation supplies are a precondition for employees being able to segment work and private life (Althammer et al., 2021). A lack of segmentation supplies likely plays a role in the permeable home boundary characteristic of WREA (Thörel et al., 2022). However, having segmentation supplies at one's disposal does not necessarily mean that individuals segment work and private life as some individuals prefer integration (Kreiner, 2006). Following that, we expect:

Hypothesis 2a (H2a): Scores on the WREA scale are low to moderately negatively associated with segmentation supplies.

Unlike segmentation supplies that can be considered a structural precondition for segmenting work and private life, segmentation preferences refer to the attitude that they should be separated (Kreiner, 2006). While segmentation preferences reflect an individual's attitude toward separating work and private life, individuals who prefer such separation may still demonstrate varying levels of WREA, influenced by external factors such as segmentation supplies. Prior studies assessing relationships between work-related behaviors during personal time and segmentation preferences have found low to moderate correlations (e.g., Xie et al., 2018). Accordingly, we expect:

Hypothesis 2b (H2b): Scores on the WREA scale are low to moderately negatively associated with segmentation preferences.

Extraversion is a personality trait characterized as being sociable, talkative, and active (McCrae & Costa, 1987). Extraverted individuals are more likely to engage in social interaction and may be more receptive to work-related communication during leisure time (Barber & Santuzzi, 2015). However, WREA captures a specific readiness to address work-related matters during non-work time that is not primarily driven by general sociability. Hence, we expect:

Hypothesis 2c (H2c): Scores on the WREA scale are weakly positively associated with extraversion.

Criterion Validity

WREA refers to employees being available for work-related matters during personal time (Pangert et al., 2016). Therefore, higher scores on the WREA scale should be associated with a greater extent of assistance offered to a colleague in a fictional scenario during leisure time, as well as with actual availability behaviors. Specifically, individuals scoring high on WREA are expected to report answering more work-related calls and reading more work-related emails and short messages during personal time compared to those with lower scores.

Hypothesis 3a (H3a): Scores on the WREA scale are positively associated with the extent of assistance offered to a colleague in a fictional scenario.

Hypothesis 3b (H3b): Scores on the WREA scale are positively associated with the self-reported number of work-related calls accepted during personal time.

Hypothesis 3c (H3c): Scores on the WREA scale are positively associated with the self-reported number of work-related emails read during personal time.

Hypothesis 3d (H3d): Scores on the WREA scale are positively associated with the self-reported number of work-related short messages read during personal time.

Incremental Validity

A key question is to what extent availability demands versus behaviors predict negative employee outcomes. One widely studied consequence is the impact of work-related availability on life-domain balance, particularly its association with work-to-family conflict (WFC; e.g., Derks & Bakker, 2014). Research on both availability behaviors (e.g., Derks & Bakker, 2014) and demands (Dettmers, 2017) links them to WFC. However, due to overlap, it remains unclear whether WFC is primarily driven by availability expectations or behaviors. When gauging availability behaviors, individuals often engage in them because of perceived obligation. Conversely, when gauging availability demands, individuals who perceive pressure to handle work-related

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tasks during leisure time are likely to act on these expectations (Thörel et al., 2022). Given this dynamic, it is crucial to assess both to determine whether availability expectations and behaviors uniquely contribute to WFC. We propose that both increase the permeability of the home domain and will, therefore, be independently associated with WFC when controlling for the other.

Hypothesis 4 (H4): Scores on the WREA scale (which assesses availability behaviors) will account for variance in WFC beyond that explained by availability expectations.

Overview of Samples

Data were collected from two samples at a total of three time points. Data from Sample 1 were collected at one time point, whereas data from Sample 2 were collected at two time points. In Sample 1, we tested the full item pool and conducted an exploratory factor analysis to examine its structure. Final item selection was not based on Sample 1 alone. The full item pool was retained in Sample 2, and item selection was based on item statistics and analyses across both samples. The procedure and results of item selection are reported under Sample 2.

Sample 1

Methods

Participants and Procedure

Data were collected through an online study. Participants were recruited via social networks, corporate mailing lists, personal contacts, and public postings in a medium-sized German city. Participation was voluntary, and participants could enter a prize draw. They received study information, provided informed consent, and indicated their current employment status to ensure eligibility; only employed individuals who work at least 10 hr per week could proceed. At the end of the study, two attention-check items assessed response behavior. A total of $N = 439$ individuals started the study, of whom $n = 71$ were screened out for not being employed. Of the remaining $N = 368$, $N = 311$ completed the study, with one participant excluded for not properly reading the questions, resulting in a final sample of $N = 310$. Among them, $n = 196$ were women, $n = 92$ men, and $n = 22$ did not indicate their gender. Participants worked across various industries, most notably the service ($n = 78$), education ($n = 65$), and healthcare sectors ($n = 32$). $N = 163$ worked full-time (39–42 hr/week; one individual 52 hr), $n = 76$ worked 30–39 hr, $n = 47$ worked <30 hr, and $n = 24$ did not specify their hours.

Item Generation

We conducted a systematic review of prior measures and selected items that aligned with the conceptual definition of WREA (Pangert et al., 2016). The initial pool consisted of 28 items (see Supplemental Table A in the OSF repository) that were primarily derived from existing scales assessing work-related behaviors during personal time supplemented by some concrete examples from qualitative interviews from previous field research on the topic. The item pool was tested in a pre-study involving 10 participants (3 men, 7 women; age range: 20–60; 4 students, 6 working adults), who provided feedback on the clarity and comprehensibility of the items. This feedback was incorporated into the final version of the item pool.

Measures

We tested the initial pool of 28 items assessing WREA. Response options were presented on a 5-point Likert scale ranging from 1 (= *does not apply at all*) to 5 (= *fully applies*), with higher scores indicating higher levels of WREA.

Statistical Analyses

Analyses were conducted using SPSS 29. We first computed item difficulty scores and corrected item-total correlations to assess item suitability. A Principal Factor Analysis (PFA) without rotation was then performed on the full item pool to explore the factor structure.

Results

Preliminary Analyses

Before conducting item and factor analyses, we examined item statistics and correlation patterns between items. Except for Item 26, none of the items had skewness or kurtosis values exceeding the critical threshold of |2| (Watkins, 2018), with all being below |1.5|. Some items, such as Item 5, 23, and 26, contained outliers, which were later found to be associated with critical item difficulties. Most inter-item correlations were below $r = .70$, with nine correlations exceeding $r = .70$ and two correlations above $r = .80$. The Kaiser–Meyer–Olkin (KMO) coefficient and Bartlett's test confirmed the sample's suitability for factor analysis, with KMO = .96 and $\chi^2 = 6814.39$, $p < .001$.

Item Analyses

Descriptive statistics, item difficulty scores and corrected item-total correlations for the original item pool are in Table 1. Item difficulties (p) ranged from 13% to 65%, with most items falling within the ideal 30–70% range for discrimination (Kaplan & Saccuzzo, 2001). Corrected item-total correlations ranged from $r = .57$ to $r = .83$, all above the critical threshold of $r = .30$. However, some items

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Table 1. Item statistics for Sample 1

Item	*M*	*SD*	*P*	*r*	h^2	λ
Item 1	3.05	1.40	51.29	.70	.51	.71
Item 2	3.34	1.40	58.39	.59	.35	.59
Item 3	3.29	1.39	57.18	.71	.52	.72
Item 4	3.45	1.30	61.29	.69	.48	.69
Item 5	1.72	1.06	17.98	.67	.47	.68
Item 6	2.58	1.26	39.44	.76	.61	.78
Item 7	2.03	1.13	25.81	.67	.47	.69
Item 8	1.93	1.23	23.15	.64	.43	.65
Item 9	2.57	1.26	39.35	.79	.64	.80
Item 10	2.26	1.41	31.61	.70	.51	.72
Item 11	2.08	1.14	26.94	.74	.56	.75
Item 12	2.96	1.27	49.11	.57	.33	.58
Item 13	2.78	1.44	44.44	.28	.08	.28
Item 14	2.73	1.31	43.23	.81	.68	.82
Item 15	3.17	1.49	54.35	.75	.57	.76
Item 16	2.50	1.41	37.42	.79	.65	.81
Item 17	2.72	1.42	42.90	.73	.55	.74
Item 18	1.98	1.17	24.60	.73	.56	.75
Item 19	2.97	1.46	49.35	.73	.55	.74
Item 20	2.58	1.43	39.44	.79	.64	.80
Item 21	3.59	1.45	64.84	.69	.48	.70
Item 22	2.37	1.12	34.35	.83	.73	.85
Item 23	1.93	0.88	23.15	.68	.48	.69
Item 24	1.79	0.94	19.68	.75	.59	.77
Item 25	1.77	1.04	19.35	.74	.58	.76
Item 26	1.53	0.88	13.15	.57	.34	.59
Item 27	2.12	1.10	27.98	.64	.43	.66
Item 28	2.07	1.10	26.77	.67	.47	.68

Note. N = 310; r = corrected item-total correlation; values for inverted items are based on the recoded items; MIIC = .50; explained variance is 51%; α = .96.

exhibited high intercorrelations (see above) and corrected item-total correlations, suggesting redundancy, which was expected given that many items would be eliminated later in the process.

Exploratory Factor Analyses

We conducted a PFA on the item pool without specifying the number of factors. The Kaiser criterion suggested two factors, the scree plot indicated one, and both the MAP test (Velicer, 1976) and parallel analysis (Horn, 1965) conducted with O'Connor's (2000) SPSS Macro suggested four. Specifically, the first five empirical Eigenvalues and random Eigenvalues were 14.39 versus 0.81, 1.48 versus 0.67, 0.80 versus 0.60, 0.68 versus 0.53 and 0.43 versus 0.48. However, the Eigenvalue of the second factor was low, and it showed no interpretable pattern, so we extracted one factor as indicated by the scree plot. This factor explained 51% of the variance, with communalities ranging from .08 to .73 and factor loadings from .28 to .85 (Table 1).

Sample 2

Methods

Participants and Procedure

The sample size was determined based on recommendations for conducting CFAs (Wolf et al., 2013). The sample was recruited via the research online panel WiSoPanel (Göritz, 2014). Participants had to work at least 19 hr per week and hold employee status, both verified at the start of the study. To reduce common method variance, we separated data collection into two time points: demographics, WREA, and availability expectations were assessed first, while all other constructs were assessed at a second time point, 2 weeks later. Initially, the study link was clicked N = 2,115 times and N = 1,526 individuals started the first time point. Of these, n = 352 were screened out, because they did not fulfil the inclusion criteria. N = 1,066 finished the first time point. Participants failing an attention check (n = 37), completing the study in under 3 min (n = 71), or having missing data for the matching variable (n = 2) were excluded, resulting in N = 957 invited to the second time point. N = 649 participants began the second time point, and N = 623 completed it. We excluded n = 14 participants failing the attention check and n = 18 participants who either completed the study in under 2.5 min (n = 4) or were over 70 years (n = 14). The final sample consisted of N = 591 participants. At both time points, participants were informed about the study, assured of confidentiality, and told that they could withdraw from the study at any time. The estimated response time provided to participants was between 5 and 10 min, and participants received 1 Euro for each time point.

The final sample had a mean age of M = 50.48 years (SD = 10.59). Of the participants, n = 323 were women, n = 267 were men, and n = 1 identified as non-binary. Regarding education, n = 262 participants reported holding a university degree as their highest level of education, n = 174 held the German equivalent of a high school diploma, n = 120 had a secondary school diploma, n = 34 held a lower-level school leaving certificate, and one participant did not have any school leaving certificate. The largest proportions of participants worked in the health sector (n = 106), public administration (n = 89), and education (n = 69), the rest spread across various sectors. N = 427 worked full-time, and n = 164 worked part-time. On average, participants worked M = 36.78 hr per week (SD = 8.13).

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Measures

All constructs were assessed using a 5-point Likert scale, ranging from 1 (= *does not apply at all*) to 5 (= *fully applies*), unless otherwise noted.

WREA (Time Point 1)

We used the full item pool with 28 items from Sample 1. Based on the item and factor analyses in Sample 1 and item analyses in Sample 2 (reported below), we selected ten items for the final scale with an alpha of α = .92.

Availability Expectations (Time Point 1)

Availability expectations were assessed using the 4-item scale by Dettmers et al. (2016), which measures participants' perceptions of expectations to be available for work during leisure time. The original scale had a Cronbach's alpha of .90, and in our sample it was α = .91.

Home Boundary Strength (Time Point 2)

We assessed home boundary strength using a German version (Koch & Binnewies, 2015) of the scale by Hecht and Allen (2009). Participants indicated on 8 items the extent to which they conducted work-related tasks at home. The original scale had a Cronbach's alpha of .87, and in our sample it was α = .86.

Work-Related Smartphone Use (Time Point 2)

Work-related smartphone use was assessed with our own translation of the 4-item scale by Derks and Bakker (2014), measuring participants' use of smartphones for work purposes after hours. The original scale had a Cronbach's alpha of .80, and in our sample it was α = .79.

Segmentation Preferences (Time Point 2)

We assessed segmentation preferences with a German translation (Daniel, 2013) of the 4-item scale by Kreiner (2006), where participants indicated the degree to which they preferred segmenting work and private life. The original scale had a Cronbach's alpha of .91, and in our sample it was α = .88.

Segmentation Supplies (Time Point 2)

We assessed segmentation supplies with a German translation (Daniel, 2013) of the 4-item scale by Kreiner (2006), which measured the extent to which participants' organizations enabled them to segment work and private life. The original scale had a Cronbach's alpha of .94, and in our sample it was α = .92.

WFC (Time Point 2)

WFC was assessed using a German version (Nübling et al., 2005) of the 5-item WFC scale by Netemeyer et al. (1996). Participants indicated the extent to which work interferes with their private life due to time constraints and strain. The original scale had a Cronbach's alpha ranging from .88 to .89, and in our sample it was α = .92.

Extraversion (Time Point 2)

We used the 4-item extraversion subscale from the BFI-K scale by Rammstedt and John (2005). The original subscale had Cronbach's alphas ranging from .81 to .86. In our sample it was α = .84.

Work-related contacts (Time Point 2)

Work-related contacts (i.e., the number of phone calls, emails, and short messages) were assessed with 3 items from Pauls et al. (2017). Participants reported the number of work-related contacts they typically handle each week for each item.

Scenario (Time Point 2)

Participants were presented with a fictional Friday evening WhatsApp message about a minor work issue (a colleague asking for help with a Powerpoint presentation). Participants were asked how they would likely respond, with predefined options ranging from (1) ignoring the message, (2) suggesting the issue be addressed on Monday during working hours, (3) addressing the issue at a convenient time on Saturday, (4) offering to review it later that evening or (5) providing immediate feedback.

Statistical Analyses

All hypothesis tests and the PFA were conducted using SPSS 29. Confirmatory factor analysis (CFA) was performed in R using the semTools package (Jorgensen et al., 2025) with the WLSMV estimator (Brauer et al., 2023). To examine the structure of the final scale, we ran an additional PFA in Sample 1 and a CFA in Sample 2. The CFA included both the final WREA measure and constructs used to assess discriminant validity. As an initial test of discriminant validity, we applied the CICFA(sys) procedure proposed by Rönkkö and Cho (2022). To test Hypotheses 1–3, we computed bivariate correlations between WREA scores and the relevant constructs to assess convergent (H1a–c), discriminant (H2a–c), and criterion validity (H3a–d). Incremental validity was examined via multiple regression with WFC as the outcome, entering availability expectations in Step 1 and WREA in Step 2.

Results

Preliminary Analyses

Before conducting item and factor analyses, we examined item statistics and correlation patterns. Three items exceeded the critical threshold of |2| for skewness and kurtosis (Watkins, 2018) – one severely (Item 26), and two items had kurtosis slightly over |2| (Items 5 and 25). Most

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Table 2. Item statistics for Sample 2

Item	*M*	*SD*	*P*	*r*	Item	*M*	*SD*	*P*	*r*
Item 1	2.72	1.47	42.89	.77	Item 15	2.67	1.58	41.79	.78
Item 2	2.94	1.55	48.43	.69	Item 16	2.02	1.33	25.42	.81
Item 3	2.88	1.50	47.04	.79	Item 17	2.16	1.40	29.02	.76
Item 4	3.04	1.54	50.93	.72	Item 18	1.81	1.23	20.30	.76
Item 5	1.64	1.13	15.91	.62	Item 19	2.30	1.45	32.40	.77
Item 6	2.33	1.34	33.33	.82	Item 20	2.06	1.35	26.44	.79
Item 7	2.05	1.25	26.14	.74	Item 21	3.14	1.60	53.38	.66
Item 8	1.70	1.15	17.60	.64	Item 22	2.10	1.24	27.45	.86
Item 9	2.48	1.41	37.06	.80	Item 23	1.81	1.00	20.14	.73
Item 10	1.93	1.27	23.14	.74	Item 24	1.67	1.03	16.84	.78
Item 11	2.04	1.23	25.93	.75	Item 25	1.63	1.13	15.78	.70
Item 12	2.57	1.33	39.21	.66	Item 26	1.45	0.89	11.13	.62
Item 13	2.54	1.53	38.62	.34	Item 27	1.95	1.17	23.69	.70
Item 14	2.53	1.38	38.20	.78	Item 28	1.90	1.15	22.55	.71

Note. N = 591; r = corrected item – total correlation.

of the remaining items had skew and kurtosis well below |1.5|. Again, there were some outliers in items deviating in levels of difficulty. Inter-item correlations in the 28-item pool were between .17 and .88, most of them below r = .70, with 39 correlations exceeding r = .70 and three correlations above r = .80. As for the criterion variables in the validity analyses, we also examined skewness and kurtosis. Work-related calls (skewness = 6.10, kurtosis = 49.59), emails (skewness = 8.39, kurtosis = 103.01), and short messages (skewness = 8.33, kurtosis = 109.37) showed extreme deviations from normality. To address this, we conducted a sensitivity analysis using Kendall's tau, which yielded slightly higher associations for all three variables compared to Pearson's r. To ensure comparability between studies, we decided to report the Pearson correlations.

Item Analyses

Descriptive statistics, item difficulty scores, and corrected item-total correlations for the original item pool are in Table 2. In Sample 2, item difficulties (p) ranged from 11% to 53% and corrected item-total correlations from r = .34 to r = .86.

Item Selection

We selected items based on substantive considerations as well as the item analyses for Samples 1 and 2 and the PFA for Sample 1. Items with communalities below .20 (Child, 2006) or factor loadings below .40 (Stevens, 1986) were removed. Items with high difficulty were not excluded by default, as we aimed to develop a measure capable of differentiating between individuals with higher levels of WREA. Likewise, medium-difficult items with good item-total correlations were not automatically retained, as these correlations can be inflated by redundancies (Clark & Watson, 1995). We decided to retain 10 items (see Table 3) that reflect a range of situations and aspects. The most common reason for item exclusion was redundancy (n = 10), identified through qualitative evaluation and quantitative indicators. Additionally, five items were removed due to problematic statistics and three due to unclear wording. Supplemental Table B (see OSF repository) provides an overview of the reasons for excluding items.

Exploratory Factor Analyses on Final Scale (Data From Sample 1)

We conducted a PFA with the finalized item pool with the data from Sample 1. Both the Kaiser-Meyer-Olkin (KMO) coefficient, KMO = .92, and Bartlett's test of sphericity, χ^2 = 1689.64, p < .001, indicated the data were suitable for factor analysis. The average inter-item correlation was r = .515. The Kaiser criterion, the scree plot, and the MAP test indicated the extraction of one factor, while parallel analysis suggested four. Specifically, the first five empirical Eigenvalues and random Eigenvalues were 5.19 versus 0.43, 0.42 versus 0.29, 0.24 versus 0.22, 0.15 versus 0.14 and 0.04 versus 0.09. However, as the Eigenvalue of the second factor was well below one (0.4), we extracted one factor. The extracted factor explained 52% of the variance. Communalities ranged from .43 to .65, and factor loadings ranged from .66 to .81 (Table 3). Cronbach's alpha of the final measure was .91 in Sample 1.

Confirmatory Factor Analyses

We conducted a confirmatory factor analysis (CFA) on the data from Sample 2 and included our WREA measure as well as the constructs for assessing discriminant validity to explore whether our assumptions regarding discriminant validity meet the standard (Rönkkö & Cho, 2022). When we

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Table 3. Item statistics and results of factor analyses for the final scale in Samples 1 and 2

Items	Sample 1				Sample 2		
	P	*r*	h^2	λ	*P*	*r*	λ
Item 5: check work emails before sleep	17.98	.67	.50	.70	15.19	.64	.77
Item 7: accept contacts when spending time with friends or family	25.81	.67	.51	.72	26.14	.71	.74
Item 8: check work emails after waking up	23.15	.66	.48	.69	17.60	.67	.76
Item 9: accept work-related contacts on days off	39.35	.76	.65	.81	37.06	.75	.82
Item 11: make sure to be reachable for work during personal time	26.94	.72	.58	.76	25.93	.75	.82
Item 15: use ICT to handle work matters during personal time	54.35	.69	.51	.71	41.79	.73	.86
Item 19: work from home during free time when tasks are urgent	49.35	.65	.46	.68	32.40	.71	.82
Item 24: take care of work during vacation	19.68	.75	.63	.79	16.84	.78	.91
Item 27: actively contact work during free time	27.98	.62	.43	.66	23.69	.69	.80
Item 28: continue working from home when sick	26.77	.64	.44	.66	22.55	.69	.77

Note. N = 310 for Sample 1; N = 591 for Sample 2; λ in Sample 1 for EFA and in Sample 2 for CFA; Items are abbreviated; actual items can be found in the Supplementary Table A.

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ran the model, standardized factor loadings for our measure were between .78 and .89. However, fit indices, specifically the RMSEA, indicated room for improvement (χ^2 = 865.046, p < .001; CFI = .97; TLI = .97; RMSEA = .07; SRMR = .05). We inspected the model and consulted modification indices. There were some correlations between errors in our data that can be attributed to item difficulties and similar item contents (e.g., Item 5 and 8). Based on these deliberations, we allowed four error terms to correlate and reran the model. Factor loadings for our measure (Table 3) now were between .74 and .91, and fit indices had improved (χ^2 = 562.682 p < .001; CFI = .98; TLI = .98; RMSEA = .056; SRMR = .05). The explained variance for our scale was 55%. We then ran the CI_{CFA}(sys) procedure which indicates discriminant validity if .80 is not included in the confidence interval for the correlations of the latent variables (Rönkkö & Cho, 2022). The latent correlation of our WREA measure with segmentation supplies was r = −.58, 95% CI [−.64, −.52], with segmentation preferences r = −.60, 95% CI [−.66, −.53] and with extraversion r = −.08, 95% CI [−.01, .17]. The mean inter-item correlation for the final measure was r = .55 and α = .92.

Hypothesis Testing

Means, standard deviations and intercorrelations between all constructs are displayed in Table 4.

Hypotheses 1a–c assessed convergent validity. As expected, WREA was (a) strongly negatively associated with home boundary strength (r = –.77, p < .001), and strongly positively associated with (b) availability expectations (r = .74, p < .001) and (c) work-related smartphone use after hours (r = .75, p < .001).

Hypotheses 2a–c assessed discriminant validity. WREA was negatively associated with (a) segmentation supplies (r = −.50, p < .001) and (b) preferences (r = −.49, p < .001), though both relationships were somewhat stronger than expected. Contrary to expectation, (c) WREA was not significantly related to extraversion (r = .08, p = .07).

Hypotheses 3a–d tested criterion validity. As expected, WREA was positively associated with (a) helping behavior in a fictional scenario (r = .39, p < .001), (b) the number of work-related calls (r = .45, p < .001), (c) emails (r = .41, p < .001), and (d) short messages accepted or read during personal time (r = .35, p < .001).

Hypothesis 4 tested incremental validity (Table 5). A model with only availability expectations predicted 15% of the variance in WFC (β = .39, p < .001). Adding WREA increased the explained variance by 5% (p < .001). In the final model, both (a) availability expectations (β = .15, p < .01) and (b) WREA (β = .32, p < .001) remained significant predictors, supporting H4.

Discussion

The goal of this study was to develop, refine, and validate a psychometrically sound instrument to assess WREA. From an initial pool of 28 items, we retained 10 that represent a range of situations and aspects of WREA. Supporting convergent validity, WREA was strongly negatively associated with home boundary strength (H1a) and strongly positively associated with perceived availability expectations (H1b) and work-related smartphone use after hours (H1c). Discriminant validity was supported by moderate-to-strong associations with segmentation supplies (H2a) and preferences (H2b). Contrary to expectation, WREA was only weakly and non-significantly related to extraversion (H2c). In support of criterion validity, WREA predicted the extent to which participants were willing to support a colleague during leisure time (H3a), as well as the number of work-related calls (H3b), emails (H3c), and short messages (H3d) accepted or read during personal time.

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Table 4. Means (*M*), Standard Deviations (*SD*), and intercorrelations between measures

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. WREA	2.04	0.97	.92											
2. Boundary strength	3.66	0.96	−.77	.86										
3. Availability demands	2.04	1.13	.74	−.59	.91									
4. Smartphone use	1.97	0.93	.75	−.66	.61	.79								
5. Segmentation supplies	3.38	1.10	−.50	.61	−.51	−.43	.92							
6. Segmentation preferences	4.11	0.89	−.49	.48	−.36	−.37	.31	.88						
7. Extraversion	3.22	0.88	.08	−.05	.05	.02	.02	−.09	.84					
8. Scenario	2.97	1.33	.39	−.32	.25	.38	−.17	−.19	−.02	–				
9. Work-related calls	1.72	4.38	.45	−.41	.37	.40	−.26	−.24	.09	.14	–			
10. Work-related emails	7.23	19.56	.41	−.46	.32	.39	−.32	−.25	.06	.14	.47	–		
11. Work-related short messages	4.59	12.43	.35	−.34	.31	.31	−.30	−.16	.07	.13	.33	.18	–	
12. WFC	2.18	1.02	.43	−.52	.39	.42	−.52	−.04	−.05	.22	.18	.25	.20	.92

Note. Correlations with $|r| \geq .08$ are significant at $p < .05$, $|r| \geq .11$ at $p < .01$, and $|r| \geq .14$ at $p < .001$. Cronbach's αs are reported on the diagonal.

Table 5. WFC regressed on availability demands and WREA

	b	*SE b*	β	*t*	*p*
Model 1					
Availability demands	0.35	0.03	.39	10.26	<.001
$R^2 = .15$, $F = 105.26$, $p < .001$					
Model 2					
Availability demands	0.14	0.05	.15	2.78	.006
WREA	0.34	0.06	.32	5.88	<.001

$R^2 = .20$, $F = 72.95$, $p < .001$, $\Delta R^2 = .05$, $p < .001$.

Finally, WREA showed incremental validity in predicting WFC beyond availability expectations (H4).

Scale Items, Reliability and Factorial Validity

We selected the final scale items based on both substantive considerations and the results of item- and factor-analyses. Because we aimed to represent a broad range of situations and aspects of WREA, some items retained fall outside the 30–70% difficulty range typically considered optimal for discrimination (Kaplan & Saccuzzo, 2001). Nevertheless, item-total correlations were strong in both samples. The medium inter-item correlation is slightly above what is recommended (Clark & Watson, 1995), but inter-item correlations were otherwise consistent, suggesting a well-balanced mixture of items.

Factor analyses indicated a dominant factor, with explained variance exceeding the 50% threshold commonly recommended (e.g., Streiner, 1994) in both samples, though falling below the more conservative 60% guideline (Hair et al., 2019). This result is not unexpected, as we prioritized conceptual coverage over statistical optimization. Specifically, we retained items with higher difficulties to allow for differentiation among individuals with higher levels of WREA, thus pre-empting ceiling effects when employing the scale. Such items tend to show lower variance and lower communalities, which reduces the proportion of variance explained (Gulliksen, 1945). Nonetheless, factor loadings were high across both samples, indicating robust psychometric properties despite the retention of items with higher difficulties. Internal consistency was high in both samples and exceeds commonly accepted standards (Nunnally & Bernstein, 1978).

Construct Validity

The pattern of correlations largely supports the construct validity of the new WREA measure. Associations with conceptually closely related constructs (H1a-c), indicating convergent validity, were in the .70 range. Associations with more remote but related constructs (H2a & b), indicating discriminant validity, were notably smaller, showing medium-to-high correlations. These were slightly stronger than anticipated based on theory and prior research (e.g., Xie et al., 2018). However, we believe that this does not necessarily undermine discriminant validity, as it is theoretically plausible that both segmentation supplies and preferences

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are substantially related to the extent of WREA. Importantly, following the procedure recommended by Rönkkö and Cho (2022), disattenuated correlations did not indicate problems with discriminant validity. Finally, the association between the WREA measure and extraversion, expected to be weakly positive (H2c), was not significant. However, although unexpected, this finding does not undermine construct validity of our measure as it merely shows that general sociability does not significantly drive work-related communication during personal time.

Criterion Validity

The findings provide support for the criterion validity of the measure. WREA scores predicted both participants' choices in a hypothetical scenario (H3a) and reported availability behaviors, such as accepting work-related calls (H3b) and reading work-related emails (H3c) and short messages (H3d) during personal time. These results suggest that higher WREA scores are meaningfully associated with corresponding self-reported real-life behaviors.

Furthermore, our measure demonstrated incremental validity in predicting WFC. Specifically, WREA scores accounted for additional variance in WFC beyond that explained by availability expectations. Notably, the inclusion of WREA to the model even reduced the variance attributed to availability expectations, indicating that both constructs independently contribute to WFC and that the link between availability expectations and WFC may partially be mediated by availability behaviors.

Research and Practice Implications

The WREA scale provides a validated alternative to the large number of ad-hoc measures currently used and may serve as a unifying instrument for future research in the field. Although primarily developed for white-collar occupations in which employees can actively take care of work tasks during personal time, the scale is also applicable to broader occupational groups, as workers in non-digital jobs may nonetheless be contacted outside regular working hours. In such contexts, some items (especially items 15, 19, and 28) may be less sharp, yet the items still capture meaningful variance, since low scores constitute informative responses. In addition to its utility in research contexts, the scale has potential applications in organizational practice. It goes beyond assessing the number or frequency of work-related contacts and captures the pervasiveness of availability across different contexts and situations. Finally, by retaining higher-difficulty items, the scale enables differentiation among individuals with higher levels of WREA, which is advantageous for both research and practice: It mitigates ceiling effects in empirical studies and facilitates the identification of employees with particularly high WREA.

Strengths and Limitations

One strength of this study is the effort to mitigate, though not eliminate, common method bias by separating the assessment of WREA and the constructs for construct and criterion validity across two time points (Podsakoff et al., 2003), thereby reducing response bias. The resulting scale, comprising ten items, is economical and suitable for studies at high risk of dropout due to respondent burden. However, several limitations must be acknowledged: First, although we used two large, relevant, and broad samples, sectors like education and healthcare are overrepresented, and participants are highly educated, limiting generalizability to the broader working population. Second, although we assessed criterion validity, we focused on concurrent validity and did not examine predictive validity, which may offer additional insights. Third, we have not assessed the temporal stability of the measure, which would show whether WREA is relatively stable over time. Fourth, while the validation study was conducted at two time points, all measures relied on self-reports. Ideally, criterion validity could also be examined using objective behavioral indicators – such as recorded work-related communication during personal time – but this was not feasible due to practical and methodological constraints. Future research should examine predictive validity using behavioral criteria and assess the temporal stability of the WREA scale.

Conclusion

The WREA scale is a brief and psychometrically sound measure for assessing WREA. The scale demonstrates a clear one-factor structure, strong internal consistency, and good construct and criterion validity.

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Publication Ethics
Participants in Sample 1 provided informed consent.

Open Science
We report how we determined our sample size, all data exclusions (if any), all data inclusion/exclusion criteria, whether inclusion/exclusion criteria were established prior to data analysis, all measures in the study, and all analyses including all tested models. If we use inferential tests, we report exact *p*-values, effect sizes, and 95% confidence or credible intervals.

Open Analytic Code: We confirm that all the scripts, code, and outputs needed to reproduce the results are provided (https://osf.io/2TD3Z; Thörel & Göritz, 2025).

Open Data: We confirm that there is sufficient information for an independent researcher to reproduce all of the reported results, including codebook if relevant (https://osf.io/2TD3Z; Thörel & Göritz, 2025).

Open Materials: The information needed to reproduce all of the reported methodology is not openly accessible. The material is available on request from the authors.

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