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Article

Assessing Motives for Delaying Bedtime: Development and Psychometric Properties of the Reasons for Bedtime Procrastination Scale

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ABSTRACT

Background: *Bedtime procrastination* (BP) is an increasingly prevalent behavior with detrimental outcomes for individuals. Three reasons for BP have been identified: Deliberate procrastination, mindless procrastination, and strategic delay. Developing an instrument to assess the reasons for BP allows better identification of patterns of behaviors and tailored interventions. The present study aims to develop and study the psychometric properties of the *Reasons for Bedtime Procrastination Scale* (RBPS). **Method:** The study sample included adults living in Portugal (N = 653). Validity and reliability analyses were conducted. **Results:** Principal component analysis suggested that the RBPS is composed of two factors (factor 1 – deliberate and mindless reasons; factor 2 – strategic reasons). Confirmatory factor analysis supported the two-factor structure of the scale (e.g., CFI = .984; TLI = .976 RMSEA = .053). The scale demonstrated good internal consistency, with a Cronbach's alpha coefficient of .85 for factor 1, and of .72 for factor 2. Convergent validity was supported by significant correlations with the number of activities people engage in before going to bed, BP, bedtime gap, fall-asleep time gap, and wake-up time gap. **Conclusions:** The RBPS appears to represent a reliable way of assessing reasons for BP in the general adult population.

Palabras clave:
Dormir
Procrastinación a la hora de acostarse
Razones para procrastinar a la hora de acostarse
Validez
Fiabilidad

Evaluando los Motivos para Retrasar la Hora de Acostarse: Desarrollo y Propiedades Psicométricas de la Escala de Procrastinación de la Hora de Acostarse

RESUMEN

Antecedentes: La *procrastinación a la hora de acostarse* (PHA) es cada vez más frecuente con consecuencias perjudiciales, habiendo sido identificados tres razones: Deliberada, *mindless* y estratégica. Pretendemos desarrollar y estudiar las propiedades psicométricas de la *Escala de Razones para Procrastinar a la Hora de Acostarse* (ERPHA), que permitirá identificar patrones de comportamiento y adaptar intervenciones. **Método:** La muestra incluyó adultos residentes en Portugal (N = 653). Realizamos estadísticas de validación y fiabilidad. **Resultados:** El análisis de componentes principales sugirió que la ERPHA está compuesta por dos factores (factor 1 – razones deliberadas y *mindless*; factor 2 – razones estratégicas). El análisis factorial confirmatorio apoyó la estructura de dos factores de la escala (p.ej., CFI = .984; TLI = .976 RMSEA = .053). La escala demostró una buena consistencia interna, con un coeficiente alfa de Cronbach de .85 para el factor 1 y de .72 para el factor 2. La validez convergente fue respaldada por correlaciones significativas con el número de actividades que los individuos realizan antes de acostarse, PHA, y los desfases de la hora de acostarse, de dormir, y de despertar. **Conclusiones:** La ERPHA es válida para evaluar las razones de los individuos para la PHA en la población adulta general.

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Sleep contributes to the performance of several bodily functions (e.g., metabolic functions, cognitive abilities, emotional processing). Importantly, lack of sleep can negatively affect people's mental (e.g., depression, anxiety, rumination; Baglioni et al., 2010; Dong et al., 2022; Holdaway et al., 2018) and physical health (e.g., cardiovascular diseases, diabetes; Andersen et al., 2021; Chattu et al., 2019; Patel & Hu, 2008), and disrupt many areas of life, such as performance at school or work (Hill et al., 2024; Musshafen et al., 2021). However, despite the importance of sleep, many individuals fail to meet the recommended daily sleep amount. For example, Jones (2013) investigated sleep behaviors in the US population and found that 40% of participants reported sleeping less than the recommendations in the international guidelines. Moreover, Kroese, Evers, et al. (2016) investigated a Dutch community sample and found that about 53.1% reported going to bed later than intended on two or more days per week, and 54.5% felt that the amount of sleep was insufficient. Furthermore, a U.S. study with the adult population reported that 29.8% of adults experienced sleep problems, and 27.2% experienced daytime sleepiness, with this number increasing over the years (Di et al., 2022).

The key role of sleep in the individual's overall well-being and function has instigated research focused on the causes of sleep insufficiency, i.e. sleeping less than recommended, other than sleep disorders. Extant research has been discussing the role played by behavioral causes in sleep insufficiency, particularly *bedtime procrastination* (BP; Carlson et al., 2023; Kroese et al., 2014; Kroese, Nauts, et al., 2016). *BP* (Kroese et al., 2014; Kroese et al., 2016; Kroese, Nauts, et al., 2016), refers to delaying or going to bed later than intended without an evident reason. BP is a deliberate, unwarranted action entailing loss of sleep (Anderson, 2016; Hill et al., 2024). Prior research shows that BP is associated with later wake-up (Herzog-Krzywoszanska & Krzywoszanski, 2019; Magalhães et al., 2020) and dinner times (Oliveira et al., 2022; Przepiórka et al., 2019); symptoms of depression, anxiety, and insomnia (Guo et al., 2020; Li et al., 2020); stress (Schmidt et al., 2023); and poor sleep quality (Yuan et al., 2023). In addition, BP explains sleep-related outcomes, such as experience of sleep insufficiency and daytime fatigue (Kroese et al., 2014; Kroese, Evers, et al., 2016). Importantly, extant research (e.g., Exelmans & Van Den Bulck, 2021; Flores et al., 2023; Sirois et al., 2019; Zhuo, 2024) suggests that psychological/trait-like (e.g., self-control), motivational (e.g., self-regulation), emotional (e.g., self-compassion), or behavioral (e.g., watching TV; using mobile phone) factors contribute to this detrimental behavior.

Studies exploring BP have related it to the type and number of activities individuals engage in before going to bed. Extant research reports that the main activities individuals are involved before going to bed, or when already in bed, are technology (e.g., cell phone, computer, television; Chung et al., 2020; Exelmans & Van Den Bulck, 2021) and social related (e.g., using social networks; Correa-Iriarte et al., 2023; Gellis & Lichstein, 2009; Magalhães et al., 2020). Regarding the number of activities individuals engage in before going to bed, a study with the Portuguese population showed that approximately 56% of participants engaged in five or more activities; mainly related to study or work (Oliveira et al., 2022). Moreover, Magalhães et al. (2020) investigated Portuguese high school students and found a relationship between late dinnertime and BP; interestingly, these data are consistent with research conducted with Portuguese college students (Magalhães et al., 2021). These findings illustrate the role that daily schedules and routines may play on BP.

Extant research has been focused on understanding whether individuals procrastinate their bedtime, the consequences of that delay, and in which activities individuals get involved when they procrastinate. Interestingly, while acknowledging the complexity of BP, prior research suggests that the reasons for procrastinating may not be directly tied to a particular activity. In other words, individuals may engage in similar activities while procrastinating bedtime, despite their different reasons for doing so; or engage in different activities despite all serving the same underlying reason for procrastinating. This highlights a need to further investigate BP with a focus on the underlying reasons. Recently, Nauts et al. (2019) developed a qualitative study to unveil why individuals procrastinate at bedtime. Individuals scoring high on the BP scale were interviewed and three reasons for delaying bedtime emerged: deliberate procrastination, mindless procrastination, and strategic delay. According to these authors (i.e., Nauts et al., 2019), deliberate procrastination describes individuals' deliberate intention to delay bedtime by purposefully getting involved in an activity that is not imperative at that moment. Mindless procrastination refers to postponing bedtime due to inattention or distraction, i.e. by getting involved in activities competing with going to bed and losing track of time. Lastly, strategic delay refers to delaying bedtime due to the belief that falling asleep will be more effective afterward, and their sleep will benefit from the delay. Investigating the reasons for BP, along with the variables contributing to BP and the activities individuals engage in before bedtime, is crucial, as it will allow tailoring interventions to prevent and mitigate this pernicious behavior.

The multifaceted nature of the reasons for BP and the quantitative and qualitative components linked to BP point to the complexity and challenges inherent to identifying and assessing this behavior. Nauts et al. (2019) have identified and compiled three reasons for BP; data corroborate the need for robust instruments to evaluate these reasons because similar activities may serve different reasons, and distinct activities may serve the same reason, for procrastinating bedtime. All considered, there is a call to develop trustworthy quantitative measures fit to assess the reasons supporting BP, and further deepen our understanding about this phenomenon (Clark & Watson, 2019).

While the literature already includes validated scales for assessing BP (Kroese et al., 2014) and the subsequent consequences of this behavior (e.g., Magalhães et al., 2020), there remains a distinct need for a validated scale that delves into the predictors of BP. Specifically, there is a gap in scales that comprehensively evaluate the reasons individuals give for delaying their bedtime. Developing such a scale is crucial as it can provide valuable insights into the underlying factors contributing to BP, ultimately aiding in the development of tailored interventions to prevent and mitigate this behavior.

The purpose of the present research was to develop and study the validity (i.e., structural, concurrent, and predictive) and reliability (i.e., internal consistency) properties of the *Reasons for Bedtime Procrastination Scale* (RBPS). RBPS is an instrument derived from the qualitative exploratory study of Nauts et al. (2019); concretely, qualitative data from this study helped set the ground for RBPS. This research aims to: i) examine the structural validity of the RBPS, by conducting a *principal component analysis* (PCA) with half of the

sample and a *confirmatory factor analysis* (CFA) with the other half; ii) assess the concurrent validity regarding the relationship with BP, number of activities performed while procrastinating bedtime, and bedtime gap (i.e., time interval between the planned and actual bedtime); iii) evaluate the predictive validity through analyzing its relationship with the fall asleep time gap (i.e., time interval between the planned and the actual fall asleep time) and wake-up time gap (i.e., time interval between the planned and the actual wake-up time); and iv) assess the reliability (i.e., internal consistency) considering the *Cronbach's alpha* (α) and *McDonald's omega* (ω_t) coefficients (Malkewitz et al., 2023).

Based on the literature, we hypothesize that: 1) the RBPS will load on three factors (i.e., deliberate procrastination, mindless procrastination, and strategic delay; Nauts et al., 2019); 2) the RBPS will be positively related to BP, the number of activities, and the bedtime gap (Gellis & Lichstein, 2009; Kroese et al., 2016); and 3) the RBPS will be positively related to the fall asleep and wake-up time gaps (Nauts et al., 2019; Oliveira et al., 2022). Besides quantitatively testing the findings of Nauts et al. (2019), this study will allow the validation of an instrument that will support intervention with individuals who procrastinate their bedtime

Method

Participants

Participants had to reside in Portugal, be over 18 years old, and be native Portuguese speakers (i.e., inclusion criteria). The survey was opened by 1,379 individuals, one thousand two hundred thirty-nine people started filling out the survey (partial completion rate: 89.84%) and 872 participants completed the survey (full completion rate: 63.23%). From this sample, 159 participants were excluded due to factors that may impact sleep insufficiency (i.e., exclusion criteria; Kroese et al., 2016; Kühnel et al., 2018; Nauts et al., 2019), particularly: i) having a sleep disturbance (n = 27), ii) having a physical or psychological health problem that affects sleep (n = 97), iii) working in shifts (n = 42), and iv) taking care of a child under the age of three (n = 23). Moreover, 60 outliers (e.g., participants with 30 hours of sleep) were excluded. The final sample consisted of 653 participants. All participants resided in Portugal, with 613 (93.9%) with Portuguese nationality, 27 (4.1%) Brazilians, and the remainder (2.0%) from other European and African nationalities (e.g., France, Angola, Germany, Cape Verde). Four hundred eighty-eight participants (74.7%) were women. Ages ranged between 18 and 75 years (M = 29.80, SD = 12.45), and three (0.5%) participants had completed elementary school, 181 (27.7%) had completed high school, 218 (33.4%) had an undergraduate degree, and 251 (38.4%) had a postgraduate degree.

Instruments

Sociodemographic Questionnaire

The sociodemographic questionnaire included questions about participants' age, gender identity, nationality, and educational attainment. To verify the exclusion criteria, participants were asked (yes/no) if they: 1) "had physical and/or psychological health problems diagnosed by a professional that affected sleep (e.g., restless legs syndrome, depression, obsessive-compulsive disorder)"; 2) "worked in shifts"; 3) "had health problems related to sleep diagnosed by a professional (e.g., obstructive sleep apnea, sleepwalking)"; and 4) "had a child under the age of three at their care" (Kroese et al., 2016; Kühnel et al., 2018; Nauts et al., 2019) Participants who answered "yes" to at least one of these four questions were excluded from the database.

Reasons for Bedtime Procrastination Scale

In a qualitative study with individuals scoring high in the *Bedtime Procrastination Scale* (BPS; Kroese et al. 2014), Nauts et al. (2019) found three main reasons for BP: Deliberate procrastination, mindless procrastination, and strategic delay (see 'Introduction' section for more details on each type of these reasons). Based on these findings, we developed the RBPS. A group of experts from distinct backgrounds (e.g., sleep procrastination, self-regulation) and research seniority (e.g., full professor, junior researchers, Ph.D. students) met to discuss the appropriateness of the developed scale for measuring reasons for BP in the target population of the present study (i.e., adults living in Portugal). The RBPS, a quantitative questionnaire based on the qualitative findings from Nauts et al. (2019), was composed of nine items (specifically, three items per reason; Table 1). All items were answered on a five-point Likert-like scale from 1 (never) to 5 (always) and were formatted in a positive direction to reduce the likelihood of response bias (Suárez-Álvarez et al., 2018). For each subscale, higher scores reflected more engagement in that type of reason for BP.

Bedtime Procrastination Scale

BP was assessed through the BPS, originally developed by Kroese et al. (2014) and adapted to the Portuguese context by Magalhães et al. (2020, 2021). This is a nine-item scale (e.g., "I go to bed later than I had intended", "I do not go to bed on time"), with four items reverse-scored, and items were answered on a five-point Likert-like scale from 1 (never) to 5 (always). Higher scores indicate more engagement in BP. The scale's reliability for the current study was excellent (α = .90; ω_t = .90; AVE = .55; CR = .91). The BPS was used to study the concurrent validity.

Number of Activities Carried out Near Bedtime

To study the concurrent validity, the total number of activities the participants engaged in before bed was considered. From a list of 14 activities (e.g., thinking/planning the next day, doing a beauty/hygiene ritual; Oliveira et al., 2022), participants answered each activity on a dichotomous scale (yes/no) if they were usually engaged with this activity near bedtime.

Bedtime, Fall-Asleep Time, and Wake-Up Time Gaps

Information about sleep-related routines was collected. Participants answered the following open-ended questions: The time they planned to go to bed and the actual bedtime; the time they planned to fall asleep and the actual fall-asleep time; and the time they planned to wake up and the actual wake-up time. The bedtime, fall-asleep time, and wake-up time gaps consisted of the

Table 1
Reasons for Bedtime Procrastination Scale

English Items	Portuguese Items
1. I intentionally delay my bedtime, even though I know I will regret it.	1. Atraso a minha hora de deitar de forma intencional, mesmo sabendo que me vou arrepender.
2. Before going to bed, I engage in activities that could wait for the next day.	2. Antes de me deitar, envolvo-me em atividades que poderiam esperar pelo dia seguinte.
3. I go to bed late because I feel like I lose track of time.	3. Vou para a cama tarde porque sinto que perco a noção do tempo.
4. Before going to bed, I engage in exciting activities and can't stop.	4. Antes de me deitar, envolvo-me em atividades entusiasmantes e não consigo parar.
5. Before going to bed, I start a brief activity, and, before I know it, much time has passed.	5. Antes de me deitar, começo uma atividade rápida e, quando dou por mim, já passou muito tempo.
6. I believe I won't be able to sleep even if I go to bed early.	6. Acredito que não vou conseguir dormir mesmo que vá para a cama cedo.
7. Before going to bed, I feel awake and full of energy.	7. Antes de me deitar, sinto que estou desperto e com muita energia.
8. Before going to bed, I feel anxious and think about my worries.	8. Antes de me deitar, sinto-me ansioso e penso nas minhas preocupações.
9. Before going to bed, after a day filled with obligations, I feel that I deserve time for myself.	9. Antes de me deitar, depois de um dia cheio de obrigações, sinto que mereço tempo para mim.

time intervals between the planned and actual behaviors for each variable, respectively (for in-depth information, see section 'Data treatment'). The bedtime gap was used to study the concurrent validity, and the fall-asleep time and wake-up time gaps were used to study the predictive validity.

Procedure

This is a cross-sectional study. The online survey was disseminated via institutional e-mail, social media (e.g., Facebook, Instagram, WhatsApp), and personal contacts. The survey was constructed and completed by the participants in Qualtrics Survey Software® 2021 Qualtrics® (Qualtrics, 2020), and the average total completion time was 13.42 minutes (SD = 17.86; MIN = 4).

The study was approved by the Ethics Committee for Research in Social Sciences and Humanities of the Ethics Committee of the University of Minho (CEICSH 087/2020) and it was conducted in accordance with the Declaration of Helsinki. Before participating, participants read the informed consent form and explicitly agreed to engage in the study. Participation was voluntary, anonymous, confidential, and unpaid, and participants could quit the survey anytime without prejudice.

Data Analysis

Data Treatment

The data collected were analyzed with IBM® SPSS® Statistics™ 29.0 (IBM Corp. Released, 2022b) and IBM® SPSS® Amos™ 29.0 (IBM Corp. Released, 2022a) for Windows®. Descriptive statistics and frequency analyses were conducted. For data analysis, the total results that each participant obtained in the RBPS and BPS were transformed into average results (i.e., ranging between 1 and 5). Bedtime, fall asleep time, and wake-up time gaps were calculated using the difference between the actual and the planned hours for each of the behaviors (i.e., bedtime gap equals to actual bedtime minus planned bedtime; fall asleep time gap equals to actual fall asleep time minus planned fall asleep time; finally, wake up time gap equals to actual wake up time minus planned wake-up time).

Validity Analysis

The data were analyzed in several phases, coinciding with the current goals. First, to examine the factor structure of the RBPS, participants were randomly divided into two groups (i.e., Group 1, n = 323; Group 2, n = 330). With Group 1, we conducted a PCA with direct oblimin rotation (delta = 0). The appropriate number of factors for retention was determined by several criteria: the scree plots, eigenvalue > 1.0, and conceptual meaningfulness of items on each factor. The theoretical framework that guided the construction of the RBPS suggested three types of reasons for BP. However, considering the criteria used to determine the appropriate number of factors for retention, we found a two-factor solution (see 'Structural validity' section for more details). Based on this finding, we conducted a CFA with Group 2 to examine whether the factors of the RBPS were empirically distinguishable by comparing the difference in goodness-of-fit between (a) one-factor model (i.e., factorially indistinct) and (b) two-factor model (i.e., factorially distinct). For the evaluation of the models, multiple goodness-of-fit indicators were used, including *comparative fit index* (CFI) ≥ .95 (Hu & Bentler, 1999), *Tucker-Lewis index* (TLI) ≥ .95 (Hu & Bentler, 1999), *root mean square error of approximation* (RMSEA) ≤ .05 indicating good fit and RMSEA ≤ .08 indicating reasonable fit (Kenny et al., 2015; MacCallum et al., 1996) , and standard root mean squared residual (SRMR) < .08 (Hu & Bentler, 1999). Additionally, the *Akaike information criterion* (AIC) was used to compare alternative models as it considers both the goodness-of-fit indicators and the number of parameters (Bentler, 2006). Although there are no guidelines for the AIC, smaller values indicate a better fit (Hu & Bentler, 1999). The *Pearson correlation coefficients* (r) between the scores of the RBPS and the other measures were examined to analyze concurrent and predictive validity. Effect sizes were analyzed according to Cohen's d suggestions (Cohen, 1992, 2013): d < .20 indicates a minimal size of the effect; .20 < d < .50 that the size of the effect is small; .50 < d < .80 that the effect size is medium; and d > .80 that the effect size is large.

Reliability Analysis

The reliability of the scale (i.e., internal consistency) was assessed using α ω_t coefficients. We used the criteria of α ≥ .70 to assess the adequacy of the α coefficient for research purposes

(Nunnally, 1978). Additionally, we followed the recommendation that the adequacy of the ω_t coefficient needs to meet the same criteria as the α coefficient (Watkins, 2017).

Results

Descriptives

Table 2 shows the descriptive statistics (i.e., minimum, maximum, mean, standard deviation, skewness, and kurtosis) of the variables included in the present study. Data from the RBPS and BPS followed the normal distribution.

Structural Validity

A factor analysis was conducted for group 1 (n = 323). The Kaiser-Meyer-Olkin test verified the adequacy of the sample for the analysis with the value of KMO = .88. Bartlett's test of sphericity χ^2 (28) = 901.85 was significant (p < .001) and indicated that it was appropriate to apply a principal component analysis. A PCA with direct oblimin rotation was performed. The qualitative results of Nauts et al. (2019), suggested a theoretical model with three reasons for BP. However, PCA results showed that a three-factor solution is not suitable (i.e., analysis of the scree plot, third factor eigenvalue = .67). Considering these criteria and the conceptual meaningfulness of the items, data showed a solution with two factors, accounting for 62.14% of the variance. All items loaded rather acceptably (> .50) on the two factors, which can be appropriately referred to as (1) deliberate and mindless reasons and (2) strategic reasons. Table 3 presents the factor pattern and structure coefficients.

For group 2 (n = 330), CFA findings showed that, compared with a one-factor solution (MLRχ2 = 119.304; df = 21; CFI = .907; TLI = .877; RMSEA = .119; 90% CI [.099 - .141]; SRMR =.0665), the two-factor solution yielded a much better fit to the data (MLRχ2 = 36.464; df = 19; CFI = .984; TLI = .976 RMSEA = .053; 90% CI [.026 - .079]; SRMR = .0303) (see Table 4). Therefore, deliberate and mindless reasons, and strategic reasons for BP were empirically distinguishable for group 2. The PCA did not provide sufficient statistical support to justify testing a three-factor model in the CFA.

Since each of the eight items was specified to load on only one factor in the two-factor solution (deliberate/mindless reasons or strategic reasons), the structure coefficient estimated indicator–construct correlations (Kline, 2023). As displayed in Table 5, the standardized estimates for each of the eight indicators were substantively meaningful (ranging from .648 to .809), providing additional empirical support for convergent validity (Maruyama, 1997). Moreover, *average variance extracted* (AVE) and *composite reliability* (CR) values also provided empirical support for convergent validity. In fact, according to (Hair et al., 2010), AVE values equal to or greater than .50 and lower than CR indicate an adequate convergent validity. Finally, the estimated correlation between deliberate and mindless, and strategic reasons was .572, p < .001.

Table 3
Rotated Factor Pattern (Structure) Matrix for the RBPS

Item	Factor	
	1	2
Item 1	.708 (.739)	
Item 2	.834 (.813)	
Item 3	.655 (.718)	
Item 4	.856 (.806)	
Item 5	.820 (.829)	
Item 6		.791 (.819)
Item 7		.525 (.675)
Item 8		.860 (.812)

Note. Group 1 (n = 323). Factor 1 = Deliberate and mindless reasons; Factor 2 = Strategic reasons.

Concurrent and Predictive Validity

Table 6 shows the Pearson correlation coefficients of the relationships between the two factors of the RBPS and five relevant external measures (i.e., number of activities people enroll in before going to bed, BP, bedtime gap, fall asleep gap, and wake-up time gap). Data confirmed the hypothesis that both factors were positively and statistically related to the external measures.

Reliability

The means of the scale for the two groups combined (N = 653) were 2.62 (SD = .87) for deliberate and mindless reasons and 2.87 (SD = .93) for strategic reasons. The α coefficient for deliberate and mindless reasons was .85, and the corresponding ω_t coefficient was .85; the α coefficient for strategic reasons was .72, and the corresponding ω_t coefficient was .73. These reliability coefficients are considered good in measurement practice (Nunnally, 1978; Watkins, 2017). Item-total correlations for RBPS varied from .459 to .701, indicating good homogeneity.

Table 2
Descriptive of Observed Measures (N = 653)

	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis
RBPS	1	5				
RBPS (factor 1)	1	5	2.622	0.865	0.200	0.096
RBPS (factor 2)	1	5	2.872	0.925	0.121	-0.572
BP	1	5	3.110	0.853	-0.197	-0.803
Number of activities	0	12	4.649	2.222	0.405	-0.138
Bedtime gap	-1.00	5.50	1.426	1.107	0.923	0.993
Fall asleep time gap	-0.50	5.50	1.581	1.445	0.870	0.653
Wake-up time gap	-4.00	6.00	0.568	1.430	0.371	0.932

Table 4
Model Comparison for RBPS: Summary of Goodness-Of-Fit Indices

Models	MLRχ2	df	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR	AIC
One-factor model	119.304	21	.907	.877	.119	.099 - .141	.0665	149.304
Two-factor model	36.464	19	.984	.976	.053	.026 - .079	.0303	70.464

Note. Group 2 (n = 330). CI = confidence interval.

Table 5
Standardized Coefficients for the Two-Factor CFA Model of the RBPS

Latent construct	Item	β
Deliberate and mindless reasons	1	.674
	2	.723
	3	.732
	4	.774
	5	.809
	6	.782
Strategic reasons	7	.698
	8	.648

Note. Group 2 (n = 330); CR for deliberate and mindless reasons = .86; AVE for deliberate and mindless reasons = .55; CR for strategic reasons = .75; AVE for strategic reasons = .51.

Table 6
Pearson Correlations Between the RBPS and the five External Measures

External measures	RBPS	
	Deliberate and mindless reasons (effect size)	Strategic reasons (effect size)
BPS	.762*** (medium)	.560*** (medium)
Number of activities	.325*** (small)	.226*** (small)
Bedtime gap	.591*** (medium)	.449*** (small)
Fall asleep gap	.627*** (medium)	.487*** (small)
Wake-up time gap	.412*** (small)	.347*** (small)

Note. N = 653; ***$p < .001$.

Discussion

The present study aimed to develop and analyze the psychometric properties of the RBPS. Results indicated that RBPS has good psychometric quality regarding reliability (i.e., exhibits good α and ω_t coefficients) and validity evidence (e.g., positive relationship with number of activities individuals engage in before going to bed, BP, bedtime gap, fall asleep gap, and wake-up time gap). The scale was initially developed based on the three factors of reasons for delaying bedtime suggested by Nauts et al. (2019). However, PCA and CFA results showed that a two-factor solution yielded a better fit, i.e., deliberate and mindless reasons, and strategic reasons for BP. Moreover, the two-factor model has also shown a better fit than the one-factor model, i.e., items focused on deliberate/mindless reasons were saturated in one factor, and items focused on strategic reasons were saturated in a different factor. The deliberate/mindless reasons factor describes behavioral reasons for BP, such as engaging in leisure activities, chores at home, and work activities. In contrast, the strategic reasons factor describes cognitive-related reasons for bedtime delay, such as believing one cannot fall asleep unless one engages in a certain activity/delays going to bed (Nauts et al., 2019). These data reinforce the need for further research exploring the concept of procrastination associated with strategic delay. This BP reason has been distinguished from deliberate/mindless reasons, and it is not clear whether it should be considered a type of procrastination (Nauts et al., 2019).

Regarding concurrent validity, results confirmed the hypothesis that both factors of RBPS are positively associated with the number of activities people engage in before going to bed, BP, bedtime gap, fall asleep time gap, and wake-up time gap (Magalhães et al., 2020; Nauts et al., 2019; Oliveira et al., 2022). Pearson correlation coefficients were higher for the deliberate and mindless reasons factor than for the strategic reasons factor. Moreover, Pearson correlations with RBPS were low for the number of activities people engage in before going to bed and the wake-up time gap, medium for BP, the bedtime gap and fall-asleep time gap. These results are consistent with the literature showing that BP is associated with engaging in activities close to bedtime, especially studying and working, and translates to a shorter total sleep time, and a later waking up hour (Magalhães et al., 2020; Oliveira et al., 2022). Note that the effect size of the correlations between RBPS and bedtime and fall-asleep time gaps are slightly different, suggesting that the latter are distinct phenomena. These are preliminary findings, future research could consider further exploring these constructs; for example, investigating the differences between the bedtime and fall-asleep gaps (D'Angiulli et al., 2023; Oliveira et al., 2022). All considered, RBPS appears to represent a reliable way of assessing reasons for BP in the general adult population.

Moreover, this scale is expected to be helpful for practitioners in distinct areas. For example, health professionals (e.g., physicians and psychologists) could use the RBPS to assess the reasons for BP in their patients and design tailored interventions to decrease BP behaviors accordingly. Personalized interventions that consider individual characteristics are positively linked to more effective behavioral changes in participants (Jeoung et al., 2023; Strömmer et al., 2020; Suh et al., 2022). Moreover, this scale could also be used to evaluate the impact of educational interventions targeting sleep hygiene and routines. Researchers could also use the RBPS to explore further the relationships between the reasons to procrastinate bedtime and other variables likely to influence BP (e.g., co-sleeping, chronotype; (Herzog-Krzywoszanska & Krzywoszanski, 2019; Kadzikowska-Wrzosek, 2018).

Despite the present study's promising contribution, some limitations must be acknowledged. Caution must be taken when generalizing results because we did not have adequate representation of the population regarding some features, such as gender, race/ethnicity, and socioeconomic status. In fact, we did not have access to a random sample, and we did not control for sample bias recruitment. Most participants were women; therefore, there is a need to replicate the present study with a representative and balanced sample of women and men. This is relevant as research shows that women tend to procrastinate more at their bedtime than men (Herzog-Krzywoszanska & Krzywoszanski, 2019), being likely that the reasons behind this procrastination differ across genders. Still related to sample bias, validating the RBPS in other cultures could be

relevant, as the reasons for BP could differ from country to country (e.g., distinct norms regarding off-time work-related smartphone use after hours may impact differently BP-related outcomes (Hu et al., 2022). What is more, we did not measure the test-retest reliability of the RBPS to assess its stability over time. Thus, future studies could aim to include such measures. Another limitation is that we did not include a measure to test the divergent validity of our scale. Future studies could include additional measures to assess this aspect.

Overall, the deliberate and mindless reasons, and strategic reasons for BP are positively associated with the number of activities people engage in before going to bed, BP, bedtime gap, fall asleep time gap, and wake-up time gap. This study contributes to the literature by developing an instrument that allows capturing the reasons for BP irrespective of the nature of the activity with which the individual is engaged before bedtime. The RBPS will allow screening and grouping individuals into deliberate and mindless or strategic bedtime procrastinators, which will contribute to tailored interventions for the individuals' specific needs. Particularly, intervening directly on the underlying factors influencing BP instead of being focused on managing specific problematic behaviors individuals engage in before going to bed, could prevent the occurrence of non-adaptive compensatory behaviors (e.g., switching from problematic smartphone use to maladaptive work-related tasks).

Author Contributions

André Oliveira and Beatriz Pereira contributed equally to this work.

André Oliveira: Conceptualization, Data Curation, Investigation, Methodology, Software, Writing – Original Draft. **Beatriz Pereira:** Conceptualization, Formal Analysis, Investigation, Methodology, Software, Writing – Original Draft. **Camila Aguiar:** Investigation, Validation, Writing – Original Draft. **Pedro Rosário:** Funding, Project Administration, Resources, Supervision, Writing – Review and Editing. **Paula Magalhães:** Conceptualization, Investigation, Methodology, Project Administration, Resources, Supervision, Writing – Review and Editing.

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Declaration of Interests

The authors declare that there are no conflicts of interest. The funding agency had no role in the study's design and writing of the manuscript.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon request.

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