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# TYPOLOGIES OF WORK CONNECTIVITY BEHAVIOR AFTER HOURS AMONG UNIVERSITY TEACHERS: A CLUSTER ANALYSIS APPROACH

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***Abstract*—***The rapid integration of digital technologies has significantly impacted work connectivity behaviour after hours (WCB-AH), particularly among university teachers who navigate complex professional responsibilities. This study investigates the typologies of WCB-AH using a cluster analysis approach to identify distinct behavioural patterns and their implications for teachers' well-being, work-life balance, and productivity. The motivation for this research lies in addressing the challenges posed by blurred boundaries between work and personal life, especially for educators who face flexible yet demanding workloads. The main objective is to categorize teachers' after-hours connectivity behaviours into meaningful typologies to understand their varied effects on stress, recovery, and teaching outcomes. Employing cluster analysis as the primary methodology, the study classified behaviours into three distinct typologies: Always-On Workers, Balanced Responders, and Disconnectors. The analysis integrated variables such as frequency, duration, and psychological strain, alongside theoretical frameworks like Boundary Theory and the Conservation of Resources (COR) Theory. The findings reveal that Always-On Workers exhibit high stress and emotional exhaustion due to constant connectivity, Balanced Responders maintain moderate boundaries to manage stress effectively, and Disconnectors prioritize personal boundaries but may face professional isolation. The conclusion emphasizes the need for tailored interventions, highlighting the value of cluster analysis in understanding complex behaviours. Policy recommendations include implementing organizational guidelines to limit after-hours connectivity for Always-On Workers and fostering inclusive communication strategies to support Disconnectors, ensuring equitable professional engagement while safeguarding well-being.*

***Keywords— Boundary Theory, Cluster Analysis, Work Connectivity Behaviour After Hours (WCB-AH), Work-Life Balance***

## I. INTRODUCTION

The ever-increasing use of digital technologies and connectivity tools has blurred the boundaries between work and personal life, a phenomenon referred to as work connectivity behaviour after hours (WCB-AH). This behaviour includes activities such as responding to emails, instant messaging, and engaging in work-related tasks after regular working hours. Among university teachers, this trend has garnered growing attention due to their unique professional demands, which involve a mix of teaching, administrative, and research responsibilities (Bauwens et al., 2020). The purpose of this study is to explore the typologies of work connectivity behaviours after hours (WCB-AH) among university teachers using a cluster analysis approach. By identifying distinct behaviour patterns, this paper seeks to understand the implications of WCB-AH on teachers' work-life balance, mental health, and overall productivity. Work connectivity behaviour has been described as a double-edged sword on one hand, it promotes flexibility and facilitates responsiveness, while on the other hand, it can result in emotional exhaustion, stress, and reduced recovery time (Zhu et al., 2024; Leung & Choo, 2022). For university teachers, these behaviours can significantly impact their ability to disconnect from work, leading to spillover effects on their personal lives and relationships (He et al., 2023). This paper aims to shed light on how typologies of WCB-AH manifest within this profession, providing insights for policymakers and institutions to address its consequences effectively.

Existing literature has predominantly examined the general effects of after-hours work connectivity on employee well-being, often focusing on corporate settings (Zhu et al., 2024; Cheng et al., 2021). However, university teachers represent a unique professional group due to their flexible yet often overwhelming workloads. Their roles extend beyond traditional office hours, as they are expected to engage in digital communication, grading, research, and administrative responsibilities at irregular times (Virtanen, 2021). Despite the prevalence of WCB-AH among educators, limited studies have explored specific behavioural patterns or typologies within this context. Moreover, there is an insufficient focus on the analytical methodologies capable of identifying distinct clusters of behaviour. Most research in this domain adopts linear approaches, failing to account for the diversity of experiences and behavioural profiles among teachers (Khalid et al., 2022; Yao et al., 2024). To address this gap, the present study employs cluster analysis, a robust method for grouping individuals based on shared behavioural traits, to uncover typologies of work connectivity among university teachers. This approach provides a more nuanced understanding of how different types of teachers engage in WCB-AH and experience its effects.

The findings of this study are significant for several reasons. First, understanding typologies of WCB-AH can help educational institutions implement targeted interventions to mitigate the negative consequences of after-hours connectivity, such as emotional exhaustion, burnout, and family conflict (Leung &Choo, 2022; He et al., 2023). Second, the study contributes to the broader literature on work-life integration and boundary management theories by exploring how connectivity behaviours vary across different typologies (Zhu et al., 2024). Third, insights into these typologies will help inform policy recommendations, such as setting boundaries for digital communication after hours or offering training programs to promote healthier connectivity behaviours. The role of technology-mediated work has become increasingly critical in the post-pandemic context, where remote work and digital learning have intensified after-hours demands on teachers (Yao et al., 2024). By identifying typologies of WCB-AH, this study highlights the need for balanced use of digital tools to enhance productivity while minimizing their negative psychological and relational impacts (Wang et al., 2022; Khalid et al., 2022). Additionally, this study expands the discourse surrounding work-family conflict, a critical issue for teachers who struggle to maintain boundaries between professional and personal roles. To address the research question, the paper is structured as follows. Section 2 provides a review of the literature, exploring the concept of work connectivity behaviours, their impact on university teachers, and the theoretical frameworks underpinning this study. Section 3 outlines the proposed methodological approach, focusing on cluster analysis as a means to identify typologies of WCB-AH. Section 4 discusses the implications of these typologies for teachers' well-being and institutional practices. Finally, Section 5 concludes the paper by summarizing key findings and offering recommendations for future research and practice.

## II. LITERATURE REVIEW

*Work Connectivity Behaviour*

Work connectivity behaviour (WCB) refers to the extent to which employees engage in work-related tasks and communications beyond their regular working hours. This behaviour often involves checking emails, attending virtual meetings, responding to messages, or engaging in professional tasks outside standard office hours using digital tools and communication technologies (Nurmi & Hinds, 2020; Büchler et al., 2020). Such connectivity behaviours are largely facilitated by the widespread use of smartphones, laptops, and ubiquitous internet access, which blur the boundaries between personal and professional life. Work connectivity is categorized into two main forms: voluntary connectivity and imposed connectivity. Voluntary connectivity occurs when employees choose to engage with work after hours due to personal or professional reasons (Chen & Casterella, 2018). In contrast, imposed connectivity stems from organizational expectations or leadership workaholism that demand constant availability (Dong et al., 2022). These behaviours, although increasing productivity, can conflict with psychological detachment a necessary process for mental recovery and work-life balance (Wang et al., 2023).

*Work-Life Boundary Theory and Technology-Mediated Work*

The work-life boundary theory explains how individuals manage boundaries between their professional and personal lives. It proposes that workers adopt either integration or segmentation preferences (Wang et al., 2023). Individuals with integration preferences are more likely to allow work-related connectivity to intrude on their personal time, while those with segmentation preferences actively resist after-hours work demands. Technology-mediated work exacerbates these boundary challenges. Digital technologies enable instant communication but reduce opportunities for psychological detachment, which is critical for maintaining well-being (Chen & Casterella, 2018). For instance, frequent use of work-related communication tools outside work hours can lead to work-leisure conflict and increased psychological distress (Dong et al., 2022; Wang et al., 2023).

Cheng et al. (2022) emphasize that perceived organizational support and psychological entitlement moderate the effects of WCB. Employees who feel supported by their organization are less likely to experience negative consequences, whereas those with high psychological entitlement are more vulnerable to dissatisfaction due to constant connectivity demands. Several studies have highlighted the impacts of WCB. For example, Nurmi and Hinds (2020) demonstrated that higher connectivity demands are associated with reduced job satisfaction and increased psychological stress. Similarly, Büchler et al. (2020) found that constant connectivity negatively affects employees' well-being, particularly for individuals with low coping mechanisms. Additionally, Wang et al. (2023) reported that daily WCB leads to work-leisure conflict, particularly among employees unable to detach from work tasks during personal time.

TABLEI
SUMMARY OF KEY STUDIES ON WORK CONNECTIVITY BEHAVIOUR

| **Study** | **Focus** | **Key Findings** |
|---|---|---|
| Nurmi & Hinds (2020) | Connectivity demands and psychological outcomes | High demands increase stress and reduce job satisfaction. |
| Büchler et al. (2020) | Constant connectivity and employee well-being | Constant connectivity decreases well-being, especially for low-resilience individuals. |
| Dong et al. (2022) | Leadership workaholism and WCB | Leader workaholism exacerbates work-family conflict and psychological distress. |
| Wang et al. (2023) | WCB and work-leisure conflict | Daily WCB disrupts psychological detachment, leading to work-leisure conflict. |
| Cheng et al. (2022) | Moderating role of organizational support | Perceived organizational support mitigates negative WCB outcomes. |
| Chen & Casterella (2018) | Technological antecedents of WCB | Ubiquitous technology facilitates connectivity but hinders detachment. |

*Impact of Connectivity on University Teachers*

University teachers face unique professional challenges, including flexible yet demanding workloads, expectations of constant availability, and the pressure to balance teaching, research, and administrative tasks (Taylor et al., 2018; Bahinting et al., 2022). Unlike traditional office workers, university teachers often work outside regular hours to accommodate grading, preparing lectures, and responding to student queries. The post-pandemic shift toward online education has exacerbated these challenges, as teachers must remain digitally connected to deliver lectures, manage virtual classrooms, and resolve technical issues. This heightened connectivity has led to increased work-related stress and decreased opportunities for psychological recovery (Saria Khalid et al., 2023).

After-hours connectivity can result in significant negative consequences for university teachers, including burnout, work-family conflict, and psychological stress. Mercado-Varela et al. (2017) noted that constant connectivity disrupts teachers' ability to maintain work-life balance, leading to exhaustion and diminished job satisfaction. Similarly, Bahinting et al. (2022) highlighted that persistent internet connectivity creates an overwhelming sense of "always-on" work, which limits teachers' ability to disconnect and recover. Burnout among teachers is particularly concerning, as it can negatively impact their effectiveness in teaching and research. Salvagno et al. (2015) reported that technology-mediated connectivity increases stress levels and hinders teachers' overall well-being. Furthermore, constant availability often leads to work-family conflict, as teachers struggle to allocate time for personal relationships and responsibilities (Taylor et al., 2018; Bahinting et al., 2022).

Despite the negative outcomes, WCB can also yield positive impacts, such as improved efficiency, responsiveness, and professional development. Haythornthwaite (2019) emphasized that digital connectivity allows teachers to collaborate with colleagues, share resources, and engage in continuous learning. Similarly, Salvagno et al. (2015) observed that teachers who embrace connectivity tools can enhance their teaching effectiveness and remain updated on technological advancements. Connectivity enables greater flexibility, allowing teachers to manage their workloads at their own pace. For instance, Mercado-Varela et al. (2017) found that some teachers viewed after-hours connectivity as an opportunity to stay organized and respond promptly to student needs. However, these benefits are contingent on teachers' ability to maintain healthy boundaries and avoid excessive connectivity demands.

Table II
SUMMARY OF IMPACTS OF WCB ON UNVERSITY TEACHERS

| Impact | Description | Supporting Studies |
|---|---|---|
| Burnout | Emotional exhaustion caused by excessive connectivity demands. | Bahinting et al. (2022); Salvagno et al. (2015) |
| Work-Family Conflict | Difficulty balancing professional and personal responsibilities. | Taylor et al. (2018); Bahinting et al. (2022) |
| Psychological Stress | Increased stress due to inability to disconnect after hours. | Mercado-Varela et al. (2017); Saria Khalid et al. (2023) |
| Improved Efficiency | Enhanced ability to complete tasks and respond promptly. | Haythornthwaite (2019); Salvagno et al. (2015) |
| Professional Growth | Greater opportunities for collaboration, learning, and resource sharing. | Haythornthwaite (2019); Mercado-Varela et al. (2017) |

*Typologies of Work Connectivity Behaviour*

Typologies represent the classification of individuals or behaviours into distinct categories based on shared characteristics or patterns. In the context of work connectivity behaviour after hours (WCB-AH), typologies help distinguish how individuals engage in after-hours work-related activities, such as responding to emails, participating in virtual meetings, or interacting with colleagues. These typologies are essential for understanding how employees' behaviours vary and the extent to which these variations influence work-life balance, well-being, and overall job satisfaction. Studies have shown that employees exhibit different connectivity habits depending on their personal preferences, organizational demands, and psychological coping strategies (Hu, Kuang, & Lu, 2024; Fan, Dong, & Wang, 2024). For example, individuals with a strong preference for work-life segmentation tend to resist work connectivity demands after hours, while those with weaker boundaries or higher perceived professional obligations often remain constantly connected, leading to emotional exhaustion.

Previous research has emphasized the diversity of behavioural patterns in connectivity. Hu et al. (2024) explored the emotional exhaustion caused by WCB-AH, noting that employees with poor psychological detachment and lower segmentation preferences experience heightened fatigue and stress. Similarly, Fan et al. (2024) identified that employees' connectivity behaviours influence their ability to engage in job crafting activities, such as modifying work tasks or interactions to improve performance. By understanding such typologies, organizations can recognize that employees respond differently to after-hours work demands, and one-size-fits-all policies for managing connectivity behaviours may not be effective. Instead, identifying clusters of behaviours allows for more tailored interventions to minimize adverse consequences while maximizing the benefits of flexible work practices.

The concept of typologies is further strengthened in the work of Lihualei and Arshad (2024), who conducted a literature review of WCB-AH and identified three major behavioural types: high-connectivity users, moderate-connectivity users, and low-connectivity users. High-connectivity users remain consistently available and engaged in work-related activities outside regular hours, often to meet organizational expectations or professional demands. These employees are more likely to experience emotional exhaustion and work-family conflict due to the lack of psychological detachment. In contrast, moderate-connectivity users maintain a balance by engaging in connectivity selectively, often based on specific requirements or emergencies. On the other end of the spectrum, low-connectivity users prioritize personal boundaries and actively disconnect from work after hours to preserve their well-being. This categorization provides a foundation for understanding how diverse behavioural patterns emerge based on individual preferences, organizational culture, and technological accessibility.

Research by Li, Chen, Wang, and Bao (2024) sheds further light on the consequences of WCB-AH by introducing a "reactive disconnector" typology. Their study revealed that employees often resort to time banditry a behaviour where individuals compensate for excessive after-hours connectivity by reducing their productivity during official working hours. This behaviour serves as a coping mechanism to regain control over their time and energy, reflecting the adverse psychological impact of constant

connectivity. Similarly, Vayre and Vonthron (2019) highlighted the problematic use of internet connectivity for work-related tasks and its associations with reduced work-home balance and increased stress. Their findings emphasized the importance of addressing connectivity demands to prevent employees from developing unhealthy coping behaviours.

The identification of typologies allows for a deeper understanding of the complexity of WCB-AH and its impacts. High-connectivity users may exhibit greater professional responsiveness and efficiency but are also at greater risk of burnout, while moderate and low-connectivity users may benefit from better work-life balance but face challenges in meeting organizational expectations for availability. Recognizing these typologies underscores the importance of tailored strategies to address after-hours connectivity, ensuring that employees' well-being and performance are simultaneously prioritized.

*Typologies in Prior Research*

The role of typologies in understanding work behaviours has been explored extensively in recent research. Studies have demonstrated that individuals' connectivity behaviours differ based on factors such as personal preferences, organizational support, and coping strategies. For example, Hu et al. (2024) examined how segmentation preference moderates the relationship between WCB-AH and emotional exhaustion, finding that employees with a stronger preference for boundaries experience fewer negative consequences. Similarly, Lihualei and Arshad (2024) emphasized that connectivity behaviours are not uniform across employees, and recognizing these differences can provide valuable insights into managing after-hours work demands.

Fan et al. (2024) extended this understanding by incorporating the concept of job crafting, demonstrating that employees who engage in high levels of connectivity after hours often exhibit proactive behaviours aimed at improving their work processes. However, these benefits are offset by increased psychological strain, highlighting the dual-edged nature of WCB-AH. In contrast, Li et al. (2024) introduced a behavioural typology where employees who experience excessive connectivity resort to time banditry as a form of self-regulation. These studies collectively highlight the importance of identifying behavioural clusters to develop strategies that balance professional responsiveness with individual well-being. To synthesize these findings, Table 1 summarizes key typologies of WCB-AH identified in previous research, illustrating the behavioural patterns and associated consequences.

TABLE III
SUMMARY OF TYPOLOGIES OF WORK CONNECTIVITY BEHAVIOUR

| **Typology** | **Description** | **Consequences** | **Authors** |
|---|---|---|---|
| High-Connectivity Users | Employees who remain constantly connected after hours. | Emotional exhaustion, stress, work-family conflict. | Hu et al. (2024); Tao et al. (2023) |
| Moderate-Connectivity Users | Employees who engage selectively in after-hours connectivity. | Balanced work-life integration, occasional stress. | Lihualei & Arshad (2024); Fan et al. (2024) |
| Low-Connectivity Users | Employees who actively disconnect to maintain personal boundaries. | Improved well-being, risk of professional isolation. | Lihualei & Arshad (2024); Vayre & Vonthron (2019) |
| Reactive Disconnectors | Employees who engage in time banditry to compensate for WCB-AH. | Reduced productivity, psychological coping. | Li et al. (2024); Fan et al. (2024) |

*Cluster Analysis in Behavioural Research*

Cluster analysis is a statistical method used to group individuals or behaviours into meaningful categories based on shared characteristics. It is widely applied in behavioural research to identify patterns in data without requiring predefined group labels. By classifying individuals into clusters, researchers can uncover hidden relationships and gain deeper insights into complex behavioural phenomena. In the context of work connectivity behaviour, cluster analysis enables the identification of distinct behavioural profiles that reflect employees' connectivity preferences, coping mechanisms, and psychological outcomes (Landau & Ster, 2010; Blashfield & Aldenderfer, 1978). This method is particularly valuable for understanding WCB-AH, where behaviours vary widely among individuals and exhibit non-linear relationships with psychological and occupational outcomes. The significance of cluster analysis lies in its ability to handle complex datasets and reveal behavioural patterns that are not immediately evident through traditional linear approaches. For example, Hofstetter et al. (2014) used cluster analysis to identify co-occurring risk behaviours among individuals, highlighting its potential for uncovering nuanced patterns. Similarly, Battaglia, Di Paola, and Fazio (2016) applied cluster analysis in education research to classify student behaviours, demonstrating its utility in identifying diverse learning strategies and preferences. These studies illustrate the flexibility of cluster analysis as a tool for exploring behavioural diversity and developing targeted interventions.

In studies on work behaviours, cluster analysis has been widely used to identify distinct employee profiles based on connectivity habits, coping mechanisms, and psychological responses. Tao et al. (2023) applied cluster analysis to investigate the relationship between WCB-AH and turnover intentions, identifying multiple clusters with varying levels of connectivity and associated risks. Their findings revealed that employees in high-connectivity clusters were more likely to experience burnout and turnover intentions, whereas those in low-connectivity clusters reported better work-life balance. Similarly, Fan et al. (2024) utilized cluster analysis to explore the impact of WCB-AH on job crafting behaviours, identifying behavioural adaptations based on employees' connectivity patterns. These studies highlight the value of cluster analysis in uncovering behavioural profiles that inform organizational policies and interventions. Juengst et al. (2017) further demonstrated the applicability of cluster analysis in identifying behavioural symptoms among individuals with traumatic brain injuries, providing insights into personalized treatment strategies. This approach underscores the versatility of cluster analysis in behavioural research, where diverse factors interact to produce complex outcomes. By applying cluster analysis to WCB-AH, this study aims to identify meaningful behavioural clusters among university teachers, offering insights into how different connectivity patterns influence their well-being, productivity, and work-family balance. The utility of cluster analysis in this context is evident, as it allows researchers to move beyond generalized findings and identify specific behavioural groups that reflect employees' lived experiences. This method is particularly suitable for exploring the heterogeneity of work connectivity behaviours, where individual differences in segmentation preferences, coping strategies, and organizational support play a significant role.

TABLE IV
SUMMARY OF CLUSTER ANALYSIS APPLICATIONS IN BEHAVIOURAL RESEARCH

| **Study** | **Application** | **Key Findings** |
|---|---|---|
| Blashfield & Aldenderfer (1978) | Introduction to cluster analysis methodology | Cluster analysis effectively groups individuals into categories. |
| Hofstetter et al. (2014) | Co-occurrence of risk behaviours | Identified clusters with specific behavioural risks. |
| Battaglia et al. (2016) | Behavioural classification in education | Revealed diverse student learning behaviours. |
| Juengst et al. (2017) | Behavioural symptoms in neuropsychology | Identified behavioural clusters for targeted treatment. |
| Tao et al. (2023) | WCB-AH and turnover intentions | Uncovered clusters with varying connectivity levels and risks. |
| Fan et al. (2024) | WCB-AH and job crafting | Highlighted behavioural adaptations based onconnectivity levels. |

## III. PROPOSED FRAMEWORK

*Theoretical Basis*

The proposed framework for analyzing the typologies of Work Connectivity Behaviour After-Hours (WCB-AH) among university teachers is grounded in two key theories: Boundary Theory and the Conservation of Resources (COR) Theory. These theories provide a conceptual foundation to explain how university teachers navigate the boundary between work and personal life and allocate their psychological and physical resources in the face of connectivity demands after work hours. The Boundary Theory posits that individuals manage the boundaries between work and personal life through segmentation and integration preferences (Wang, Zhang, & Shi, 2023). Those with segmentation preferences aim to maintain clear boundaries, disconnecting from work after hours to protect their personal time. In contrast, individuals with integration preferences permit the permeability of these boundaries, engaging in after-hours connectivity and work-related tasks. This theory is highly relevant for understanding university teachers' connectivity behaviours, as their flexible and often demanding workloads encourage blurred boundaries between professional and personal roles (Fan, Dong, & Wang, 2024).

University teachers often face role ambiguity as their teaching, research, and administrative tasks extend beyond typical work hours. For those with integration tendencies, technological advancements further enable them to remain "always-on" to meet students' and institutional demands (Hu, Kuang, & Lu, 2024). However, the lack of segmentation can result in work-family conflict, emotional exhaustion, and reduced recovery time, particularly for teachers unable to establish psychological detachment (Vayre & Vonthron, 2019). On the other hand, teachers with strong segmentation preferences actively disengage from after-hours

work, preserving personal boundaries and promoting their well-being, albeit sometimes risking perceptions of unavailability or inefficiency.

The Conservation of Resources (COR) Theory emphasizes how individuals strive to acquire, maintain, and protect valuable resources, including time, energy, and emotional well-being (Li, Chen, Wang, & Bao, 2024). When these resources are depleted due to excessive after-hours connectivity, individuals experience stress, burnout, and diminished performance. The COR theory is particularly relevant for analyzing how university teachers allocate their limited resources in response to connectivity demands. Teachers who engage in excessive WCB-AH are at risk of resource depletion, as constant availability hinders their ability to recover and maintain psychological and emotional balance (Hu et al., 2024; Fan et al., 2024). The theory also provides insights into coping mechanisms used to manage resource loss. For example, reactive disconnectors compensate for resource depletion through behaviours like time banditry, reducing productivity during formal working hours as a self-preservation strategy (Li et al., 2024). Alternatively, teachers with strong segmentation preferences actively protect their resources by disconnecting from work after hours, enabling recovery and maintaining long-term well-being. This theoretical grounding allows for a nuanced understanding of how different connectivity behaviours affect university teachers' resource management, work-life balance, and psychological outcomes.

*Typology Development*

The development of typologies for WCB-AH among university teachers is central to the proposed framework. Typologies represent distinct categories of connectivity behaviours that reflect teachers' preferences, coping strategies, and resource management patterns. By using a cluster analysis approach, the study aims to identify behavioural clusters that reveal varying degrees of after-hours connectivity and their associated consequences. The proposed typologies are as follows:

1. Highly Connected (Always-On): Teachers in this category engage in constant connectivity after hours, responding to emails, messages, and administrative tasks without boundaries. Their behaviours are often driven by organizational expectations, personal perfectionism, or the belief that continuous availability improves performance (Hu et al., 2024). While highly connected teachers may demonstrate high responsiveness and professional engagement, their lack of psychological detachment increases the risk of emotional exhaustion, burnout, and work-family conflict (Fan et al., 2024; Li et al., 2024).

2. Moderately Connected (Selective Responders): Moderately connected teachers exhibit selective connectivity, engaging in after-hours work only when necessary. These teachers strike a balance between professional demands and personal well-being by responding to urgent or high-priority tasks while avoiding non-essential work outside formal hours. This behaviour reflects a moderate level of integration, enabling teachers to maintain some boundaries while addressing critical tasks (Tao et al., 2023). Although this group experiences occasional stress, their ability to establish boundaries promotes better resource preservation and work-life balance compared to highly connected teachers (Lihualei& Arshad, 2024).

3. Rarely Connected (Disconnected): Teachers in this category actively avoid after-hours connectivity to preserve their personal time and boundaries. Their behaviours align closely with strong segmentation preferences, as they prioritize psychological detachment and recovery (Vayre & Vonthron, 2019). While disconnected teachers benefit from improved well-being, reduced stress, and stronger work-family balance, they may face challenges such as perceptions of unavailability or lack of commitment (Hu et al., 2024). This group demonstrates the importance of boundary management for resource conservation and long-term well-being.

4. Reactive Disconnectors: Reactive disconnectors represent a unique typology characterized by compensatory behaviours. These individuals engage in high levels of connectivity after hours due to external demands but later reduce their productivity during formal working hours as a coping mechanism to recover lost resources (Li et al., 2024). Reactive disconnectors exhibit signs of resource depletion and stress, highlighting the negative consequences of excessive WCB-AH. This typology underscores the need for organizational interventions to address unsustainable connectivity demands and promote healthier work practices.

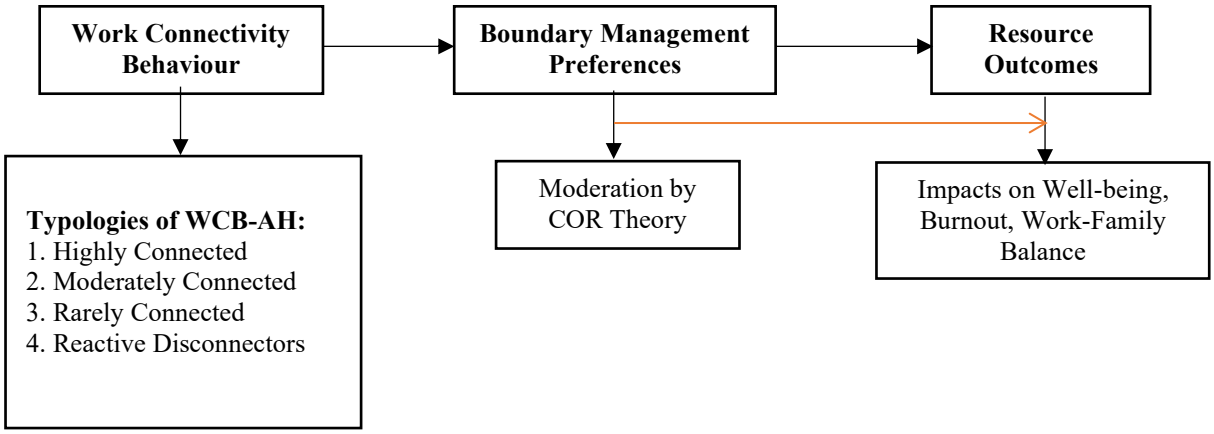
TABLEV SUMMARY OF PROPOSED TYPOLOGIES

| Typology | Behavioural Characteristics | Implications | Supporting Authors |
|---|---|---|---|
| Highly Connected (Always-On) | Constantly connected and responsive after hours. | High responsiveness, emotional exhaustion, burnout. | Hu et al. (2024); Fan et al. (2024) |

| | | | |
|---|---|---|---|
| Moderately Connected (Selective Responders) | Selective connectivity based on urgency. | Balanced work-life integration, occasional stress. | Tao et al. (2023); Lihualei & Arshad (2024) |
| Rarely Connected (Disconnected) | Actively avoids after-hours work to maintain boundaries. | Improved well-being, risk of perceived unavailability. | Vayre & Vonthron (2019); Hu et al. (2024) |
| Reactive Disconnectors | Compensates for after-hours connectivity by disengaging during work hours. | Resource depletion, stress, reduced formal productivity. | Li et al. (2024); Fan et al. (2024) |

*Conceptual Model for Analysis*

The proposed framework integrates the Boundary Theory and COR Theory to analyze the typologies of WCB-AH among university teachers. The framework recognizes that connectivity behaviours arise from individual preferences, organizational demands, and coping mechanisms, which influence teachers' ability to manage boundaries and conserve psychological resources. The typologies highly connected, moderately connected, rarely connected, and reactive disconnectors reflect diverse patterns of connectivity and resource allocation.




The conceptual model, as illustrated in Figure 1, demonstrates the relationship between connectivity behaviours, boundary management preferences, and resource conservation outcomes.

## IV. METHODOLOGICAL FRAMEWORK

*Cluster Analysis Steps*

The preparation of data remains the foundation for conducting cluster analysis and interpreting work connectivity behaviours. Variables such as frequency of connectivity (number of interactions per week), duration (total time spent engaging in work-related tasks after hours), and psychological stress levels are critical in understanding how university teachers manage their work connectivity. Other metrics like emotional exhaustion, work-family conflict, and perceived job satisfaction offer deeper insights into how connectivity affects teachers' personal and professional lives (Hofstetter et al., 2014; Blashfield & Aldenderfer, 1978). For instance, a teacher who frequently checks emails late at night is likely to experience greater emotional exhaustion compared to a peer who disconnects completely after hours. Data sources such as self-reported surveys, time logs, or automated digital activity trackers can help capture the variables systematically. Teachers may be asked to record how often they engage in after-hours work, how long the connectivity persists, and how stressful they perceive these activities. Once collected, the data undergoes preprocessing steps like normalization to ensure that variables are comparable on a unified scale, as differences in scales could bias the clustering outcome (Landau & Ster, 2010).

*Algorithm Selection*

The K-means clustering method is suitable for analyzing large behavioural datasets, as it efficiently classifies participants into predefined clusters based on shared characteristics. This approach minimizes intra-cluster variability by grouping individuals who

exhibit similar connectivity behaviours. For example, university teachers with high levels of connectivity and elevated stress would fall into one cluster, while those who avoid connectivity would form another distinct group (Battaglia, Di Paola, & Fazio, 2016). For validation, hierarchical clustering can complement K-means to produce a dendrogram, visually illustrating the relationships between different clusters and their proximity to one another (Landau & Ster, 2010).

1. The Always-On Workers

The Always-On Workers typology represents teachers who remain constantly connected to work after hours. These individuals are highly responsive to work-related communications, including emails, virtual meetings, and administrative requests, regardless of the time of day. Data for this cluster would show high frequency of connectivity, exceeding 15 instances per week, and long durations of engagement, sometimes extending for several hours each day. While these teachers may appear highly productive and committed, their behaviour comes at a significant cost to their mental health and personal lives (Juengst et al., 2017; Hofstetter et al., 2014). Teachers in this group often face severe emotional exhaustion and work-family conflict due to the lack of psychological detachment from work tasks. The Conservation of Resources (COR) Theory explains this outcome as a consequence of resource depletion, where constant connectivity erodes individuals' energy, emotional resources, and ability to recover (Li et al., 2024). The pressure to remain "always available" may stem from institutional expectations, professional perfectionism, or the increasing digitization of education systems. A notable challenge for Always-On Workers is their inability to disengage, which prevents adequate recovery and increases the risk of burnout. For instance, a teacher responding to student emails late at night might face fatigue the next morning, leading to decreased teaching effectiveness and personal dissatisfaction. Although this typology may initially improve perceived productivity, the long-term consequences include poor mental health, strained family relationships, and diminished job satisfaction.

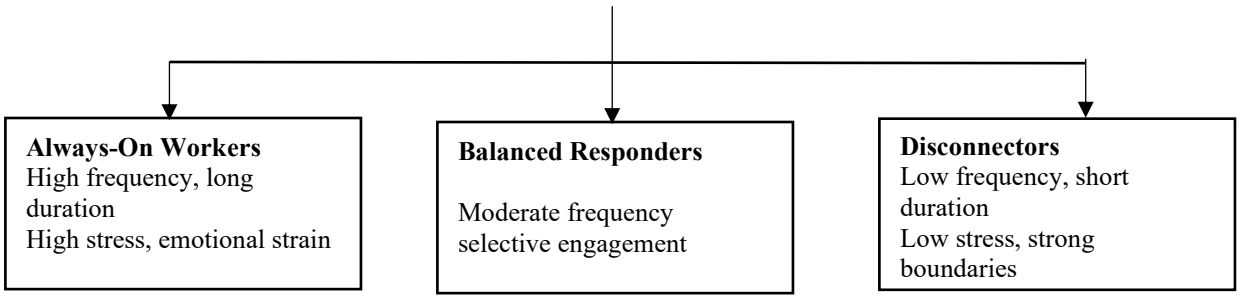
2. The Balanced Responders

The Balanced Responders typology includes teachers who adopt a moderate and selective approach to work connectivity after hours. These individuals engage in connectivity based on urgency, necessity, or importance, ensuring that they address critical tasks while maintaining clear boundaries to preserve their personal time. Data for this cluster would show a moderate frequency of connectivity (approximately 5–10 instances per week) and shorter durations compared to Always-On Workers. The stress levels reported by Balanced Responders are moderate, reflecting their ability to balance professional and personal demands effectively (Battaglia et al., 2016; Landau & Ster, 2010). Balanced Responders exemplify integration preferences, as proposed by Boundary Theory, where work and personal life intersect to an extent but do not fully permeate one another. For instance, a teacher might respond to a time-sensitive email from a student but refrain from engaging in non-urgent administrative tasks during personal time. This selective behaviour allows teachers to retain control over their work connectivity and ensures that they prioritize well-being and recovery. The Balanced Responders typology highlights the importance of boundary management strategies. By recognizing their limits, these teachers reduce the risk of emotional exhaustion while remaining professionally responsive. Their approach reflects a healthy compromise that aligns institutional demands with personal well-being. Although they may face occasional stress or work-family conflicts, their ability to prioritize and disconnect when necessary fosters better psychological health and work-life satisfaction.

3. The Disconnectors

The Disconnectors cluster represents teachers who actively avoid after-hours connectivity to prioritize personal boundaries, recovery, and well-being. Teachers in this group exhibit low frequency of connectivity (fewer than 3 instances per week) and short durations of engagement. They maintain strong segmentation preferences, ensuring that work tasks do not intrude on their personal time (Landau & Ster, 2010; Juengst et al., 2017). Teachers in this category report low levels of stress and significantly better psychological detachment compared to the other clusters. By disconnecting entirely from work after hours, they create opportunities for resource recovery, which aligns with the principles of COR Theory. This typology illustrates the benefits of maintaining clear boundaries, as Disconnectors often experience improved mental health, reduced emotional exhaustion, and stronger family relationships. However, while Disconnectors prioritize personal well-being, they may face challenges in professional contexts. Their deliberate disconnection could be perceived as unresponsiveness or lack of commitment, especially in environments where after-hours connectivity is normalized. For instance, a teacher who avoids responding to urgent emails during weekends may risk negative perceptions from colleagues, students, or administrators. Despite this, the Disconnectors' behaviour underscores the importance of advocating for sustainable work practices and institutional support to reduce the pressures of after-hours connectivity.

Work Connectivity Behaviour After Hours




The three hypothetical clusters Always-On Workers, Balanced Responders, and Disconnectors represent distinct behavioural patterns of work connectivity after hours among university teachers. These typologies illustrate the varying levels of engagement, stress, and boundary management preferences that influence teachers' well-being and professional outcomes. Understanding these clusters provides valuable insights for institutions to implement targeted strategies that promote healthier connectivity practices, reduce emotional exhaustion, and support work-life balance.

## V. DISCUSSION

*Implications for University Teachers*

The findings of this study reveal three distinct typologies of work connectivity behaviour after hours Always-On Workers, Balanced Responders, and Disconnectors each with unique implications for university teachers' work-life balance, mental health, and teaching productivity. The Always-On Workers typology, characterized by constant connectivity and high responsiveness, demonstrates a significant negative impact on work-life balance and mental health. Teachers in this group often struggle with emotional exhaustion and psychological strain due to the inability to disengage from work tasks, as described by the Conservation of Resources (COR) Theory. The persistent demands for availability after working hours deplete their emotional and cognitive resources, leaving them with limited capacity for recovery. This lack of psychological detachment not only diminishes their personal well-being but also hampers teaching productivity, as fatigue and burnout impair focus, creativity, and engagement in the classroom.

In contrast, the Balanced Responders represent a healthier typology, as they adopt a selective and moderate approach to after-hours connectivity. Their ability to prioritize urgent tasks while maintaining boundaries allows for better resource management and improved mental health. By balancing professional obligations with personal recovery time, Balanced Responders achieve greater work-life harmony, which supports sustained productivity and teaching effectiveness. Although occasional stress may arise when balancing connectivity demands, their overall ability to maintain boundaries reduces the risk of burnout and fosters a healthier long-term engagement with their work. The Disconnectors, on the other hand, actively avoid work-related connectivity after hours to protect their personal time and well-being. This typology aligns with the preferences for strong segmentation as proposed in Boundary Theory, where clear boundaries between work and home roles allow for better psychological detachment. Disconnectors benefit from reduced stress levels and higher overall well-being compared to their Always-On counterparts. However, this behaviour may inadvertently impact perceptions of professional availability, particularly in environments where after-hours connectivity is normalized. Disconnected teachers may face exclusion from critical communications, which could undermine their ability to collaborate effectively, keep up with institutional developments, or respond promptly to students' needs.

*Practical Recommendations*

To address the challenges associated with these typologies, practical interventions should focus on promoting healthier connectivity behaviours while maintaining professional inclusivity. For Always-On Workers, institutions should implement clear policies that encourage work-life boundaries. Organizational initiatives such as limiting after-hours email expectations, introducing communication-free periods, or establishing guidelines for urgent communications can help teachers disengage from work. Providing professional development workshops on boundary management and psychological detachment can further support these teachers in recognizing the importance of recovery time. Additionally, fostering a workplace culture that values well-being and detachment will reduce the implicit pressure to remain constantly available. For Disconnected teachers, it is equally important to ensure fair communication practices that prevent exclusion while respecting their boundaries. Institutions can promote scheduled communications, where work-related updates are shared during designated hours to accommodate varying

connectivity preferences. Encouraging collaboration through well-structured, synchronous platforms and shared team calendars ensures that disconnected teachers remain informed and engaged without compromising their work-life balance. Fair and transparent communication systems reduce the risk of isolating teachers who prioritize disconnection while supporting inclusivity and team cohesion.

*Theoretical Contributions*

This study makes significant theoretical contributions by extending Boundary Theory to the context of university teachers. Previous applications of this theory have focused primarily on corporate employees, but the unique nature of university teachers' workloads characterized by flexible yet demanding professional obligations necessitates a more nuanced understanding of work-life boundary management. By identifying distinct typologies of connectivity behaviours, this research demonstrates how university teachers negotiate their boundaries in response to institutional demands and personal preferences. The findings underscore that segmentation and integration preferences are not uniform across individuals; rather, they reflect a spectrum of behaviours influenced by both organizational and psychological factors. Furthermore, this study highlights the value of cluster analysis as a methodological approach for behavioural research. Traditional linear models often fail to capture the complexity and variability of after-hours connectivity behaviours, whereas cluster analysis allows for the identification of meaningful behavioural patterns. By uncovering the typologies of Always-On Workers, Balanced Responders, and Disconnectors, this study showcases the utility of cluster analysis in classifying heterogeneous behaviours into interpretable and actionable groups. This methodological contribution demonstrates that behavioural research can benefit significantly from advanced analytical techniques that account for individual differences and underlying patterns.

## VI. CONCLUSION

This paper has contributed significantly to understanding work connectivity behaviour after hours (WCB-AH) by identifying distinct typologies among university teachers: Always-On Workers, Balanced Responders, and Disconnectors. These typologies illustrate the varying degrees to which teachers engage with work-related activities outside regular hours, reflecting differences in their stress levels, work-life balance, and professional productivity. By categorizing these behaviours, the study highlights how connectivity patterns are not uniform but instead are shaped by individual preferences, institutional expectations, and coping mechanisms. This nuanced understanding provides a foundation for developing tailored interventions to promote healthier connectivity practices. The application of cluster analysis as an analytical method in this study underscores its value in behavioural research. Unlike traditional approaches that often assume homogeneity, cluster analysis effectively captures the complexity and diversity of connectivity behaviours, enabling the classification of teachers into meaningful and interpretable groups. This methodological contribution advances research on work-life boundaries by demonstrating the importance of data-driven techniques for identifying behavioural patterns. Finally, the study offers both practical and theoretical insights. Institutions can utilize these findings to design policies that support sustainable connectivity practices, while the extension of Boundary Theory to university teachers enriches the theoretical discourse on managing professional boundaries in flexible yet demanding work environments.

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