



Selective attention as an indicator for qualification for routine knowledge work in public long-distance trains and single offices

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Abstract

Aim The growing prevalence of mobile knowledge work in trains and flexible office environments introduces new demands on employees' individual skills and performance.

Subject and methods This study aimed to examine whether selective attention can serve as an indicator of performance and mental workload in routine knowledge work across different work environments. A total of 52 participants completed standardized routine tasks (email categorization, phone calls) for 2 h in both an InterCity Express train environment and a single office. Task performance was measured by correctly processed tickets, while mental workload was assessed at 10-min intervals using a self-report scale. Selective attention was measured afterward with the Vienna Test System.

Results Results show that higher levels of selective attention were significantly associated with better performance in both environments, with a stronger effect observed in the single office. Selective attention, however, did not influence mental workload, which in turn negatively correlated with performance in the single office setting.

Conclusion These findings suggest that selective attention is a reliable indicator of performance in routine knowledge work but not of mental workload. Future research should explore alternative measures of selective attention and extend the analysis to other types of knowledge work to refine aptitude diagnostics for mobile work contexts.

Keywords Selective attention · Work performance · Mobile work · Cognitive ergonomics · Routine work · Work environment

Introduction

In recent decades, mobile knowledge work has become increasingly important. More employees are taking advantage of the chance to work remotely, whether during commutes on public transportation or in flexibly designed office environments. This trend not only offers benefits like greater flexibility but also introduces new demands on work design and the individual skills of employees (Arlinghaus 2017).

Mobile knowledge work involves activities where knowledge is generated, processed, and applied, and can be

performed independently of location, such as during commuting or at various workplaces (Arlinghaus 2017). Public transportation, such as long-distance trains, is increasingly used as a mobile workplace, even though it is not primarily designed for this purpose. The rise of mobile knowledge work raises questions about its health effects, especially when individual needs for this type of work are not adequately considered. Research has shown that mobile knowledge work on public transportation, such as long-distance trains, is associated with higher mental workload and lower performance compared with working in a private office (Pauer et al. 2026). Conversely, activity-based office concepts designed to meet specific task needs can result in a lower workload and improved performance (Pauer et al. 2024). These findings highlight the importance of suitability for mobile knowledge work, as a mismatch between the work environment and individual skills can increase the risk of health issues.

Despite the relevance of this topic, little is known about the specific suitability criteria for mobile knowledge work.

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In particular, there is a lack of reliable methods for assessing the individual prerequisites necessary for successful and health-promoting mobile knowledge work. One approach is measuring selective attention, as this cognitive ability is closely related to the ability to distinguish relevant from irrelevant information and focus on essential tasks. Good selective attention could therefore result in lower mental workload and improved performance in mobile knowledge work (Krummenacher and Müller 2017).

Selective attention is the human ability to selectively perceive certain information from the environment while ignoring other stimuli. This concept was first introduced by Broadbent (1958) in his filter theory of attention, which proposes that information is filtered based on physical characteristics to prevent overloading the processing system. Several experimental methods have been created to study selective attention. A common example is the dichotic listening paradigm, where participants hear different messages in each ear and are instructed to focus on only one (Broadbent 1958). This method enables the assessment of how effectively attention filtering works. Another method is the dot-probe task, where participants respond to the position of a dot that replaces previously presented stimuli. Reaction times provide insights into which stimuli attention was directed toward (Schmukle 2005).

In everyday life, selective attention enables one to focus on relevant information and ignore irrelevant stimuli. This is especially crucial in busy environments, like traffic or open-plan offices. Good selective attention allows one to complete tasks efficiently and without mistakes.

Well-developed selective attention is closely linked to performance in various fields. Research has shown that mindfulness meditation can improve the efficiency of attention processes, resulting in better cognitive flexibility and performance (MacLean et al. 2010).

However, it remains unclear how selective attention influences specific types of cognitive knowledge work, such as routine tasks. Additionally, no studies have examined whether low selective attention ability correlates with increased mental workload. Finally, the question arises whether strong work performance in highly stimulating work environments, such as on a long-distance train, can be predicted by well-developed selective attention ability. This would position selective attention as a factor for assessing the suitability of mobile knowledge work in dynamic work settings.

This article examines whether selective attention can predict performance and mental workload during routine knowledge work across different work environments.

Method

Sample

A total of 59 participants were recruited for this study. After excluding inconsistent data records, 52 participants were included in the analysis, consisting of 31 men and 21 women. Participants' ages ranged from 20 to 62 years, with a mean age of 29.1 years (standard deviation [*SD*] = 10.69).

Design

Participants were required to complete routine work tasks on two separate occasions, each lasting 2 h. The tasks involved sorting emails within a ticketing system and making phone calls. Participants had to read incoming emails and decide which category to assign them to based on the content. If requested in an email, a phone call was made to a call center that had been set up, staffed with a collaborative person. The ticketing system is illustrated in Fig. 1 for better understanding.

The study was conducted under two experimental conditions: one on a long-distance train in Germany and the other in a single office environment. The experiment took place in Germany in 2022. The session in the single office was conducted at the campus of the Karlsruhe Institute of Technology in a human engineering laboratory. Participants had their own room to complete their task. The experiment in the long-distance train was conducted in an InterCity Express (ICE) of Deutsche Bahn (DB), in a public second-class carriage with a table fitting four people. Each participant was provided with a laptop, a mouse, and a smartphone to complete the tasks in both experimental conditions. The two experimental sessions, single office and long-distance train, were conducted over 2 days, 1 week apart, in a randomized order. The experimental procedure is illustrated in Fig. 2.

Execution

The participants' performance was measured by the number of correctly sorted emails. To prevent training effects and to account for two different experimental environments, two separate scenarios were created for the ticketing system. One was an online store selling clothes, furniture, and electronics; the other was a telecommunication company dealing with internet and telephone setup.

Every 10 min, participants completed a digital questionnaire on their laptops to report their current mental

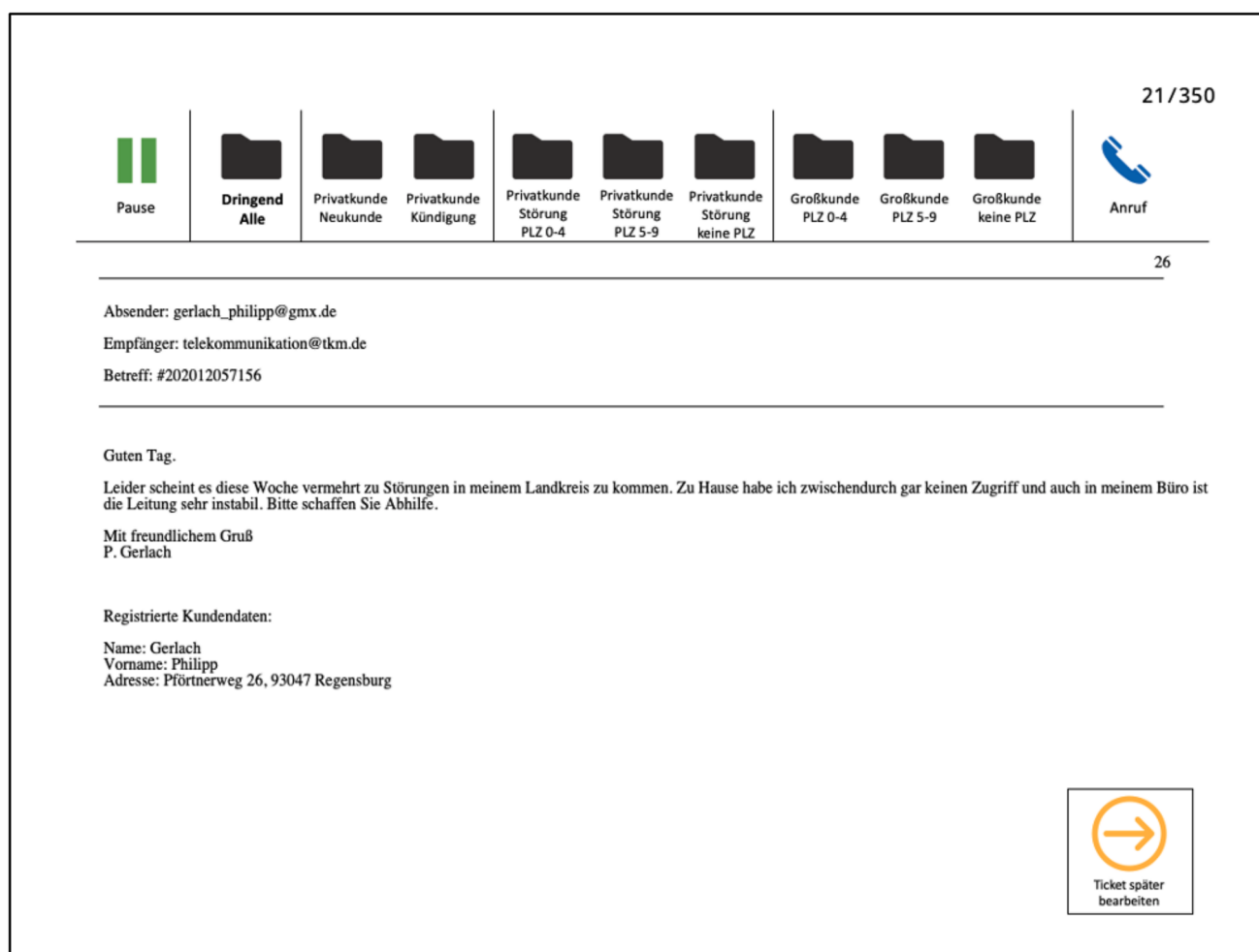


Fig. 1 Ticketing system used in the routine task

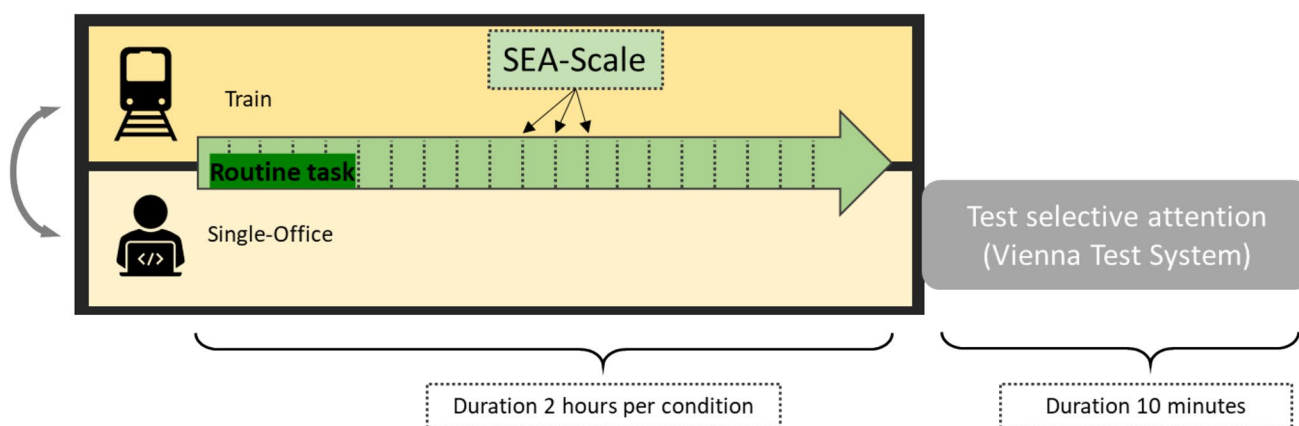
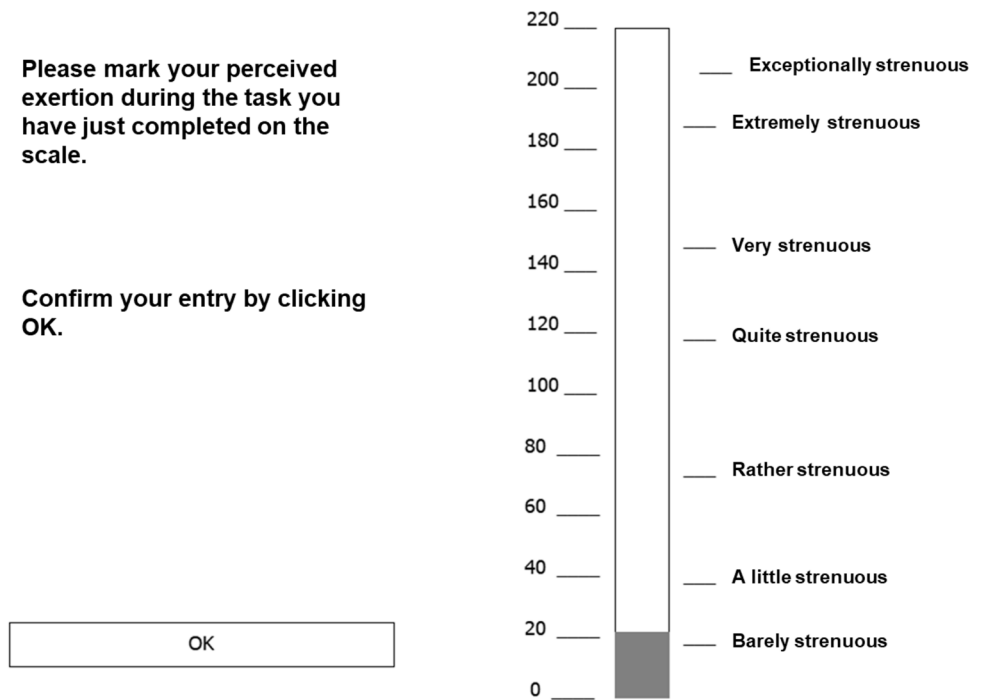


Fig. 2 Procedure of the field experiment

workload. The questionnaire was based on the SEA scale introduced by Eilers et al. (1986). This was a one-dimensional scale ranging from 0 to 220, with labels at certain

intervals for easier understanding (Fig. 3). Additionally, environmental parameters such as brightness, temperature, and volume were measured every 20 min.

Fig. 3 SEA scale used in the experiment (translated to English)



After completing the experiment in the single office, participants performed a test to measure visual selective attention using the Vienna Test System (WTS). The WTS is a psychological testing procedure used to measure various cognitive abilities, including selective attention. It allows for the standardized recording of individual performance profiles and is frequently used in aptitude diagnostics (Schuhfried 2026). The executed test took approximately 10 min and was conducted by the participants alone in a non-stimulating environment. Since selective attention is considered a stable trait, the measurement was conducted only once.

Analysis

For the data analysis of the performance, selective attention, and mental workload, Pearson correlations were calculated to explore the relationships among selective attention, mental workload, and participants' performance during the

routine task. Subsequently, a linear regression analysis was performed.

Results

The analysis of the correlation between selective attention and participants' performance in the long-distance train showed significant cohesion: the higher the level of selective attention, the better the participants performed in the routine task. Similar results appeared within the experimental condition in the single office, where better performance could be associated with the participants' selective attention ability. Furthermore, analysis of the performance of the routine task in general (independently of the experimental condition) indicated a significant influence of selective attention on work performance. For further details, see Table 1.

Table 1 Correlation matrix of selective attention, performance, and mental workload

	Selective attention	Performance long-distance train	Performance single office	Performance overall	Mental workload overall
Selective attention	1	—	—	—	—
Performance long-distance train	−0.283*	1	—	—	—
Performance single office	−0.397**	0.504**	1	—	—
Performance overall	−0.398**	0.834**	0.897**	1	—
Mental workload overall	−0.065	−0.195	−0.038	−0.124	1

* $p < 0.05$; ** $p < 0.01$

The analysis of the correlations between selective attention and mental workload showed no significant effect of selective attention on the level of mental workload in the experimental condition for the long-distance train and the single office.

However, it was shown that the level of mental workload influenced participants' performance while working in the single office. A lower level of mental workload was associated with better performance ($r(50) = -0.29, p = 0.04$) (Fig. 4).

Performance was measured by the number of correctly assigned tickets during the task. The selective attention score was provided by the WTS, with a lower score indicating better selective attention. Therefore, the x -axis ("Score Selective Attention") is displayed in reverse.

In the regression analysis, the performance score was used as the criterion variable, and selective attention as the predictor. The regression model was statistically significant, $F(1, 52) = 4.66, p = 0.035$, but explained only a small fraction of the variance in WTS ($R^2 = 0.083$). The score predicted performance negatively, which is explained by the fact that lower WTS scores indicate a higher characteristic value ($b = -0.13$, standard error $[SE] = 0.06, \beta = -0.29, t(52) = -2.16, p = 0.035$).

Discussion

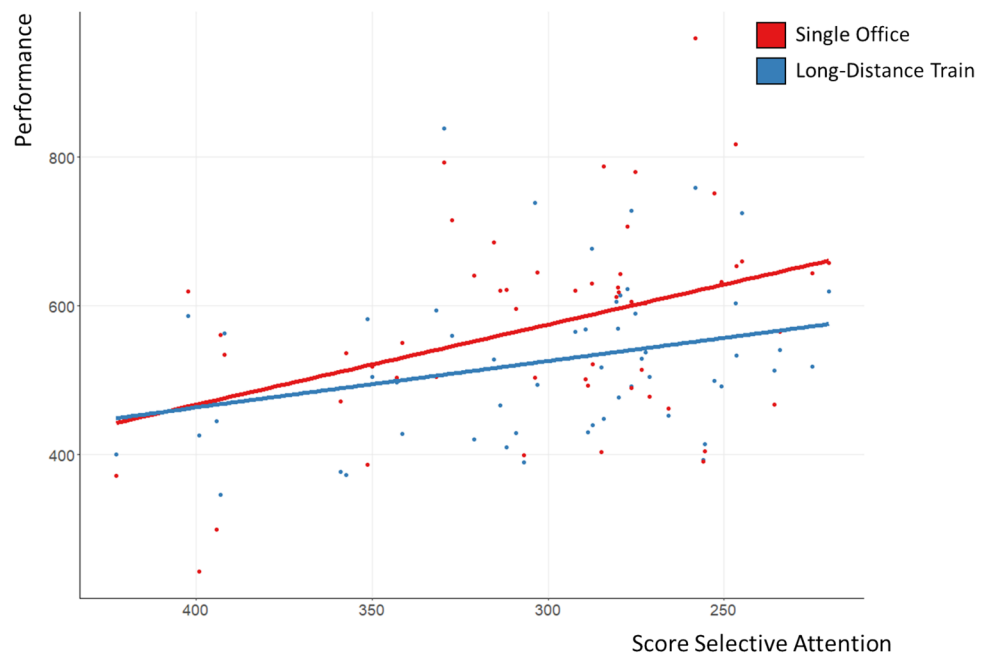
The results demonstrate a link between selective attention ability and performance during routine knowledge work: the better participants are able to focus selectively, the higher their performance. This connection was stronger in the single office setting. This indicates that the impact of selective attention decreases in

highly stimulating work environments. Presumably, a busy environment, like a long-distance train, provides so many distracting stimuli that even highly developed selective attention can be impaired. Nevertheless, the results clearly show a correlation between the level of selective attention and performance during routine knowledge work, regardless of whether the setting is a single office or a long-distance train. Therefore, while selective attention ability may not predict adaptability to highly stimulating environments, it can indicate whether a person is capable of performing well in routine knowledge work. The findings suggest that selective attention ability can serve as an indicator of performance in routine work. However, since the regression analysis showed a value of $R^2 = 0.083$, indicating that only 8.3% of the variance could be explained by the predictor, selective attention, there is a need for further investigation. This could be accomplished with a larger sample and by multiple different measurements of selective attention, meaning not only visual but also auditory, and a combination of visual and auditory. Both tests can be carried out with the WTS (Schuhfried 2026) or with a different instrument, such as the Test of Attentional Performance (TAP) published by PSYTEST (Zimmermann and Fimm 2003).

Furthermore, it was shown that selective attention ability has no influence on mental workload during the execution of routine tasks. This suggests that these two constructs are unsuitable for joint consideration. This assumption is reinforced by the results, which show a clear relationship between performance and mental workload during routine tasks.

Furthermore, it should be examined whether performance in other types of knowledge work, such as creative knowledge work, can also be evaluated using measured selective

Fig. 4 Correlation between selective attention and performance in routine knowledge work



attention. It would also be valuable to assess other aspects of attention to forecast performance in routine tasks. The aim could be to develop test batteries for determining the suitability of different types of knowledge work, helping to prevent poor results and frustration among employees and enabling better task allocation.

This article demonstrates that selective attention is not a reliable indicator of mental workload during routine tasks. Therefore, it would be useful to identify a similarly structured predictor for mental workload.

Conclusion

In conclusion, this study shows that selective attention is associated with performance in routine knowledge work, although its predictive strength appears to depend on the work environment. While selective attention was not found to be a reliable indicator of mental workload, it may still serve as a useful predictor of task performance. However, the relatively low explained variance indicates that additional cognitive and environmental factors should be considered. Future research should therefore validate these findings with larger samples, broader attention measures, and different types of knowledge work.

Author contributions The research was mainly planned, implemented, and analyzed by the main author. The manuscript was mainly written by the main author. All authors have contributed significantly to the research and preparation of this manuscript and have approved its final version.

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Data availability As the transfer of data during data collection by the test subjects was not agreed to in the data protection agreement, transfer is no longer possible at this time.

Declarations

Declaration of originality We, the authors, hereby declare the following:

Originality and authorship This manuscript is our original work and has not been published or submitted elsewhere.

Ethics declarations and informed consent This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. Ethical approval for this research was obtained from the Ethical Committee of the Karlsruhe Institute of Technology (<https://www.ethik.kit.edu/index.php>) on December 10, 2020. The committee does not issue approval numbers. Written informed consent was obtained from all participants on the day of their first examination prior to participation in the study.

Public health and welfare implications The authors acknowledge the potential implications of this work for public health and general welfare and affirm that all necessary disclosures have been made.

Competing interests The authors declare no financial or non-financial conflicts of interest.

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References

- Arlinghaus A (2017) Wissensarbeit: Aktuelle arbeitswissenschaftliche Erkenntnisse. MFB-Report 35
- Broadbent DE (1958) Perception and communication. Pergamon Press, Elmsford
- Eilers K, Nachreiner F, Hänecke K (1986) Entwicklung und Überprüfung einer Skala zur Erfassung subjektiv erlebter Anstrengung. Zeitschrift Für Arbeitswissenschaft 40:215–224
- Krummenacher J, Müller H (2017) Aufmerksamkeit. In: Müsseler J, Rieger M (eds) Allgemeine Psychologie. Springer Berlin Heidelberg, Berlin, Heidelberg, pp 103–151
- MacLean KA, Ferrer E, Aichele SR, Bridwell DA, Zanesco AP, Jacobs TL, King BG, Rosenberg EL, Sahdra BK, Shaver PR, Wallace BA, Mangun GR, Saron CD (2010) Intensive meditation training improves perceptual discrimination and sustained attention. Psychol Sci 21:829–839. <https://doi.org/10.1177/0956797610371339>
- Pauer C, Lorenz M, Deml B (2024) Kognitive Ergonomie mobiler Wissensarbeit in öffentlichen Verkehrsmitteln und aktivitätsbasierten Bürokonzepten. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)
- Pauer C, Tegtmeier P, Lafrenz B, Deml B (2026) Routine knowledge work: mental workload and performance during work in long-distance trains and activity-based work environments. J Public Health (Berl). <https://doi.org/10.1007/s10389-026-02781-5>
- Schmukle SC (2005) Unreliability of the dot probe task. Eur J Pers 19:595–605. <https://doi.org/10.1002/per.554>
- Schuhfried (2026) Über das Wiener Testsystem. In: Schuhfried. <https://www.schuhfried.com/wiener-testsystem/ueber-das-wiener-testsystem/>. Accessed 17 June 2026
- Zimmermann P, Fimm B (2003) TAP – Testbatterie zur Aufmerksamkeitsprüfung. <https://www.psytest.net/de/testbatterien/tap/tests>. Accessed 17 June 2026

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