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Reading as an Individual Style: Investigation of the Stability of Reading Styles and their Relationship to Cognitive Strategies

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Abstract

The stability of reading strategies across different texts and tasks has been the subject of much discussion. It is not clear whether reading strategies combine to form individual reading styles, nor is the link to cognitive style. We applied eye-tracking technology to verify the concept of reading styles in reading tasks using specific eye-tracking metrics: mean length of saccades, frequency of regressions and transitions between paragraphs. To measure cognitive style, specifically analytic and holistic cognitive style, we used a Compound Figure Test (CFT). The results revealed that all the eye-tracking metrics applied in measuring reading strategies were stable across similar tasks. However, these reading strategies do not necessarily relate to each other to form a complex reading style. We also found no evidence for the assumption that reading strategies might be linked to the analytic-holistic dimension of cognitive style. Reading strategies metrics are stable across similar tasks. If we present differently structured tasks, a reading strategy can be modified. We did not find sufficient evidence to suggest a relationship between reading strategies/reading style and the analytic-holistic cognitive style.

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Introduction

Reading is a very specific and complex skill which challenges the reader to simultaneously engage their oculomotor system and several higher cognitive processes. This results in a functional interplay of processes which allows the reader to read and comprehend the text. Precisely how this works has been the topic of broad discussion and evolved into the development of two main computational models which describe these processes, i.e., SWIFT model (Engbert et al., 2005), E-Z Reader model (Reichle et al., 1998) or alternatively, the CRISP model, which was originally modelled on fixation duration basis during scene viewing and then extended to reading (Nuthmann & Henderson, 2012). All these models specify the general mechanisms and associated phenomena which occur as a skilled adult reader reads and processes text.

Another branch of research aims to explore the trajectory of reading development (Häikiö et al., 2009; Huestegge et al., 2009; Joseph et al., 2009). Although the stimuli differ, it seems that the developmental changes displayed by participants are very similar across studies, and researchers also agree that eye movement behaviour attains adult levels around the age of 11 years (Blythe & Joseph, 2011). It might therefore seem that reading skills are a complex set of skills which an individual usually gains up to a certain age and which subsequently remains stable and predictable.

However, little evidence has been provided until now concerning whether individuals differ in how they process written text and what these differences look like. Is it possible that each individual develops a unique set of reading mechanisms according to their cognitive skills or personality traits which can be unified into an integrated reading style? Is reading style consistent between various types of stimuli in an individual or are the characteristics of a text able to overcome these and bias the reading style?

Reading a Text: Top-down or Bottom-up?

It has been shown that adults tend to gaze longer at long words (Rayner et al., 1996), although this strong tendency is also present in children (Joseph et al., 2009). Word frequency also affects fixation time in adults, their fixation time being longer with low-frequency words (Just & Carpenter, 1980). Research focusing on the effect of word frequency in children has provided mixed results (for review, see Blythe & Joseph, 2011). It is also apparent that the more difficult a word is to encode, for example, as a consequence of less contrast between letters and the background (Reingold & Rayner, 2006) or less legible fonts (Rayner et al., 2006), the longer the fixation. In the context of eye movements during reading, O'Regan (1992) also mentions the nature of perceptual span and the amplitude of saccade changes when the reader peripherally perceives a simple-to-read word.

Nonetheless, factors which contribute to a greater demand on processing are not always associated with textual characteristics. Similar words may be less difficult to process for one individual than others due to their knowledge or reading skills. Several factors are thus linked to top-down processes which might affect the reading strategies of an individual, for example, age (Blythe & Joseph, 2011), reading proficiency (Rayner et al., 2006) and existing knowledge (Cole et al., 2013). Using eye tracking metrics to investigate eye movements according to these factors

may provide important information not only about perception but also the processing strategies applied in reading a text.

In studies which have explored individual differences in reading, some authors suggested the existence of various reading styles, reading strategies, or even types of reader. Hyönä et al. (2002) defined four clusters of readers according to the characteristics of re-inspections and look backs: fast linear reader, slow linear reader, non-selective reviewers and topic structure processors. The first two types of reader exhibit less look backs overall and differ in reading speed. Topic structure processors tend to look back often and select specific areas of text to return to, unlike non-selective reviewers, who reinspect randomly. The authors claimed that the individual differences in reading are systematic and consistent between the variety of texts read for the same purpose. These findings were later supported by another study (Hyönä & Nurminen, 2006), although the number of reader types was reduced to three, omitting non-selective reviewers. The results also showed that readers are aware of looking back in the text, and therefore it may be an intentional strategy.

Rayner et al. (2006, 2009) suggested another classification of readers. They defined the characteristics of a risky reader as one who exhibits more regressions, longer saccades, more word skipping and has smaller perceptual span. In the former study, older readers tended to adopt a risky reading strategy, while younger readers adopted a conservative strategy. The authors explained this phenomenon as a possible compensation for slower processing of text or smaller perceptual span (both associated with poorer oculomotor skills), in which risky readers attempt to guess the next word to diminish their disadvantage. Another suggested explanation was age-related differences in working capacity, in which risky readers attempt to integrate smaller units of information during reading and thus deplete their processing resources, while conservative readers may read the entire sentence, store the information in working memory during reading, and integrate it fully at the end.

Koornneef and Mulders (2017) tested the concept of risky readers on undergraduate students, using implicit causality verbs. Their findings indicated that not only older readers adopt a risky reading strategy. The authors also described a potential interplay between bottom-up (reader's strategy) and top-down (text characteristics) factors while reading a text. As with the findings by Rayner et al. (2006), alterations in text characteristics affected risky readers differently to conservative readers. Reading style has also been investigated in university students by Lu et al. (2023), who concluded that the concept of reading style based on selected eye-tracking features is stable across reading various texts and thus it is possible to work with this concept as a behavioral trait related to the processing of textual information.

It still remains uncertain whether a dominant reading strategy, i.e., a reading style stable across different texts and tasks, is employed by individuals. It is evident that some readers tend to use a risky reading strategy while others do not; some readers process texts linearly, others look back through the text. These strategies might be associated with the individual's cognitive characteristics (Rayner et al., 2006), and it is possible that personality traits also have an effect. It is also unclear whether reading strategies are linked to eye movement systems as domain-specific (e.g., reading or visual search) or domain-general (without any differences in gaze control) approaches (Henderson & Luke, 2014), or even other previously described psychological constructs. Since cognitive style involves aspects

of both cognition and personality (Kozhevnikov, 2007), we aim to explore the relationship which may exist between reading and cognitive style.

Relationship to Cognitive Style

Several perspectives on cognitive style have been described in the literature and later resulted in broad discussion and attempts to develop an integrated theoretical framework (Kozhevnikov, 2007; Riding, 1997). Nevertheless, cognitive style might be defined as "individual differences in how we perceive, think, solve problems, learn, relate to others etc." (Witkin et al., 1977), and is a consistent manner in which a person processes information. Cognitive style can be identified in multiple levels of processing, from automatic data encoding to conscious metacognitive strategies (Kozhevnikov, 2007). Field (in)dependence is the most notorious of the cognitive style concepts (Asch & Witkin, 1948). According to this concept, people differ in their perception of a focal objects in relation to its background/field: some individuals process the environment with an emphasis on field characteristics (field dependent, later linked with holistic perception), while others are not influenced by the entire scene (field independent, later linked with analytic perception). It appears that field (in)dependence is relatively consistent in time throughout adult life, with interindividual differences being well described (Goodenough & Witkin, 1977); the concept is also consistent across sense modalities (Axelrod & Cohen, 1961).

Since we suppose that cognitive style consistently operates on several levels of perceiving and processing information in an individual, it is legitimate to hypothesise on the possible relationship between cognitive style and reading. Several studies have shown that there is indeed a link between field (in)dependence and reading skill, indicating that reading skills are better in more field independent individuals (Blanton & Bullock, 1973, Nozari & Siamian, 2015). Blanton and Bullock (1973) assume that even the "analytical-global... cognitive styles influence the way an individual responds during reading", including strategies which readers employ during reading. Similarly, Henderson and Luke (2014) focused on individual differences of eye movements across various types of tasks (e.g., reading or viewing tasks), showing the stability between fixation durations and saccadic amplitude in several viewing tasks. However, research which addresses the relationship between cognitive style and reading style instead of reading performance is scarce.

The Conceptual Model

In the present study, we explored the concept of reading styles, the stability of these styles in individuals across different texts, and the relationship to the analytic-holistic continuum of the cognitive style (see Figure 1). As the definition of a reading style, we adopted Rayner's classification of risky and conservative readers (Rayner et al., 2006) and used eye tracking metrics according to the classification (saccade length, frequency of regression), with transitions between paragraphs added as a metric which operates on a more global level of text perception. Based on these metrics, we assumed that individuals would be consistent in their reading strategies across different texts and that a positive relationship between the same metrics in these different texts (stability of separate metrics) and between the different metrics (stability of reading style as a whole) could therefore be discovered, following the conclusions of Lu et al. (2023). Furthermore, we also aimed to investigate the stability of the reading style in the

case of different stimulus presentation as well as of slightly different instructions, as the gaze-based individual patterns might differ depending on the task (see e.g., Henderson & Luke, 2014). To examine the above mentioned, we focused on a specific and homogenous population and used data on gifted secondary school students to examine the stability of reading style metrics in younger readers.

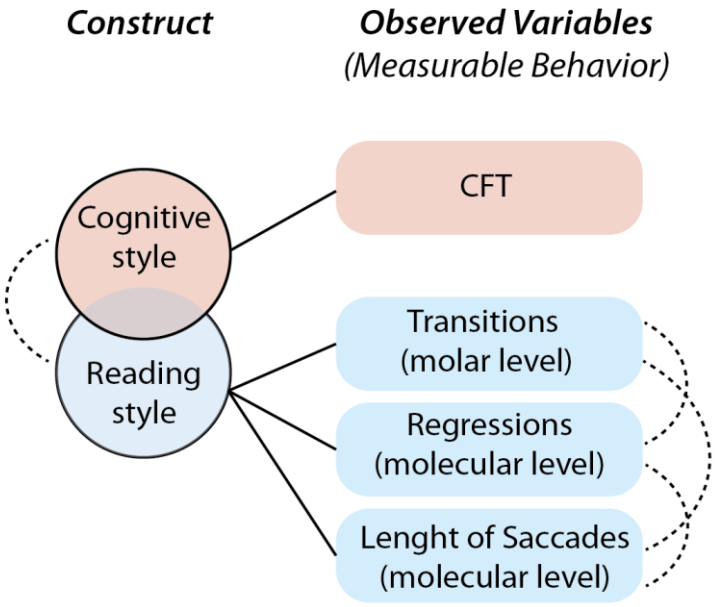

Figure 1. The Conceptual Model of Relationships between Variables
(Two main research objectives are explored. Are two theoretical constructs related to each other? And, are three different readings eye-tracking metrics (observed variables) related to each other?)

Another aim of the study was to explore the relationship between the reading style defined by the above-mentioned metrics and cognitive style. Longer saccades, more regressions (risky strategy) and also more transitions between paragraphs might indicate a more holistic approach in the reading process and signify an attempt to integrate information continuously during reading and the use of context to advantage. We suggest that a reader who employs this strategy might also tend to use a more holistic approach in other cognitive tasks as a result of the interplay of higher cognitive processes which might affect reading style and cognitive style in a similar manner.

Methods

Compound Figure Test

Since our aim was to determine the analytic/holistic continuum of cognitive style, we used a PC administered version of Navon's original test (Navon, 1977) called Compound Figure Test (CFT). To administer CFT on a PC, we used software called Hypothesis (Šašinka et al., 2017). CFT has been previously validated on Czech participants, demonstrating sufficient test-retest reliability, split-half reliability, a discriminant validity with general intelligence and personality (Lacko et al., 2023), and measurement invariance across age, gender, and eleven countries (Lacko et al., 2024).

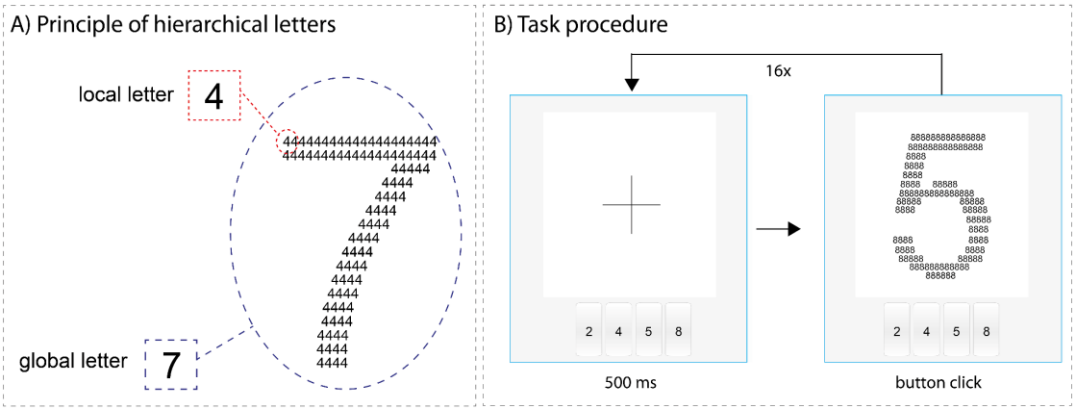

Figure 2. The Example of CFT Stimuli

For the CFT, we presented 32 hierarchical figures: small numbers placed together to form the shape of one large digit. The task for participants was to identify the correct local (small numbers) or global (large number) component and select one answer from four possible options (see Figure 2); we measured their reaction times (RT) concurrently for both local and global tasks and their error rates. Participants with an analytic style quickly identify local figures, while those with a holistic style are faster at recognizing the global figure. Each condition (local/global task) therefore comprised 16 trials, with 3 practice trials for each and a fixation cross presented for 0.5 seconds before each trial. For a detailed description of the CFT test, including stimuli, see (Lacko et al., 2023).

For each participant, we computed the global preference rate (GPR) similar to indexes previously used by other authors (Gerlach & Poirel, 2018; Gerlach & Starrfelt, 2018) using the simple formula of *local RT* minus *global RT*. The higher the GPR values, the quicker global components were processed compared to local components. We did not apply error rates in further analysis but rather as exclusive criteria to eliminate the scores of participants who did not understand the task or were not sufficiently motivated.

Reading Task

Our study applied Rayner's classifications of risky and conservative readers. To investigate the reading strategies of individuals, we designed a specific reading task. The reading task consisted of two thematically related texts, both which describe the culture of a fictional island to avoid any bias of prior knowledge in the participants. The texts were identically structured, i.e. they consisted of a title, the author's name and three paragraphs (see Figure 3). All three paragraphs contained the same number of lines, with a comparable number of sentences and words (see Table 1). Gaps between the paragraphs were intentionally established to differentiate the paragraphs visually and moreover to facilitate reading and reduce potential inaccuracies in the eye-tracking measurements. Individual paragraphs in both texts contained a certain connection in content, i.e., the content of each paragraph was linked to a corresponding paragraph in the second text. The structure was as follows: the first paragraph (A.1) in Text A was consonant with the first paragraph (B.1) in Text B. P1 explained the origin of the fictional island's culture in both texts. The second paragraphs (A.2 and B.2) described the social principles of the society but outlined conflicting information in text A compared to text B, i.e., Text A and Text B thematically contradicted each other. In the final paragraphs (A.3 and B.3), Text A described the fictional island's agriculture and Text B described the

island's art. Both paragraphs focused on different topics.

Table 1. Details of the Text Parameters

	Number of lines		Number of sentences		Number of words	
Paragraph/Text	Text A	Text B	Text A	Text B	Text A	Text B
P1	6	6	7	7	138	144
P2	6	6	10	5	132	131
P3	6	6	7	7	132	134

To increase the accuracy of measurement and eliminate negative effects (e.g., learning effect), two versions of the experiment were created which counterbalanced the order of the texts. After successive presentation of both texts, a comparison slide was displayed which showed both texts simultaneously, providing participants with an opportunity to compare the texts (see Figure 3).

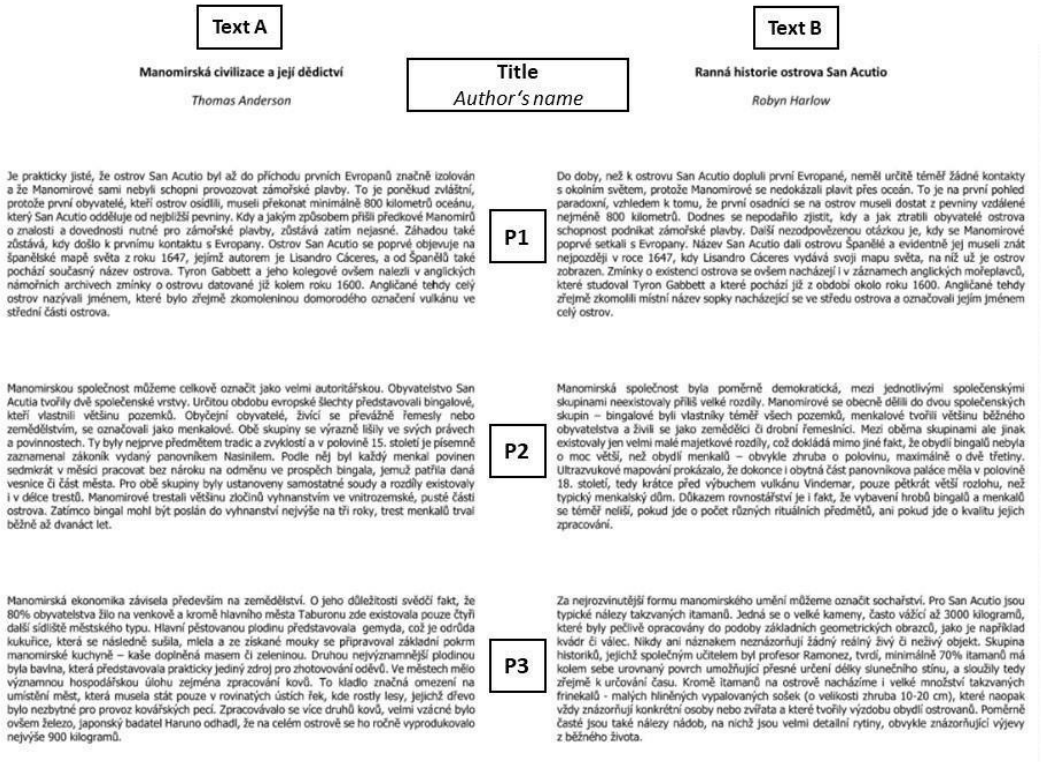

Figure 3. Comparison of Text A and Text B in a Single Slide

To increase the accuracy of measurement and eliminate negative effects (e.g., learning effect), two versions of the experiment were created which counterbalanced the order of the texts. After successive presentation of both texts, a comparison slide was displayed which showed both texts simultaneously, providing participants with an opportunity to compare the texts (see Figure 3).

Participants

A group of 41 Czech individuals participated in the main phase of the study (i.e., recording eye movement data and the CFT). Participants with recorded eye tracking data of insufficient quality were excluded from further analysis. The final count of participants for analysis was 32, composed of 18 females and 14 males. All of the participants were students in the final grade of basic school or the corresponding grade in the eight-year secondary general school (i.e., 4th grade). Their scores in intelligence tests were equal to or above IQ 120 (regarding the IQ measures, see Portešová et al., n.d.). The IQ of the participants was measured by a standardised test of intelligence with the score equaling or above to IQ 120, considering this value as corresponding to the level of moderate giftedness according to Gagné et al. (1998). The age of participants varied from 15 to 16 years (mean age 15.35 years, *SD* = 0.28 years).

Procedure and Apparatus

Data collection was performed at the participants' schools. The parents of all participants were informed of the research and signed informed consent forms before any data collection was performed. We presented the tasks in the following order: 1) Compound Figure Test, 2) Reading task. Both tasks were presented on a Philips 22″ LCD monitor with a resolution of 1680 x 1050 pixels and refresh rate of 60 Hz. The distance between each participant's eyes and the monitor was set to approximately 60 cm. Eye movements were recorded with an SMI RED 250 remote eye tracker with a 250 Hz sampling rate. The experiment was created and executed in SMI Experiment Center™ 3.7. Eye-tracking measurement commenced with 4-point calibration. We accepted deviations in eye movement up to 0.5 degrees for further measurement. Eye-tracking measurement then continued with a single slide introduction to the topic of both articles, followed by written instructions to read both texts and remember important information. Participants were also instructed that they would first see each text successively and then be presented both texts simultaneously for the opportunity of comparison. They were informed that they would complete a short test at the end to verify what information they had remembered from the texts. No time limit was set to complete the entire test. After the instructions, the main part of the experiment proceeded by pressing the space bar, which displayed the first text on the screen. For a scheme of the procedure (see Figure 5).

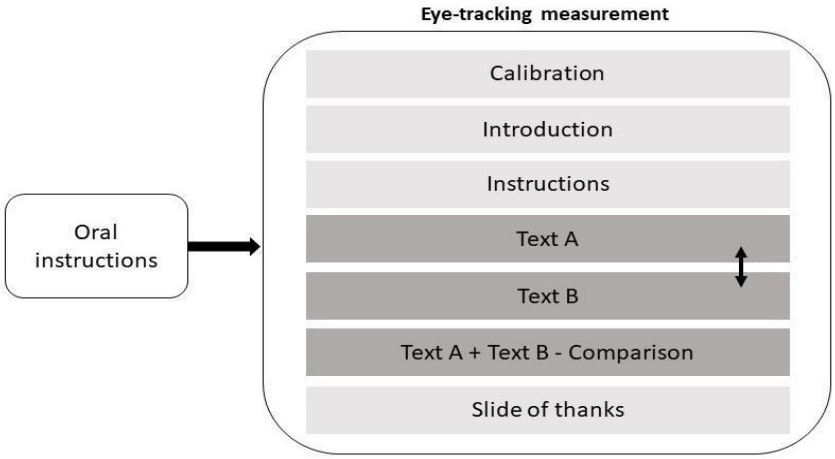

Figure 5. Scheme of the Procedure

Data Analysis

Two participants produced unacceptably high error rates in the CFT (i.e., more than 5 errors in both subtests). We therefore removed their responses from further analysis. Based on Rayner's theories (Rayner et al., 2006, 2009), which classify readers according to their reading style as either risky or conservative, and similarly as Lu et al. (2023), we selected the following metrics for analysis: length of saccades and frequency of regressions. As an additional metric, we added transitions between paragraphs (see also Lu et al., 2023). Transitions between paragraphs data can give us crucial information about the reader's approach to the text at a more global level. More specifically, we assumed that risky readers would show a greater number of transitions than conservative readers, who focus more on details as they read a text. For the reading task measurements, we applied certain criteria for data cleaning. A quantitative criterion was first applied to exclude all eye-tracking records with data loss greater than 10 %. We then qualitatively evaluated all eye-tracking measurements by excluding those that did not possess the required gaze data quality (e.g., skewness of an eye movement record, excessive loss of eye movements). In some obvious cases, we corrected the gaze paths or fixations to the right position. For the eye-tracking metrics "number of regressions" and "length of saccades", we excluded all saccades of less than 0.3 visual degrees from the dataset. We applied the same to saccades which had an inclination from the horizontal axis (text lines) greater than ± 40 degrees. After a thorough inspection of the eye-tracking data and cleaning procedure, we computed the key eye-tracking metrics as arithmetic means and sums (see Table 2). These indexes were used in further statistical analysis (correlation and regression analysis). We verified the assumptions of the correlation and regression analysis in the first step.

Table 2. Descriptive Statistics of Relevant Variables

Variable	*M* [95 % *CI*]	*SD*
CFT local RT (ms)	1.404 [1.344, 1.464]	0.166
CFT global RT (ms)	1.249 [1.173, 1.324]	0.208
CFT global preference score	0.155 [0.102, 0.208]	0.147
Mean length of saccades (Text A)	3.006 [2.827, 3.185]	0.496
Mean length of saccades (Text B)	3.111 [2.876, 3.347]	0.653
Frequency of regressions (Text A)	2.659 [2.427, 2.891]	0.643
Frequency of regressions (Text B)	2.737 [2.489, 2.984]	0.687
Number of transitions (Text A) sum	10.069 [8.122, 12.015]	5.397
Number of transitions (Text B) sum	10.633 [8.978, 12.288]	4.589
Number of transitions (Text A + B) sum	31.103 [25.531, 36.675]	15.455

M = mean, CI = confidence interval, SD = standard deviation.

An analysis of univariate outliers identified four extreme values (i.e., values greater than $Q3 + 3 * IQR$ or less than $Q1 - 3 * IQR$), which were removed from further analysis. Despite this removal, the data still contained some outliers and influential values according to boxplots and Cook's distances. We retained these values for analysis because of the rather small sample size and weak statistical power. Q–Q plots and univariate Shapiro–Wilk tests also suggested a non-normal data distribution or the non-normality of residuals in several cases.

Hence, we applied a non-parametric Kendall's Tau-b rank correlation and robust regression with an SMDM estimator (i.e., S-estimate -> M-estimate -> Design Adaptive Scale estimate -> M-step; see Koller & Stahel, 2016). Additionally, the coefficients, 95 % confidence intervals and *p*-values were estimated on the basis of 10,000 bootstraps. These procedures are sufficiently robust to handle outliers, non-Gaussian data distributions and other violations of correlation and regression assumptions. We also applied Holm–Bonferroni correction for multiple comparisons in the correlation analyses. For regressions, bootstrapping was performed on the raw data, and therefore the confidence intervals correspond to the unstandardized regression coefficients (*B*). We also calculated point-estimates and Z-scores, which produced the standardized regression coefficients (β). The eye-tracking data were inspected in *BeGaze*. Statistical analyses were conducted in *R* (v4.0.3; R Core Team, 2020). Correlations were performed in the *psych* package (v2.0.12; Revelle, 2020); regressions were performed in the *robustbase* (Maechler et al., 2021) and *complmrob* (Kepplinger, 2019) packages.

Results

The correlation analysis of eye-movements measured with the same eye-tracking indicators in Text A and Text B revealed statistically significant and medium to large associations (see Table 3). This finding suggests that proposed eye-tracking indicators were stable across slightly different reading tasks and therefore reliable measurements for identifying the reading style. However, the stability of the reading pattern in terms of the number of transitions was not confirmed in the different reading tasks (Text A + B), as both correlations were statistically insignificant.

Table 3. Correlations between the Different Reading Task Content

Correlations	τ_b [95 % *CI*]	N	p_{holm}
Mean length of saccades: Text A ~ Text B	.563 [.292, .767]	30	.002
Frequency of regressions: Text A ~ Text B	.566 [.377, .735]	31	< .001
Number of transitions: Text A ~ Text B	.444 [.218, .642]	28	.001
Number of transitions: Text A ~ Text A + B	.159 [-.119, .433]	27	.268
Number of transitions: Text B ~ Text A + B	.050 [-.296, .390]	27	.772

τ_b = Kendall's Tau-b rank correlation coefficient; 95 % *CI* = 95 % confidence interval; p_{holm} = *p*-value corrected with the Holm–Bonferroni method; N = Number of participants.

The correlations between various reading style indicators in each textual stimulus were therefore verified (see Table 4). Despite weak associations between the mean length of saccades and frequency of regressions in both texts, these associations were statistically insignificant. The results also revealed that the relationship between the mean length of saccades and number of transitions was statistically significant (τ_b = -.364, p = .001), i.e., participants who performed longer mean saccades performed fewer transitions. However, this association was not confirmed in the other textual stimuli.

Table 4. Correlations between Eye-tracking Metrics

Correlations	τ_b [95% *CI*]	N	p_{holm}
Text A: Mean length of saccades ~ Frequency of regressions	-.255 [-.494, .011]	30	.064
Text B: Mean length of saccades ~ Frequency of regressions	-.290 [-.552, -.004]	31	.058
Text A: Mean length of saccades ~ Number of transitions	-.364 [-.536, -.165]	29	.001
Text B: Mean length of saccades ~ Number of transitions	-.015 [-.289, .263]	29	.915
Text A: Frequency of regressions ~ Number of transitions	.098 [-.178, .351]	29	.482
Text B: Frequency of regressions ~ Number of transitions	.087 [-.192, .342]	29	.522

τ_b = Kendall's Tau-b rank correlation coefficient; 95 % *CI* = 95 % confidence interval; p_{holm} = p-value corrected with the Holm–Bonferroni method; N = Number of participants.

Because we expected that the eye-movements which indicate reading style should be predicted by the analytic/holistic cognitive style, we performed a set of robust regression analyses. The results suggest that the global precedence score obtained through the CFT did not predict reading style (see Table 5) in all cases, with one exception: frequency of regressions in Text A. Even though this result was statistically significant (p = .046), its regression coefficient was rather weak (B = .828, β = .191), the 95 % confidence interval contained a zero value, and the global precedence score explained only 7 % of variance in frequency of regression.

Table 5. Robust Regressions

Robust regressions	*B* (*β*) [95 % *CI*]	*SE*	*p*	R^2	*RRSE*
Text A: Mean length of saccades ~ CFT	0.147 (.044) [-1.006, 1.309]	0.585	.402	.002	0.505
Text B: Mean length of saccades ~ CFT	-0.787 (-.178) [-2.274, 0.689]	0.735	.136	.033	0.662
Text A: Frequency of regressions ~ CFT	0.828 (.191) [-0.114, 1.815]	0.495	.046	.070	0.472

Robust regressions	*B* (*β*) [95 % *CI*]	*SE*	*p*	R^2	*RRSE*
Text B: Frequency of regressions ~ CFT	1.108 (.233) [-0.504, 2.681]	0.813	.089	.053	0.699
Text A: Number of transitions ~ CFT	-6.237 (-.171) [-15.750, 3.597]	4.914	.097	.039	4.781
Text B: Number of transitions ~ CFT	-5.074 (-.164) [-14.365, 4.413]	4.723	.144	.032	4.004
Text A + B: Number of transitions ~ CFT	21.703 (.208) [-6.547, 49.456]	14.396	.066	.067	12.84

B = unstandardized coefficients; *β* = standardized coefficients; 95% *CI* = 95 % confidence interval; p = *p*-value, SE = standard error, R^2 = multiple R-squared, RRSE = robust residual standard error.

Discussion

Our results show that the use of reading strategies is stable in an individual: the relationships between the same metrics measured in Text A and Text B are robust (see Table 3). This also applies to the additionally measured metric: transition between paragraphs. We can therefore claim that readers use the same reading strategies across similar texts and tasks at both the molecular and global levels of reading. Lu et al. (2023) reached similar conclusions by measuring eye-tracking data in university students to investigate the stability of reading style across reading tasks and its possible relationship with the concept of cognitive style. Lu's et al. (2023) results indicate the stability of selected eye-tracking metrics (mean length of saccades, frequency of regressions, number of transitions between paragraphs) across similar reading tasks.

However, it does seem that while the comparison slide (Text A + B) was displayed, readers may have changed their reading patterns. We measured only one metric (transitions between paragraphs) during this type of stimuli since the stimuli in this text was too small to measure eye movements at the molecular level. As we discovered no significant relationship in the comparison stimuli between transitions between paragraphs in Text A and in Text B, we suppose that readers adjusted their reading strategies during the comparison stimuli. They perhaps needed to perceive the information in another way, compare the texts that they already knew, search for specific information, and skip irrelevant parts: a process entirely different from the first, linear reading. We can therefore agree with Koornneef and Mulders (2017), that a reader can exhibit more than one reading profile depending on the problem which must be solved. These reading profiles might be stable in similar texts, and flexibly adjusted in other types of texts or tasks, with some authors claiming this process might be intentional (Hyönä & Nurminen, 2006).

Nonetheless, our results cannot allow us to conclude the existence of a general construct called reading style that would contain several reading strategies used by an individual simultaneously (see Table 4). The relationships

between metrics, including those defined by Rayner et al. (2006, 2009), were either insignificant or significant in the opposing direction of our expectations. We have not found enough evidence for the construct of a reading style. The visual strategies used by an individual might be stable, yet it is also highly probable that they are independent of each other.

Our results cannot support our hypothesis that reading style (or individual reading strategies) are linked to cognitive style (see Table 5). We originally suggested that readers who tend to make more regressions and use longer saccades might manifest a more holistic cognitive style, even in processing various stimuli different from texts. While measuring cognitive style with CFT (analytic-holistic concept), this cannot be supported, although it is still possible that reading strategies are linked to other concepts within the construct of cognitive style. The correlation between reading style and cognitive style was also explored in a comparable manner by Lu et al. (2023), who reached the same conclusions, i.e., they did not find any significant relation between CFT metrics representing the concept of cognitive style and selected eye-tracking features (mean length of saccades, transitions, frequency of regressions) in the context of reading style. However, the research gap should be further explored by applying other types of measurement of cognitive style and also including other eye-tracking metrics that might be featured for individual differences in reading, such as mean fixation duration (see e.g. Henderson & Luke, 2014) or other specifically word-based eye-tracking features (e.g., landing position of fixation on words). Further exploration of these concepts is recommended also due to the current limitations of presented study.

The main limitation of the present study is selection of a specific population as the research sample. The specifics of the group restrict the generalizability of the results beyond Czech above average intelligent children. We therefore suggest that the measurements should be replicated in the adult population, including participants with differing characteristics. Furthermore, in contrast to previous research, we did not compare two groups of participants (Rayner et al., 2006, 2009; Koornneef & Mulders, 2017) but rather inspected individual reading strategies and their stability and the relationships in a single group of young participants. Future research could, therefore, focus on potential cross-cultural differences in the observed patterns. Another limitation of the study lies in the small sample size. Since no a priori power analysis was conducted, our study might be underpowered. This particularly relates to robust regression, where non-significant findings are likely due to low power rather than a lack of effect. Therefore, future replications with larger samples are desirable.

Conclusion

Our goal was to investigate the concept of reading style and whether such an attribute exists, and if yes, what does it include and is it linked to cognitive style? Our results showed that reading strategies are stable across similar tasks: the tendency to use more regressions or to perform shorter saccades might be considered a top-down process. However, these reading strategies do not necessarily relate to each other and form a complex reading style. Also, if we present entirely different stimuli which require the solution of different tasks, a reading strategy otherwise assumed as stable might demonstrate variances. We did not find sufficient evidence to suggest a relationship between reading strategies/reading style and the analytic-holistic continuum of cognitive style.

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Statements

Conflicts of Interest

The authors declare no conflict of interest.

Ethics Statement

The research involved human participants. The design of the project, part of which is the present study, was approved by the Ethical Committee of Masaryk University (ref. number EKV-2016-086). The parents of the participants involved in the study signed informed consent forms, approved by the Research Board of the HumeLab–Experimental Humanities Laboratory at the meeting on 21 January, 2019.

Data Availability

Data available on request from the authors.

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