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RESEARCH MEMORANDUM

Literacy Skills at and Around Level 2 of the PIAAC Cycle 2 Proficiency Scale

An ETS Return on Investment Study: Phase 1

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Literacy Skills at and Around Level 2 of the PIAAC Cycle 2 Proficiency Scale
An ETS Return on Investment Study, Phase 1

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Preface

This research memorandum highlights the collaborative efforts of the literacy panel for the ETS Return on Investment (ROI) Study, Phase 1, comprising Jean-François Rouet, M. Anne Britt & Tobias Richter, in developing their research memorandum, *Literacy Skills at and Around Level 2 of the PIAAC Cycle 2 Proficiency Scale*. This memorandum captures the expert opinions from the panel sessions. It is provided as supporting documentation for the policy report, *Level Up: Raising the Skills of Adults in the United States and Other Countries* (Irwin Kirsch, Mary Louise Lennon, and Anita Sands, with Jean-François Rouet, Anne Britt, Tobias Richter, Dave Tout, Kees Hoogland, and Javier Diez-Palomar). A second ROI study, which also supports the *Level Up* policy report, addresses numeracy: *Improving the Quality of Numeracy Skills: Progressing from Level 2 to Level 4 on the PIAAC Cycle 2 Proficiency Scale: An ETS Return on Investment Study, Phase 1* (Dave Tout, Kees Hoogland, Javier Díez-Palomar).

The ROI project, funded by ETS and led by Irwin Kirsch (retired) and Anita Sands of the ETS Research Institute, presents findings and recommendations based on the panelists' expertise and thorough analysis. However, these findings and recommendations should be interpreted with caution as they have not undergone formal peer review. This memorandum is intended for informational purposes only. ETS does not endorse or assume responsibility for any conclusions or recommendations made by the panelists. The views expressed are solely those of the authors and do not necessarily represent the official policy or position of ETS. Any errors or omissions are the responsibility of the authors.

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Paired Reports

Policy Report: *Level Up: Raising the Skills of Adults in the United States and Other Countries* by Irwin Kirsch, Mary Louise Lennon, and Anita Sands, with Jean-François Rouet, Anne Britt, Tobias Richter, Dave Tout, Kees Hoogland, and Javier Diez-Palomar https://www.ets.org/Media/Research/pdf/RR-25-04.pdf

Research Memorandum: *Literacy Skills at and Around Level 2 of the PIAAC Cycle 2 Proficiency Scale* by Jean-François Rouet, Anne Britt, and Tobias Richter. https://www.ets.org/Media/Research/pdf/RM-25-01.pdf

Research Memorandum: *Improving the Quality of Numeracy Skills: Progressing from Level 2 to Level 4 on the PIAAC Cycle 2 Proficiency Scale: An ETS Return on Investment Study, Phase 1* by Dave Tout, Kees Hoogland, Javier Díez-Palomar. https://www.ets.org/Media/Research/pdf/RM-25-02.pdf

Introduction

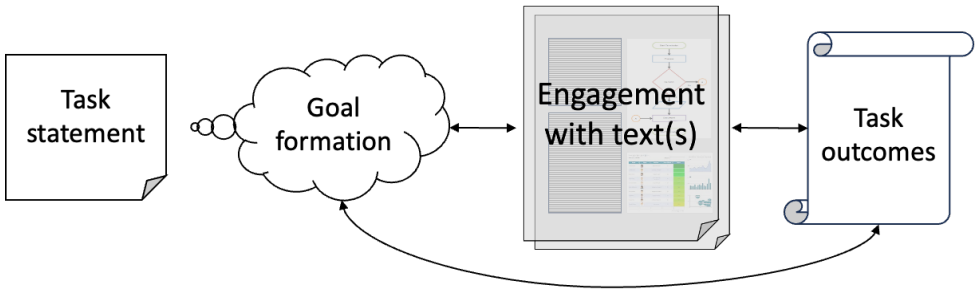
This working paper describes the skills that support literacy proficiency at and around Level 2 of the PIAAC Cycle 2 scale. We examine how these skills differ from those at work at Level 1 and at Level 3, respectively.

We begin with an overarching framework that defines foundational skills needed to perform literacy tasks at any level of proficiency. The framework then differentiates literacy knowledge and skills related to texts, tasks, and interactions between texts and tasks. We then identify the specific factors that drive proficiency in reading in terms of text and task features. Finally, we examine the skills associated with texts and tasks representative of Levels 1, 2 and 3 of the PIAAC Cycle 2 Literacy scale.

A General Framework for Adult Literacy Skills

Literacy may be defined "accessing, understanding, evaluating and reflecting on written texts in order to achieve one's goals, to develop one's knowledge and potential and to participate in society" (OECD, 2021, p. 42). This definition emphasizes both the pervasiveness and the versatility of reading. Indeed, on a daily basis, skilled readers engage with many different kinds of written texts in a broad diversity of contexts and for very different types of purposes (McCrudden & Schraw, 2007; Snow 2006; White et al., 2010). In addition, the OECD definition highlights the importance of readers' ability to set up and manage their own goals as they interact with texts. In a given context and for a given task, a skilled reader may want to comprehend a text in its entirety, reading the text from top to bottom with much attention. However, when assigned a different task, the same reader may want to skim the text in search of a specific detail as fast as possible. In other words, what drives skilled readers' engagement with text(s) and subsequent outcomes is the goal they pursue and their sense of achieving their purposes (Figure 1; Britt et al., 2018; 2022; van den Broek et al., 2011).

Figure 1. Relationships Between Tasks, Texts, and Reading Goals, Processes and Outcomes



As a consequence of this approach, a complete account of the knowledge and skills involved in proficient reading needs to consider each of three main dimensions of reading. The first dimension encompasses the characteristics of texts that readers can successfully engage with, in terms of length, cohesiveness, topic familiarity and language complexity, and diversity of sources. The second dimension captures the characteristics of tasks that readers can handle. Tasks that are communicated to the reader by a third party, for instance in the form of questions or instructions, may vary in terms of their intrinsic complexity (e.g., short vs. longer questions), amount of text information to be acquired (e.g., a single vs. multiple pieces of information), and whether the question requires some structured search in the materials (e.g., headers, tabs or sources). The third dimension captures the interactions of texts and tasks. The text(s) at hand may or may not contain the information that readily addresses the question, leading the reader to engage in some amount of reasoning about the text contents. Depending on the task and the text, the reader may also have to relate distant pieces of information, and to get around distracting information at various levels of density and prominence.

A detailed examination of the testing units and items that make up the PIAAC Cycle 2 assessment of literacy shows a continuous increase in difficulty from Level 1 to Level 3 along each of these three main dimensions. We have defined three criteria per dimension (i.e., a total of nine criteria) that further specify the skills acquired at each level of the proficiency scale. Each criterion corresponds to a level of mastery ranging from Basic to Intermediate to Advanced (see Appendix 1 for a description of each criterion at each of these levels). This description enables an analysis of skill acquisition in terms of what adults know and can do

at each level of proficiency, but also the level of mastery at which they can use each of the skills. This typology is at the basis of our analysis presented below.

Readers' ability to deal with texts and tasks of increasing complexity is supported by a number of foundational skills related to the basic processes at work during reading. Those include one's control of attention, the manipulation of information in working memory, the automaticity of word decoding processes, and one's depth and breadth of vocabulary. A full account of these skills is beyond the scope of the present report. Nevertheless, they have to be given due consideration when considering training procedures aimed at raising adult readers' proficiency. Insufficient foundational skills may constitute a serious obstacle toward the mastery of higher level skills.

In the next section, we briefly review three of these foundational skills (namely, working memory, word decoding and vocabulary) and we explain why they may pose a problem when engaging with longer or more complex texts for the purpose of achieving more demanding tasks. Then we review the higher order skills involved in addressing texts and tasks at Levels 1, 2, and 3, highlighting those that more typically define a transition across levels.

Foundational Skills That Support Reading Literacy

From a cognitive standpoint, reading is a resource-demanding activity that rests heavily on readers' ability to acquire and manipulate information in memory. During reading, a significant portion of one's cognitive resources are devoted to visually fixating written words and extracting meaning both in real time and at clause, sentence, and paragraph boundaries. The amount of resources actually needed to perform these basic processes depends on a number of individual characteristics. Memory skills, decoding fluency, prior knowledge, and vocabulary breadth and depth are three dimensions of individual differences that are likely to qualify the impact of any initiative aimed at training the higher order skills involved in reading literacy.

Memory Skills

Memory is described as a sophisticated feature of human cognitive architecture. Memory includes several subsystems (i.e., short-term, working, and long-term memory) and ensures the encoding, storage and retrieval of information together with other systems such as attentional control and emotions. A considerable amount of scientific literature suggests

that there are stable individual differences in adults memory capacity (Unsworth, 2019; Unsworth & Engle, 2007).

When comprehending written texts, readers must draw on their working memory capacity (Butterfuss & Kendeou, 2018; Daneman & Merikle, 1996). Working memory becomes more important the longer and more complex the text is, especially when the task requires establishing coherence across longer pages of text. In that case, readers need to be able to reactivate or actively recall relevant parts of the text representation in long-term memory, implying that individual differences in long-term memory processes are important as well (Unsworth, 2019). Working memory capacity and the mastery of long-term memory processes are core aspects of cognitive mechanics and difficult to improve through training in such a way that real-world educational or intellectual tasks such as reading comprehension would benefit (e.g., Melby-Lervåg & Hulme, 2013). At the same time, working memory capacity differs widely between individuals, including adults (e.g., Alloway & Gregory, 2013), and a low working memory capacity is likely to pose limits on the proficiency level individuals can reach on the literacy scale and on the success of interventions aimed at improving reading strategies in adult readers (e.g., Naumann et al., 2008; Tighe & Schatschneider, 2016). That said, research has identified teachable reading strategies that may help readers to use their working memory capacity more efficiently in reading (see below).

For reading tasks that require the comparison, evaluation, or integration of sources, not only the information itself but also the source need to be represented (or encoded and later reactivated from the discourse representation formed in long-term memory). In addition, readers of multiple documents are more likely to seek connections across documents in order to assess consistency, complementarity, or to explain discrepancies. Therefore, individual differences in working memory and other memory processes likely contribute to performance in reading tasks and texts that involve multiple sources (Barzilai & Strømsø, 2018). Moreover, for integrating information across sources and evaluating and comparing information and arguments from different sources, prior knowledge is helpful. Thus, low working memory and low prior knowledge might limit performance in these tasks.

Decoding Fluency

A basic aspect of literacy that becomes more relevant for reading longer text is reading fluency. Fluency may be broadly defined as the ease and accuracy of making meaning from written words (Pikulski & Chard, 2005). A higher fluency usually results in readers' ability to read faster and with less efforts, although skilled readers may also decide to slow down or think harder about the words they read if they need to. Fluent reading involves efficient word recognition, efficient syntactic parsing and semantic integration on the sentence level, and smooth comprehension processes on the text level. In people with severe reading difficulties (dyslexia), the recognition of written words is often inefficient, leading to disfluencies on higher levels of reading processes. But even beyond severe reading difficulties, huge individual differences exist in reading fluency, at the end of primary school (e.g., Karageorgos et al., 2020), in secondary education (Rasinski et al., 2005), and in adults (Tighe & Schatschneider, 2016) and share a considerable amount of variance with reading comprehension in all of these populations.

The more fluently people can read, the more cognitive resources they have available for higher order comprehension processes in reading, such as drawing inferences or reasoning about a text. For less fluent readers, reading is effortful and strenuous, especially for longer texts, which may lead to shallow reading or giving up reading before the information relevant for the task at hand has been processed.

In principle, reading fluency can be improved through reading practice and does so beyond primary school (e.g., van de Ven et al., 2017). However, once a certain level (which differs between individuals) is reached, further reading practice may lead only to negligible improvements. Less fluent readers tend to read little on their own because reading is aversive for them, leading to a low reading motivation and less frequent leisure reading, which in turn negatively affects reading development (Becker et al., 2010). Targeted training approaches, for example based on repeated reading or listening while reading, have proven to be effective in adults with reading problems (e.g., Winn et al., 2006; see also Kindl & Lenhard, 2023). These training approaches may be useful to lay the foundations necessary to improve the proficiency level of less fluent readers from Level 1 to Level 2 or from Level 2 to Level 3, respectively. However, the training of reading fluency per se is likely not to be sufficient to achieve these improvements.

Prior Knowledge and Vocabulary

The degree of familiarity of a text's content describes how well a reader's prior knowledge matches the content of a text. Prior knowledge is an extremely important domain-specific ability that is conceptually distinct from literacy but nevertheless a strong predictor of reading comprehension outcomes (Shapiro, 2004). Prior knowledge is equally important for performing efficient information search ("access" tasks), especially in complex texts (e.g., Symons & Pressley, 1993), and for information evaluation ("evaluate" tasks; e.g., Christodoulou & Diakidoy, 2020). High prior knowledge can even compensate for low verbal abilities and poor text quality (McNamara et al., 1996; Schneider et al., 1989). A broad knowledge base, ideally paired with experiences with a broad array of different text structures and genres, will increase the likelihood that readers will be familiar with a written text that they encounter in everyday life. It would be unrealistic to create such a broad knowledge base in a targeted intervention. Rather, it is the result of years of formal and informal education. Therefore, the lack of prior knowledge is a boundary condition that will limit the effectiveness of any intervention that aims at improving adult literacy.

A source of individual differences that is closely linked to prior knowledge, literacy, and reading comprehension is vocabulary (see, for example, Cromley & Azevedo, 2007). A broad vocabulary means that readers know and are able to access the meanings of many words, including the meanings of relatively infrequent words. Vocabulary may also be characterized in terms of "depth," that is, how much information a reader possesses about any given word they know (e.g., word spelling, sounding, meaning, and meaning variations across contexts, etc.; Devonshire et al., 2013; Perfetti, 2007). Comprehending a text that contains many unfamiliar words is difficult, which negatively affects performance in "understand" and "evaluate" tasks. Knowing the meaning of words is also essential for mastering "access" tasks, especially those for which paraphrasing of the relevant keywords in the question is necessary.

From a cognitive viewpoint, vocabulary is a subset of semantic knowledge. Thus, like general world knowledge, a broad vocabulary is the result of a long history of formal and informal learning and severe deficits are difficult to repair in a targeted intervention. Therefore, readers with a reduced vocabulary might profit from targeted literacy interventions to a lesser extent compared to those with a broader vocabulary.

As mentioned earlier, this short review of the foundational skills involved in reading literacy is far from complete. Other dimensions of individual differences, including outside the traditional cognitive frame of reference, should also be considered. These include, among others, readers' perception of their own competence in reading, but also their interest, motivation, and value associated with reading proficiency (McArthur et al., 2020). Our point here is to underscore the necessity of a precise diagnosis and screening standards prior to any attempt to train adult reading literacy skills in the sense of the PIAAC study.

In the rest of this paper, we examine the skills associated with the text and task dimensions of literacy processes (Figure 1). We also consider the skills associated with handling task by text interactions, that is, taking into account the characteristics of a particular text in one's effort to achieve a particular task. Such an analytic approach highlights some key features of proficiency at Levels 1, 2 and 3 of the PIAAC proficiency scale. However, as we discuss in this paper's conclusion, proficiency is in part defined by one's ability to deal with a high level of difficulty combining multiple drivers from either the text, the task, or the interaction of both.

Literacy Skills Associated With Text Features

There is a general consensus that more proficient readers can engage with more challenging texts. What matters for adult skill development is to define precisely what features of difficult texts challenge readers with low or intermediate skills. A detailed examination of the texts featured in PIAAC Cycle 2 testing units shows a continuous increase from Level 1 to Level 3 in length and also a decrease in cohesiveness, more unfamiliar content, an increase in difficult language, and a larger diversity of sources. We describe those changes and then we describe the skills that enable readers to deal with longer and more difficult texts.

Description of Text Features and Related Skills at Levels 1 Through 3

Table 1 presents an overview of the text features characteristic of Levels 1, 2, and 3. These features are derived from an exhaustive analysis of the PIAAC Cycle 2 testing units and items. *Text length* combines the total number of words, the possible presence of an embedded frame, table or graph, and the distribution of text across multiple pages. Note that in PIAAC the longest texts include at most a few thousand words distributed on three or four pages. *Topic novelty* describes the likelihood for test takers to have previously dealt

with the situation described in the text. In addition, some texts (mostly among the less familiar) use specialized language and longer sentences. The most difficult items combine these two features. Finally, *sources* represent the number of authors or contributors that issue information in any single testing unit. Roughly two thirds of the units in PIAAC involve a single author; multiple-source units may feature messages issued by multiple forum contributors to texts or longer texts written by different authors.

Table 1. Text Features at Proficiency Levels 1, 2, and 3 of the PIAAC Literacy Scale

Feature	Level 1	Level 2	Level 3
Text length	Short text (less than 200 words) featured on a single page Maybe a list or a collection of two or three short independent passages	Text of more than 200 words featured on one or two pages Possibly a simple 2D table or a diagram Occasionally, multiple sources with no requirement to use source information	Texts include either a single lengthy passage or multiple pages in a digital environment (e.g., website) Pages may combine continuous and noncontinuous passages
Topic novelty / language difficulty	Situation is mostly familiar and language is simple with easy vocabulary For less familiar situations, no inference is required	Texts may deal with unfamiliar situations but vocabulary remains easy If the text is more challenging, then the task requires only one literal or close to literal match	Texts occasionally combine an unfamiliar topic a complex structure (argument) and some difficult vocabulary Readers may deal with both a difficult text and a non-trivial task, although this is not typical
Number of sources	Texts typically come from a single source	Some texts feature multiple sources but readers do not need to evaluate the sources or to integrate information across sources	Some texts feature multiple sources. Source information is generally not critical to the task, but may facilitate access or understanding. A few items at the upper end of Level 3 require the reader to interpret discrepancies across texts using source information

At Level 1 of the PIAAC proficiency scale, readers comprehend syntax and basic coherence and cohesion relationships. They can access and understand short texts presented on a single page. The texts may include a few independent sections (such as the presentation of three different entities) or a list of items to select from.

At Level 2, readers can deal with longer narrative, descriptive or explanatory texts whose contents are not immediately visible. These include texts distributed across two digital pages. Accessing relevant information may require scrolling or clicking on tabs. This suggests that readers at Level 2 have developed an awareness of at least the most common types of text signals (Goldman & Rakestraw, 2000; Lemarié et al., 2008). Readers can access and understand information arising from multiple sources (e.g., forums or document sets). Level 2 readers can also make use of simple two-dimensional tables and charts.

At Level 3 and above, readers can understand lengthy multipage texts. The texts may deal with unfamiliar topics and use difficult language. They may present multiple conflicting claims supported by arguments. In the most complex tasks at this level, readers can use source information to interpret discrepancies across texts. Readers at Level 3 can also deal with more complex tables, for instance, tables in which the cells include continuous texts. Importantly, whereas most texts at Level 2 involve one driver of difficulty at a moderate level, texts at Level 3 are likely to include several drivers (e.g., both long and unfamiliar), often at an advanced level (e.g., distributed on more than two pages). See Appendix 1 for details.

Reading Strategies to Deal With Text Dimensions

The influence of text features on reading comprehension has been thoroughly investigated over the past decades. Several strategies that characterize more proficient readers have been identified.

Reading Strategies to Deal With Longer Texts

The reasons why longer texts may challenge adults with low literacy skills are rather intuitive: If asked to read a text for comprehension, the longer the text the more challenging the task will be for readers who struggle to comprehend what they read.

Theory and research on reading and learning strategies suggest a bundle of strategies (or “families” of strategies) that can help readers to deal effectively with longer texts. Meta-analyses suggest that these strategies can be taught with considerable success

(e.g., de Boer et al., 2018; Edmonds et al., 2009; National Reading Panel, 2000) although most intervention studies have been conducted with secondary school students and university students. The usefulness of each of these strategies also depends on the reading task in question. In that sense, the strategies represent skills necessary to deal with difficulties imposed by text-by-task interactions.

One family of reading strategies that readers can use to better accomplish access and understand tasks with longer texts are *organizational/structuring strategies*. These strategies include, for example, the use of text and content schemata to comprehend text ("understand" tasks; Hebert et al., 2016; for example, León & Carretero, 1995) or to find specific information in a text ("access" tasks; e.g., Cataldo & Oakhill, 2000; Rouet & Coutelet, 2008), or the use of graphic organizers or concept maps for extracting the macrostructure of a text (i.e., the main ideas and their relations; Schroeder et al., 2018).

In reality, however, adults seldom engage with long texts for the sake of global comprehension (White et al., 2010). Reading fiction for enjoyment, for instance, accounted for less than 10% of the daily reading time of American adults. Instead, adults often engage with written texts with the purpose of locating one or several pieces of information that will let them achieve a more specific goal such as answering a question. This is, in fact, what the PIAAC assessment requires test takers to do. With longer texts, the difficulty to locate the information of interest increases. Readers with low or intermediate skills may easily "get lost" in the text and either give up or try to guess the answer (see Vörös & Rouet, 2016, for an analysis of persistence and task outcomes based on the PIAAC Cycle 1 "problem solving in technology-rich environments" tasks, some of which are not very different from complex comprehension tasks). As another challenge, readers of long texts are more likely to encounter distracting information that may confuse them especially if they fail to monitor their initial goal.

Paying attention and using textual signals may be useful for finding specific information in a text (e.g., Dreher & Guthrie, 1990; Meyer & Poon, 2001; Potocki et al., 2017). Textual signals are a broad category of linguistic devices (Lemarié et al., 2008; Lorch, 1989). For example, linguistic expressions, one type of linguistic device, communicate the importance or role of specific ideas in a text or their semantic or argumentative relationships to other ideas (e.g., connectives, modal verbs, cross-references, thematic sentences). Other important types are navigational devices such as navigation menus or

marked links in electronic texts that span several pages, headers in continuous texts, or tables of contents or other kinds of advance organizers that signal the global text structure.

"Understand" and "evaluate" tasks for lengthy texts may be especially challenging because they can require relating or integrating information distributed over different parts of the text, such as different sections or pages. For this type of task, the broad class of *elaborative* or *generative learning strategies* that aim at activating prior knowledge and integration of text information with prior knowledge (e.g., self-explanations, concept mapping, elaboration prompts) are helpful to establish global coherence and to construct or reconstruct semantic or argumentative relationships within and across texts (Barzilai et al., 2018; Fiorella & Mayer, 2016).

The comprehension of points of views and claim-argument relationships play a key role in transitioning from Level 2 to Level 3. In fact, the PIAAC Cycle 2 assessment did not include a single testing item featuring multiple conflicting sources below Level 3. It is well known that argumentative texts pose specific challenges to teenage readers, in part because they rest on the development of so-called epistemic cognition, or an awareness that knowledge is relative and maybe subject to updating (Bråten et al., 2011). Integrating information from multiple documents also requires readers to construct an integrated mental model whereby contents are partially indexed on the respective sources (Rouet et al., 2021).

Reading Strategies to Deal With Unfamiliar Texts

Texts can be more familiar to a reader in terms of their content, the vocabulary used, and the text genre and structure. Some of the texts in the units with higher level items of the PIAAC assessment are likely to be less familiar to most test takers, although familiarity/lack of familiarity does not seem to be a major driver of difficulty in the PIAAC literacy assessment. One possible explanation for this observation is that the items/units were purposefully chosen for the assessment in such a way that they should be equally familiar to readers in all participating countries. Therefore, they mostly represent texts and text topics that participants are likely to encounter in everyday life. Nevertheless, unfamiliar texts are common in the real world and the ability to deal with less familiar texts is undoubtedly an important aspect of literacy in the real world and should be considered in a comprehensive intervention program.

Readers must notice that a text is unfamiliar and hence difficult for them in order to take appropriate remedial actions. Therefore, accurate *metacognitive monitoring of comprehension* (Baker, 1979), which includes becoming aware of comprehension problems and attributing these comprehension problems to a lack of prior knowledge or a limited vocabulary, is important. Metacognitive comprehension monitoring develops during secondary school as a result of schooling but is a skill that can be trained in targeted interventions (Schneider et al., 2022).

The only way to overcome comprehension problems that are due to a lack of prior knowledge or vocabulary is to fill the knowledge gaps by consulting additional information sources or resources. Readers need to know how to find and use the relevant information that helps them to understand the text or unknown words and to accomplish the reading task. Therefore, strategies of how to research information effectively and how to evaluate the relevance of information ("information literacy") may be important.

Reading Strategies to Deal Successfully With Multiple Sources

The presence of multiple sources per se does not seem to be a driver of difficulty that clearly distinguishes between proficiency Levels 1 to 4 of the PIAAC assessment. Multiple sources are present in some (but not all) tasks on all levels starting from Level 1. However, multiple sources in combination with "evaluate" or "understand" tasks that require comparisons between arguments or information from different sources or the integration of information across sources appear more often on Level 3 and beyond. Likewise, multiple sources presenting discrepant and conflicting information or arguments are specific to more difficult tasks on Level 3 and beyond.

To improve performance in reading tasks that involve multiple sources, paying attention to the source of information and considering source information in inferencing and reasoning about the text is important (sourcing, Bråten et al., 2017). Various specific sourcing strategies have been identified in the literature and targeted trainings have been developed and evaluated to teach these strategies and their application (mostly for secondary school and university students, e.g., Britt & Aglinskas, 2002; for an overview, see Brante & Strømsø, 2018). Apart from raising awareness of the importance of sources for many reading tasks, the usefulness of particular strategies very much depends on the specific task. For example, for "evaluate" tasks, strategies that help readers to identify

credible sources are often helpful. For sources presenting discrepant information, encouraging and training systematic comparisons of information and arguments across sources might be helpful (Wineburg et al., 2022). Finally, the integration of information across sources, which may be relevant for certain "understand" and "evaluate" tasks that involve multiple sources, can be fostered through appropriate strategies (Barzilai et al., 2018).

Skills Associated With Task Comprehension and Management

As stated earlier, in their daily life adults most often engage with texts having a specific purpose in mind. In the PIAAC study, reading purpose is communicated through questions that test takers answer using one or several texts that are made available to them. Questions are designed so as to prompt one of three main categories of cognitive processes (OECD, 2021, p. 45): access information within the text, understand either literal or through inferences, or evaluate text information. In absolute terms, the PIAAC data suggest that there is a hierarchy of difficulty among these categories of processes. Up to Level 2 of the PIAAC proficiency scale, most tasks require only access or understanding of text information. Most questions mainly require literal understanding and inferences, when needed, consist of matching phrases that differ in wording. Only three tasks at Level 2 require the reader to evaluate content. In two cases, evaluation consists in pointing to a section of the document that matches a stated communicative purpose. The third case asks for the evaluation of a simple claim. Evaluation is represented more often and in more diverse forms from Level 3 on. At that level, readers perform mostly content evaluation on the basis of a single document. More complex forms of evaluation (e.g., inferences about multiple information sources) correspond to the upper end of Level 3 and above.

At this point, it is important to stress that while an effort was made to design questions that call for a specific category of process, the most difficult tasks sometimes require a combination of different processes. For example, some tasks labelled "understanding" or "evaluate" require the test taker to access relevant information within the text before they can engage in these processes. Likewise, most evaluation tasks require the test taker to understand what they read before they can evaluate it. In fact, readers at Level 3 are able to engage in multistage activities that involve a combination of access, understand, and/or evaluate. It is also important to note that question difficulty depends in

large part on the amount, organization, and content of the text(s) provided to the reader. We return to this in the next section (Skills Associated With the Interaction of Tasks and Texts).

Description of Task Features and Related Skills at Levels 1 Through 3

Besides the core cognitive process targeted by the question, reading literacy tasks differ on three types of features (Table 2). First, some questions are intrinsically more complex than others. Question complexity may be proxied by a simple word count. An example of Level 1 question might ask, "What type of X is needed in [this or that] situation?" with a set of four short response options, totaling less than 20 words. In contrast, a Level 3 question may start with a 2-sentence scenario and ask the test taker to choose among four conjugated sentences representing a total of some 80 words (C514P002). Question complexity also increases when the question uses abstract, vocabulary expressing certainty, comparison, or argument strength such as "likely," "least," "most," or "support (for claim X)." Finally, some questions provide guidance by specifying the form of the answer and/or directing the test taker to a specific portion of the material, whereas others leave it up to the test taker to figure out exactly what is requested and how to find it. These combine to characterize each PIAAC item as basic, intermediate or advanced in terms of question complexity.

Another factor of difficulty is the complexity of the reading goal structure needed to perform the task. Simple tasks involve a single goal, typically to access or understand a single piece of information in a short continuous or non-continuous text. More complex questions require the readers to generate subgoals either because the reader needs to access several adjacent or nonadjacent pieces of information (i.e., multiple targets) or because locating the single target requires a combination of cues, such as line and column headers in a two-dimensional table. Additional complexity in the goal structure comes when the reader has to compare or contrast multiple pieces of information (as opposed to simply locating these pieces of information).

Finally, task complexity depends on the strategy required to find information of interest. Simple tasks do not require a specific strategy to locate the information of interest. Readers may simply browse through the text until they find a relevant passage. More complex tasks require the reader to make use of navigation or content signaling devices. For

instance, the reader may need to identify links and select one to reach the passage of interest. Or they may need to combine the line and column headers in a document in order to focus on the relevant cell in a complex two-dimensional table.

Table 2. Task Features at Proficiency Levels 1, 2, and 3 of the PIAAC Literacy Scale

Feature	Level 1	Level 2	Level 3
Question length, complexity	Questions are short and explicit, asking the reader to locate and/or understand information in the text. When applicable, the question points to a particular portion of the stimulus. No evaluation is requested beyond sentence meaningfulness.	Most questions are simple and straightforward, asking the reader to locate and/or understand information in the text. Some questions may feature a longer stem; they may come with a short introductory scenario, or they may ask the reader to operate with complex response options.	Questions may ask the reader to locate, understand and/or evaluate information in the text. Some questions involve a scenario, a complex stem, or they involve a complex response mode. Questions sometimes use difficult language including modals and comparatives. Increased question length or complexity may come with at least another driver of difficulty. Some questions combine 2 or 3 distinct difficulty drivers.
Complexity of reading goal structure	Questions involve a single target and step. There is little or no need to compare or contrast beyond locating target information in the text.	Some questions may involve either two targets, or two steps may be needed in order to access relevant content.	Questions may involve comparing information across multiple targets and/or multiple processing steps.
Need to use text signals or navigation devices	Questions do not require any use of text signals or navigation devices.	Questions may require the location of information through section or table headers in a single page text.	Questions may require the use of navigation devices and the location of information through section or table headers in a multipage text.

Our content analysis of the PIAAC Cycle 2 tasks shows that at Level 1 of the proficiency scale, readers can deal with simple and straightforward questions that sometimes come with explicit instructions as to where to look in the materials. These questions require the location and understanding of a single piece of information, which

may be achieved by simply browsing the text, without considering any structural or navigation components.

Level 2 still involves simple questions asking mostly for the location and/or understanding of a single passage in the text. Some tasks at this level have a longer stem; they may require the location of two target passages or pieces of information or the completion of two steps in order to locate the target. When this happens, the use of text signals or navigation devices may be required in order to locate the information of interest. Almost no task at Level 2 features a difficulty driver at an advanced level (i.e., an intrinsically very complex question or a question with more than two goals or a question that would require using multiple text signals or navigation devices).

These more complex tasks begin at Level 3. Some questions ask the reader to not just locate and understand information, but also to evaluate content information against various types of criteria. Questions may include a longer stem and/or a complex response mode. The question's intrinsic difficulty may come with another driver of difficulty, such as the need to complete multiple steps, for instance to locate more than one target, making use of text signals or navigation devices. It should be noted that in the PIAAC assessment, most tasks at Level 3 are still relatively simple. However, readers at this level do demonstrate an ability to deal with the difficulty drivers identified above.

Strategies to Improve the Comprehension of Reading Tasks

Comprehending a question is a complex cognitive process in itself, not much different from comprehending other types of text. Questions usually include a question word (e.g., when, what, how, why) and a focus (usually a phrase or a sentence). The focus indicates what the question is about, whereas the question word indicates the type of information that is to be searched (Graesser & Franklin, 1990). In addition, questions often include some contextual information that may further specify the focus, at the cost of a higher "wordiness" of the question. For instance, "What color is the cup?" is a simple but rather vague question, whereas "What color is the cup placed to the right of the plate on the small wooden table?" is a more specific but longer question. Research suggests that readers need to build a mental model of the question, or "task model" (Britt et al., 2017) in order to search effectively. A task model includes a cognitive representation of what the question is about, a representation of what the response may look like, and a

representation of what information is needed and how one might acquire that information. The latter aspect of the task model is not trivial, as readers may sometimes feel that they know the answer when in fact they are really missing some information that they may find in the text. Developing readers' correct assessment of their information need is a prerequisite for deciding to engage in reading and also for knowing what to look for in the text (Potocki et al., 2017; Rouet & Coutelet, 2008). What the response may look like depends not just on the question per se but also on the context in which the question is asked. In some contexts, a vague response may be good enough provided that it is obtained quickly. In other contexts, response accuracy and completeness may be of utmost importance. Therefore, comprehending questions also involves reflecting about response accuracy, completeness and time effectiveness, among others. In the context of an untimed assessment protocol such as PIAAC, it is likely that most test takers would prioritize response accuracy and completeness. However, because this is a low-stakes assessment and because test takers may be under some kind of time pressure unrelated to the assessment, there may be some individual variations regarding what test takers are really trying to achieve.

Research with developing readers shows that they sometimes fail to accurately understand what the question is asking (Kobasigawa, 1984; Rouet & Coutelet, 2008), often because they do not correctly identify the question focus. For instance, Kobasigawa (1983) reported that in response to a lengthy question about the challenges of food production in China, fourth and even eighth graders said they would search for information about "China." Students in the elementary grades may also be unsure about whether they can respond based on their prior knowledge or whether they need to engage in reading (Cerdán et al., 2011; Raphael & Pearson, 1985). Finally, readers' memory for their task model may be challenged by the incoming irrelevant information. Rouet and Coutelet (2008) observed that fifth and even seventh graders sometimes forgot what they were searching for. In the best-case scenario, the participant realized the problem and asked to be reminded about the question, or at least paused. However, in other cases the students simply answered a question slightly or entirely different from the question they had been asked.

Research into training students to better understand search or comprehension questions is still scarce at that point. Brand-Gruwel and van Strien (2018) stressed that the skills that underlie an internet search are skills rarely taught at all levels of education.

Recent research suggests that an explicit, analytic approach to comprehending questions supports students functional reading comprehension skills at the fifth grade (Potocki et al., 2023). An approach combining direct instruction with guided practice has also proven beneficial with undergraduate students (Macedo-Rouet et al., in press). Whether these instructional approaches would be relevant for training question comprehension in low literacy adults remains, to our knowledge, an open question.

Skills Associated With the Interaction of Tasks and Texts

In addition to the intrinsic complexity dimensions reviewed in the previous section, the actual complexity of a question depends on the characteristics of the texts that are available to answer them. For example, a question may be easy to answer if the text contains a ready-made response placed in a prominent position, but more difficult if the text includes only indirect cues buried among distracting information. Thus, in addition to text-specific and question-specific drivers of reading proficiency, there exists a number of additional dimensions that characterize the ease of answering a question given a particular text or set of texts, or, conversely, the "easiness" of a set of texts as a function of question contents. These dimensions, too, vary as a function of PIAAC literacy levels; thus, it is relevant to ask whether they are associated with specific skills.

Description of Task-by-Text Dimensions of Reading Proficiency

Our detailed analysis of PIAAC literacy materials has elicited a number of dimensions that characterize the relationship between a task and the text(s) used to perform that task. We have grouped them into three categories (Table 3).

Indirect Match, Inferencing, Reasoning

This broad category defines the distance between what is being asked in the question and the information explicitly mentioned in the text. A direct match means that the question may be readily answered by reading from the text. Simple inferences include substantial paraphrasing, temporal ordering, connecting causes and antecedents, and categorization. More complex inferences consist in extracting gist from several sentences or interpreting characters or authors' motives from indirect cues. Like the other dimensions of task difficulty/proficiency, inferences are scored as basic, intermediate or advanced as a function of the complexity of the cognitive operations they require.

Need to Relate Distant Pieces of Information

Some texts provide all needed information in a single location thanks to author-generated cues (e.g., consecutive words in a sentence or sentences within a paragraph or a single table cell). Other texts require the reader to identify and use multiple pieces of information distributed across paragraphs, messages, or even pages in a website type of environment. At an advanced level, readers must integrate pieces of information distributed in distant paragraphs or on multiple pages.

Amount and Salience of Distracting Information

We define distracting information not as any information surrounding the target (which is already captured in the "text length" dimension described in section 3.1.), but as information contained in the text that resembles the target information. Information may be distracting because it shares a content word with the question, or a visual feature in the case of pictures. Distracting information may be easier or harder to discard, depending on its position in the text and on how closely it resembles the target. This matches the construct of "plausibility of distractors" put forward by Mosenthal (1996). At an advanced level, the text may contain multiple pieces of distracting information, possibly placed in a prominent position.

Note that these dimensions are not independent from some of the dimensions of texts and tasks that we have reviewed in the previous sections. For instance, the need to relate distant pieces of information mostly concerns questions that require the reader to relate at least two pieces of information (i.e., a complex goal structure). The probability of distractors increases with text length and so forth.

Table 3. Dimensions of Task-by-Text Interactions at Proficiency Levels 1, 2, and 3 of the PIAAC Literacy Scale

Feature	Level 1	Level 2	Level 3
Indirect match, inferencing, reasoning	Questions directly match a piece of information in the text. When required, inferences consist of just matching a word in the question with a related word in the text.	Questions involve diverse types of inferences or the integration of several ideas into one main claim or point. Inferences go beyond connecting related words. Some require connecting actions with enabling circumstances (C518P001), or recognizing temporal order from diverse textual cues (C510P006) Only two PIAAC items at this level require inferences about opinions or intentions.	Most questions at this level involve one among various types of inferences. Although some inferences may involve connecting questions and text, others require elaborative inferencing or reasoning about extended portions of the text. In other cases, overall meaning needs to be constructed. (E323004). Some inferences at this level regard authors or characters' state of mind, intent or opinion.
Connecting distant pieces of information	Tasks at Level 1 require a single step. The information to be integrated belongs to the same sentence or table. There is no need to relate distant pieces of information.	Only a few tasks at this level require connecting distant pieces of information. The pieces to be connected are featured in adjacent paragraphs or messages, one the same page.	Tasks may require the reader to connect information from distant paragraphs, or from the text and an inserted table or graph, or from two pages.
Dealing with distracting information	Tasks at Level 1 typically do not include distracting information.	Some texts at Level 2 contain distractors. In most cases they can be discarded if readers go slightly beyond surface processing (i.e., tabs, pictures or words matching the question focus).	Texts at Level 3 may include multiple distractors. The distractors are sometimes in a prominent position (tabs, headers, top of the text). Distracting information requires some thinking in order to be rejected.

The distribution of task-by-text difficulty drivers in PIAAC Cycle 2 resembles that of task features (see the previous section, Skills Associated With Task Comprehension and Management). At Level 1, task-by-text interactions are often minimal. At most, some tasks require a simple inference or the text contains some easy-to-discard distracting information.

At Level 2, a majority of tasks involve at least one interaction with the text, but these are at most at an intermediate level of difficulty. About half of the tasks at Level 3 have one type of task-by-text interaction scored as advanced. Thus, readers at Level 3 must be prepared to deal with either substantial inferences, or to handle multiple cycles of locating and/or integrating information across passages of text, or to discard distractors that share a high level of resemblance with target information.

Skills Supporting the Management of Task-by-Text Interactions

Inference generation is undoubtedly a feature of skilled reading comprehension (Yuill et al., 1989). However, because inferences involve such a broad category of cognitive processes, it is difficult to identify precisely the skills that support them. Various categorizations have been proposed (Bowyer-Crane & Snowling, 2005; Graesser et al., 1994; Kintsch, 1998). An important distinction is between connecting and elaborative inferences. Connecting inferences identify relationships among text segments. An example of connecting inference is the identification of a referent for the pronoun *she* in the passage "The president came out of a large armored vehicle. She was holding a little girl in her arms." Elaborative inferences add information to the discourse representation through associations, computation or informal reasoning. For instance, when reading "Jack inadvertently dropped the fragile China vase.", a reader may conclude that the vase is going to be damaged. Elaborative inferences can be used to add coherence to discourse. For instance, when reading the passage, "Mary really wanted the fancy cross-country bike she had seen for months on display at the bike shop. She decided to take a summer job instead of going on a vacation with her friends.", a reader may infer that Mary took the job in order to earn money to purchase the bike. Whereas connective inferences do not always require a lot of prior knowledge about the situation described in the text, elaborative inferences generally do.

Readers' ability to generate inferences increase with age and reading skills (Oakhill et al., 2003). It is unclear whether one's ability to generate inferences is specific to reading or even to language comprehension. In fact, there is evidence that inference generation may rely on processes partly independent from the medium (i.e., written texts, pictures, or movies; Kendeou et al., 2008). Attempts to train inference generation in young readers generally yield positive results. One method consists in questioning readers or having them

ask questions about the text they are reading, making explicit the reasoning they bring to bear in the process (McGee & Johnson, 2003).

Inferences may be more difficult to produce when they require the reader to connect distant pieces of discourse (Table 3, second feature). The reader then has to hold the question and previously read information in mind while locating and processing the other piece(s) of information needed to answer the question (Yuill et al.,1989). This results in a high load in working memory (see the Memory Skills subsection), as well as a need for the reader to monitor their progress with the task. Likewise, avoiding distractors (Table 3, third feature) rests on an inhibition mechanism that depends on the reader's executive functioning. As discussed in the Memory Skills subsection, there is currently no strong evidence that adults' memory skills could be trained in a way that transfer into better literacy skills. However, it could be that guided practice with tasks of increasing difficulty on all three dimensions of task-by-text interactions could improve adult low literacy skills.

Summary and Conclusions

Our analysis of the PIAAC Cycle 2 literacy results has elicited three main drivers of proficiency. These are the skills associated with dealing with longer and more complex texts, those associated with more complex tasks (questions), and those associated with more complex interactions between tasks and texts.

Skills associated with more complex texts are apparent from Level 2 on. However, adults at Level 3 can handle multipage texts presenting contrasted or even conflicting viewpoints. They can assess the quality of arguments and the credibility of information sources.

Adults at Level 3 can also address more complex comprehension tasks. Notably, they can deal with lengthy questions that require them to evaluate text contents against various criteria. They can also deal with questions that require multiple processing steps, making use of text signals or navigation devices.

Finally, adults at Level 3 can generate deeper inferences, connect distant pieces of information and avoid multiple distractors even when placed in prominent positions. These skills rest on advanced memory functions and it is highly relevant to ask if training into these more complex comprehension tasks may help adults compensate for their limited cognitive capacity.

Most importantly, a core distinction between Levels 2 and 3 lies in adults' ability to handle tasks that involve several constraints (e.g., a complex question about a long text). Level 2 adults are able to handle some complexity on one aspect of the task as long as other aspects are not also complex. Teaching adults to identify multiple constraints and difficulties and how to deal with them is key to their transition across these levels.

From this analysis, one may look into possible interventions targeting the skills needed to transition across levels of the PIAAC proficiency scale. Issues to be discussed include the instructional engineering of literacy skills, the role of explicit instruction, guided practice with feedback, consolidation, and generalization, as well as interventions targeting motivation, beliefs about self, and values associated with literacy skills.

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Appendix

Table A1. Scoring Criteria for Literacy Drivers of Proficiency

Mastery level Criterion	Basic (score 0)	Intermediate (score 1)	Advanced (score 2)	Comments
Text length	Very short text (less than 200 words).	1) Single cohesive text of more than 200 words up to a full page OR multiple independent passages, OR multi-part document OR includes 2D table Note: To be scored as intermediate, text length must be equivalent to what would fit on a single US letter page. 2) Websites featuring only one content page (possibly including links to empty pages); Website pages featuring popups with constant framing. To be scored as intermediate, a Web page must require no more than one window worth of scrolling	1) Multi-page texts. 2) Long website pages with more than two windows worth of scrolling (i.e., more than approx. one US letter page. 3) Websites made of multiple pages.	We score the text as it is presented for each particular item. The text may change within a unit, therefore the rating may be different from an item to another.
Familiarity (lack) and reading difficulty (syntax, vocabulary)	Texts addressing topics that test takers are likely to have experienced before.	Text may refer to situations or activities TT is unlikely to have experienced before.	Same as "intermediate" plus text uses difficult vocabulary, acronyms, long sentences. A text is scored as "advanced" if it has a Fog index higher than 12, i.e., end of secondary education.	
Multiple sources	Single source, no source info, or sources irrelevant to unit.	Text includes multiple sources (authors, entities issuing content) Note: We consider the following as multiple sources: forum messages, or a set of texts each of which includes an explicit source cue, even if the cue is not informative per se.	Multiple sources with discrepant content.	
Question length, complexity	Short questions without a contextual scenario. When applicable, the question points to a particular	Intermediate tasks include an introductory scenario or contextual information that is required to comprehend the actual question, OR Question is long, involves abstract vocabulary, or calls for relative thinking	Same as Intermediate plus the item incorporates a complex response mode, e.g., choosing or sorting from complex sentences with little discrimination - TT needs to build a mental model of each response option.	Reliability of intermediate vs. advanced scoring would need to be assessed in a validation study.

	portion of the stimulus	(e.g., to "challenge a claim", "likely", "least", "most credible," "support for this claim"	Questions asking to select a sentence from a text are not considered complex response modes because responding only takes one selection.	
Multiple steps, targets, need to compare/ contrast	Single step and/or target.	Task includes the application more than one criterion OR target OR multiple steps (question to text)	Task includes multiple criteria, targets AND steps.	To be further verified against materials
Need to use text structure/signals (e.g., headers or tabs)	No need to use structure or signals	TT needs to use text signals in order to locate target(s). Often the question uses specific terms like links, tabs. Reading tables.	N/A	Could also be 0 vs. 2 in order to balance weighing in a linear equation.
indirect match, inferencing, reasoning	Direct or paraphrase match between question and text content.	Some inferencing required OR two ideas need to be integrated. Inferencing consists in connecting or easy elaboration.	Deep (elaborative) inferencing or reasoning required, overall meaning or intent needs to be constructed.	Reliability of scoring 1 vs. 2 need to be further assessed.
Need to relate distant pieces of information	If information pieces need to be integrated, they belong to the same sentence or table.	Need to relate (or integrate) two distant pieces on the same passage/page in the absence of author-created cues. The pieces do not belong to adjacent sentences or to the same list/table (otherwise this criterion would be redundant with 22).	Need to relate two or more pieces from different passages or pages.	
Amount/ salience of distracting information	No distracting information	Some distracting information, defined as information that resembles the target information. Not to be confounded with text length. A long text with a single, distinctive target does not qualify.	Much distracting information, possibly in prominent position	To be further checked for reliability.

Note: This table presents a set of criteria regarding the dimensions of texts, tasks, and interactions of texts and tasks that are assumed to drive proficiency acquisition across Levels 1 to 3 of the PIAAC literacy scale. The criteria were initially identified in May 2024 as part of the PIAAC Cy2 expert group meeting and applied to a subset of test items. After the meeting, the criteria were iteratively revised and applied to all literacy items until August of 2024. There was no empirical evidence regarding the possibility to reliably score each criterion at the time of submission. Furthermore, the scores indicated in the columns are indicative. Additivity and weighing also need to be further assessed in a validation study. **The version of the table presented here should be considered work in progress and not used outside the scope of the ROI study. Note: TT refers to test taker.**

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