

Research Article

Diagrams in Contracts: Fostering Understanding in Global Business Communication

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Abstract—Research problem: *Business-to-business contracts are complex communication artifacts, often considered “legal stuff” and the exclusive domain of lawyers. However, many other stakeholders without a legal background are involved in the negotiation, drafting, approval, and implementation of contracts, and their contributions are essential for successful business relationships. How can we ensure that all stakeholders in the global business context—whatever their native language or professional background—easily and accurately understand contract documents? This study suggests that integrating diagrams in contracts can result in faster and more accurate comprehension, for both native and non-native speakers of English. Literature review:* We focused on the following research topics: (1) ways to integrate text and visuals to create more effective instructions, since we conceptualize contracts as a type of business instructions; (2) cognitive load theory, as it may help explain why contracts are so hard to understand and why text-visuals integration may ameliorate their understandability; (3) cognitive styles, as individual differences may affect how individuals process verbal and visual information, thus allowing us to explore the limitations of our suggested approach; (4) the English lingua franca spoken by business professionals in international settings, their needs and challenges, and the fact that pragmatic approaches are needed to ensure successful communication. **Methodology:** We conducted an experiment with 122 contract experts from 24 countries. The research participants were asked to complete a series of comprehension tasks regarding a contract, which was provided in either a traditional, text-only version or in a version that included diagrams as complements to the text. In addition to measuring answering speed and accuracy, we asked the participants to provide information about their educational background, mother tongue, and perceived mental effort in task completion, and to complete an object–spatial imagery and verbal questionnaire to assess their cognitive style. **Conclusions:** We found that integrating diagrams into contracts supports faster and more accurate comprehension; unexpectedly, legal background and different cognitive styles do not interact with this main effect. We also discovered that both native and non-native speakers of English benefit from the presence of diagrams in terms of accuracy, but that this effect is particularly strong for non-native speakers. The implication of this study is that adding diagrams to contracts can help global communicators to understand such documents more quickly and accurately. The need for well-designed contracts may open new opportunities for professional writers and information designers. Future research may also go beyond experimental evaluations: by observing this new genre of contracts in vivo, it would be possible to shed light on how contract visualizations would be perceived and interpreted in a global communication environment.

Index Terms—Contract visualization, contract design, cognitive load, diagrams, global communicative competence (GCC), international business communication (IBC).

INTRODUCTION

Think about contracts: long, complex, demanding documents written in “legalese,” not really an archetype of effective, clear, and easy professional communication. Misunderstandings may lead to litigation, which damages businesses in terms of wasted resources and reputation. For instance,

Manuscript received May 15, 2015; revised September 8, 2016; accepted September 10, 2016. Date of publication; date of current version.

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BellAliant and Rogers Telecom, two Canadian firms, went through a bitter 18-month dispute, worth \$1 million CDN, on whether BellAliant was allowed to terminate a contract by simply giving notice or whether the agreement was iron-clad until the end of the contract period. The source of confusion boiled down to a single comma in the English version of the agreement, which suggested that the first interpretation was the correct one, while the French version of the agreement (Canada is a bilingual country) supported the latter interpretation [1]. Plain language scholars have been addressing the shortcomings of traditional legal writing for years. Even attorneys and legal scholars have repeatedly warned that legalese is a waste of money for businesses and governments in the form of claims, administrative and compliance costs, and time lost in writing, reading, and managing confusing documents [2]–[4].

IEEE 10.1109/TPC.2017.2656678

It is also erroneous to think of contracts as merely “legal stuff,” the exclusive, specialized domain of lawyers [5]. In today’s global, networked economy, contracts represent key business instruments for companies to synchronize, collaborate and undertake new ventures. They are used in all spheres of business, from narrow aspects such as the working conditions of a certain employee, to large corporate-wide issues such as mergers and acquisitions. Moreover, after signature, contracts need to be implemented by responsible teams, who need to carefully follow contracts as instructions and translate them into concrete actions. Thus, we see contracts as a business communication genre. Managers and executives, in addition to lawyers, are the key stakeholders of contracts, and should be able to understand what contracts say and how they impact day-to-day business.

The challenge is even greater in international business, as parties do not share the same language and may lack common interpretive frames. The highly formal register of English “legalese,” which is modeled on the English used by its legally trained native speakers (NS), is the standard language of international contracts. However, this is not the real-life English used in international business, which is better characterized as a *lingua franca*, typically used by non-native speakers (NNS) of English, to get work done. As shown in the BellAliant versus Rogers case, the long and syntactically complex sentences typical of legalese may be ambiguous even for NS managers. In light of the concept of global communicative competence (GCC) [6], [7]—which, drawing on the *lingua franca* aspect of English, stresses pragmatic communication skills rather than flawless native proficiency—we propose that the threat of ambiguity to international contracts must be addressed by going beyond the use of textual language. After all, the legal principle of freedom of contract does not limit in any way contract formats, style, and aspect (even a verbal contract is valid, although it may be hard to enforce).

In this study, we show how the comprehension of agreements among international contract professionals can be enhanced by presenting information in a more visual fashion: contracts complemented with explanatory diagrams and presented in clearly structured layouts. The argument in favor of visualizations as a way to clarify the meaning of complex textual information is based on these areas of earlier research:

- (1) The benefits of integrating texts and visuals in instructional texts (and how contracts can be intended as a particular type of instructions)
- (2) Cognitive load theory (CLT) and the effects of individual cognitive styles on learning
- (3) The specific needs of professional NNSs of English for pragmatic solutions and practices that can improve their overall communicative competence

The overall problem of this study can be formulated as follows: can a visually enhanced style of communication help professionals to understand complex contractual information? This leads to our first two research questions:

RQ1. To what extent can professionals’ understanding of contracts be enhanced by employing diagrams in these documents?

RQ2. To what extent can diagrams in contracts reduce the time taken to understand these documents?

If we find that diagrams indeed support contract comprehension, we want to investigate whether their presence equally benefits individuals with different cognitive styles, language abilities, and knowledge of specific jargon. For instance, could a visual approach increase the communicative competence of NNSs dealing with English legalese and reduce the gap with NSs? This leads to two further research questions:

RQ3. Which individual characteristics (e.g., cognitive style, educational background, age, language . . .) may affect the extent to which a professional benefits from diagrams in contract documents?

RQ4. In light of the possible effects of individual characteristics, what are the implications of using diagrams in contracts in an international business setting?

The remainder of the paper is structured as follows. In the literature review, we describe our theoretical orientation and the selection process for the literature, and then present the identified key topics. At the end of that section, we suggest eight hypotheses. Then, we introduce the methodology of this study, after which the results are presented and discussed. Finally, we address limitations and suggestions for future research.

LITERATURE REVIEW

Insights from past research motivate our interest in complementing international contracts with

explanatory diagrams as a way to make them more understandable. The reviewed studies help us to formulate the hypotheses of our study and identify the relevant variables to investigate. This section begins with an introduction of our theoretical orientation, followed by sections focusing on visual representations in instructions, CLT and instructional design, and cognitive styles and the challenges of English legalese within the frame of GCC.

Theoretical Orientation This study is multidisciplinary in nature, combining theories of visual communication and of cognition and language. Although the study focuses on business contracts, it looks at them from the perspective of design and communication rather than from the tradition of legal studies. Communication effectiveness in a global business setting is the main concern, and we zoom in on how and why complementing texts with diagrams enhance information search and comprehension.

Traditionally, the efforts of clarifying and simplifying contracts have aimed at “lifting the fog of legalese” [8]. Rethinking legal and bureaucratic language has been (and still is) the main battle of the proponents of Plain Language—

Language that reflects the interests and needs of the reader and consumer rather than the legal, bureaucratic, or technological interests of the writer or of the organization that the writer represents. [9, p. 7]

The focus on visual communication is thus a novelty in contracts, even though a number of plain language authors have acknowledged the key role of information design in communicating content clearly [10], [11]. A small but growing body of legal scholarship has been proposing the use of visual representations—for instance, diagrams [12], [13], photographs [13], comics [14], and icons and document design [9], [15]—as means of increasing the understandability of contracts [5], [9], [12]–[14], [16]–[19] and other legal documents [20].

One issue in the literature, however, is that several studies do not rely on actual user testing [5], [14], [16]. The studies that provide some quantification of the comprehension benefits of visual communication do so in an insufficiently rigorous manner—for example, the samples are too small [17], [12], [19], and statistical analysis is insufficient [17], [19]. A theoretical explanation of **why** and **to what extent** visual communication supports contract comprehension is also missing.

Our concern with user-centeredness and effective communication led us to deepen our understanding of individuals and the context in which they communicate. Although contracts encode complex information, understanding is not dependent only on the intrinsic ease or difficulty of the document; the cognitive resources available to the readers should also be accounted for. For this reason, we looked into cognitive theories about learning and comprehension, as well as individual cognitive variables affecting the processing of verbal and visual information. We focus in particular on CLT, which acknowledges the importance of information presentation in promoting or hindering understanding, and on individual cognitive styles, that is, how each individual prefers to process, encode, and express information. Additionally, we reviewed literature on communicative competence in global settings, and since our study focused on the comprehension needs of contract experts operating in an international setting, we paid particular attention to the research streams of English as (business) lingua franca and English for specific purposes (ESP).

The reviewed literature also affected our methodological choices: we designed the study as an experiment, but paired it with a self-reported questionnaire. The experimental setup follows the tradition of evaluating and comparing design solutions in their ability to satisfy users’ needs, and improve comprehension performance; the questionnaire allows us to introduce individual cognitive and language abilities as variables in the study, and understand how they interact with the presentation format of the contract, and how they affect comprehension.

Selection of Literature for the Review To address the questions and concerns of this paper, we opted for a convenience review of past studies focusing thematically on the following:

- (1) How to integrate text and visuals to create more effective instructions (we conceptualize contracts as a type of business instructions)
- (2) CLT, as it may help explain why contracts are so hard to understand and why text-visuals integration may ameliorate their understandability
- (3) Cognitive styles, as individual differences may affect how individuals process verbal and visual information, thus allowing us to explore the limitations of our suggested approach
- (4) The English lingua franca spoken by business professionals in international settings, their

needs and challenges, and the reasons why pragmatic approaches are needed to ensure successful communication

Visual Representations in Instructions A pragmatic approach to effective communication in contracts leads us to conceptualize contracts as instructions for correctly delivering a given promise to the other party. This metaphor is not completely new, as in fact legal scholars have previously proposed contracts as “blueprints for [business] performance” [21, p. 92], “user’s guides and instruction manuals” [20, p. 21], and “visible scripts for the parties to follow” [16, p. 57]. Taking inspiration from this metaphor, we explore research on multimodal instructions, which have previously tackled the problem of supporting user comprehension by integrating texts and visuals. Most research on instructions focuses on how to effectively provide guidance to use appliances [22], use software [23], [24], perform procedures [25], [26], and solve scientific/logical problems [27], [28]. Even though these uses of instructions are quite different from contracts—where the to-do actions are more abstract (e.g., when and how to pay the supplier; how to calculate liquidated damages for a delay in product delivery)—we believe that the key results of this research area could inform and be applied to our area of inquiry.

First, visuals in instructions—such as screenshots, technical illustrations, photos, and diagrams—offer visual relief from dense pages of text [24], which users are not enticed to read [29]. Moreover, visualizations reduce complexity, for instance by preselecting and giving salience to the most important details needed to accomplish the goal [30]; making more explicit relationships that need to be inferred from the text [22]; presenting procedures in an easy-to-follow step-by-step approach [30]; illustrating more saliently alternative routes and conditions, as well as conditional information (if X then Y) [30], [31]; and offering a visual reference that helps users to verify that they are proceeding correctly and to recover from errors [32].

Second, visual representations facilitate readers in creating a mental model of themselves in action, executing the procedure [33]. In respect of successful mental model creation, research has shown the importance of presentation order in which instructions should be carried out [34] and the type of perspective—for example, user-centric or system-centric—to be adopted in visualizations [25], [35]. While mental models can also be created

from purely textual information, doing so requires more effort and induces a heavier cognitive load compared to a multimodal approach [36]: visual representations allows for a more direct construction of mental models, since external and internal representations share a quasi-spatial nature (e.g., [22], [37])

However, these observations do not mean that visual representations **alone** are sufficient to ensure comprehension. Cumulative evidence shows that the most effective instructions combine text and visuals [36], either with explanatory visuals accompanying text [38], [39], or as visually structured diagrams that include text, such as flowcharts, decision trees, and tables [30], [40], [41]. Alexander [42] summarized the benefits of integrating text and visuals as faster task completion, fewer comprehension mistakes, faster learning to use a device, and more positive user attitudes toward the instructions. Several scholars have also pointed out how visual elements play an indispensable rhetorical role in relation to text: they better organize and structure the content [43], they guide readers’ attention to precise topics and arguments [44], and they affect interpretation of the overall document [45] by providing hints about its tone, credibility, function, and relevance. [46].

Finally, several studies indicate that understanding and applying instructions is a cognitively intense activity, which imposes high demands on working memory (WM) [36], as readers need to explore the document and find relevant information, understand it, integrate it with previous and situational knowledge, and finally apply the instruction. Spatially integrating texts and visuals allows reduction of the cognitive load by creating a degree of redundancy which is beneficial to comprehension [35] and by reducing the need to split attention between sources of information located in different places [47].

In the next section we take a closer look at CLT, which is concerned with the learning of complex information and the ways that learners often struggle to process the many elements needed for understanding because of the capacity limits of WM.

CLT and Instructional Design CLT [48], [49] postulates that information that is too complex or abundant overloads our cognitive systems, as capacity limitations prevent adequate processing of all inputs and ultimately learning. CLT is based on three assumptions:

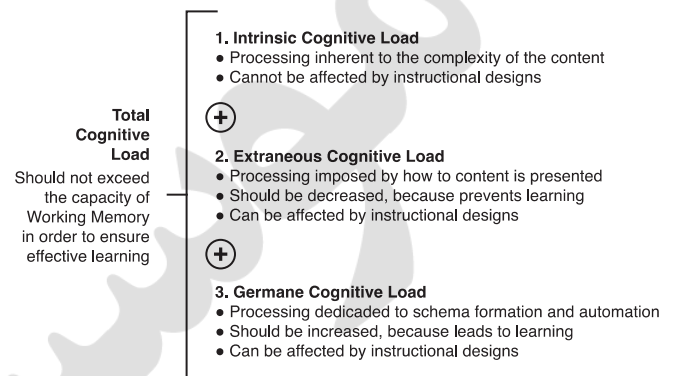
- (1) Human MW possesses different processing systems for visual and verbal information (**dual channel assumption**; e.g., [50], [51]).
- (2) Each channel has a limited processing capacity (**limited capacity assumption**; e.g., [48], [50]).
- (3) Meaningful learning requires substantial cognitive activities in scanning, organizing and integrating information from different channels (**active processing assumption**; e.g., [52]).

Additionally, Schnotz and Bannert [28] point out, comprehension is an active, goal-oriented process: humans construct multiple mental representations with the goal of accomplishing a specific task (e.g., being able to perform a calculation, solving a problem, behaving accordingly to a rule . . .). Different ways to present the same content affect how we construct it mentally, and these mental representations may facilitate or hinder problem resolution.

The superior performance associated with the integration of visuals and texts in instructions, compared to texts or visuals alone, can be explained in light of CLT. For example, a long running text may feel difficult to understand because it is processed through only one channel with limited capacity; if the same information were presented as a diagram, information processing would be routed to different channels, as text conveys separate bits of meaning, while the visual communicates the relationship that exists between those bits. The cost of interpretation of such relationships is offloaded to the external representation, as they simply need to be “read off” instead of requiring effort to be inferred [53].

In the case of contracts, one might argue that they are difficult because they carry intrinsically complex messages; however, information presentation matters. CLT conceptualizes cognitive load as being composed of three separate elements, intrinsic, extraneous, and germane load, which are differently affected by changes in how the information is designed [48] (summarized in Fig. 1).

- (1) **Intrinsic cognitive load** derives from the inherent complexity of the information, and it mainly depends on whether the different elements to be processed can be attended to individually or need to be attended to all together [54]. For example, performing a series of simple, unrelated numerical additions does not cause overload, while solving a literal equation does, as it requires knowing where and how to apply several algebraic rules, which need to be used in concert. Intrinsic load



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Fig. 1. Three components of cognitive load, according to Sweller [48].

usually cannot be affected by instructional means.

- (2) **Extraneous cognitive load** is caused by the manner in which information is presented, and thus its reduction through different designs has traditionally been the focus of instructional designers. Intrinsic and extraneous cognitive loads are additive, and both impose demands to WM. Extraneous load interferes with learning, especially when information is intrinsically complex [48], [54].
- (3) **Germane cognitive load** is the processing devoted to schema formation and automation—that is, the cognitive processing that positively contributes to understanding and learning. Usually there is an opposite relationship between extraneous and germane cognitive load [55]: for example, devoting much mental effort to understand something unclearly written (extraneous load) will not result in increased learning, but thoroughly processing and actively working through an example (germane load) will [56], [57].

Comprehension errors and slow reading/task completion are typical symptoms of cognitive overload [58]. However, to exactly assess and compare the efficiency of alternative instructional designs in supporting learning, Paas and Merriënboer [59] and Paas et al. [60] suggest the need to consider both performance and mental effort because learners may maintain a good performance in cognitively demanding tasks by simply making a greater mental effort. Considering both performance and mental effort allows us to distinguish between desirable and undesirable instructional designs: low-efficiency instructions will require high mental effort and still yield poor

performance, while high-efficiency instructions will yield good performance with little mental effort [60].

These considerations open the possibility to improve the efficiency of contracts—in terms of learning and comprehension—by changing how they are designed. In the previous section, we saw how effective instructions integrate texts and visuals. There is also considerable evidence for these results in the educational psychology literature, which shows how diagrams—which integrate visual representations with texts—support learning (e.g., [27], [61], [62]). However, other studies suggest that the effects of visual presentation modes in enhancing learning are strong for novices but tend to disappear and even reverse as expertise grows (e.g., [62], [63]–[66]). Furthermore, some studies conclude that only high visual-spatial learners can fully benefit from integrating visual and verbal materials [27], [67]. Our study thus needs to assess whether adding diagrams to contracts will result in higher efficiency instructions and whether the hypothesized benefits are limited to only some groups of readers.

Cognitive Styles In addition to CLT, individual cognitive styles should be taken into consideration when optimizing information for learning and understanding. “Cognitive style” is a term used to describe the consistent way in which an individual acquires and processes information (e.g., [68], [69]). According to Ausburn and Ausburn [69], cognitive styles are stable characteristics, resistant to change by training and in no way correlated with intellectual ability: if a learner struggles with learning, the problem might be in how the information is presented, and a different approach to conceptualizing, encoding, and displaying information can result in successful learning. Thus, for training to be more inclusive, they recommended providing alternative complementary representations. For instance, an individual scoring low on verbal ability might struggle to interpret a complex text and integrate its parts; if we were to complement this text with a diagram, and were the learner to possess high scores on visual cognitive styles, the problematic information processing would be **supplanted** by an appropriate instructional design, thus facilitating understanding [69].

While several labels and tools to describe and assess cognitive styles exist, it has been suggested [70]–[72] that they can be all grouped under two main cognitive style dimensions: the **wholist-**

analytic style dimension (whether an individual processes information as wholes or in parts) and the **verbal-imagery** style dimension (whether an individual better processes and represents information as words or images) [71]. Given the focus of this paper, we will concentrate on the verbal-imagery style dimension.

Recent developments on the study of the verbal-imagery cognitive style have shown how this is not, as previously believed, a bipolar continuous construct, according to which individuals are categorized as either verbalizers or visualizers [73], [74]. In fact, three relatively independent dimensions exist [68], [73], [75]:

- (1) Object imagery: ability in building and processing vivid, colorful, detailed images of individual objects
- (2) Spatial imagery: ability in representing and processing schematic images, spatial relationship between objects, movement, and spatial transformations
- (3) Verbal: ability in verbal, logical, sequential, and analytical reasoning

With this understanding, we can see that an individual with a distinctively favorite cognitive style may or may not struggle with other types of information representations, as a high score on one dimension does not imply low scores on the other two.

In the same way in which the savvy global communicator has to be sensitive to different values and cultures, a higher appreciation of different cognitive styles may lead to more effective communication, given that a contract may already be **intrinsically** complex, and even more so for a NNS of legalese or English. In the next section, we will consider the lingua franca spoken by global business professionals, their practical communication needs, and the ways such needs can be supported through a pragmatic approach.

The Challenges of English Legalese within the Frame of GCC In the past 20 years, English has become the shared language of most international organizations, both at the macrolevel of the organization as “the corporate language,” and at the microlevel of the individual professionals working within the organization (e.g., [76]–[79]). For this reason, we must examine what this extremely fast spread of English to international companies—and, hence, to contracting—might mean from the point of view of communicative competence.

The majority of the international professionals who use English as a shared language are NNSs, making use of a resource often called **English as a lingua franca** (ELF) or more specifically, **English as a business lingua franca** (BELF). This resource-based view of language differs from English as a **native** language (ENL), English as a **second** language (ESL, e.g., Singaporean English) or English as a **foreign** language (see, e.g., [80]), which all reflect the conceptualization of language as an independent entity and a pre-existing system.

ELF research looks at language differently: ELF is not “owned” by anyone, nor it is directly linked to a particular cultural context (see, e.g., [81]). Instead the ELF approach assumes a constructionist view that emphasizes the particular ELF situation and its participants. ELF communicators tend to avoid complex lexis or structures, and they incorporate their own native communicative practices and situation-specific requirements into the situation at hand [82].

The conceptualization of ELF as an independent linguistic resource also entails that ELF speakers are not assumed to imitate ENL as closely as possible, but rather identify themselves as speakers in their own right (see, e.g., [83], [84]). Neither is ELF considered deficient in comparison to ENL, albeit rather different, nor is resorting to other languages during interaction regarded as evidence of a gap in the knowledge of English but rather as a bilingual pragmatic resource (see, e.g., [85]).

Drawing from ELF research, but contextualizing their study in international business, Louhiala-Salminen et al. [86] identified BELF to emphasize the significance of the domain—the “B”—with its goal-oriented nature and shared business fundamentals. When the employees of globally operating companies attend to their daily practices—including contracting—they thus draw from their BELF resource, but also need business know-how and multicultural competence to do their jobs. Although the “English” in BELF may not be grammatically perfect, BELF competence involves the use of highly specialized, shared terms, concepts, and genres so that the speaker can adapt to the business situation at hand. It also includes an element of strategic skills; as shared understanding cannot be taken for granted, successful BELF communicators ask questions, repeat utterances, and use more than one channel or mode to achieve shared understanding. Finally, clarity, directness, and politeness are essential.

As was pointed out earlier, although legal English causes challenges for **both NS and NNS** of English because of its highly specialized, formal register, it is particularly demanding for NNSs (see, e.g., [87]). The needs of NNSs are addressed in the paradigm of ESP, focusing on the pedagogy of teaching specialized language, in this case legal English. Although the English needed is defined as “legal,” it is still conceptualized as the English of the NS, whose language use the learner is supposed to imitate. The difference from the ELF/BELF paradigm is distinct: in ELF/BELF, the language user is a professional **using** the language at work, whereas in the ESP paradigm, the focus is on **learning** a language.

Lawyers can be seen as “NSs of legalese,” but they are far from being the only ones involved with contracts. As suggested by Haapio [5, pp. 54–55], several contract users exist at the same time, in different contexts of use, with different goals and needs. On the one hand, traditional legal scholarship focuses on judges, arbitrators, litigating lawyers, and authorities, and the prototypical scenario of use is the courtroom: the main interest is to predict how courts might interpret contracts, so contract drafting is seen as a communication and persuasion activity happening between legal professionals. This is the paradigm where contracts written in “native legalese” are the unchallenged norm and where communication might break down if the correct grammar, registers, rhetorical devices, and norms are not followed.

On the other hand, Haapio identifies a managerial-legal paradigm, focusing on the needs of in-house counsels, managers (sales, procurement, risk management), financial officers, and engineers, where the main driver is to reach business objectives through commercial relationships, proactively minimizing legal and business risks, and always balancing them with rewards. These contract users, who may well be English NSs, are the “NNSs of legalese,” for whom communicative success can be assessed according to criteria similar to those relevant to GCC [6]: multicultural (in this case, also multidisciplinary) competence or the awareness and sensitivity of the communicator toward how different cultures/disciplines get things done, specific business know-how, and BELF competence.

In conclusion, findings on BELF and GCC can be used as a lens to look at any context where imposing a native English language model (e.g., legalese) on NNSs (e.g., internationally operating

managers) not only causes difficulties in comprehension, but does not serve the practical goals of the professionals, that is, getting their work done.

Conclusions from Literature Review and Hypotheses

The earlier studies discussed above suggest a way forward to answer our research questions. Diagrams and other strategies to integrate texts and visuals offer a way to provide effective instruction to individuals tasked with accurately following a procedure—a scenario akin to using a contract in day-to-day business. The difficulty in understanding contracts accurately and quickly, moreover, hints at a problem of cognitive overload, in particular the presence of extraneous load, as typically contracts do not follow any best practice in document design and have been criticized by plain language supporters for their use of legalese. Changing the design of the information is a way to reduce cognitive load, and support better understanding.

We also established that the risks associated with ineffective contract communication are particularly high in international settings, as the English lingua franca used by NNSs differs from the convoluted register of native-language-informed English legalese. Reframing and redesigning contracts as instructions, in our view, is a solution well in line with the pragmatic approach to communication needed by global communicators. However, given the novelty of this approach in contracts, we need to discover the extent of benefits that may be brought forward by integrating text and visuals, and define how this solution may also accommodate individual characteristics, such as cognitive styles, language, and professional proficiency of native and non-native contract professionals alike. Below, we have formulated a series of testable hypotheses that will help us find answers.

Based on the consistent evidence indicating that instructions integrating visuals and texts support better comprehension, and on the predictions of CLT (that errors and slow reading/answering are symptoms of cognitive load, and that the extraneous cognitive load can be reduced through design solutions, arguably reducing errors and time taken), we put forth two initial hypotheses:

H1. *Contracts including diagrams allow for faster information finding than traditional, text-only contracts.*

H2. *Contracts including diagrams allow for more accurate comprehension than traditional, text-only contracts.*

Although improved and rapid comprehension is the ultimate practical goal for contract readers, this alone cannot tell us whether different designs actually reduce cognitive load. When performing a difficult task, people may still achieve good performance by investing even more mental effort as a reaction to an increase in cognitive load [59]. For a more meaningful comparison of different communication solutions, we need to assess how mentally efficient they are—how much mental effort they require to achieve a certain level of performance. Estimating efficiency allows us to determine whether one document requires more mental effort than the other (meaning that it imposes a higher cognitive load) and what the performance outcomes of such mental effort investment are. As a result, we propose this hypothesis:

H3. *The mental efficiency of the version of the contract including diagrams is higher than that of the text-only version, meaning that participants require less mental effort to achieve an equal level of performance.*

An appreciation for individual and different ways to process, learn, and represent information—as shown in studies on cognitive styles—might warrant a more finely tuned assessment of the benefits that visualizations might bring to comprehension. As illustrated in Appendix I, the “visual contract” used in our study includes explanatory diagrams, which complement rather than substitute for the text. We know that spatial-visualizer learners benefit more from multimodal instructions [67], and we assume that verbalizers may easily process either version, given the high content of text. Predominantly object visualizers may somewhat improve their performances with a more visual contract, but since contract understanding requires analytic skills, they may still have a comparatively weaker performance. However, since verbal and visual skills are not mutually exclusive, we need to study all possible interactions of cognitive styles and treatment in an exploratory manner, as it is difficult to predict what their final effects on performance will be and whether a specific class of learners is the fastest and most accurate. Thus, we have developed these hypotheses:

H4a. *Cognitive styles interact with experimental treatment. Verbalizers are equally fast with either*

contract and are the fastest group with the textual contract; spatial visualizers are the fastest with contracts including diagrams; object visualizers become faster with contracts including diagrams than textual ones, but remain the slowest performing group.

H4b. *Cognitive styles interact with experimental treatment. Verbalizers are equally accurate with either contract, and are the most accurate group with the textual contract; spatial visualizers are the most accurate with contracts including diagrams; object visualizers become more accurate with contracts including diagrams than textual ones, but remain the least accurate group.*

Finally, we need to discriminate the effects of visualization for native and NNSs of English, the globally shared language used in international contracting. Arguably, NSs (especially if they have a legal background) should be more proficient in understanding contracts than NNSs. Studies on CLT have consistently demonstrated an “expertise reversal effect,” in which more knowledgeable readers do not benefit from additional instructional aids, and actually experience higher cognitive load because of the presence of redundant, more explicit information (see, e.g., [62]–[66]). Although NNSs using English—or rather BELF—in their everyday work may be highly competent global communicators, English legalese is not within that type of pragmatic competence. As a result, as nonexperts they are more likely to benefit from more explicitly presented information, and so we propose these hypotheses:

H5a. *Language interacts with experimental treatment: NSs of English are faster and more accurate than NNSs with the traditional version of the contract (text-only), while NNSs perform faster and more accurately with the version of the contract including diagrams.*

H5b. *Profession-specific knowledge interacts with experimental treatment: subjects with a legal background are faster and more accurate with the traditional version of the contract (text-only), while subjects without legal background perform faster and more accurately with the version of the contract including diagrams.*

H5c. *Language interacts with profession-specific knowledge and experimental treatment: NSs of English with a legal background are the fastest and most accurate with the traditional version of the contract (text-only), while NNSs without a legal background are fastest and most accurate with the version of the contract including diagrams.*

METHODOLOGY

In this section, we explain how we designed our study—an experiment combined with a questionnaire aimed at collecting control variables—and analyzed the results. First, we introduce our choice of a research methodology and the way that we sought out participants. Then, we review how we collected data, administered the study, and analyzed the data. Finally, we present how we ensured the reliability and validity of the study.

Choice of a Research Methodology In line with the research traditions analyzed in our literature review, we opted for an experimental design, integrating it with a self-reported questionnaire. This combination of methodologies allowed us to collect objective comprehension performance data with the use of two different versions of a contract (experiment), and to integrate those results with individual psychometric and self-reported data. The experiment and the questionnaire were previously piloted during two smaller scale studies [17], [19], and their design and measures were discussed with several researchers not involved in the study.

Participants We sought to recruit participants who

- (1) Currently held a position in which they routinely wrote, negotiated, or implemented international contracts
- (2) Were currently involved in international deals
- (3) Represented both sell-side or buy-side of business transactions
- (4) Represented both native and non-native English speakers
- (5) Represented different organizational functions involved with contracts (commercial and contract management, sales, procurement, legal)
- (6) Had a university degree, so as to avoid low literacy as a confounding factor

The participants were thus recruited from the members of the International Association for Contract and Commercial Management (IACCM), a global, industry-independent professional association promoting best practices and standards in contract and commercial management. At the time of the study, IACCM had 34,000 members from 158 countries, working in private and public organizations alike. Collaborating with IACCM allowed us to access a highly diverse community, without the need to individually contact a variety of organizations worldwide.

IACCM sent out our request for participants as part of their newsletter, and we recruited 122 participants. Even though the newsletter was sent to all IACCM members, their webinars (which last approximately 1 h, just like our study) are most typically attended by 200 people. Since 200 people was, most likely, the best participation rate we could aspire to, we calculate response rate on its basis (62% response rate). As an incentive, the volunteers were offered the possibility to receive their detailed, individual results of the experiment, information about how they compared with the overall average, and an assessment of their cognitive style.

How Data Were Collected Here we describe the methods that we employed to collect quantitative data for our study. We begin with a description of the experimental task, followed by an explanation of the questionnaire that we used to collect data about the control variables.

Experimental Task: We asked participants to answer six comprehension questions about a contract, randomly assigned to the participants in its traditional, text-only version or in a visually enriched version which featured explanatory diagrams, and clearer layout and typography.

The contract used in the experiment was a business-to-business (B2B) agreement for the purchase of machinery and equipment. We obtained the permission from Ruukki (now SSAB), a European metal and engineering company operating globally, to use an anonymized version of their B2B machinery and equipment purchase agreement, as we were aware that they had collaborated with a graphic designer to develop a new, visualized version of it. The visual version and the older, text-only version of the agreement had exactly the same text, and differed only in the way in which it was presented. The order and numbering of the clauses was also the same. All sensitive details such as the names of the contracting parties, prices, places, and scope of delivery were fictionalized.

In this agreement, diagrams are presented below the relevant clause that they seek to clarify. The diagrams can be categorized mostly as timelines or charts representing a process. All diagrams contain textual labels, repeating terms from the clause nearby, so as to connect texts and diagrams through a strategy of repetition [22]. The layout of the agreement is a single column, with clause headings on the left-hand side to facilitate searching. Compared

to the text-only version, there are wider margins and more white space on the page. In addition to the diagrams, key information (e.g., deadlines, prices) is displayed in boldface in the text of the agreement to give it more salience. Excerpts from the visualized contract are shown in Appendix I.

Comprehension performance on the experimental task was measured as follows:

- (1) Answering speed—The sum of the time taken to answer the six comprehension questions. The time taken for each answer was measured individually, and then summed up.
- (2) Answering accuracy—The sum of correct answers. Each fully correct answer was assigned one point. Partially correct answers were graded with 0.25, 0.5 or 0.75 points, depending on the magnitude of the mistakes and imprecisions (see grading rationale in Appendix II), and thus the scores vary between 0 (all completely incorrect) and 6 (all completely correct). To avoid bias, we asked two colleagues not involved in this study and blind to the experimental condition in which the answers were given to grade the accuracy of the answers. The graders agreed on 98% of the answers, and were asked to agree and reassess together the answers that they had graded differently.

Instrument: Before the experiment, we asked the participants to complete a questionnaire, thus providing data on the following variables (see details in Table I):

- (1) Age
- (2) Gender
- (3) Educational background
- (4) Legal background
- (5) Nationality
- (6) Level of English language proficiency
- (7) Native language
- (8) Current professional role
- (9) Years of experience in working with contracts
- (10) Industry
- (11) Object-spatial-verbal cognitive style
- (12) Mental effort

While most of these were control variables, we will explain “native language,” “legal background,” “object-spatial-verbal cognitive style,” and “mental effort” in more detail, as they were instrumental in our analysis and hypothesis testing.

English Language Proficiency/Native Language: As it would have been impossible, because of time

TABLE I
VARIABLES COLLECTED THROUGH THE QUESTIONNAIRE

Variable	Description	Role
1. Age	Continuous variable	Control
2. Gender	Categorical variable: female (1); male (0)	Control
3. Educational background	Categorical variable: Engineering, manufacturing, construction; Law; Business and administration; Life sciences, physics, math, computer science; Education; Arts; Humanities; Social sciences; Other	Background information
4. Legal background	Categorical variable: yes (1); no (0) (variable obtained from "Educational background")	Analysis of main and interaction effects
5. Nationality	Categorical variable: US; UK; Canada; Australia; Germany; Italy; Spain; Finland; Norway; Ireland; Czech Republic; Denmark; Poland; France; Hungary; Netherlands; Ukraine; Croatia; China; India; Pakistan; Senegal; South Africa; Nigeria	Background information
6. Level of English language proficiency	Categorical variable: No proficiency (0); Elementary proficiency - (1); Elementary proficiency (2); Elementary proficiency + (3); Limited working proficiency (4); Limited working proficiency + (5); Professional working proficiency (6); Professional working proficiency + (7); Full professional proficiency (8); (9); Full professional proficiency + (10); Native or bilingual proficiency (11)	Background information
7. Native language	Categorical variable: English (1); Other (0)	Analysis of main and interaction effects
8. Current professional role	Categorical variable: Contract management; Legal; Sales/Commercial; Procurement/Strategic sourcing; Combination sales/sourcing; IT; HR/Recruitment/Placement; Finance; Operations; Academic; Other	Background information
9. Years of experience in working with contracts	Continuous variable	Control
10. Industry	Categorical variable: IT/Telecoms; Oil/Gas/Minerals/Utilities; Banking/Insurance/Finance; Aerospace/Defense; Technology; Services/Outsourcing/Consulting; Transportation/Logistics; Automotive; Engineering/Constructions; Electronics; Healthcare/Pharma/Chemicals; Public sector; Manufacturing/Processing; Retail; Other	Background information
11a. Object-visualizer cognitive style	Continuous variable: value ranging from 0 to 5; obtained as average of the 15 "O" items in the OSIVQ questionnaire	Analysis of main and interaction effects
11b. Spatial-visualizer cognitive style	Continuous variable: value ranging from 0 to 5; obtained as average of the 15 "S" items in the OSIVQ questionnaire	Analysis of main and interaction effects
11c. Verbalizer cognitive style	Continuous variable: value ranging from 0 to 5; obtained as average of the 15 "V" items in the OSIVQ questionnaire	Analysis of main and interaction effects
12. Mental effort	Categorical ordinal variable ranging between: very, very low mental effort (1) and very, very high mental effort (9)	Analysis of main and interaction effects

constraints, to objectively test the participants for English language proficiency, we asked participants for a self-evaluation of their language skills on a rating scale from 0 (no proficiency) to 11 (native or bilingual proficiency), using the number and type of proficiency levels as measured by the Interagency Language Roundtable's scale [88]. We clearly instructed the participants to mark 11 **only** if English was actually their mother tongue. In this way we were able to discriminate between NSs and NNSs in our analysis. Information on the English proficiency of NNSs was kept as background information.

Legal Background: Based on the educational backgrounds of the participants, we created a dummy variable to single out everyone with a legal background. Because we assumed that

participants with legal knowledge should be able to skim through and interpret legal texts with more ease as "legalese NSs," we needed to analyze whether this variable had a simple or interaction effect on either answering speed or accuracy.

Object-Spatial-Verbal Cognitive Style: The verbal-visual cognitive style of the participants (the individual preference in relying on visual imagery versus verbal strategies in thought processes) was measured according to the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) developed by Blazhenkova and Kozhevnikov [68]. The OSIVQ is an efficient self-report instrument composed of 45 items that uses a 5-point Likert scale, and provides three separate scores: object-imagery skills (ability to build and process vivid, colorful, detailed images of individual objects); spatial-imagery skills (ability

to represent and process schematic images, spatial relationships between objects, movement, and spatial transformations); and verbal skills (ability in verbal, logical, sequential, and analytical reasoning). The questionnaire is easy to administer and, as shown by Blazhenkova and Kozhevnikov [68], it displays a relatively good internal reliability (Cronbach's alpha of 0.74 for the verbal scale, 0.83 for the object scale, and 0.79 for the spatial scale).

The OSIVQ is superior to previous instruments assessing individual differences in the ability to process visual and verbal information (e.g., Individual Differences Questionnaire [51] and Verbalizer–Visualizer Questionnaire [74]) because it corrects some misconceptions. First, the visual–verbal dimension is not a bipolar construct, and different processing abilities need to be evaluated individually and separately [89]. Second, neuroscientific evidence shows that visual information is processed in **two** different imagery subsystems, the object imagery system and the spatial imagery system [90], resulting in two distinct visual cognitive styles rather than one [68].

Mental Effort: Although a self-assessed measure of perceived mental effort may appear questionable, especially on a unidimensional scale, several studies on CLT had employed this simple and quick method (for a review, see [60]), as these scales have been demonstrated to be as sensitive and reliable as more intrusive and complex methods [91]. Moreover, given the virtual setup of our experiment, it would have been impossible to use physiological measures (e.g., heart rate and pupillary responses). Following Paas and Merriënboer [59], we chose a 9-point scale, ranging from “very, very low mental effort” (1) to “very, very high mental effort” (9). Mental effort was used as a control variable in our regression models, and as a means to calculate mental efficiency (see “How Data Were Analyzed”).

Process for Administering the Study: The participants had the chance to get instructions on the study and on its procedure by attending one of three webinars, organized at different times to accommodate the time zones of our international participants and to ensure wide participation. One of the authors was available online for the duration of the experiment to answer any further questions from the participants in regards to the procedure. The webinars were also recorded for participants who could not attend live (2% of the participants), and we gave them the possibility to ask further questions of one of the authors via email. The link

to the survey was shared with participants during the webinar.

Upon accessing the webpage for the experiment and the survey, a script randomly assigned the participants into control and treatment groups. First, the participants completed the questionnaire collecting data for the control variables. Then, they proceeded to the experimental setup, and had up to 4 min to get acquainted with the assigned version of the document. Next, each of the six comprehension questions were presented one at a time. After having carefully read the question, the participants had to click a button to start the time countdown and gain access to the document to search for the information needed to provide the correct answer. Once they had completed their answers, the participants stopped the timer, and could proceed to the next comprehension question. After stopping the timer, participants could not modify their answers any further.

The participants were given a maximum of 7 min to answer each comprehension question. This restriction was imposed for two reasons: first, to limit the length of the research session (experiment plus questionnaire) to about 1 h; second, because our questions were quite practical and expressed operational doubts, and did not require legal interpretation (Appendix III): if contracts are to be seen as instructions or “blueprint[s] for performance” [21], it must be possible for readers to find information and understand in a relatively short time what needs to be done in business-as-usual situations. If doing so is not possible, then the contract is not an effective communication tool.

After the experiment, the participants were asked to self-assess the mental effort they experienced in completing the tasks.

How Data Were Analyzed To test H1 and H2, relating to speed and accuracy, we analyzed the comprehension performance scores obtained in the experiment. The difference in mean answering speed in the two experimental groups was analyzed with a Welch *t*-test, an adaptation of the classical *t*-test to be alternatively used when two samples have unequal variances, as in this case. The difference in answering accuracy, however, had to be analyzed through the nonparametric Mann–Whitney U-test, because the scores of the experimental group were non-normally distributed, thus violating one of the assumptions required for a *t*-test. The Mann–Whitney U-test could be interpreted as a test of medians because its two

main assumptions were respected: the two samples had equal variance, as assessed through a Levene's test, and their distributions were similar in shape (as assessed through visual inspection of the plotted data-points).

In order to test H3, we followed the methodology described in [59] on how to calculate the mental efficiency of alternative instructional conditions. The method puts individual performance in the context of related subjectively experienced cognitive load, and vice versa [59]. This procedure was deemed appropriate as it provides an overall score for each document alternative, helping to determine which one requires less mental effort and yields better performance.

The first step of the procedure is to standardize answering speed, answering accuracy, and mental effort scores into z -scores:

$$z = \frac{(\text{individual score} - M)}{SD}$$

Performance is then obtained as the mean of $Z_{\text{Answering Speed}}$ and $Z_{\text{Answering Accuracy}}$. Mean z -scores of performance and mental effort constitute the Cartesian coordinates to plot a result point for each condition (x -axis = performance; y -axis = mental effort). Efficiency (E) of each condition is finally calculated as the distance of the plotted points from the bisecting diagonal:

$$E = \frac{Z_{\text{Performance}} - Z_{\text{Mental Effort}}}{\sqrt{2}}$$

The statistical difference between efficiency scores is then assessed through a t -test, as the data were normally distributed and had homogeneous variance, and samples were independent.

To test H4a, H4b, H5a, H5b, and H5c, related to the interaction of the cognitive style and language with experimental treatment, we employed stepwise linear regression and two-way analysis of variance (ANOVAs).

First, we examined the interactions of objective performance measures (speed and accuracy) by different verbal skills (OSIVQ verbal skill score, native language, and legal background) and by different visual skills (OSIVQ object-imagery skill and spatial-imagery skill scores). All variables involved in the interaction terms were centered to avoid multicollinearity between these terms and their individual components [92, pp. 37–38].

Regression analysis also helped us to prove that the experimental manipulation was the main cause for changes in comprehension performance, and thus made it possible to discard other variables as alternative explanations for differences in performance between groups, ensuring internal validity. Linear regression was appropriate as it allowed us to include all control variables—categorical, continuous, and interaction terms—in the same analysis. Since our study sample was too small to generate sufficient predictive power if all variables and interaction terms had been included at once, we chose a stepwise method based on probability of the F value. We included the variables in the regression model one at a time, starting with those with lowest p -values. Variables already in the equation would be eliminated if their p -value became not significant (higher than 0.05) because of the inclusion of a new variable.

We used a two-way ANOVA to investigate further the only interaction term, native language \times experimental treatment, that showed statistical significance in the regressions. ANOVA was a suitable follow-up method because the interaction term that we discovered was between categorical independent variables on one continuous dependent variable, and we could more precisely assess the main effect of each independent variable and the way that they interacted.

To conclude, we also analyzed the simple main effects through univariate post hoc tests and Bonferroni-adjusted pairwise comparisons. The post hoc tests reveal whether there are simple main effects at each combination of variable levels (e.g., whether “treatment” has a significant effect on NSs and NNs), and provides an effect size through the F -value. The pairwise comparisons establish whether the mean difference between two variable levels within a group is statistically significant (e.g., whether the mean score difference of NSs and NNSs within the “visual” treatment group is significant).

All statistical tests and analyses were performed with the statistical software SPSS.

Assuring Reliability and Validity In this section, we examine the efforts we took to assure reliability and validity.

To ensure ecological validity,

- (1) We used an authentic agreement, for which both text-only and visually-enhanced versions existed.

- (2) We asked experts from IACCM to check whether the type of contract we chose, its language and structure, and our comprehension tasks would be plausible and “business as usual” for the average contract professional.
- (3) We ran the experiment with actual contract professionals, rather than using a convenience sample of master’s students.

To ensure population validity,

- 1) We sought to increase the cultural and professional diversity of the participants as much as possible by recruiting participants through IACCM, an international association, rather than through individual national associations (some countries do not even have national associations of contract professionals). We also organized explanatory sessions at different times to eliminate hurdles to participation due to unfavorable time zones. Finally, we avoided preselecting participants based on specific criteria. However, we acknowledge that our participants are volunteers, and may also be considered a convenience sample because to facilitate recruiting, we sought to recruit the members of an international association, rather than trying to recruit participants directly from individual firms randomly chosen from all around the world.

To ensure reliability of the instruments,

- (1) We sought to use scales and procedures documented and validated in previous studies.
- (2) In grading answering accuracy, we followed an established rationale (Appendix II) and checked interrater reliability.

RESULTS

In this section, we report detailed information about the participant sample, as well as the analyses performed to test our hypotheses.

Participants The sample was composed of 122 participants, of whom 59 were women, 31 had a legal background, and 71 had English as their mother tongue and were thus NSs. Among the NNSs, the average self-assessed proficiency in English was 8.570 on an 11-point scale ($SD = 1.375$). The average age of the participants was 44.46 years old ($SD = 10.12$), and on average they had been working with contracts for 12.611 years ($SD = 9.032$).

Most participants were from North America ($n = 56$) and Europe ($n = 45$). The most represented professions were contract manager ($n = 71$) and lawyer/in-house counsel ($n = 16$). The most represented industries were information technology ($n = 36$), services/outsourcing/consulting ($n = 16$), oil/gas/utilities ($n = 15$), and technology ($n = 11$). In terms of cognitive styles, we had 53 predominant object visualizers, 44 predominant verbalizers, 28 predominant spatial visualizers, and 3 with mixed cognitive styles (their highest score was the same for 2 or 3 cognitive styles). The average scores of the whole sample were 3.370 for object imagery, 2.950 for spatial imagery ability, and 3.230 for verbal ability. Sixty-seven people were randomly allocated to the control group (answering the comprehension questions with the text-only, original contract), and 55 to the treatment group (answering the comprehension questions with the redesigned visually enhanced contract).

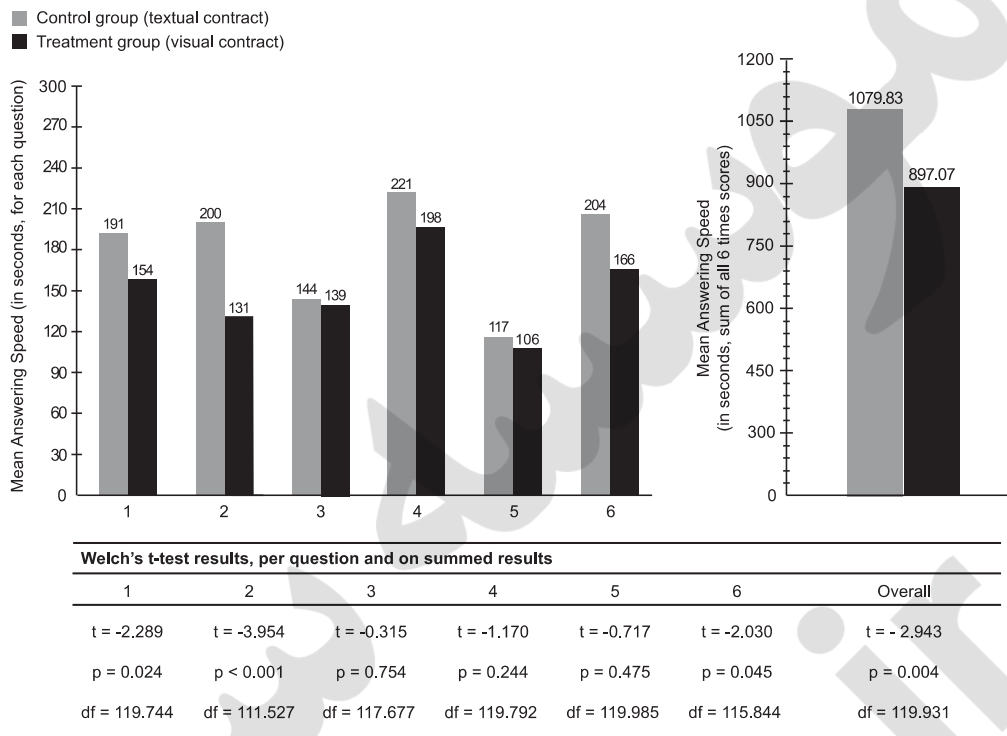
Hypothesis Testing The results of our hypothesis testing follow.

H1. *Contracts including diagrams allow for faster information finding than traditional, text-only contracts.*

Experimental data on the answering speed of the participants confirmed H1. The treatment group, using the visually enhanced version of the contract, was significantly faster than the control group in finding the relevant information and solving the comprehension tasks. Comparing the sums of answering times of the two groups, in average the treatment group was 182.760 s faster (treatment group mean = 897.070 ± 305.750 ; control group mean = 1079.830 ± 396.440). This difference is statistically significant, as assessed through a two-tailed Welch’s t -test ($t = -2.940$, $p = 0.004$). Fig. 2 shows the mean of the time taken to answer each question and the mean of the sum of all individual scores.

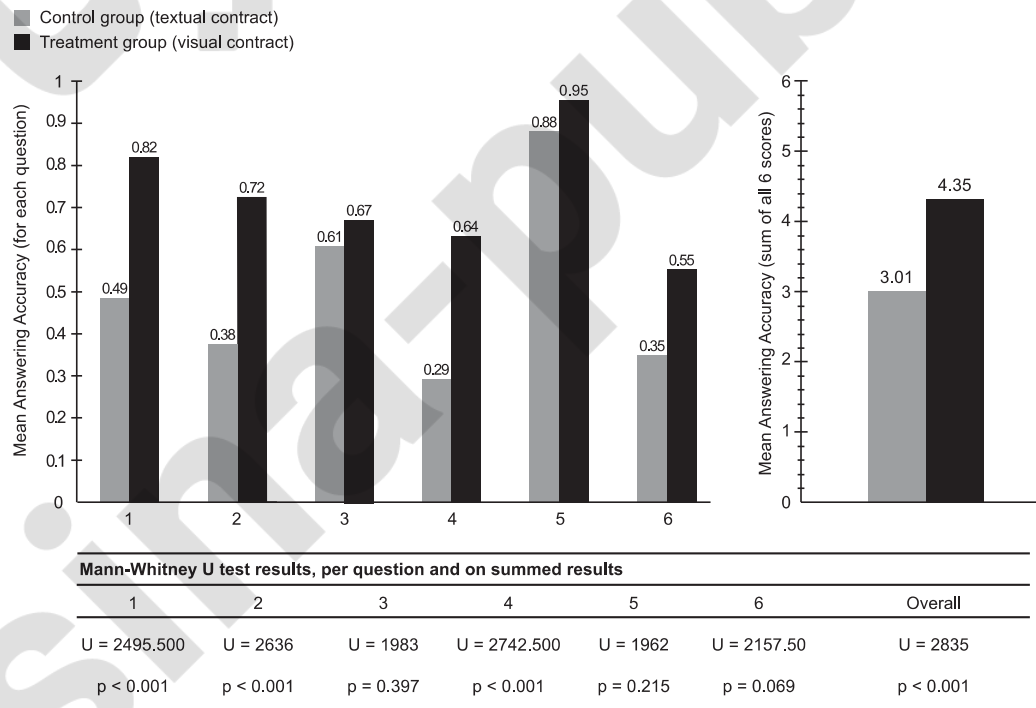
H2. *Contracts including diagrams allow for more accurate comprehension than traditional, text-only contracts.*

Experimental data on the answering accuracy confirmed H2: the treatment group was significantly more accurate than the control group, with respectively a mean score of 4.350 correct answers versus only 3.010 correct answers. This difference is statistically significant, as assessed through a two-tailed Mann–Whitney U-test ($U = 2835$, $p < 0.001$). Fig. 3 shows the mean



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Fig. 2. Mean answering speed for each comprehension question (left), and total mean answering speed (right). Results of Welch's t-test (table at the bottom).



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Fig. 3. Mean answering accuracy for each comprehension question, where 0 indicates a wrong answer and 1 indicates a correct answer (left). Total mean answering accuracy, where 0 indicates that participants' answers were all wrong, and 6 indicates that they were all right (right). Results of Mann-Whitney U-test (table at the bottom).

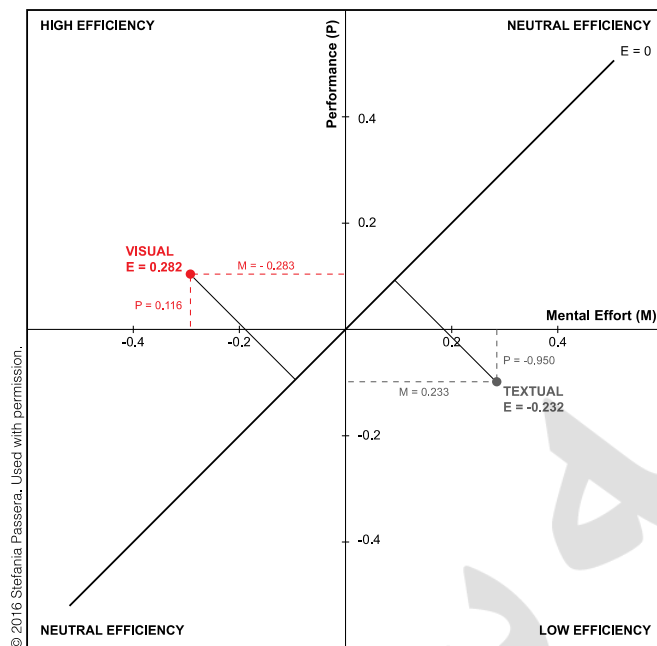


Fig. 4. Graph of efficiency (E) for visual and textual conditions.

accuracy scores for each question and as a sum of all individual scores.

H3. *The mental efficiency of the version of the contract including diagrams is higher than that of the text-only version, meaning that participants require less mental effort to achieve an equal level of performance.*

H3 is strongly confirmed as the participants in the treatment group not only exerted less mental effort but also achieved higher performance. Given the formula presented earlier, the visual contract's efficiency (0.282) is higher than the textual contract's (-0.232), and the difference is statistically significant ($t = 3.399$, $p = 0.001$). Moreover, the visual contract's score indicates high efficiency, while the textual contract's indicates low efficiency (see Fig. 4). We can also exclude that performance in the visual group was caused by the motivation of investing extra effort to succeed.

Since the intrinsic cognitive load was arguably the same in each group (because all participants had the same contract content and the same tasks), we can infer that the overall decrease in mental effort was caused by a reduction in extraneous cognitive load, which is the load imposed by inefficient ways of communicating the content and representing a problem.

H4a. *Cognitive styles interact with experimental treatment. Verbalizers are equally fast with either contract and are fastest with the textual contract; spatial visualizers are the fastest with contracts including diagrams; object visualizers become faster with contracts including diagrams than textual ones, but remain the slowest performing group.*

H4b. *Cognitive styles interact with experimental treatment. Verbalizers are equally accurate with either contract, and are most accurate with the textual contract; spatial visualizers are the most accurate with contracts including diagrams; object visualizers become more accurate with contracts including diagrams than textual ones, but remain the least accurate group.*

We then proceeded to run regression analyses (descriptive statistics and correlations are provided in Table II). The results show that cognitive styles do not interact with experimental treatment, alone or in concert, and do not have a statistically significant effect in predicting answering accuracy or speed

The regression model explaining answering speed (see Table III) shows that the only statistically significant coefficient is experimental treatment ($\beta = -0.271$, $p = 0.03$), and the model predicts answering speed with statistical significance ($R^2 = 0.073$, $F(1, 119) = 9.404$, $p = 0.03$).

If we look at the regression model explaining answering accuracy (see Table IV), treatment is also statistically very significant ($\beta = 0.468$, $p < 0.001$). The model is statistically significant in predicting answering accuracy ($R^2 = 0.27$, $F(3, 117) = 14.438$, $p < 0.001$), and features two more significant coefficients—mother tongue, alone and in interaction with experimental treatment—which we will discuss in the next section.

To conclude, we can confidently associate the cause of lower response times and increased comprehension accuracy to the design of the visualized contract, for visualizers and verbalizers alike. The results provide further support to accept H1 and H2, while H4a and H4b are rejected.

H5a. *Language interacts with experimental treatment: NSs of English are faster and more accurate than NNSs with the traditional version of the contract (text-only), while NNSs perform faster and more accurately with the version of the contract including diagrams.*

TABLE II
DESCRIPTIVE STATISTICS AND CORRELATIONS

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Answering speed	997.438	360.193											
2. Answering accuracy	3.606	1.431	0.059										
3. Experimental treatment	0.450	0.500	-0.254**	0.464**									
4. Age	44.460	10.118	0.021	-0.041	-0.001								
5. Gender	0.480	0.502	-0.015	-0.156	-0.086	-0.162							
6. Legal background	0.270	0.464	-0.028	-0.038	0.183*	-0.128	0.072						
7. Years of experience in working with contracts	12.611	9.03	0.011	0.017	-0.048	0.674**	-0.299**	0.047					
8. Mother tongue	0.580	0.495	0.161	0.151	-0.034	0.230**	-0.211*	-0.079	0.293**				
9. Object-imagery skill score	3.375	0.595	-0.039	-0.148	-0.057	-0.093	0.273**	0.049	-0.145	-0.226**			
10. Spatial-imagery skill score	2.951	0.646	-0.001	0.069	-0.080	-0.065	-0.281**	-0.052	0.025	-0.178*	-0.001		
11. Verbal skill score	3.230	0.499	-0.013	-0.022	-0.028	0.175	0.051	.251**	0.151	0.161	-0.183	-0.190*	
12. Mental effort	4.668	1.556	0.237**	-0.208*	-0.258*	-0.048	0.128	-0.046	-0.098	0.065	-0.153	0.076	-0.132

$n = 121$ * $p < 0.05$ ** $p < 0.01$.

As already illustrated above, the experimental treatment is the only factor explaining the answering speed scores, so H5a is partially rejected in regards to this dependent variable: experimental subjects do not differ in their answering speed because of their native language, but because of the contract version they use.

However, there is a difference in terms of answering accuracy: the results of the regression analysis show not only a statistically significant coefficient for experimental treatment, but also for mother tongue ($\beta = 0.167$, $p = 0.037$) and for the interaction effect of mother tongue \times treatment ($\beta = -0.179$, $p = 0.026$). Thus, answering accuracy is affected both by the version of the contract used in the comprehension task and by whether the respondent is a native English speaker. The statistically significant interaction term suggests that the performance of both native and NNSs is affected by the type of contract, but to a different degree. We further investigated this difference and assessed whether an expertise reversal effect is present using a two-way ANOVA (see Table V), with post hoc tests (see Tables VI and VII) and pairwise comparisons (see Tables VIII and IX).

In the control group, NSs are on average significantly more accurate than NNSs (mean difference = 0.959, 95% CI [0.350, 1.567], $F(1, 118) = 9.737$, $p = 0.002$), but surprisingly,

this superiority disappears in the treatment group: native and NNSs are virtually equally accurate, and there is no statistically significant difference in their accuracy ($F(1, 118) = 0.67$, $p = 0.796$).

In fact, the average of correct answers by NNSs (4.385) is even slightly higher than the average for NSs (4.289) (see Fig. 5). However, this difference is statistically insignificant (see Table IX): NNSs “catch up” on NS, performing equally accurately, but a full expertise reversal effect is not observed because both groups significantly improve their accuracy with visual contracts, even though the effect is stronger for NNSs (mean difference = 1.95, 95% CI [1.265, 2.635], $F(1, 118) = 31.771$, $p < 0.001$) than for NSs (mean difference = 0.905, 95% CI [0.320, 1.489], $F(1, 118) = 9.397$, $p = 0.003$).

We can conclude that H5a is partially confirmed when considering answering accuracy. As postulated by the expertise reversal effect prediction, instructional visual aids are more effective for those with lower expertise (in this case, native language expertise). However, a full expertise reversal effect is not observed, because even NSs benefit from visualization—just to a lesser extent than NNSs.

H5b. *Profession-specific knowledge interacts with experimental treatment: subjects with a legal*

TABLE III
RESULTS OF THE REGRESSION ANALYSIS (ANSWERING SPEED AS THE DEPENDENT VARIABLE)

Variables	Coefficients
<i>Variables included in the model</i>	
Experimental treatment	-0.271*
<i>Variables excluded from the model, $p > 0.05$</i>	
Age	0.021
Gender	-0.021
Legal background	0.012
Years of experience in working with contracts	-0.008
Mother tongue	0.136
Spatial-imagery skill score	-0.025
Object-imagery skill score	-0.089
Verbal skill score	-0.011
Mental effort	0.175
Spatial-imagery skill score \times Experimental treatment	0.004
Object-imagery skill score \times Experimental treatment	-0.002
Verbal skill score \times Experimental treatment	0.114
Spatial-imagery skill score \times Verbal skill score	0.018
Object-imagery skill score \times Verbal skill score	-0.087
Object-imagery skill score \times Spatial-imagery skill score	-0.065
Legal background \times Mother tongue	0.086
Legal background \times Experimental treatment	0.086
Mother tongue \times Experimental treatment	0.084
Object-imagery skill score \times Spatial-imagery skill score \times Experimental treatment	-0.129
Object-imagery skill score \times Verbal skill score \times Experimental treatment	-0.066
Spatial-imagery skill score \times Verbal skill score \times Experimental treatment	-0.089
Object-imagery skill score \times Spatial-imagery skill score \times Verbal skill score	-0.137
Legal background \times Mother tongue \times Experimental treatment	-0.029
Object-imagery skill score \times Spatial-imagery skill score \times Verbal skill score \times Experimental treatment	0.051
Adjusted R^2	0.065
R^2	0.073
$F(1, 119)$	9.404
Significance of the model, p	0.003

$n = 121$ * $p = 0.003$.

background are faster and more accurate with the traditional version of the contract (text-only), while subjects without legal background perform faster and more accurately with the version of the contract including diagrams.

H5c. *Language interacts with profession-specific knowledge and experimental treatment: NSs of English with a legal background are the fastest and most accurate with the traditional version of the contract (text-only), while NNSs without a legal background are fastest and most accurate with the version of the contract including diagrams.*

As illustrated in Tables III and IV, all regression coefficients involving the variable “Legal background”—alone or in interaction with other terms—are not significant in accounting for answering speed and accuracy results. Thus, H5b and H5c are rejected.

CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

In this section, we elaborate on our results, and their implications for practice and theory. We close by considering the limitations of the study and by suggesting areas for future research.

Conclusions In this study, we argued for integrating diagrams in B2B contracts as a way to enhance comprehension speed, accuracy, and ultimately communication in an international business setting. Given the novelty of the approach, we proposed four research questions to explore the merit of this suggestion: to what extent this approach may be beneficial, whether individual characteristics may alter its effectiveness, and what the implications for international businesses might be.

We discovered that adding diagrams to contracts indeed supports more accurate and faster

TABLE IV
RESULTS OF THE REGRESSION ANALYSIS (ANSWERING ACCURACY AS THE DEPENDENT VARIABLE)

Variables	Coefficients
<i>Variables included in the model</i>	
Experimental treatment	0.468**
Mother tongue	0.167***
Mother tongue × Experimental treatment	-0.179***
<i>Variables excluded from the model, $p > 0.05$</i>	
Age	-0.083
Gender	-0.055
Legal background	-0.095
Years of experience in working with contracts	-0.012
Spatial-imagery skill score	0.139
Object-imagery skill score	-0.085
Verbal skill score	-0.023
Mental effort	-0.075
Spatial-imagery skill score × Experimental treatment	0.029
Object-imagery skill score × Experimental treatment	0.070
Verbal skill score × Experimental treatment	0.025
Spatial-imagery skill score × Verbal skill score	-0.005
Object-imagery skill score × Verbal skill score	-0.046
Object-imagery skill score × Spatial-imagery skill score	-0.015
Legal background × Mother tongue	0.016
Legal background × Experimental treatment	-0.092
Object-imagery skill score × Spatial-imagery skill score × Experimental treatment	-0.076
Object-imagery skill score × Verbal skill score × Experimental treatment	0.130
Spatial-imagery skill score × Verbal skill score × Experimental treatment	-0.155
Object-imagery skill score × Spatial-imagery skill score × Verbal skill score	0.074
Legal background × Mother tongue × Experimental treatment	0.052
Object-imagery skill score × Spatial-imagery skill score × Verbal skill score × Experimental treatment	-0.038
Adjusted R^2	0.251
R^2	0.270
$F(3, 117)$	14.438
Significance of the model, p	< 0.001

$n = 121$ ** $p < 0.01$ *** $p < 0.05$.

TABLE V
TWO-WAY ANOVA: TEST OF BETWEEN-GROUPS EFFECTS ON ANSWERING ACCURACY

Source of Variance	Sum of Squares	df	Mean Squares	F	p -value	Partial Eta Squared
Treatment	59.945	1	59.945	39.410	<0.001	0.250
Mother Tongue	5.587	1	5.587	3.673	0.058	0.030
Treatment × Mother Tongue	8.041	1	8.041	5.286	0.023	0.043
Error	179.485	118	1.521			
Total	247.740	121				

TABLE VI
POSTHOC UNIVARIATE TESTS ON SIMPLE MAIN EFFECT OF TREATMENT WITHIN
"MOTHER TONGUE" GROUPS

Source of Variance	Sum of Squares	df	Mean Squares	F	p -value	Partial Eta Squared
NSs	14.293	1	14.293	9.397	0.003	0.074
Error	179.485	118	1.521			
NNSs	48.326	1	48.326	31.771	<0.001	0.212
Error	179.485	118	1.521			

TABLE VII
POSTHOC UNIVARIATE TESTS ON SIMPLE MAIN EFFECT OF "MOTHER TONGUE"
WITHIN TREATMENT GROUPS

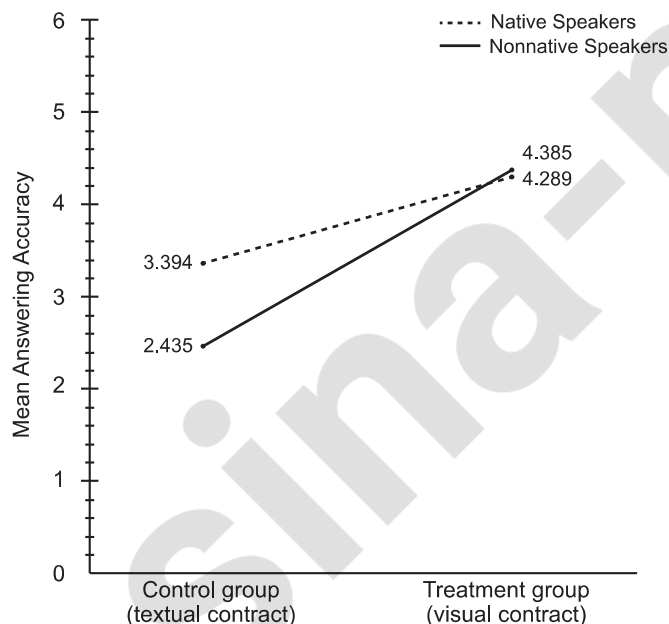
Source of Variance	Sum of Squares	df	Mean Squares	F	p-value	Partial Eta Squared
Treatment group (visual)	0.102	1	0.102	0.067	0.796	0.001
Error	179.485	118	1.521			
Control group (textual)	14.811	1	14.811	9.737	0.002	0.076
Error	179.485	118	1.521			

TABLE VIII
PAIRWISE COMPARISONS: MEAN DIFFERENCE OF "TREATMENT" WITHIN MOTHER TONGUE GROUPS

Mother-tongue Groups	Mean Score Treatment Group (visual)	Mean Score Control Group (textual)	Mean Difference	p-value	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
NSs	4.298	3.394	0.905	0.003	0.320	1.489
NNSs	4.385	2.435	1.950	<0.001	1.265	2.635

TABLE IX
PAIRWISE COMPARISONS: MEAN DIFFERENCE OF "MOTHER TONGUE" WITHIN TREATMENT GROUPS

Treatment Groups	Mean Score NSs	Mean Score NNSs	Mean Difference	p-value	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Treatment group (visual)	4.298	4.385	-0.087	0.769	-0.757	0.577
Control group (textual)	3.394	2.435	0.959	0.002	0.350	1.567



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Fig. 5. Mean answering accuracy for NS and NNS in the control group and in the treatment group.

comprehension of their content, and the increase in accuracy is especially significant for NNSs of English, and positive also for NSs, thus reinforcing our belief that this approach may be highly beneficial in international business, where English is the de facto lingua franca. Moreover, we have not observed negative reversal effects caused by any individual characteristic of respondents (e.g., cognitive styles, expertise, and professional background), leading us to conclude that this approach will not potentially backfire with specific user groups.

Implications for Practice: The implications for global business are important, because through a multimodal approach to contract design, firms could ensure that professionals from different backgrounds and cultures understand each other and collaborate more easily. This mutual understanding and collaboration, in return, could lead to more effective negotiations, prevent legal troubles resulting from contract misinterpretation, and improve business relationships. Technical and professional communicators, as well as information designers, could apply their skills in the field of

contracts and help global firms conduct transactions more effectively and successfully.

Visualization skills can be seen as part of the strategic competence of the global communicator, whose goal is to communicate effectively to “get the job done” [6]. In Louhiala-Salminen and Kankaanranta’s Global Communication Competence framework [7], in fact, communication proficiency goes beyond grammatical and discourse proficiency. One of the key abilities of competent global communicators is the ability to continuously check for understanding (their own and that of their communication partners) through questions, repeated utterances, and the use of more than one channel or modality. We suggest that a competent global communicator should craft messages in whichever way offers the best possibilities of constructing shared understanding: proficiently using different media and modalities is a critical skill for professionals involved in international business.

Implications for Theory: The results from the experiment show how a **supplantation** strategy [69] based on diagrams helps international managers understand contracts more accurately and more quickly. In particular, we discovered that diagrams can support NNSs of English in developing a more accurate understanding of a complex document written in English, the shared business language of today’s professional communicators. This effect will ultimately close the accuracy gap in regards to NSs. These results are partially explained in terms of expertise reversal effect (see, e.g., [62]–[66]); while NNSs benefit more than NSs from visual aids in contracts, the latter also see an improvement in their answering accuracy.

These results can be further explained in light of CLT [48], [49]: when information is already intrinsically complex and requires substantial processing, inefficient or confusing presentation formats need to be minimized as much as possible; better instructional design prevents extraneous cognitive load by offering a meaningful problem representation. When this problem representation offers a ready solution to the task at hand, the design is more mentally efficient: fewer cognitive resources need to be invested, and understanding will be better and faster.

However, we believe that the presence of visualizations is not enough to ensure comprehension [28], [62], as for some tasks we found that there were no performance improvements. Diagrams must offer problem

representations that are more explicit and readily applicable in relation to a given task (we will return to this point in the “Limitations” below). There is no such thing as **the correct diagram**, only diagrams well-suited to answer specific questions and achieve specific goals.

These results also suggest avoiding predetermined assumptions about what modes of presentation may work well for particular cognitive styles. Counterintuitively, individual cognitive styles did not have an effect on how the participants processed either version of the contract. Object and spatial visualizers were not at a particular disadvantage in understanding the traditional contract (it was equally difficult for verbalizers), and verbalizers did not benefit less from diagrams in the experimental version of the contract. The “fitness-for-purpose” of a design apparently trumps cognitive style in predicting the comprehension performance of an individual processing particularly complex information: dense prose will remain dense even for the best verbalizer, and an irrelevant diagram will not be helpful even for the most skilled spatial visualizer.

Limitations This study is not without limitations. First, while experiments provide a way to control for variables, they are carried out in an artificial setting. In real life, managers might overcome their difficulties in understanding a document by discussing and sharing knowledge with colleagues, so in addition to individual cognitive mechanisms, there are social mechanisms at play in sensemaking that our study does not consider.

Second, the participants in our experiments constituted a convenience sample: at best, the results can be generalized to the population of the members of IACCM Association. The members of this association are very active in learning contractual and commercial best practices, and all participants were volunteers. Arguably, the participants were interested from the start in trying out their contract comprehension skills or having a chance to try out a visual contract. This interest may affect the results and participants’ characteristics in terms of nonresponse bias, as we do not know how the respondents may compare with nonrespondents.

There is good evidence that volunteers in psychological research are, for instance, more educated and have higher IQs than nonvolunteers [93]. If this factor was at play, it may have affected the representativeness of our sample and the mean

overall performance results. Moreover, the fact that they were invited to participate in the study through the IACCM may have biased them in unconsciously considering the visual contract a superior solution from the very start. On the other hand, running the experiment without the help of the Association would have made it almost impossible to recruit such a varied and international sample, which was necessary to assess the possible benefits of our proposal for global communicators.

Third, to further increase validity, the sample might have been bigger, or the experiment might have been replicated within different communities. Within the scope of this study, however, we felt confident to present only one experiment, because converging results have been obtained in other studies where visual communication has been used to improve speed and accuracy in contract interpretation (see, e.g., [9], [12], [94]).

Fourth, some variables may be more rigorously measured. We acknowledge that actual English language proficiency could have been more thoroughly assessed. Since a self-assessment without an objective test may not be reliable, we did not include self-assessed English proficiency as a control variable in our analysis. However, differences in English proficiency among NNSs—and in literacy among NSs—may yield more nuanced results. Moreover, we considered only the verbal-imagery dimension of cognitive style and found no evidence for their effect on contract comprehension. Future studies might need to additionally consider different dimensions of cognitive style, for instance the wholist-analytical dimension [70]–[72]. Better controls for the culture of the participants could also be included, as visual representations are interpreted differently in high-context and low-context cultures [95].

Finally, it is to be noted that the results of our study apply only to diagrammatic visualizations. The contracts used in the experiment did not include other types of visuals such as photographs, illustrations, or cartoons that possess a more pictorial or metaphorical nature. Moreover, more attention should be paid to the type of diagram (or visual representation used) **in relation to** the task that participants need to complete. More research is needed to discover the actual doubts and practical goals of contract professionals, as identifying those tasks is the first step to envision truly helpful diagrams. For example, in tasks 3 and 5 there was no significant difference in accuracy or speed across treatments because, we hypothesize,

+	If Acceptance takes place MORE THAN A YEAR after Delivery	Warranty Period expires 24 MONTHS after Acceptance
=	If Acceptance takes place EXACTLY ONE YEAR after Delivery	Warranty Period expires 36 MONTHS after Delivery
-	If Acceptance takes place LESS THAN A YEAR after Delivery	

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Fig. 6. Suggestion for improving the “Warranty Period” diagram (see Appendix I).

the diagrams did not provide a problem representation that was sufficiently helpful for the respondents and readily applicable.

Question 3 (Appendix III) asks the participant to calculate the correct duration of the warranty period. The diagram (Appendix I) does suggest how to perform the calculation correctly but does not provide a ready-made answer and does not reframe the problem. The readers still needed to apply a “tricky” rule. A better approach would have been, perhaps, to create a simple table proposing an easier-to-apply rule, as we suggest in Fig. 6.

Question 5 (Appendix III) had very high correct response rates in both groups because, we discovered, it is customary that the Supplier carries the risk for the equipment during its testing. Most managers were probably familiar with this convention and already possessed the relevant knowledge to answer the question very quickly. The diagram (Appendix I) as well as the text thus was rather irrelevant, as it was not the main driver behind people’s good performance.

Suggestions for Future Research This study establishes the usefulness of diagrams in simplifying contract interpretation and supporting effective global communication. We suggest that further research should go beyond experimental evaluation, by possibly observing in vivo how visual representations support comprehension and knowledge sharing. Such a study could shed light on how global communicators might interpret the very presence of visualizations in a contract: would the benefits in comprehension be accompanied by an increase in trust and collaboration? Or would people feel patronized? Would they fear that images could be used insincerely, thus leading to lower mutual trust between the parties?

Other studies looking at both experimental and observational data could help us shed light on

what diagrams more effectively foster competent contractual communication, and how and when they should be used in an international business setting. Is there such a thing as an archetypical, best way to communicate certain clauses, or does communication effectiveness depend on the goal readers want to achieve with that information? Are certain types of representations consistently clearer and easier to process than others, or does their effectiveness depend on individual and cultural variables? Future research could take into consideration other types of visuals in addition to diagrams, for instance comics and photographs, which have been reportedly used in contracts [13], [14], but have not been systematically evaluated.

Finally, one possible avenue to take would be to investigate the relationship between cognitive load, information design, and cognitive styles more thoroughly, as the current study counterintuitively showed a weak link between the verbal-imagery dimension of cognitive style and comprehension of differently presented materials. Such an investigation might reinforce the argument that individual cognitive styles ultimately do not significantly impact learning [96]; on the other hand, it may suggest a mechanism between cognitive load and cognitive styles that is undiscovered in this study and that would explain these results.

APPENDIX I

EXCERPTS FROM THE VISUALIZED CONTRACT

Figs. 7–11 illustrate the “visualized contract” used in our study, including explanatory diagrams that

complement rather than substitute for the text.

APPENDIX II

RATIONALE FOR GRADING THE ACCURACY OF PARTICIPANTS RESPONSES

The following rationale is copyrighted (© 2013) by Stefania Passera.

0.25 points = The participant mentions only the clause number where the correct answer can be found, or copy-pastes the relevant excerpt. However, s/he does not provide a correct, precise, and clear response in his/her own words (e.g., if answering correctly would require to provide a precise date, the date is not given).

0.50 points = The participant wrote down the relevant clause or rule in his/her own words. However, s/he does not provide a correct, precise, and clear response in his/her own words (e.g., if answering correctly would require to provide a precise date, the date is not given).

0.75 points = The participant provided a correct, precise, and clear response in his/her own words, eventually referencing the clause or rule s/he applied. However, there is a minor imprecision (e.g., if answering correctly would require to provide a precise date such as 4th March 2016, the participant wrote 5th March 2016).

1 point = The answer is fully correct. The participant provided a correct, precise, and clear response in his/her own words, eventually referencing the clause or rule s/he applied (e.g., if answering correctly would require to provide a precise date, the date is given).

APPENDIX III

COMPREHENSION QUESTIONS

The following questions are copyrighted (© 2013) by Stefania Passera.

Question 1 – What are the consequences if the Test Run of the Equipment fails for the second time?

Question 2 – Given that the date of provisional acceptance is 6th March 2012, which date marks the end of the availability measurement period?

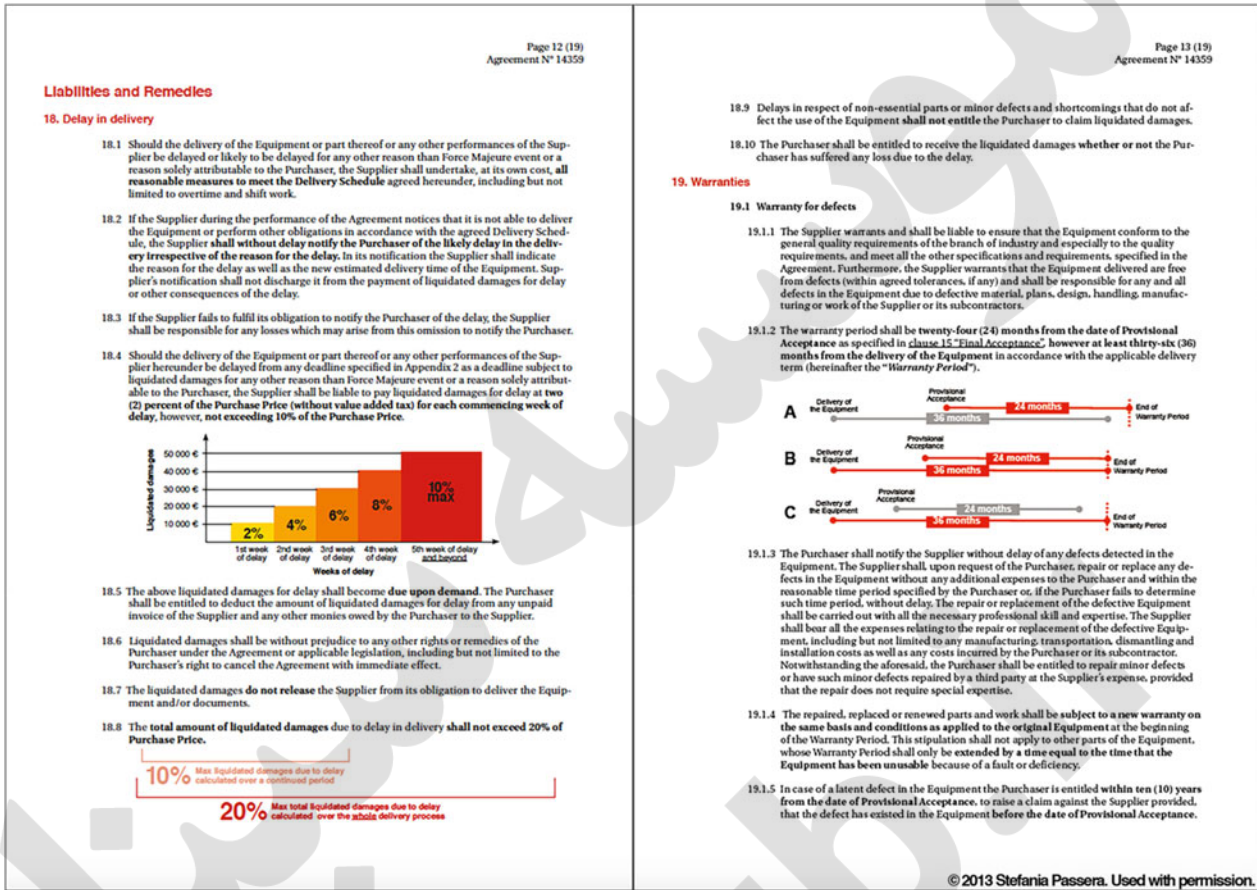


Fig. 7. Sample spread of the visualized agreement.

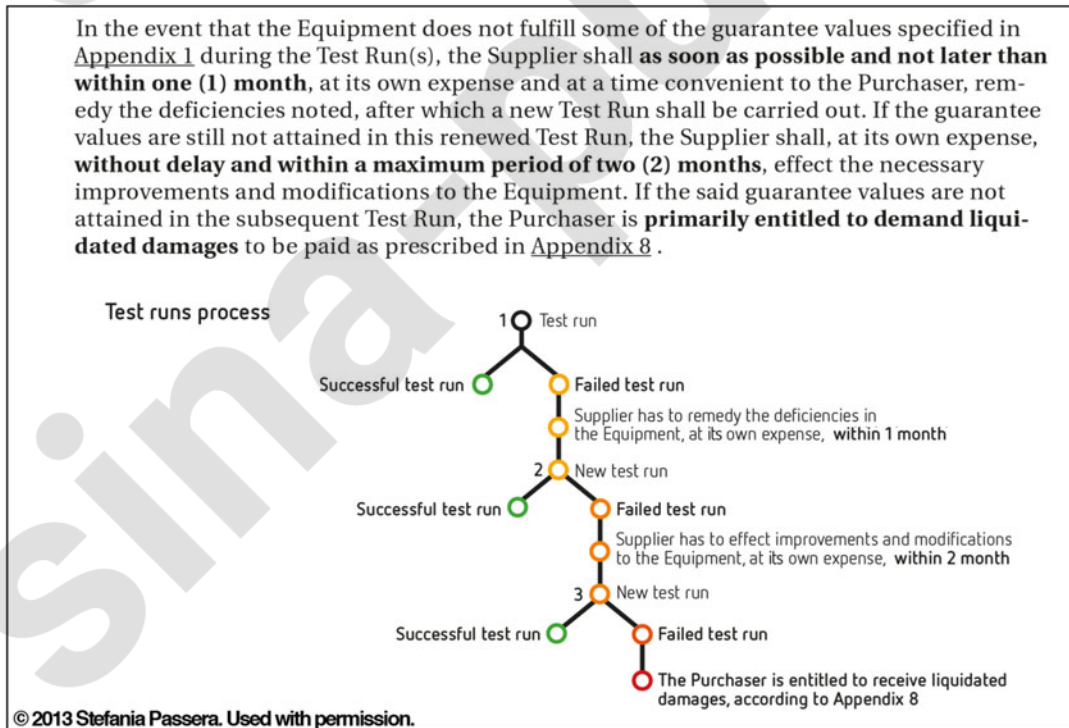


Fig. 8. This excerpt from “Test Runs” (clause + diagram) provides an answer to Question 1.

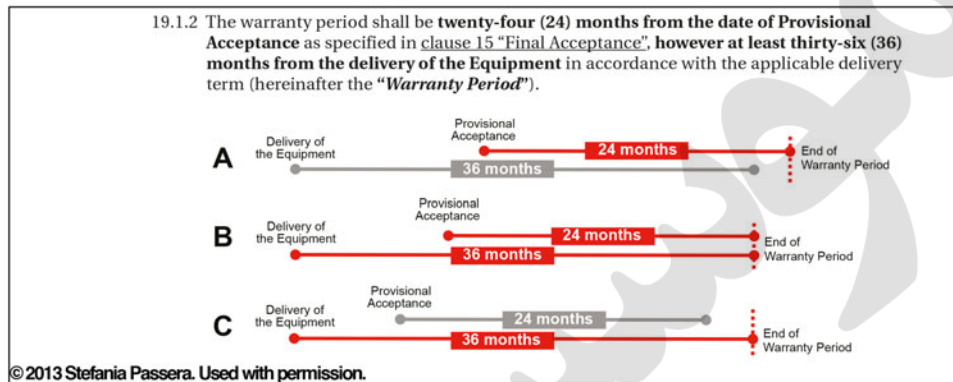


Fig. 9. This excerpt from "Warranty" (clause + diagram) provides an answer to Question 3.

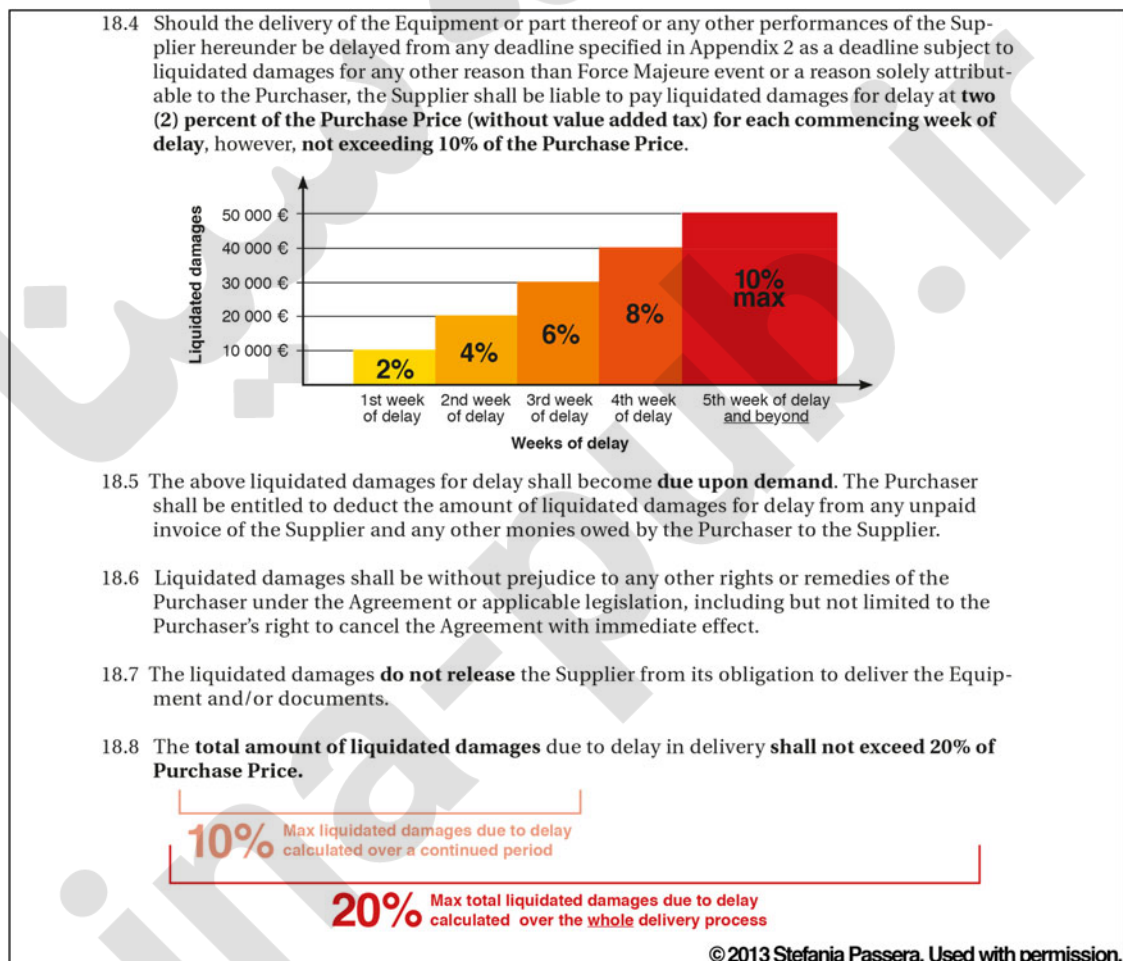


Fig. 10. This excerpt from "Liquidated Damages" (clause + diagram) provides an answer to Question 4.

Question 3 – Given that the date of the delivery of the Equipment is 15th July 2011, and the date of provisional acceptance is 6th March 2012, on what date does the Warranty Period expires?

Question 4 – The first batch of the Equipment delivery was delayed 6 weeks. The second batch of the Equipment delivery was delayed 3 weeks. The third batch of the Equipment delivery was again delayed 3 weeks. What is the total amount

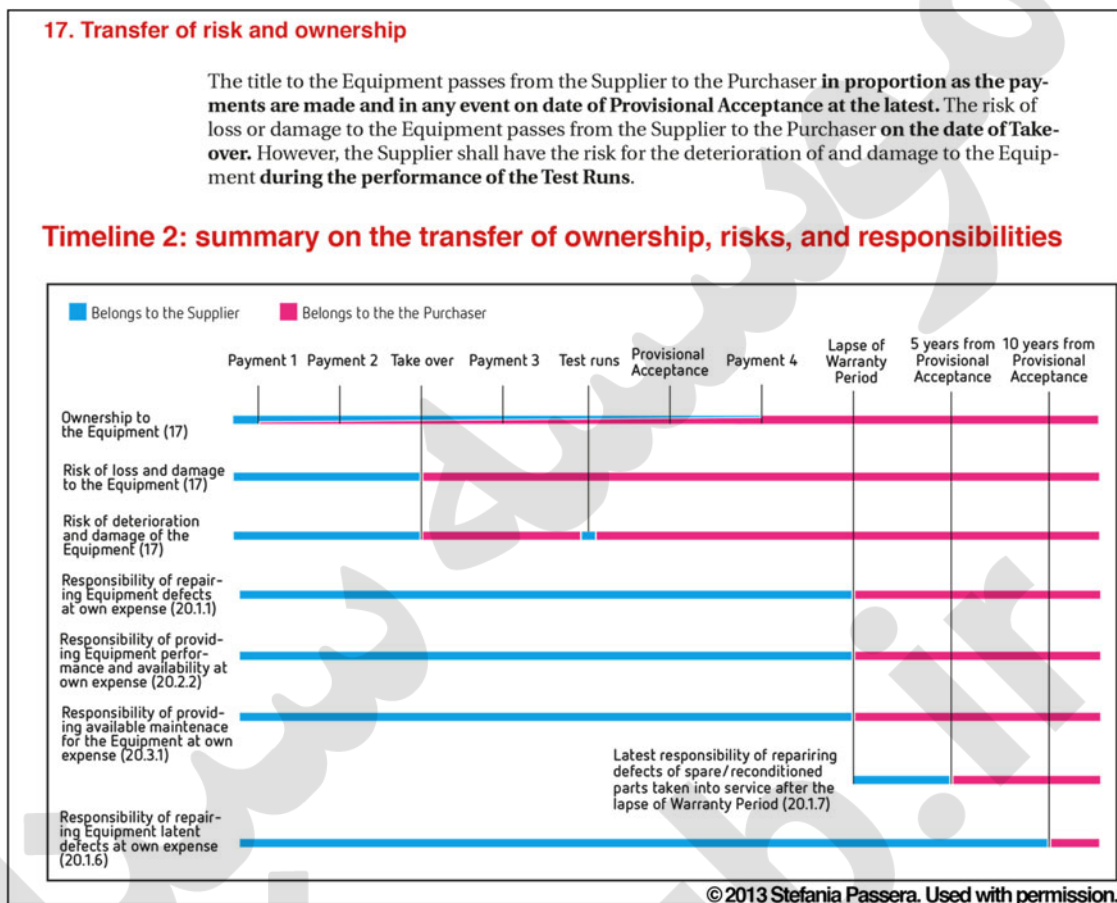


Fig. 11. This excerpt from “Transfer of risk and ownership” (clause + diagram) provides an answer to Question 5.

of liquidated damages that the Supplier is liable to pay to the Purchaser?

Question 5 – Which of the Parties shall bear the risk for deterioration and damage to the Equipment during the Test Runs?

Question 6 – A spare part, included in the original scope of supply, is taken into service and

brought back to the Purchaser on 20th May 2015. Given that the date of provisional acceptance is 6th March 2012, on what date does the Warranty Period for such reconditioned part expire?

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