EasyTalk: A Digital Writer's Workshop for Leichte Sprache (Easy-To-Read German)

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Abstract

Leichte Sprache (*LS*; Easy-to-Read German) is a simplified variety of German characterized by simplified syntactic constructions and a small vocabulary. It provides barrier-free information for a wide spectrum of LS readers including individuals with learning difficulties, intellectual disabilities and/or a low level of literacy in the German language. Usually, text in LS is produced by authors proficient in standard German. LS readers audit the ease of understandability. We would like to change this division of roles and empower LS readers to autonomously participate in written discourse. To this end, we present *EasyTalk*, an assistive writing system for LS. In essence, it supports fast and correct sentence formulation based on profound computational linguistic processing. *EasyTalk* aims to support users in writing freely while practicing general linguistic concepts. Users are supported at their personal reading-comprehension level by underpinning the vocabulary with customizable picture symbols, and by read-aloud options for commands and contents. *EasyTalk* takes readership-design aspects into account by reminding the user to add place/time of an event. On the discourse level, it prompts the user to add coherence specifications to express the communicative function of the sentences. In the writer's workshop mode (called *EasyText*), the system aims at teaching when and how to consider audience-design concepts. Accordingly, the users get trained in text production similarly to elementary school children, who also tend to omit audience-design cues. Evaluations demonstrate that *EasyTalk/-Text* supports users in writing text beyond the scope of short message communication by offering intuitive and easy-to-use dialogues.

Keywords: Augmentative and Alternative Communication (AAC), Controlled Languages (CL), Plain Language, Natural Language Generation (NLG), Paraphrase Generation, Writing Workshop/Schreibwerkstatt

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Introduction

Controlled/Simplified natural languages, like Basic English (Ogden, 1930), have long been a topic of great interest (see Kuhn (2014) for a broad survey). *Leichte Sprache* (LS) is a simplified variety of German. It was developed as part of the Plain Language Movement in the 2000s, which aimed to produce easy-to-understand texts for the spectrum of people with intellectual disabilities or learning difficulties (Bredel & Maaß, 2016, p. 60) who often have low literacy skills (Light, McNaughton, & Caron, 2019)—in the following called *LS readers*. In Germany, LS is enshrined in law as the means of choice for providing accessible information in text form (BITV 2.0, 2011). The three main rule books of LS (BITV2.0, 2011; NLS, 2013; IE, 2014) have been the subject of previous scientific investigations (Kuhlmann, 2013; Lieske & Siegel, 2014; Löffler, 2015; Zurstrassen, 2015; Bredel & Maaß, 2016; Bock, 2017/2019; Nüssli, 2019; Pottmann, 2019; Hansen-Schirra & Maaß, 2020). Many LS rules concern the vocabulary (e.g., "Use easy words." or "No abbreviations.") or the avoidance of complex structures (e.g., more than one statement per sentence, complex clauses, subjunctive mood or passive voice). Put in a nutshell, only main clauses are licensed in LS. In main declarative clauses, the canonical word order is Subject-Verb-Object (SVO). All sentences should be phrased in the active voice, indicative mood, and present and present perfect tenses. To date, it has been usual for texts in LS to be produced by authors proficient in standard German and then evaluated for ease of comprehensibility by LS readers (BITV2.0, 2011; NLS, 2013). One factor preventing LS readers from producing texts themselves may be the lack of technical support during the process from message conceptualization in the mind of the speaker/writer to sentence realization in a computer-assisted writing tool that remedies reading/writing deficits.

To the best of our knowledge, there is no easy-to-use writing system for LS readers that offers linguistic support beyond the phrasing of simple, partly personal sentences, let alone a system capable of teaching the concepts of written text production. The writing of coherent, understandable text requires an emphasis on audience-design concepts (Bell, 1984) because the reader cannot seek clarification—unlike the listener in face-to-face communication. In practice, German elementary school children learn written text production by the widely applied method of the *Schreibwerkstatt/Schreibkonferenz* 'writer's workshop' (see, e.g., Reichardt, Kruse, & Lipowsky (2014) for a broad survey).

This leads to two research questions concerning assisted writing: What individual support can help LS readers to write understandable, coherent text? How can an assistive writing system teach the concepts of written text production, like audience/readership design, using intuitive dialogues at the individual LS-reader level?

To support LS readers in text writing, we developed a computational linguistic system, dubbed *EasyTalk*. It actively stimulates the user to add text-understandability and text-coherence elements, at both the constituent-structure and the sentence-combining levels. The system's two principal components support LS readers in formulating grammatically correct and semantically coherent texts: (1) a natural language paraphrase generator supports fast and correct sentence production while taking readership-design aspects into account; and (2) explicit coherence specifications based on *Rhetorical Relation Theory (RST*; Hovy 1988; Mann & Thompson, 1988) serve to express the coherence at the sentence-combining level. For practicing text writing concepts, we added a digital writer's workshop to *EasyTalk*, called *EasyText*. This system controls the choice options in (1) and (2). Mandatory questions

generated by the system aim to teach the user when and how to consider audience-design concepts.

This paper is organized as follows. First, we summarize the state of the art in technical writing support for LS-readers. Then, we introduce *EasyTalk* by a tour through the system followed by a more detailed survey of the two core components. After that, the digital writer's workshop *EasyText* is outlined. In order to illustrate the appropriateness of the user interface of our system, we report recent evaluation results. Finally, we discuss open issues and suggest directions for future work.

1   The State of the Art in LS Writing Support

First, we look at systems from the area of *Augmentative and Alternative Communication (AAC)* (see, e.g., Lancioni, Singh, O'Reilly, & G. Alberti (2019) for a detailed survey, and Light, McNaughton, & Caron (2019) for current research directions) that aid users with complex communication needs to write based on the concatenation of symbols and/or words. For reasons of space, we focus on systems with support through *natural language processing (NLP)* here. According to Higginbotham, Lesher, Moulton, & Roark (2012) or Waller (2018), NLP is increasingly in demand—however, its potential is not yet exploited.

In German, the target language of *EasyTalk,* a rich morphology and relatively free word order complicate the generation of useful and grammatically correct suggestions. The commercial systems *MindExpress 5* (Jabbla, 2021), *Gateway* (Gateway to Language & Learning, 2021) and *Snap Core First* (Tobii Dynavoxx, 2020) offer a representative sample of widely provided features in symbol-based AAC systemx. For writing, they provide basic linguistic support such as adaptive word prediction and automatic inflection for simple constituents. Technical AAC solutions are currently evolving rapidly, increasingly available on mainstream devices (e.g., smartphones and tablets; Light & McNaughton, 2012). All popular free apps for German allow users to access large customizable vocabularies of (visual) symbols. However, they focus on direct (face-to-face) communication between conversation partners (cf. *LetMeTalk* (2017) and *SymboTalk* (2019)). None of those products provides well-founded linguistic support for sentence construction.

There is an increasing market for writing support based on *natural language generation (NLG)* (see, e.g., ARRIA (n.d.); cf. Gatt & Krahmer (2018), who illustrate the full range of NLG applications, and G2.com (n.d.), which provides links to NLG systems). However, there are few approaches designed for the needs of AAC users (cf. the pioneering approach by Demasco & McCoy (1992) or the storytelling system by Tintarev, Reiter, Black, Waller, & Reddington, 2016). The target language there is Easy-to-Read English. To our knowledge, there is no recent system for AAC users based on NLG for German.

2   EasyTalk and EasyText

In this section, we first give an intuitive impression how our system supports fast and correct typing. In the following, we go into the details of the computational linguistic mechanisms used to support the writing of a sentence and the production of sentence-coherence elements, respectively. In Section 3.4, we introduce *EasyText*, the writer's workshop mode.

2.1   Tour through EasyTalk

Let us familiarize ourselves with the assisted text-production process of *EasyTalk* through an outline of its five essential steps (cf. the numbers in orange circles in Figure 1; also see Steinmetz and Harbusch (2021) for a demonstration video). The system permanently displays three panels (distinguished by blue bars). Panel 1, at the top, contains the previously written text. Panel 2, in the middle, switches between (A) and (B). Panel 2 (A) accumulates the wordforms of a sentence written so far. Panel 2 (B) stipulates sentence-connector specifications. Panel 3, at the bottom, offers syntactically filtered wordform suggestions for a typed string according to the current context.
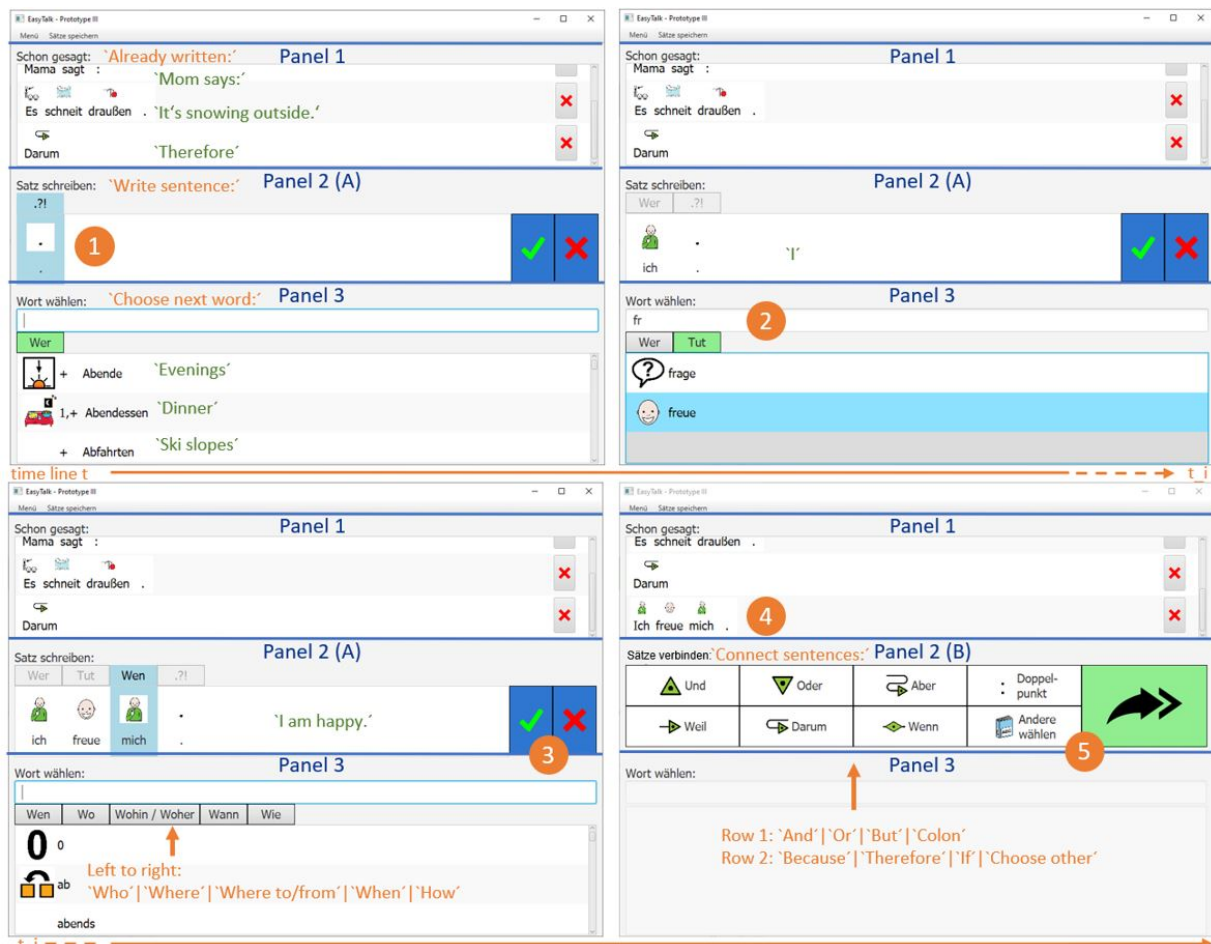
1. In empty Panel 2 (A), clue "./?/" is provided (click button to change; declarative is the default);
2. Add next word to Panel 2 (A) by selecting word by word from the suggestion list offering inflected forms;
3. Choose ✓ to finish the sentence (X deletes last word) → Step 3 in parallel to switching Panel 2 to (B) (cf. step 4);
4. The completed sentence moves to Panel 1 (it can be read out loud and/or exported for further use);
5. Select connection of the next sentence → The system switches back to Panel 2 (A) for next sentence.

Figure 1: The Five Essential Steps of the Text Production Process in *Easytalk*.

Figure 1 shows four snapshots from a text production session in *EasyTalk*. So far, the user has produced the following lines of text (where the symbol "//" indicates line breaks): *Mama sagt://Es schneit draußen.//Darum//* 'Mom says://It's snowing outside.//Therefore//'. Complete sentences are displayed in Panel 1. For longer text, the user can scroll through Panel 1 to look back within the flow of thoughts. A read-aloud function serves to remedy reading deficits. To support writers with low literacy skills, AAC symbols (here, we use the ARASSAC symbol set, 2021) supplement each wordform. The produced text can be exported from the

system for further use, with or without symbols. At the beginning of a new sentence, Panel 2 (A) offers the punctuation cue ".?!" in order for the sentence type to be selected. By repeatedly clicking the box (marked in blue as active; cf. step 1), the user can change the displayed punction symbol. As a result, the canonical LS word order of the constituents in Panel 3 changes. Here, the user did not change the default setting ".". Accordingly, Panel 3 offers inflected fillers for the subject of a main declarative clause. In order not to overtax the user, the subject is referred to by **Wer** 'who'—comparable to the teaching strategy in German elementary schools to identify grammatical functions. In Panel 3, the user is supposed to type the next word. In step 1, no input is yet provided. Accordingly, *EasyTalk* enumerates an alphabetic list of nouns in nominative case from the lexicon. In step 2, the subject *ich* 'I' with its wh-header **Wer** has already been entered. It is displayed in Panel 2 (A), followed by the selected punction symbol that remains sentence final. Panel 3 displays the header **Tut** 'does' as currently active in green, where the user has typed the string "*fr*". As a result, the suggestion list displays verbforms in First Person, Singular according to the subject-verb agreement-checking in the linguistic core component of *EasyTalk*. The user can select an entry from the list (shown in blue). Consequently, the element moves to Panel 2 (A). According to the valency of the verb, the user has to fill the displayed argument boxes (presented along with a list of facultative adjuncts) before being able to finish the sentence by selecting the green checkmark in Panel 2 (A). In step 3, the user has chosen the latter option for the typed sentence *Ich freue mich*$_{ReflexivePronoun\_DirectObject}$ 'I'm happy'. In response, the completed sentence moves to Panel 1. At the same time, Panel 2 switches to (B). Snapshot 4, in the lower right panel, depicts the new state where Panel 1 is extended (step 4) and Panel 2 (B) offers sentence connectors to make the overall information structure of the text more explicit (cf. the causative adverb *therefore* in our example). The chosen connector is appended to Panel 1, and Panel 2 switches back to (A), i.e., step 1.

In the following two sections, we explain how the computational linguistic support is realized in *EasyTalk*.

2.2   Fast and Correct LS-Sentence Writing in *EasyTalk*

All over a sentence, *EasyTalk* maintains its correctness and completeness. The goal is to present the user with linguistically well-reasoned support without unnecessarily restricting the variability of expression. For this purpose, Panels 2 (A) and 3 refer to the derivation tree of a *natural language paraphrase generator* using a declarative grammar of the LS rules and a restricted lexicon.

In *EasyTalk*, we adapt an approach developed in earlier work for L2 learners of German. In a dialogue with the user, COMPASS (Harbusch, van Breugel, Koch, & Kempen, 2007; Harbusch, Härtel, & Cameran, 2014) helps them to write an arbitrarily complex, syntactically correct German sentence. During the so-called *scaffolded writing* (Harbusch & Kempen, 2011), the user graphically assembles the overall derivation tree with feedback by the system. Such a tree applies lexicalized syntactic rules of the *Performance Grammar* that distinguishes dominance rules from rules for word ordering (Harbusch & Kempen, 2002; Kempen & Harbusch, 2002). COMPASS covers all wordforms in the *German CELEX* (Gulikers, Rattnik, & Piepenbrock, 1995). For a reasonable suggestion list in *EasyTalk*, its lexicon is restricted to *CEFR L2-learner level A1/A2* (Council of Europe, 2020). The system can also be adapted to the user's personal vocabulary (e.g., to include proper names of protagonists) or specific contexts (e.g., for school purposes). The set of declarative rules applied by *EasyTalk* is restricted to the LS rules. For example, the verbforms are restricted to the active voice,

indicative mood, present and present perfect tenses. Moreover, the system suggests non-inversion word order.

For the LS readers, the interface of *EasyTalk* has to be simple and intuitive. Nevertheless, the necessary information for building up the derivation tree has to be collected. In order to avoid linguistic terms, we use the cues in the form of interrogative pronouns, as outlined in Column 1 of Table 1, to communicate with the user about grammatical functions and maintain scaffolded writing. (This technique resembles elementary school exercises for identifying grammatical function fillers in a sentence.) In return, the system is enabled to propose correctly inflected forms. In general, the user is presented with the canonical orders defined in LS. Non-canonical rules for word ordering remain inactive, unless the user actively selects a wh-cue from the list in Panel 3. In such a case, *EasyTalk* automatically orders the sentence in Panel 2 (A).

Table 1 enumerates the constituents of a main declarative sentence (supplemented with the cue words used in the dialogue with the user; cf. the first column) in the order they get presented in the Panels 2 (A) and 3. As soon as the verbform is entered, the lexicalized grammar rules stipulate that all obligatory/facultative arguments are displayed (cf. the second panel). *EasyTalk* does not move any sentence with unfilled obligatory valency slots to Panel 1. In order to prompt the user to add information that the reader cannot infer (audience design), a list of adjuncts/modifiers is additionally provided (cf. the third panel).

Cue	Automatically inflected filler
Wer 'who$_{nom}$'	Elements of the **SUBJ**ect in nominative case
Tut 'does'	**FIN**ite verbform in active voice, present tense, coinciding in person and number with the subject
Wem 'whom$_{dat}$'	Elements of the **I**ndirect **O**bject in dative case
Wen 'whom$_{acc}$'	Elements of the **D**irect **O**bject in accusative case
P$_f$ was 'P$_f$ what'	Elements of the **P**repositional **O**bject in the case **P**$_f$, the instantiated preposition requires
Was tun 'what to do'	**P**ast **P**articiple in case the finite verbform is an auxiliary, or **INF**initive in case the finite form is a modal, or Infinitve_with_**ZU** in case the finite form is a complement-taking verb
Wann 'when'	Elements of **MOD**ifier_time
Wo 'where$_{loc}$'	Elements of **MOD**ifier_location
Woher/-hin 'where$_{dir}$'	Elements of **MOD**ifier_direction from/to
Wie 'with what'	Elements of **MOD**ifier_instrument

Table 1: List of constituents in a main declarative sentence (in the top panel, subject and finite verbform are obligatory; the second panel enumerates all possible arguments/valency-frame fillers of the finite verb; and in the lower panel, adjuncts/modifiers are enumerated). Column 1 provides the cue words to be displayed as headers in Panels 2 (A) and 3.

In the rest of the section, we highlight additional supportive features of *EasyTalk*. The snapshot in Figure 2 sketches a later state of the text-production session from Figure 1: *Und//Ich ziehe gleich meine Jacke an.//Weil//Ich will Ski fahren.* 'And//I immediately put on my jacket.//Because//I want to go skiing'. In the current snapshot, Panels 2 (A) contains the sentence prefix *Ich$_{Wer}$ will$_{Tut}$ fahren$_{Was\_tun}$.* 'I want to go/drive'. In Panel 3, the user has typed "*Ski*". According to the lexicon, one suggestion is displayed.
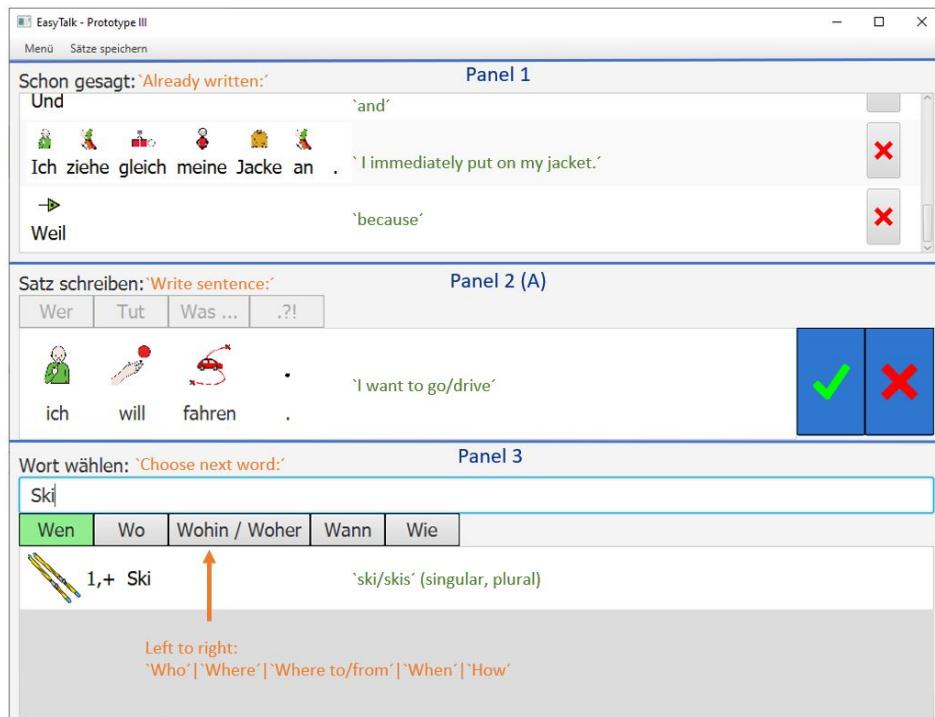
Figure 2: Later state of the text-writing session sketched in Figure 1.

In the choice list for **Tut** 'does', all forms with a separable verb prefix (SVP; cf. *ziehe an* 'to put on' in Panel 1) that the currently selected lexicon covers are presented to the user. In case a verb with SVP is selected, *EasyTalk* maintains the correct word ordering automatically (cf. *Ich ziehe$_{FiniteVerb\_1stP.,Sing.,Ind.Mood,Act.Voice}$ gleich$_{Adverb}$ (meine Jacke)$_{DirectObject}$ an$_{SVP}$.* 'I immediately put on my jacket.'). In case the finite verb is an auxiliary, a modal or complement-taking verb (e.g., *to want to do sth.*) like in Panel 2, the sentence can go on either with a direct object or another verb with its own valency frame to be filled (e.g., *Ich will (ein Eis)$_{DirectObject}$.* 'I want an ice cream.' vs. *Ich will (Ski fahren)$_{to\_do\_sth}$.* 'I want to go skiing.'). This decision is presented to the user in a simple manner by the choice between the cues **Wen** 'whom$_{Accusative}$' and **Tut was** 'does what', respectively (see Steinmetz and Harbusch (2020) for details of this process). As soon as the verb is entered, the system presents the user with cues according to of the overall valency restrictions/arguments provided in the lexicalized grammar where every wordform is supplemented with the syntactic structure. In the example, the user is about to fill the direct object cued by **Wen** 'whom$_{DirectObject}$' with *Ski* 'ski'. The additionally displayed modifier/adjunct cues should remind the user to supplement the sentences properly with audience-design information like time and place of an event. In Panel 1, the user has filled the cue **Wie** 'how' with the adverb *gleich* 'immediately' that is automatically ordered at an appropriate place in the sentence.

In general, inflected suggestions speed up typing by unifying the two-stage process of selection and manual morphological adaptation. Hence, not only is syntactic correctness ensured, but typographical errors are also avoided, and individual typing speed is supported.

2.3   Discourse-Structure Cue-Specification in *EasyTalk*

Writing support in *EasyTalk* is not restricted to intra-sentential items. Text consisting of a series of simple main clauses with canonical word order lacks flow, and the writer's thoughts are only partially conveyed. In terms of natural language generation, the so-called *text plan*—assembled

in the conceptualization/what-to-say phase—comprises propositions, i.e., the not yet syntactically shaped atomic semantic concepts to be uttered, related by *rhetorical/discourse structure relation*s to express the discourse structure/speaker's intention (e.g., the RST relations CONSEQUENCE(know(speaker, fact: snowing(place: outside, time: now)), happy(speaker, time: now))). In the aggregation phase in NLG, the text plan is mapped onto a linear sentence structure (e.g., snowing(place:outside, time:now)) is a separate sentence not verbalizing that this fact is known by the speaker) before the propositions and RST-elements get verbalized in the formulation phase (e.g., *It snows outside. Therefore I am happy.*)

In *EasyTalk*, intuitive cues referring to RST relations simulate the generation of the overall text plan by stipulating that the user specifies the communicative goal for adding the next sentence. This technique is comparable to sentence-combining exercises in the Anglo-Saxon language area that teach students to integrate sets of short, staccato sentences into longer, more effective ones (see Nordquist (2018) for an online introduction; Ney (1980) for the history, and Saddler & Preschern (2007) for the context in school). Whenever the user finishes a sentence by pressing the green checkmark button (cf. step 2 in Figure 1), Panel 2 switches to menu (B) (cf. step 4 in Figure 1). This menu consists of nine buttons. The green arrow-button on the right side of the menu omits the addition of a connector. In order not to overtax the user, we restrict the choice of connectors to those widely used under LS rules (NLS, 2013). We grouped the elements in the menu according to the conjunction type. In the upper row, the coordinating conjunctions *und* 'and', *oder* 'or' and *aber* 'but', and the colon are provided. We realize that the colon is highly ambiguous in LS texts. However, it is widespread (Bredel & Maaß, 2016, p. 254). We therefore offer this choice to prevent the users from having to search for this option. In the second row, the subordinating conjunctions *weil* 'because' and *wenn* 'if', and the causative adverb *darum* 'therefore' are displayed.

Additionally, the button *Andere wählen* 'Choose other' enables more advanced users to browse through all connectors provided by the lexicon. For the consistency and overall ease of use of the system, Panel 3 provides the list of connector choices with the same selection options as for wordforms during sentence typing. The option selected—either by button or in Panel 3— is appended to Panel 1 (cf. *darum* 'therefore', *und* 'and', *weil* 'because', and the colon in Figures 1 and 2, respectively).

So far, we have illustrated the always active supportive writing features of *EasyTalk*. In the next section, we focus on the teaching of text production concepts by wrapping an active control structure around the key components of *EasyTalk*.

2.4 The Writer's Workshop Mode *EasyText*

As mentioned above, writing coherent, understandable text emphasizes audience design concepts. A writer's workshop aims at teaching students the process of text writing through practical application (cf. Graves & Murray (1980) for the history; Hicks (2009) for the digital application of the concept). When *EasyText* is active, the system functions as a teacher taking over the initiative by asking questions at different stages of the text production. For convenience, this mode can be easily ended or reactivated at any point in time.

Initial story writing checklist	
1 Liebe Susi! 2 Denk dir eine Geschichte aus! 3 Bist Du fertig? 4 Beantworte zuerst die wichtigen Fragen von 5 der Geschichte! 6 Weil: 7 Die Leser*innen wissen viele Dinge nicht. 8 Deshalb: 9 Wir schreiben die wichtigen Dinge! 10 *Wer soll deine Geschichte lesen?* 11 *Mache ein Kreuz bei den Passenden:* 12 • Mama / Papa 13 • Petra, meine Freundin 14 • Helen, meine Lehrerin 15 *Wer fehlt in der Liste?* 16 Wir müssen jetzt herausfinden: 17 Was wissen die Leser*innen schon? 18 • Wann findet die Geschichte statt? 19 • Wo findet die Geschichte statt? 20 • Wer spielt mit?	Dear Susi! Think up a story! Are you ready? First answer important question with respect to the story. Because: The readers does not know about many things. Therefore: We write the important things. Who is the reader of your story? Mark the fitting ones: • Mum / Dad • Petra, my friend • Helen, my teacher Who is missing in the list? We have to find out now: What do the readers already know? • When does the story take place? • Where does the story take place? • Who takes part?

Figure 3: Excert from the Checklist that Can Be Adapted to Specific Text Genres and Situations Presented in the Beginning of an *Easytext* Session.

EasyText's dialogue starts with an introductory text (cf. lines 1–9 in Figure 3; on demand, the read-aloud function supports users with low literacy skills). Lines 10–15 collect background information on the reader in an intuitive manner. As far as possible, the individual questions of the checklist offer a range of alternatives to select from. Where this is not possible, the user types the answer using *EasyTalk*. Based on the currently active user profile (e.g., containing the name of the user (in our case *Susi*), and names of the caregivers, friends, etc.) and the user's previously written texts, the system offers predictions. Lines 16–20 show part of the collection of background information for the text the user would like to write. A sequence of questions is asked to characterize all the protagonists in the list of actors (line 20) so that the reader can identify them clearly. Different options are tested. Does the reader already know the name of the actor(s)? Can they be introduced by name? Can a characterization of the person(s) be added to enable the reader to become familiar with them (e.g., *Petra is my friend, Helen is my teacher*)? Such a session avoids the need for relative clauses (not allowed in LS) to establish new protagonists in the story. Similarly, the background of every sentence is explored through questions referring to the modifier cues in Table 1.

When *EasyText* is active, the system asks the user to note down all changes or details unknown to the reader by asking explicit questions. Instead of simply displaying the modifier cues in *EasyTalk* (cf. Figures 1 and 2), *EasyText* stipulates the filling of modifiers (e.g., when and where the story takes place). *EasyText* provides default fillers in the selection list of Panel 3 (e.g., time="now"/place="user's home address"). For every new sentence, the system asks whether the current fillers have to be changed. Only in the beginning of the overall story, and in case of a change, the fillers are added to the text.

This process has various benefits. Not only is the user trained in adding relevant audience-design aspects, but, in addition, the system can actively support the user during sentence production throughout the story. For instance, suggestions of personal pronouns can be made by the system when referring to protagonists during sentence production (e.g., *sie* 'she' for *Mama)*. Assuming Susi is going to write the story we sketched in Figures 1 and 2 (envisioning that the actor is her female friend *Petra)*, the system would stipulate that the time and place of the event are added to the text—resulting in: "*Es ist 3 Uhr Nachmittag.//Meine Freundin Petra*

sitz im Wohnzimmer.//Und//Sie liest ein Buch.//Die Mama von Petra ruft aus der Küche.//…
'It is 3PM.//My friend Petra is sitting in the living room.//And//She is reading a book.//The Mom of Petra calls from the kitchen.'.

3   System Evaluation

For our target group, the initial impression is crucial. Many AAC solutions are abandoned due to avoidable interface flaws (see, e.g., Dawe, 2006, Fager, Hux, Beukelman, & Karantounis, 2006, or Waller, 2018). In the following, we report results of testing the adequacy of the user interface (UI) of *EasyTalk* for the heterogenous needs of LS readers with complex communication needs and/or low literacy skills in connection with intellectual/learning disabilities.

We conducted a case study with nine participants with cognitive disabilities and/or autism spectrum disorder at the *Schreibwerkstatt* 'Writing workshop' of a facility for adults with cognitive or multiple disabilities. We employed the method of case studies to freely adapt each session to the abilities and impairments of each test person (see, e.g., Chapter 16 by Lazar, Feng, & Hochheiser, 2017). With respect to accessibility, individual customizations (e.g., individually adapted keyboards or mouses, or the sensitivity of the input recognition), although easily doable, were not provided during the study. All participants used the provided laptop in order to obtain more comparable observations. During the sessions of 30–40 minutes, we recorded the interaction of a participant with the system in the presence of a personal caregiver, or the leader of the *Schreibwerkstatt*. At the beginning of each session, we introduced the system functions to each user. Then, the participants were asked to freely write their own sentences. When needed, we helped in operating the system or assisted with spelling. In the following, we sum up important insights.

In general, all test subjects could independently use *EasyTalk* right from the beginning. The concept of writing a sentence by answering sequences of wh-questions was directly clear to all participants. They related the answering of wh-questions to oral dialogues. Figure 4 depicts three examples illustrating that the users utilized the supportive features of *EasyTalk*. For example, in E1, a temporal modifier is added; in E2, the recursion for entering two verbforms could be operated without explicit teaching; in E3, a verb with a separable verb prefix is used. To our surprise, all participants typed the complete wordforms instead of speeding up typing by selecting the intended wordform from the list of suggestions provided in Panel 3 for the typed prefix. This might change over the time when the users get more familiar with the system. Another explanation refers to a comment by the leader of the *Schreibwerkstatt*: The users get a feeling of security and accomplishment by typing the complete wordform.

We observed problems due to spelling or typing errors (e.g., accidently entering a character several times, or misspelling a word). In return, the suggestion list remains unexpectedly empty. Therefore, we plan to improve the word entering strategy in the next version of *EasyTalk*.
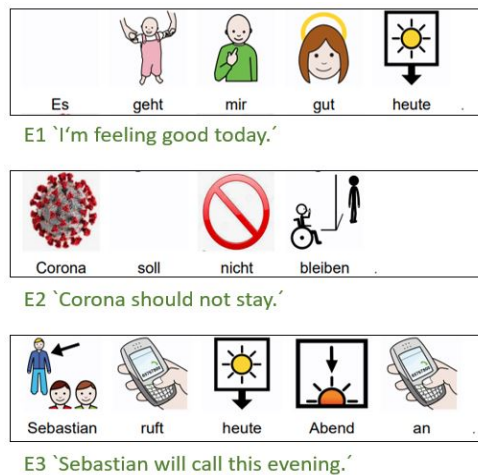
Figure 4: Example Sentences E1-E3 of Text Written with *Easytalk* in Test Sessions.

Panel 2 (B) providing sentence connections was often skipped via the large button with a green arrow. The main reason for choosing this option results from the fact that we did not force our test subjects to think up a story before exploring the system. One participant noted that the options from Panel 2 (B) provide a good solution for writing complex sentences: By writing and connecting individual main clauses, one can write long, coherent sentences without them becoming too long or complicated to write. The leader of the *Schreibwerkstatt,* a caretaker and two social workers, gave us positive feedback on the menu. They judged Panel 2 (B) intuitive to operate. It offers the right support for connecting sentences—thus, creating text coherence for their students. They see great potential for practicing sentence combination in a simple manner.

All test sessions demonstrated that *EasyTalk* meets the requirements of those users who know the alphabetic characters and have basic spelling skills, but difficulties writing whole words or complex sentences and coherent texts. All users appreciated the read-aloud and the export function with symbols. All users, caregivers and experts gave positive feedback on the AAC symbols. The experts and caregivers appreciated that the symbols can easily be exchanged, enabling users to use the symbol sets they are familiar with (e.g., *Boardmaker* or *METACOM*, 2018), and to add personal photos as symbols (e.g., for loved ones).

Without overgeneralizing the results, we were pleased with the largely positive feedback. Currently, we analyze the eye tracking data recorded during the individual sessions.

4   Conclusions and Future Work

We presented *EasyTalk*, an assistive system that supports LS readers in writing correct and complex coherent texts. Additionally, the system offers the writer's workshop *EasyText* that teaches basic concepts of audience design. Crucially, a particular highlight of our system is a user interface that, in addition to low literacy skills, compensates for factors such as working memory deficits or low computer skills.

For the notorious problem of spelling or typing mistakes by people with low literacy skills, we plan to improve the strategy of word selection in Panel 3 to avoid empty suggestion lists. We work on a prototype employing approximate instead of exact string matching. However, we are aware that this feature might be confusing. Many users—irrespective of any specific user group—do not appreciate non-static/deterministic user interfaces (Lee & Yoon, 2004).

Therefore, this mode can be switched off in the settings. Moreover, we plan to add a voice user interface (VUI) for users with functional speech in form of a speech recognition device. For *EasyText*, we work on more sophisticated user profiles for easier customization on shared workspaces (like the computer room in a school or the facility for assisted living). Moreover, we want to offer context-sensitive vocabularies (see, e.g., Demmans Epp, Djordjevic, Wu, Moffatt, & Becker, 2012) fitting different settings (e.g., leisure time or work/school environments) and an easy-to-use interface to design customized text templates and exercises that will result in a so-called *teacher mode* (cf. Harbusch, Franz, & Koch, 2012).

For visually impaired users, we realized that we need to add more options for customization in terms of creating a barrier-free interface—such as special highlighting of the mouse cursor, the font size, and the contrast of the system (e.g., dark mode). How an optimal interface for this user group should look is currently an open problem.

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