CHAPTER 15.

WHAT WRITERS DO WITH LANGUAGE: INSCRIPTION AND FORMULATION AS CORE ELEMENTS OF THE SCIENCE OF WRITING

Otto Kruse and Christian Rapp
Zurich University of Applied Sciences

The digitalization of writing, Charles Bazerman (2018) notes, moves humans into the status of intellectual cyborgs when they increasingly rely on new technologies which cover what they are less well equipped to do than the machines:

> Technology ever increasingly is taking over the work previously done by humans in the composition, distribution, storage, access, and use of communications, and is doing new tasks previously unimagined. What will the human half of the cyborg need to be able to do? (2018, p. 1)

Since writing technologies have expanded beyond offering support for lower-order activities and now, additionally, connect writing seamlessly with communication, conceptualization, visualization, calculation, and publication, writers are forced to find new roles as text workers. Bazerman's interest in human-machine interaction is clearly at the human side, when he proposes to focus on what humans can do best, not on what the machines have learned to do.

Bazerman is well aware that writing has always been a technology (Bazerman, 2000; see also Gabrial, 2008; Ong, 1982) and frequently points out that the core feature of writing is the inscription of symbols on a writing surface: "Words are the material we work with, what we inscribe to create our meanings and influence the readers. When we are done [with] writing, they are what remains on the page for others to see" (Bazerman, 2013, p. 135). What we focus on in this paper is exactly this process of bringing words into an order and putting them down on a writing surface which we address under its traditional term "formulation."

At a time, when writing technologies become knowledgeable about language and start not only to support writers but actually write and translate themselves, it seems necessary to reconsider what we know about language use in writing activities. Digital technologies change the very nature of writing (DeVoss, 2018; Haas, 1996; Williams & Beam, 2019) by supporting writers with tools such as grammar and spell checkers, hyphenation programs, word prediction software, outline generators, or structured templates. More recently, digital tools have expanded their support to higher order concerns to assist writers with their conceptual and rhetorical decisions such as focusing, coherence, and use of collocations (Allen et al., 2015; Cotos, 2014; 2015; Kruse & Rapp, 2019; 2020; 2021; Strobl et al., 2019; Williams & Beam, 2019).

Studying formulation, for us, is not an abstract endeavor but a very practical issue resulting from our work on the development of a new writing platform, called *Thesis Writer* offering linguistic support to its users (Kruse & Rapp, 2019; Rapp et al., 2020). Also, we did extensive surveys and technology reviews into digital writing (Kruse & Rapp, 2019; 2020; Strobl et al., 2019). Compared to Bazerman's position, we are clearly more on the technological side of the cyborg trying to understand what the machines do to writing. *Thesis Writer* provides a digital writing space for student writers and offers them, among other help functions, linguistic support for formulation activity. They may, for instance, consult a large phrasebook or search an attached corpus of academic texts for the usage of words and collocations.

Constructing such a tool makes it necessary to understand not only how support for formulation can be provided but also which linguistic elements are worth being supported digitally. And the answers to both questions depend on an understanding of the nature of inscription tools. What exactly is happening when writers insert letters and words into a keyboard? This question may seem trivial but is easily overlooked when writing is researched from a purely cognitive perspective. Understanding the cyborg does not start with digitalization but with writing technology itself. The aim of this paper is to sketch the outline of a formulation theory on the basis of plausible assumptions about what actually happens during inscription in digital and non-digital contexts.

A SHORT HISTORY OF FORMULATION THEORY

Even if "formulation" is not a concept currently suffering from overutilization, it has a long history that goes back into the 19th and early 20th century when language usage became both a topic in psychology and in the newly emerging discipline of linguistics as Willem Levelt (2013) in an overview on the history of psycholinguistics shows. Most research on formulation, however, is exemplified

on speech (Levelt, 1989) while formulation in writing is covered only sporadically. Formulation has been treated under various labels which also refer to different theoretical approaches. A much-used term is "sentence production" focusing particularly on the generation of the linguistic part of an utterance while the content aspect remains in the background. In psycholinguistics, the term "language production" is used for both, oral and written language creation, while "language generation" is preferred in computational linguistics.

A remarkable beginning of formulation theory is contained in a textbook on "The Pathology of Language" by Adolf Kussmaul (1877/2018) which was inspired by the neurological works of Broca, Wernicke, and Lichtheim, but also contained a general theory of language usage. Levelt considers it as the "very first psycholinguistic textbook" (2013, p. 84). It also contained a stage theory of (oral) formulation in which a preparatory stage consisting of the generation of thought and mood is assumed, followed by a second stage in which the diction is created, including syntax and word selection which, in the third stage, is then articulated as speech. Levelt (2013) sees this as a precursor of his own model of formulation (Levelt, 1989).

Wilhelm Wundt (1900), the founder of modern psychology, devoted the first of his 10-volume "Ethnic Psychology" to language picturing language as a main entrance gate to an understanding of culture and thinking. Wundt was convinced that language usage is driven by "functional exercises" connecting the motor part and the images in speaking, not by an abstract grammatical faculty. He devoted a large part of "The Language" to an analysis of sentence formation and created the phrase structure tree to account for different grammatical solutions. He started with the basic question of how a sentence arises in the speaker's mind (see Levelt, 2013, p. 193), which in his view would be the basic question for the study of formulation. In Wundt's understanding (we still follow Levelt's summary) this task demands to draw the attention on a particular issue of the "total image" that a writer initially may have on their mind. Formulation would be a selection process cutting this totality down into separate parts which then are successively connected to a sentence. His solutions for sentence structures are syntactic in nature demonstrating possible expressive varieties. His starting point for this was a subject-predicate structure to which he then successively included additional parts of sentences (POS) and their various relations. For Wundt, formulation was not understandable without a concept of syntax and other "speech forms." It is not possible for us, to do justice to Wundt's language theory, in which he reacted to a century of research before him and presented an integrated psychological and linguistic view garnished with anthropological and historical ideas.

Wundt inspired more research, particularly in Germany, which expanded his theory and followed new methodological paths. The fate of this rich line of

research was not very fortunate. It first started to collide with the upcoming Behaviorism in which mental concepts were banned and language usage was more or less reduced to the motor part of articulation. Then it fell victim to the Nazi take over in 1933, which forced many researchers to emigrate or be sent to one of the concentration camps.

New theory families emerged with the upcoming computer age in the 1950s. The early pioneers of the computer age, as Howard Gardner (1985) explained, were struck by the similarities between the human's logical abilities and the logical operations that computer programs were able to conduct. They tried to model the mind in analogy to computer programs. One of the roots lies in the early Artificial Intelligence (AI) research as initiated by Allen Newell and Herbert A. Simon (1976), who assumed a structural equivalence of computation and mental processing, as stated in Newell and Simon's (1976) Physical Symbol Systems Hypothesis (for discussions see, for instance; Dreyfus, 1972; 1992; Varela et al., 1991/2016; Winograd, 1991).

The most influential idea about language production came from Noam Chomsky (1965, 1999) who was one of the leading protagonists of the new cognitive sciences and helped overcoming Behaviorism. For him, the cognitive basis of the mind was a syntactic unit, allowing to combine words by syntactic rules. This approach to a "generative grammar" basically served the same function as a formulation theory, except that it also was a thinking theory. Chomsky believed in an algebraically working syntax at the bottom of human thinking. He finally arrived at the conclusion that there must be a universal grammar as a general linguistic competence shared by humans while natural languages are merely deviations of this universal capacity. This assumption was justified by the "poverty of stimulus" argument which claims that grammar must at least partly be inherited because education in general was too poor to explain the learning of a competence as complex as grammar. Exactly what cannot be explained by education, in Chomsky's argumentation, has to be inherited.

What is of particular importance in this model is that the computational grammar Chomsky was referring to cannot be a natural language. Cognitive models following Chomsky similarly proposed a computationally functioning mind as those of Jerry Fodor (1975, 2008) and Steve Pinker (1995), who both assumed that there must be a particular language for computations called "language of thought (LOT)," or "mentalese." Next to the poverty of stimulus argument, Pinker claimed that natural languages are to imperfect for computational thinking. Excluding natural languages from thinking, however, is a far-reaching decision not only for theory building, but also in terms of language education and the teaching of writing.

Currently, only the cognitive writing model in the tradition of John Hayes and Linda Flower (1980) (see also; Flower & Hayes, 1980; 1981; Hayes, 2012b) offers a theory of formulation for writing, even though formulation, in this context, is called "translation." The general structure of the model sees writing separated into several distinct but interacting "processes" which together form an iterative, goal directed activity. Writers draw materials of different kinds from memory and structure it—in accordance with a writing plan—to a message that then is translated into language. Chenoweth and Hayes describe sentence generation in the following ways:

> In many writing tasks we would expect that sentence generation would start with the proposer, which, influenced by the task goal and the text written so far, would generate prelinguistic material and pass it to the translator. The translator would then process the prelinguistic input and store its output in an articulatory buffer where it would be evaluated by the reviser. If the output is judged acceptable, then the transcriber will add it to the text written so far. If the output is deemed unacceptable, the proposer or the translator could opt to try again. (2001, p. 85)

In this description, they do not talk about processes but about processors, structural units which do the basic work of sentence generation and interact with each other fairly similar to how humans would. In their view, these processors are capable of creating "prelinguistic" material (called a "thought package") which is then checked and eventually translated into language. Even though the described process is called "sentence generation" no clue about linguistic activities such as word selection, usage of phrases, grammar, and the like are given. Linguistic specifications such as Wundt and Chomsky had offered, are omitted. Sentence planning is an overly cognitive process carried out left-handedly by a cognitive operator. In a later version of the model (Hayes, 2012a), the "translator" is completed by another cognitive processor, called "transcriber" which is assumed to bring the linguistically transformed word package into script.

Although there are several extensions and transformations of the translation idea (Alamargot & Chanquoy, 2001; Fayol et al., 2012; Galbraith, 1999; 2009; Hayes, 1996), trying to account better for the linguistic part of the emerging text, language remains excluded from thinking. Thinking, in all model variations, is done without language, obviously relying on some unspecified computational power of the mind. Chomsky assumed that it would happen on the basis of a generative grammar, Fodor assumed a "language of thought" (LOT) or a "mentalese" to think with. Hayes and Flower never disclosed what their ideas

about the nature of the cognitive processes are, except that there are some memory structures containing topic knowledge, linguistic knowledge, and so on.

We have to assume that the concept of the cognitive processes follows the computational idea of the early AI research in the tradition of Newell and Simon (1976), in which Hayes had been involved (Hayes & Simon, 1974; 1976; 1979). This approach claimed that the human mind and computers process symbols in similar ways, for which they chose the term "cognition" (cf., Varela et al., 1991/2016; Winograd, 1991). To understand human thinking, they designed architectural models of the mind based on the idea of algorithmic processes as the core of human thinking. When thinking is explained in such terms then, indeed, the results of the computations then must be "translated" into natural languages while readers, in contrast, would have to re-translate text into the prelinguistic cognitive structure to understand it. We propose, in contrast to this position, that human thinking always involves words, phrases, and grammars of natural languages.

Formulation, in this paper, is not seen as an activity that sets in when the thinking is done, but we follow Wrobel's (1995, 1997, 2002) claim that formulation is the thinking itself, or, to be more precise, formulation in writing is thinking enhanced by a writing medium. In Walter Ong's words: "Writing is a technology that restructures thought" (2001). What this means, we will explain in detail in the following chapter.

THEORETICAL FRAME: INSCRIPTION AS A LINEARIZATION TECHNOLOGY

This chapter offers a new perspective on formulation theory starting with the question of what it means that, in speaking and writing, information has to be linearized to be transmitted to listeners and readers. Creating linearity is more than deciding on an order to present content because the order has to be created also linguistically by means of sentence construction, grammar, and the use of function words to organize the text. For writers, formulation means selecting the next word to be inscribed but thinking ahead to anticipate the course of the next sentences.

FORMULATION AND INSCRIPTION: DEFINITIONS

We define "formulation" as the mental activities by which a writer selects words and phrases to create a meaningful chain of words, commonly called "text." We prefer the term "mental" over "cognitive" in order not to restrict theory building to one particular mental modality and avoid the exclusion of linguistic,

emotional, or imaginative components. We neither define formulation primarily through the construction of content even if this is what formulation results in. But the construction of content is done by a broad array of thinking and reading activities before and during writing. Formulation refers only to the moment when particular thought is selected to be included in the emerging line of words in progress. What formulation theory has to explain is not content generation but the miraculously effective selection process of words and word forms to create meaningful sentences.

In written communication, formulation centers around the inscription process in which words are placed on a writing surface such as papyrus, paper, or, more recently, a digital medium. Bazerman explains that this process is far from being trivial when children have to learn it:

> The inscription of letters or characters is the first clunkiness that people learning to write encounter, whether with a stylus forming cuneiform on clay, a brush forming ideographic characters on scrolls, or a pencil forming alphabetic letters in school notebooks. Much of writing education over millennia has been devoted to teaching fine motor control and visual discrimination, manipulation of writing instruments, form and decipherment of characters, spelling, arrangement of symbols on the medium, and so on. In every child's life, five or more years are devoted to gaining reasonable competence in transcribing words and sentences. Technology has been long easing those burdens, replacing stylus and brush with pens and pencils of increasing ease and reliability, and simplifying letterforms and scripts. (2018, p. 7)

In mature writers, we assume that these difficulties are solved, and inscription is referred to as a lower-order activity as compared to the higher order activities of content development, text organization and formulation. Still, inscription is what defines writing. It may be seen as a notation procedure for letters and words (or more basically: for phonemes), which are created mentally or acoustically and then placed manually on a writing surface. Inscription is the result of formulation or, as in digital writing, it is accompanied by formulation activity.

Inscription is a manual, not a cognitive activity that always needs some form of technology (Haas, 1996; Mahlow & Dale, 2014; Ong, 1982), while formulating is a purely mental activity. In writing, however, formulation is not independent of inscription as writers usually develop their text in interaction with what they write down or have already written. They can reread it, rethink it, revise, and extend it.

Thinking during writing is thus supported by the visual control of the successively emerging language string. This control is one of the advantages of writing over speaking as it adds vision to sound while oral speech uses sound alone (de Beaugrande, 1984). The fixation of words on a surface makes language permanently visible and offers a new perspective on the writer's own thoughts. Writers can contrast two different images of their thoughts with each other: the thought as it appears when it is still purely mental, and as it appears when seen on paper or on screen as a written expression. Writers learn to match these two images of thought, and formulation means to successively align them with each other. We have to assume, that both, the mental image of the thought and its written expression, are equally changed within this process. Writing is not simply a print-out of thought but a tentative movement to understand one's own thought in the light of written language. We will have to discuss, though, what the mental image of thought is and how much or what kind of language it already contains.

LINEARITY AND SEQUENTIALITY

The most fundamental constraint of language production, both oral and written, is its strict linearity in which one word follows another and in which only one word can be placed in a certain space (or said at a certain moment of time), never two or more. Inscription, thus, may be considered a linearization technology in which letters and words are lined up one by one. Formulation, in turn, is always concerned with finding the next word to be inscribed. Similar as in chess, the writer may and must think further ahead but can do only one move at a time. Different from chess, moves can be taken back and replaced repeatedly (at least in digital writing) until the best move or word is found.

While "linearity" refers to an order in which one element follows another directly and no parallelism is possible, "sequentiality" means that the order is meaningful and that the elements are related to each other by identifiable rules. The third term, "seriality" is mostly used as a synonym to "linearity" but has in computer science additionally the meaning of command structures in programs which follow one path only and where all steps of a chain of commands have to be followed, as opposed to parallel processing structures.

In language production, grammar is such a connecting force that, to a large extent, consists of rules of managing linearity and organizing the relations of subsequent words or textual elements (de Beaugrande, 1984). Sequentiality in writing is unidirectional and the line of symbols can be created and read in one direction only. The meaning of later elements depends on what has been said earlier. This makes the difference to visual representations which can be read in

several directions. Writers have to partition the information along a sequential order and then interconnect them to create coherence. For this, any language needs reference systems, called "deictic means" pointing back at things said earlier and forward at things that will be said later (anaphoric and cataphoric reference). Linearity applies not only to linguistic principles of interconnectedness but is often used to refer to thought organization as well and to the order in which content is presented (Alamargot & Chanquoy, 2001; Levelt, 1982). Even if interrelated, both kinds of linearity should be kept apart.

The question of where linearity and sequentiality in thinking come from and how we may account for them has been brought up by Karl Lashley (1951). He noticed that the behaviorist explanation of linearity as associative chains or chains of reflexes was not satisfactory as it would lead to a randomly generated connectivity. He discussed the idea that seriality of behavior may be explained by outer demands or procedural necessities, but this would not solve the question of mental seriality as it happens in thinking. The solution Lashley proposed, was that grammar may explain seriality which to him seemed a means of coordinating the spatial arrangement of memory with the temporal arrangement of language when he said, "The translation from the spatial distribution of memory traces to temporal sequence seems to be a fundamental aspect of the problem of serial order" (1951). Language, thus, transforms the rather static structure of memory into the dynamic order of speech. Chomsky (1955) picked up this idea and later made it part of his transformational grammar.

We have to be careful, though, to see grammar as the *cause* of linearity, as Chomsky did. Grammar is, if anything, the root of *sequentiality* providing the connecting rules. Grammar helps organizing it and cares for the interconnections between symbols but what creates language dynamics in first place, is its enforced linearity. Also, linearity is not created by cognitive activities. The order of causality is exactly the opposite: human cognitions are shaped by the constant need to produce linear and sequential content in both speaking and writing. Cognitions stand in the service of language production which Slobin (1996) called "thinking for speaking" and "thinking for writing" (Slobin, 2003).

We don't think that it is cognitive activity that makes memory content linear and dynamic but that it is the linearity and dynamics of language that makes the human mind progress in thinking. Cognitions such as discrimination, concept building, use of schemata, memory structures are certainly necessary to organize linearity or sequentiality but can do so only in relation to what language demands. Imagination, certainly, is a serial mental activity but it is based on visuals which cannot account for logical thinking and would not build a bridge to language production. It is the enforced successivity of word use, that makes the human mind run and that eventually makes it appear similar to a computer

program, only that computer programs are driven by a pulse generator, not by the need to decide on the next word.

The deepest justification to separate formulation as a particular part of writing as well as of thinking is given by its function as a transformational agent making out of static memory content a dynamic flow of words. Formulation completely serves the generation of sequentiality and it has to account for both, its unique form as a message and its devotion to the "orderliness of language," as Bazerman (2013) said.

INSCRIPTION AS THE BOTTLE NECK OF THE WRITING PROCESS

Inscription is the basic process of word notation but may also become the bottleneck of formulation activity, an idea that Hayes (2012a) originally brought forward. Particularly in academic writing, there are usually more thoughts and preliminary formulations piled up before this bottleneck, all awaiting linearization. The congestion at this bottleneck can be the result of a slow inscription system but may also be indicative of strategies missing for the selection and integration of content for inscription. When we talk of writing blocks, we usually picture this as a kind of mental traffic jam. Keith Hjortshoj (2001) observed that blocks happen when writers have too many ideas about what to write but lack a proper strategy for selecting or linearizing them.

Once a word, phrase, or sentence has passed this bottleneck and found its place on the writing surface, the formulation process can proceed and the writer can prepare the next string of words. Owing to digital word processors, inscribed words are no longer immovable as they once were on papyrus or paper but can now be altered flexibly and with little effort or requirement for time (Baron, 2009; Bazerman, 2018; Sharples & Pemberton, 1990). This has resulted in much better ways of managing linearity in writing and interconnecting symbols. Formulation has been extended beyond the moment of inscription. After just a few words or lines, writers usually go back to read what they have written and then start revising until the text meets their expectations. When we look at screen recording of writings today, we have the impression, that writers tend to think less prior to inscription and postpone their thinking to the moment when they can see their ideas appear as words on the screen. Often, they seem to put down short notes or single words first, before they start elaborating them (Gautschi et al., 2021). Producing linear text, today, must not necessarily comply to a linear order of the text immediately, as was necessary with paper and pencil but can jump back and forth or correct something from former parts. It is as if chess players were allowed to do the third and fourth moves first and then look what the first and second ones could be.

Oral Support for Written Language

Arne Wrobel (2002) noted, that the presence of oral speech whilst trying to write something down is an essential part of formulation. Writers often are engaged in some kind of internal dialogue when formulating, as can be seen in think-aloud studies. The fact that experienced writers usually do not talk to themselves out aloud like in the experimental situation may be explained by the interiorization of external speech to inner speech in the sense of Jean Piaget (1972) and Lew Semjonowitsch Vygotski (1934/1961). If we assume that language is involved in thinking, then Vygotsky's idea of inner speech is still the one that is most convincing. Vygotsky saw inner speech markedly different form external speech: "Inner speech must not be regarded . . . as speech minus sound, but as an entirely separate speech function. Its main distinguishing trait is its peculiar syntax. Compared with external speech, inner speech appears disconnected and incomplete" (1934/1961, p. 138). Still, inner speech is sequential and can organize thought even if it would need some transformation to become written language.

An important issue of formulation is "pretext," a concept proposed by Stephen Witte (1987) that refers to the concept that formulations do not arrive all at once and are then inscribed, but that formulation is a matter of linguistic preparation in which a writer slowly approaches the textual form of what may possibly be written down. Witte defined pre-text as a "writer's tentative linguistic representation of intended meaning, that is produced in the mind, stored in the writer's memory, and sometimes manipulated mentally prior to being transcribed as written text" (1987, p. 397). In other words, writers do not simply think about the words they could use, but produce and alter several versions of interconnected words mentally. Wrobel called this "pretextual formulating" (2002, p. 93) which he considered to be a cyclical process in which wordings are created and changed successively. The quality of this iterative activity depends on the availability of linguistic resources and metalinguistic awareness. In digital writing, we observe that writers do these try-outs of possible formulations rather on screen and not in their minds. They obviously don't do the thinking before but after inscription (Gautschi et al., 2021).

Writers produce far more words, Wrobel (2002) observed, than the emerging text actually requires. While Wrobel suggested that the excess words were oral, today, they are words that are written and cut out during revision. The relation between words written and words remaining in some writers can be 2:1, meaning that 50% of the words written down are deleted again (Gautschi et al., 2021). Formulation, in this meaning could be considered as a way of testing various wordings from which the most suitable ones remain in the text. It matters to keep in mind, that the traditional sequence of thinking—inscription—revision

does not seem to apply to many young writers (Gautschi et al., 2021). Rather, the sequence we found often was inscription—thinking—revision or even inscription—revision—thinking.

Moving Focus

Formulation depends not only on what a writer wants to say and an audience needs to be told, but also on what needs to be said at a certain point in the text (and sometimes also: what a genre expects from the writer at a certain part of the paper). Every formulation activity is effectively squeezed into the narrow space that opens up between what has already been written and what has been left to say in the remaining parts of the text. This is, again, a result of enforced linearity which does not allow to place elements next to each other as a diagram would do but enforces the construction of sequentiality.

De Beaugrande (1984) called this task the creation of a "moving focus" in which not only one particular thought has to be placed in the center, but in which the transition has to be managed from what has already been said to what comes next. Whatever a writer places into the text, is caught within such a transitional slot, waiting to be connected conceptually as well as linguistically with the adjacent textual elements. In linguistics, these two kinds of connectedness of text are called "coherence" (content) and "cohesion" (language) (de Beaugrande & Dressler, 1981; Halliday & Hasan, 2013; Taylor et al., 2019; van Dijk, 1977).

A moving focus refers to a principle that looks at the text from both the perspective of content organization and from the perspective of the reader who has to be guided through the text. There are many linguistic means to accomplish such a guidance, such as deixis, connectives, specifications, examples, repetitions, anaphoric and cataphoric references, topic sentences, metadiscourse, and accentuations. For long papers, the creation of a moving focus is supported by an outline which can be used to provide the necessary signs for the readers to comfortably follow the flow of ideas.

Reader Empathy

Even though our focus on formulation stresses the technological side, it should not be missed that it is always a social process, even if writer and audience are not together in the same room as in oral communication. Writing may be seen as a stretched speech situation as Konrad Ehlich (1983) said, where writer and audience are separated through time and space into the two communicative half-situations of writing and reading. Writers have to imagine their audience and assign themselves a role as the originator of a message. Slobin (1979, as cited

by Clark, 2000, p. 221) referred to the fact that, in writing as in speech, most things will be left unsaid as the reader already knows them or is assumed to. A text only adds something new to what readers and listeners already have in mind and never makes a complete printout of content or thought.

Formulation, thus, also has the function of a filter which eliminates those elements that need not to be said for a particular audience because everyone is familiar with them. Here is an example of a text which does not filter information along the familiarity dimension:

> Chancellor Angela Merkel walked to the door of her office. She breathed regularly and her eyes were open except for some short moments when she blinked. She carried both of her hands with her as well as her arms and shoulders. Her feet alternatively touched the ground while walking and she never used the same foot twice. She wore clothes and most parts of her body were covered by them. Her head was placed upright in the middle of her shoulders with combed hair on it and it moved little while she walked. She also carried a purse.

This short piece of fiction demonstrates what we usually do not say. For writers not familiar with their audience, this kind of filtering information may be the harder problem than selecting what has to be said. Interestingly, computers do have great problems in understanding and using this kind of everyday knowledge (Winograd, 1972; 1991).

Slobin even doubts that there is thought at all contained in text, when he claims, that: "Language evokes ideas: it does not represent them" (1979, as cited by Clark, 2000, p. 221). It is the mental activity of the reader that reconnects written language again with cognition, emotion, and imagination in order to create thoughts out of it. Writers, in the formulation situation, need something like reader empathy that helps them to infer the audience's assumed knowledge, thoughts and feelings.

LINGUISTIC RESOURCES OF FORMULATION

The organization of information within a string of language follows the rules which languages offer and demands from the writer and speaker to comply to the conventional means by which texts are assembled. The complexity of all aspects of language creation, taken together, is overwhelming and it is or it should be one particular task of writing theory to explain how such complexity can be generated during formulation. We cannot give a complete account of this task, here, but rather intend to offer first steps into this matter to show where

solutions may come from. In general, we are back in the field of psycholinguistics, here, as described in the historical part of this paper.

WORDS, LEXICONS, AND WORD USAGE

Words are the most natural linguistic resource of formulation. They are the basic building blocks for sentences and the basic elements of meaning-making. Writers depend on an extended mental lexicon in order to speak and write fluently and with a grammatical understanding of how words are used as different parts of speech (POS). Writers have to understand the conventional meanings of words and learn about the discipline-specific meanings of terms and definitions within academic and/or professional contexts. The mental lexicon, as Levelt explained:

> [It] plays a central role in the generation of speech. It is the repository of information about the words the speaker has available for production. This information involves, at least, the meaning of each item and its syntactic, morphological, and phonological properties. (1989, p. 232)

Words are not simply linguistic units carrying a meaning but virtually are knowledge platforms, to which more aspects are increasingly attached over time (Nagy & Scott, 2000). Also, they provide an interface between the individual mind and the society's knowledge, as Bazerman notes:

> As languages grow and cultures change their knowledges, the semantic possibilities change and extend both for individuals and members of the community. Lexicon and semantics grow through both an inward conceptual expansion and a probing outwards into the world to identify possible things to be indexed and turned into meaning through the form of words, often using shards and analogies of previous words and meanings. (2013, p. 145)

In academic or professional contexts, students have to acquire a specialized terminological knowledge in order to be able to participate in the appropriate disciplinary discourses (Bazerman, 2012). It is, as Faber (2015) pointed out, difficult to say what terminology actually is. Faber sees terms as much as units of specialized knowledge as of a specialized language and stresses their double-natured character as both cognitive and linguistic. Both appear as "access points to larger knowledge configurations" (Faber, 2015, p. 14). Terms, in this sense, should therefore be seen as a part of language crafting as much as they are parts of conceptual thinking. Common languages and their rich word

treasures form the background of formulation activities and frame the use of special terminologies associated to different professional, cultural, or academic domains.

Word learning, thus, forms an essential part of intellectual and cognitive growth. Sandra Waxman noted, "Word learning stands at the very centre of the crossroad of human cognition and language (Waxman, 2004, p. 295)." Every word she sees as an invitation to learn new concepts and new concepts need words to be expressed. Linguistic and conceptual advancements, Waxman continued, are powerfully linked within child development. Literacy development, we can continue, means to be socialized in language communities and learn to use the respective symbols system not only for communicative purposes but also for thinking. This process continues at all levels of education where word learning and the acquisition of their respective conceptual and definitory background information play a major role.

Connectives

A tremendously influential linguistic element in the creation of text and thought are connectives or connectors. These function words or expressions have the ability of connecting clauses and sentence parts to more complex linguistic and conceptual units. From the word class they may be conjunctions, adverbs, or prepositions. The web-based multilingual lexical resource for connectives at connective-lex.info which collected connectives from various data bases lists 142 English, 274 German, 328 French, and 173 Italian connectives (see Stede et al., 2019 for more information). Even if the numbers do not reflect the true values for either language, they still offer an estimation of the many opportunities which languages provide to connect sentences.

Connectives achieve meaning only through their connecting capacity of indicating, for instance, that "clause A" is causally related to "clause B" if the connector "because" is used. For text production, connectives play an important role in creating cohesion (Halliday & Hasan, 2013), indicating logical relations (van Dijk, 1977), structuring reasoning and argumentation (Taylor et al., 2019), and organizing causal and temporal relationships (Halliday & Hasan, 2013).

There are far more linguistic than logical connectives. It is impossible to create meaning through the usage of logical operators alone. Similar to terms, connectors are probably as much a part of thinking as they are a part of text construction, even if we don't know for sure whether we use connectives when we think. Connectives contain human knowledge on the relations that exist between thoughts and events. Consider the following sentences: "The house is old" and "The house will be torn down." What choices do we have to connect them?

"The house is old *and* it will be torn down." Indicates an additive relationship.

"The house will be torn down *because* it is old." Indicates a causal relationship.

"The house will be torn down *when* it is old." Indicates a temporal relationship.

"The house will be torn down *if* it is old." Indicates a conditional relationship.

"The house will be torn down *although* it is old." Indicates a contradictive relationship.

"The house will be torn down *unless* it is old." Indicates an exception.

"The house will be torn down *no matter* how old it is." Disregards connectedness.

"The house is old, *for this*, it will be torn down." Indicates a reason.

"The house is old; *therefore*, it will be torn down." Indicates a conclusion.

Relating the two clauses or bits of information to each other leads to different meanings dependent on the choice of the connector used. Each connector, by itself, is meaningless and only when it is placed between two phrases or sentence parts, it becomes a meaningful textual practice that has to be learned individually. Learning to write as much as learning to think both depend on a knowledge of their meanings and usages. If a new thought is integrated into a text, it usually requires a connective to define its place in relation to that which already has been said and what may be said next. The point being made here is that neither thinking nor language use can happen without the benefit of connectors.

Phrases and Multi-Word-Patterns

Still, words alone, along with connectives, do not provide the whole story where formulation is concerned. Formulating a sentence on the basis of connecting single words would hardly ever be successful if writers used words like domino tiles: placing one piece down and then checking what comes next. Formulation needs an overarching view of language construction and, therefore, has to rely upon word connections rather than single words. One

issue of particular importance in formulation theory, therefore, is the formulaicity of language (e.g., Biber et al., 2004; Pérez-Llantada, 2014; Sinclair, 1991; Wray & Perkins, 2000) and it is no accident that the term "formula" is the root of both formulation and formulaicity. Text production makes use of fixed, multi-word formulas which may be stored mentally and later retrieved as chunks of words.

Word connections have been studied under such terms as "phrases," "recurrent multiword patterns," "formulaic language," "idioms," or "collocations" (Wray & Perkins, 2000). Britt Erman and Beatrice Warren (2000) estimated that formulaic wordings, particularly in academic discourse, may cover up to 50% of the whole text. Harald Feilke stressed the instrumental nature of phrases as "text procedures" and considers learning-to-write as a change from implicit to explicit "procedural linguistic and textual knowledge" (2014, p. 27). John Swales (1981/2011, 1990) and Ana Moreno and Swales (2018) developed a text analytical approach called "move analysis" in order to study genres with respect to their phraseological nature. They look for the rhetorical purposes which authors seek to realize when writing defined parts of the research article (or other genres), which they refer to as "moves." These moves are made up by sub-units called "steps." Both moves and steps have to be inferred from the linguistic realizations which usually have the form of fixed word connections or phrases. Swales (1981/2011, 1990) exemplified this approach in his CARS (Create A Research Space) model, which grouped the important rhetorical purposes expressed in research article introductions into three main moves, each of which contains several steps.

Collocations can be accessed through collocation dictionaries available through websites such as "Just The Word" (just-the-word.com) or "Ozdic" (ozdic.com), or Freecollocation (freecollocation.com) which all rely on the British National Corpus. However, for many purposes, these collections are considered as being too broad in what they offer, hence more focused collections such as the Manchester Academic Phrasebank (phrasebank.manchester.ac.uk) (Davis & Morley, 2015) maybe considered a more useful option. The Manchester Phrasebank offers expressions that are used mostly in academic writing, and as such demonstrates the wide array of functions, they may have for text construction. We must assume that writers not only possess mental lexica, from which they can draw upon during formulation, but also individual mental phrasebooks. These may be thought of as collections of meaningful word connections that can be reused in order to solve defined rhetorical problems during the act of writing (Swales, 1990). In digital contexts, phrases can be offered by digital phrasebooks or by corpus search tools integrated within word processors.

The Need for Grammar

Amidst the formulation process, Wrobel (2002) discussed (with reference to Levelt, 1989) the existence of a "formulator;" a mental unit which cares for the "grammatical encoding" of what is to be said. This reminds us of the fact that there must be a place for grammar in any model of formulation, without which a text could certainly not come to the point of fruition. Grammar, we have said above, to a large degree, results from the need of managing linearity. Whatever rules for this have been established, they form the backbone of any (alphabetic) language with considerable stability over time. Children learn grammar, however, without knowing about grammar. If we do not follow Chomsky's nativist idea of a generative grammar—where does grammar then come from? And how does it relate to text production?

In writing, we have to assume, grammatical encoding usually occurs automatically; grammar is not consciously constructed except, perhaps, for second-language writers at a low proficiency level. For a formulation theory, it is a great challenge to understand and study grammatical automaticity without moving into "black box" models similar to Hayes and Flower's (1980) translator. Many aspects of grammar, such as morphology, cases, declination, mode, number (singular and plural), and grammatical gender are indeed performed automatically. They are learned at an early age and are applied unintentionally and unconsciously. Other aspects of grammar may be made purposefully such as the choice of connectors, prepositions, tenses, particles, and auxiliaries. It matters that writers know or learn what to do with words and how to connect them. Grammar, we have to assume, is not an abstract rule-based system that has a fixed algorithmic structure like in today's digital text generation systems. Rather, it is individually constructed from the many operative linguistic units which are picked up successively from childhood on. Grammar, as a system, comes in when it is taught in school and even then, it seems to be a metalinguistic element, rather than an operative part of language construction.

Automaticity of Text Routines

If we cut down language use into separate procedural elements which are learned and used independently and not as an integrated grammar, then we need a learning model of how they are acquired and applied when needed. A key to understanding language learning and language usage is automaticity. Automaticity stands in contrast to controlled or attentive processing (Kahneman, 2012; Schneider, 1999). Formulation, no matter whether we look at the linguistic or cognitive side of it, is a hierarchical process in which many sub-routines

are involved. Typical for automatic processes are seven qualities, as Schneider (1999) points out:

- they can be much faster than controlled processing
- they process parallel as compared to controlled processing which is serial
- they require minimal effort enabling multitask processing
- they are robust and highly reliable compared to controlled processing
- they require (constant) training and practice before they can be performed well
- subjects have reduced control over automatic processing and may have to invest time to change them if necessary
- automatic processes produce less memory modifications than controlled processes.

A large part of language learning, we have to assume, follows the path of automatization of text routines or text procedures (Feilke, 2012; 2014). A particular linguistic unit (for instance the use of a connective like "either . . . or") is applied for the first time consciously and repeated at several occasions until it is adapted to different linguistic contexts and integrated into the mental lexicon. To apply such a connective, a child must be able to make a distinction between two objects or situations which exclude each other. The cognitive task is to understand that A and non-A cannot be true at the same time and that one of them has to be chosen. We either can go to have a pizza or get ice cream but both exclude each other. We may additionally assume that the words "either . . . or" motivate the child to look for situations which are mutually exclusive and that it thus develops the cognitive skills of discrimination and logical connection to automatically detect such alternatives. Only then, the connector may be used routinely as a text procedure whenever two exclusive events have to be addressed.

Two Kinds of Language Generation

If we consider what has been said about pretext and preparation of written formulations, we have to assume that there are two different kinds of formulation going on during writing. One of them we might call "primary language production" which is still more associated with speech than with written text production even though it may be executed mentally (as inner speech). As Ann Chenoweth and John Hayes (2001, 2003) have described, text production proceeds not at a steady pace but by chunks of words which they call "bursts." Such bursts are usually followed by a pause after which text production goes on or by a revision sequence. The question is: Where do these bursts come from? In the

Hayes and Flower model there is no space, that could be associated with the production of these sentence pieces. We associate them with the primary text production which may be both, a genuine construction of a new wording or the reliance on elements from the mental phrasebook. Any mix of both, of course, is also possible. Such formulations may be kept in mind as tentative pretexts, as Witte (1987) and Wrobel (2002) have said, or written down immediately. We may assume that competent writers check these wordings mentally for their goodness of fit before they write them down.

The second kind of language production is the one happening during inscription when the text is assembled with the help of a writing tool. At this moment, a more conscious kind of language planning and decision making takes place. In digital writing, writers have more options than they had in paper-and-pencil times as they can decide to muse on a formulation first and then write it down or to start musing only when they can see the formulation appear on screen.

If we want to account for the dynamics of formulation, it is essential to separate these two language generation processes in order to understand both, the tensions between them as well as the modes of synchronizing and coordinating them. In today's flexible inscription technology, the options of coordinating them have increased and are awaiting to be analyzed in detail.

CONCLUSIONS

The aim of this paper was to re-introduce a formulation theory as a necessary part of writing studies. We have shown that such a theory needs a deeper understanding of what language is and how the enforced linearity of language determines how we structure thought. We also stressed the need to understand what inscription is and how inscription technology supports thinking and text production. We argued that cognition alone is not a sufficient concept to understand formulation but that it always needs a dialectic theory between cognitive and linguistic factors, both in human development, in individual development and in text development. Because of the limited space available, we had to omit most social and cultural factors which are not only deeply involved in writing but also in language development, literacy, education, and genre (see, for instance, Tomasello, 2003; 2008; 2014). We also find it necessary to integrate formulation research deeper into the tradition of psycholinguistic research instead of letting it start with the cognitive sciences.

Our starting point in this paper was the socio-cyborgian alliance between humans and computers which Bazerman (2018) had addressed. To fully understand how this cyborg operates, we have to become aware that the machines have started to occupy a space that until recently was completely reserved to humans: language

usage. Humans, as we have argued above, do not only communicate but also think with their native languages. For this, the cyborg does not only apply to action systems but also conquers human thinking. Already by now, intellectual and literacy development are widely entangled with digital technology, and there is still more to come. We are thankful for Bazerman's metaphor of the cyborg which helped us to grasp a core element of the connection of digitalization and human development. We have expanded the metaphor slightly to "intellectual cyborgs" to account for the intrusion of the computers into our mental worlds where we have to re-arrange our own capacities with those of the machines.

REFERENCES

Alamargot, D., & Chanquoy, L. (2001). *Through the models of writing*. Kluwer. https://doi.org/10.1007/978-94-010-0804-4

Allen, L. K., Jacovina, M. E., & McNamara, D. S. (2015). Computer-based writing instruction. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 316-329). Guildford.

Baron, D. (2009). *A better pencil: Readers, writers, and the digital revolution*. Oxford University Press.

Bazerman, C. (2000). A rhetoric for literate society: The tension between expanding practices and restricted theories. In M. Goggin (Ed.), *Inventing a discipline: Essays in honor of Richard E. Young* (pp. 5-28). NCTE.

Bazerman, C. (2013). *A rhetoric of literate action: Literate action volume 2*. The WAC Clearinghouse; Parlor Press. https://doi.org/10.37514/PER-B.2013.4791

Bazerman, C. (2018). What do humans do best? Developing communicative humans in the changing socio-cyborgian landscape. In S. Logan, & W. Slater (Eds.), *Perspectives on academic and professional writing in an age of accountability* (pp. 187-203). Southern Illinois University Press.

Biber, D., Conrad, S., & Cortes, V. (2004). If you look at . . . .: Lexical bundles in university teaching and textbooks. *Applied Linguistics, 25*(3), 371-405. http://doi.org/10.1093/applin/25.3.371

Chenoweth, N. A., & Hayes, J. R. (2001). Fluency in writing: Generating text in L1 and L2. *Written Communication*, *18*(1), 80-98. https://doi.org/10.1177%2F0741088301018001004

Chenoweth, N. A., & Hayes, J. R. (2003). The inner voice in writing. *Written Communication, 20*(1), 99-118. https://doi.org/10.1177%2F0741088303253572

Chomsky, N. (1954). A review of B.F. Skinners's Verbal Behavior. *Language, 35*, 26-58.

Chomsky, N. (1965). *Aspects the theory of syntax*. MIT Press.

Chomsky, N. (1999). On the nature, use and acquisition of language. In W. C. Ritchie, & T. K. Bhatia (Eds.), *Handbook of child language acquisition* (pp. 33-54). Academic Press.

Clark, E. V. (2000). Review of Michael Tomasello's "The new psychology of language: cognitive and functional approaches to language structure." *Journal of Child Language, 27*(1), 213-223. https://doi.org/10.1017/S0305000999224075

Cotos, E. (2014). *Genre-based automated writing evaluation for L2 research writing: From design to evaluation and enhancement*. Palgrave MacMillan.

Cotos, E. (2015). Automated writing analysis for writing pedagogy: From healthy tension to tangible prospects. *Writing and Pedagogy, 7*(2-3), 197-231. https://doi.org/10.1558/wap.v7i2-3.26381

Davis, M., & Morley, J. (2015). Phrasal intertextuality: The responses of academics from different disciplines to students' re-use of phrases. *Journal of Second Language Writing, 28*, 20-35. https://doi.org/10.1016/j.jslw.2015.02.004

De Beaugrande, R. A. (1984). *Text production: Toward a science of composition*. Ablex.

De Beaugrande, R. A., & Dressler, W. (1981). *Introduction to text linguistics*. Longman.

DeVoss, D. N. (2018). Digital writing matters. What do we talk about when we talk about digital writing and rhetoric? In J. Alexander, & J. Rhodes (Eds.), *The Routledge handbook of digital writing and rhetoric* (pp. 918-28). Routledge.

Dreyfus, H. L. (1972). *What computers can't do*. Harper.

Dreyfus, H. L. (1992). *What computers still can't do*. MIT Press.

Ehlich, K. (1983). Text und sprachliches Handeln. Die entstehung von texten aus dem bedürfnis nach überlieferung [Text and linguistic activity: The development of text from the desire to pass on]. In A. Assmann, J. Assmann, & C. Hardmeier (Eds.), *Schrift und gedächtnis. Beiträge zur archäologie der literarischen kommunikation* [Writings and memory: Contributions to the archeology of literary communication] (pp. 24-43). Fink.

Erman, B., & Warren, B. (2000). The idiom principle and the open choice principle. *Text, 20*(1), 29-62. https://doi.org/10.1515/text.1.2000.20.1.29

Faber, P. (2015). Frames as a framework for terminology. In H. J. Kockaert, & F. Steuers (Eds.), *Handbook of terminology (part (1)* (pp. 14-33). Benjamin.

Fayol, M., Alamargot, D., & Berninger, V. W. (Eds.). (2012). *Translation of thought to written text while composing. Advancing theory, knowledge, research, methods, tools, and applications*. Psychology Press.

Feilke, H. (2012). Was sind Textroutinen? Zur Theorie und Methodik des Forschungsfeldes [What are text routines? Theory and methodology of a research field]. In H. Feilke, & K. Lehnen (Eds.), *Schreib- und textroutinen. Theorie, erwerb und didaktisch-mediale odellierung* [Writing and text routines: Theory, acquisition, didactical and media-related modelling] (pp. 1-31). Lang.

Feilke, H. (2014). Argumente für eine didaktik der textprozeduren [Arguments for a didactic of text procedures]. In T. Bachmann, & H. Feilke (Eds.), *Werkzeuge des schreibens. Beiträge zu einer didaktik der textprozeduren* [Tools of writing: Contributions to a didactic of text procedures] (pp. 11-34). Klett Fillibach.

Flower, L. S., & Hayes, J. R. (1980). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg, & E. R. Steinberg (Eds.), *Cognitive processes in writing: An interdisciplinary approach* (pp. 31-50). Erlbaum.

Flower, L. S., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication, 32*(4), 365-387. https://doi.org/10.2307/356600

Fodor, J. A. (1975). *The language of thought*. Harvard University.

Fodor, J. A. (2008). *LOT 2. The language of thought revisited*. Clarendon Press.

Gabrial, B. (2008). History of writing technologies. In C. Bazerman (Ed.), *Handbook of research on writing* (pp. 27-39). Erlbaum.

Galbraith, D. (1999). Writing as a knowledge-constituting process. In M. Torrance, & D. Galbraith (Eds.), *Knowing what to write: Conceptual processes in text production* (pp. 139-160). Amsterdam University.

Galbraith, D. (2009). Writing as discovery. *British Journal of Educational Psychology Monograph Series II, 6*, 5-26.

Gardner, H. E. (1995). *The mind's new science: A history of the cognitive revolution*. Basic Books.

Gautschi, C., Kruse, O., & Rapp, C. (2021, July 7-8). *Writing and thinking: What changes with digitalization?* [Conference presentation]. 11th European Association for the Teaching of Academic Writing, online.

Haas, C. (1996). *Writing technology. Studies on the materiality of literacy*. Routledge.

Halliday, M. A. K., & Hasan, R. (2013). *Cohesion in English*. Routledge.

Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. E. Levy, & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1-27). Routledge.

Hayes, J. R. (2012a). Evidence from language bursts, revision, and transcription for translation and its relation to other writing processes. In M. Fayol, D. Alamargot, & V. Wiese Berninger (Eds.), *Translation of thought to written text while composing: Advancing theory, knowledge, research methods, tools, and applications* (pp. 15-25). Psychology Press.

Hayes, J. R. (2012b). Modeling and remodeling writing. *Written Communication, 29*(3), 369-388. https://doi.org/10.1177/0741088312451260

Hayes, J. R., & Flower, L. S. (1980). Identifying the organization of writing processes. In L. W. Gregg, & E. R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Erlbaum.

Hayes, J. R., & Simon, H. A. (1974). Understanding written problem instructions. In L. W. Gregg (Ed.), *Knowledge and cognition.* Erlbaum.

Hayes, J. R., & Simon, H. A. (1976). The understanding process: Problem isomorphs. *Cognitive Psychology, 8*(2), 165-190. https://doi.org/10.1016/0010-0285(76)90022-0

Hayes, J. R., & Simon, H. A. (1979). Psychological differences among problem isomorphs. In H. A. Simon (Ed.), *Models of thought* (pp. 498-512). Yale University.

Hjortshoj, K. (2001). *Understanding writing blocks*. Oxford University.

Kahneman, D. (2012). *Thinking, fast and slow.* Penguin Books.

Kruse, O., & Rapp, C. (2019). Seamless writing: How the digitisation of writing transforms thinking, communication, and student learning. In C. K. Looi, L. H. Wong, C. Glahn, & S. Cai (Eds.), *Seamless learning: Perspectives, challenges and opportunities* (pp. 191-208). Springer.

Kruse, O., & Rapp, C. (2020). Digitale schreibtechnologie: Entwicklungen, anforderungen und kompetenzen [Digital writing technology: Developments, affordances and competencies]. In B. Huemer, U. Doleschal, R. Wiederkehr, M. Brinkschulte, S. E. Dengscherz, K. Girgensohn, & C. Mertlitsch (Eds.), *Schreibwissenschaft—eine neue disziplin. Diskursübergreifende perspektiven, Vol. 2* [Writing science—a new discipline. Crossdisciplinary perspectives] (pp. 227-241). Böhlau Verlag.

Kruse, O., & Rapp, C. (2021). Digital writing spaces—eine verortung digitaler schreibtechnologie in räumlichen und geographischen metaphern [Digital writing spaces: A localization of digital writing technology in spatial and geographical metaphors]. In F. Freise, M. Jacoby, L. Musumeci, & M. Schubert (Eds.), *Writing spaces: Wissenschaftliches schreiben zwischen und in den disziplinen 2* [Writing Spaces: Academic writing in and between the disciplines] (pp. 69-90). wbv Media.

Kussmaul, A. (2018). Die störungen der sprache. Versuch einer pathologie der sprache [Disorders of language: Steps to a pathology of language]. In H. v. Ziemssen (Ed.), *Handbuch der speziellen pathologie und therapie, bd. 12, anhang* [Handbook of a specific pathology and therapy, vol 12, appendix]. Hanse. (Original work published 1877)

Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior* (pp. 112-146). University of Chicago Press.

Levelt, W. J. M. (1982). Linearization in describing spatial networks. In S. Peters, & E. Saarinen (Eds.), *Processes, beliefs, and questions* (pp. 199-220). Reidel. https://doi.org/10.1007/978-94-015-7668-0_7

Levelt, W. J. M. (1989). *Speaking. From intention to articulation*. MIT Press.

Levelt, W. J. M. (2013). *A history of psycholinguistics. The pre-Chomsky era.* Oxford University Press.

Mahlow, C., & Dale, R. (2014). Production media: Writing as using tools in media convergent environments. In E. M. Jakobs, & D. Perrin (Eds.), *Handbook of writing and text production* (pp. 209-230). DeGruyter Mouton.

Moreno, A. I., & Swales, J. M. (2018). Strengthening move analysis methodology towards bridging the function-form gap. *English for Specific Purposes, 50*, 40-63. https://doi.org/10.1016/j.esp.2017.11.006

Nagy, W. E., & Scott, J. A. (2000). Vocabulary processes. In M. L. Kamil, P. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research, 3* (pp. 269-284). Erlbaum.

Newell, A., & Simon, H. A. (1976). Computers and science as empirical inquiry symbols and search. *Communications of the ACM, 19*(3), 116-126. https://dl.acm.org/doi/pdf/10.1145/1283920.1283930

Ong, W. J. (1982). *Orality and literacy. The technologizing of the word*. Routledge.

Ong, W. J. (2001). Writing is a technology that restructures thought. In E. Cushman, E. Kintgen, B. Kroll, & M. Rose (Eds.), *Literacy: A critical sourcebook* (pp. 19-31). St. Martins.

Pérez-Llantada, C. (2014). Formulaic language in L1 and L2 expert academic writing: Convergent and divergent usage. *Journal of English for Academic Purposes, 14*, 84-94. https://doi.org/10.1016/j.jeap.2014.01.002

Piaget, J. (1972). *The principles of genetic epistemology*. Basic Books.

Pinker, S. (1995). *The language instinct. How the mind creates language.* Harper.

Rapp, C., Schlatter, U., & Kruse, O. (2020). The impact of writing technology on conceptual alignment in BA thesis supervision. In C. Müller Werder, & J. Erlemann (Eds.), *Seamless learning—lebenslanges durchgängiges lernen ermöglichen* [Seamless learning: Enabling seamless, lifelong learning] (pp. 183-190). Waxmann.

Schneider, W. (1999). Automaticity. In R. A. Wilson, & F. C. Keil (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 63-64). MIT Press.

Sharples, M., & Pemberton, L. (1990). Starting from the writer: Guidelines for the design of user centred document processors. *Computer Assisted Language Learning (CALL), 2*(1), 37-57. https://doi.org/10.1080/0958822900020104

Sinclair, J. (1991). *Corpus, concordance, collocation*. Harvard University.

Slobin, D. I. (1979). The role of language in language acquisition. [Invited address, University of California] 5th Annual Meeting of the Eastern Psychological Association, Philadelphia. In J. J. Gumperz, & S. C. Levinsohn (Eds.), *Rethinking linguistic relativity* (pp. 70-96). Cambridge University Press.

Slobin, D. I. (2003). Language and thought online: Cognitive consequences of linguistic relativity. In D. Gentner, & S. Goldin-Maedow (Eds.), *Language in mind* (pp. 157-192). MIT Press.

Stede, M., Scheffler, T., & Mendes, A. (2019). Connective-Lex: A web-based multilingual lexical resource for connectives. *Discours, 24*, Article 10098. https://doi.org/10.4000/discours.10098

Strobl, C., Ailhaud, E., Benetos, K., Devitt, A., Kruse, O., Proske, A., & Rapp, C. (2019). Digital support for academic writing: A review of technologies and pedagogies. *Computers & Education, 131*, 33-48. https://doi.org/10.1016/j.compedu.2018.12.005

Swales, J. M. (1990). *Genre analysis: English in academic and research settings*. Cambridge University Press.

Swales, J. M. (2011). *Aspects of article introductions*. University of Michigan Press. (Original work published 1981)

Taylor, K. S., Lawrence, J. F., Connor, C. M., & Snow, C. E. (2019). Cognitive and linguistic features of adolescent argumentative writing: Do connectives signal more complex reasoning? *Reading and Writing, 32*, 983-1007. https://doi.org/10.1007/s11145-018-9898-6

Tomasello, M. (2003). *Constructing a language*. Harvard University Press.

Tomasello, M. (2008). *Origins of human communication*. Bradford.

Tomasello, M. (2014). *A natural history of human thinking.* Harvard University Press.

Van Dijk, T. A. (1977). Connectives in text grammar and text logic. In T. A. van Dijk, & J. S. Petofi (Eds.), *Grammars and descriptions* (pp. 11-63). De Gruyter.

Varela, F. J., Thompson, E., & Rosch, E. (2016). *The embodied mind. Cognitive science and human experience* (revised). MIT Press. (Original work published 1991)

Vygotski, L. S. (1961). *Thought and language.* MIT Press. (Original work published 1934)

Waxman, S. R. (2004). Everything had a name, and each name gave birth to a new thought: Links between early word learning and conceptual organization. In D. G. Hall, & S. R. Waxman (Eds.), *Weaving a lexicon* (pp. 294-334). MIT Press.

Williams, G., & Beam, S. (2019). Technology and writing: Review of research. *Computers & Education, 128*, 227-242. https://doi.org/10.1016/j.compedu.2018.09.024

Winograd, T. (1972). *Understanding natural language*. Academic Press.

Winograd, T. (1991). Thinking machines: Can there be? Are we? In J. Sheehan & M. Sosna (Eds.), *The boundaries of humanity: Humans, animals, machines* (pp. 198-223). University of California Press.

Witte, S. P. (1987). Pretext and composing. *College Composition and Communication, 38*(4), 397-425. https://doi.org/10.2307/357634

Wray, A., & Perkins, M. R. (2000). The functions of formulaic language: An integrated model. *Language & Communication, 20*(1), 1-28. https://doi.org/10.1016/S0271-5309(99)00015-4

Wrobel, A. (1995). *Schreiben als handlung. Überlegungen und untersuchungen zur theorie der textproduktion* [Writing as action. Reflections and studies on a theory of text production]. Niemeyer. https://doi.org/10.1515/9783110917468

Wrobel, A. (1997). Zur Modellierung von formulierungsprozessen [Modelling formulation processes]. In E. M. Jakobs, & D. Knorr (Eds.), *Schreiben in den wissenschaften* [Writing in the sciences and humanities] (pp. 15-24). Lang.

Wrobel. A. (2002). Schreiben und formulieren. Prätext als problemindikator und lösung [Writing and formulation. Pretext as an indicator of problems and as a solution]. In D. Perrin, I. Böttcher, O. Kruse, & A. Wrobel (Eds.), *Schreiben. Von intuitiven zu professionellen schreibstrategien* [Writing. From intuitive to professional writing strategies] (pp. 83-96). Westdeutscher Verlag.

Wundt, W. (1900). *Völkerpsychologie. Eine untersuchung der entwicklungsgesetze von sprache, mythos und sitte* [Ethnic psychology. A study of the developmental laws of language myths, and morals]. Engelmann.